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NIPiCON 2026

8th Nirma Institute of Pharmacy International Conference

January 29-31, 2026

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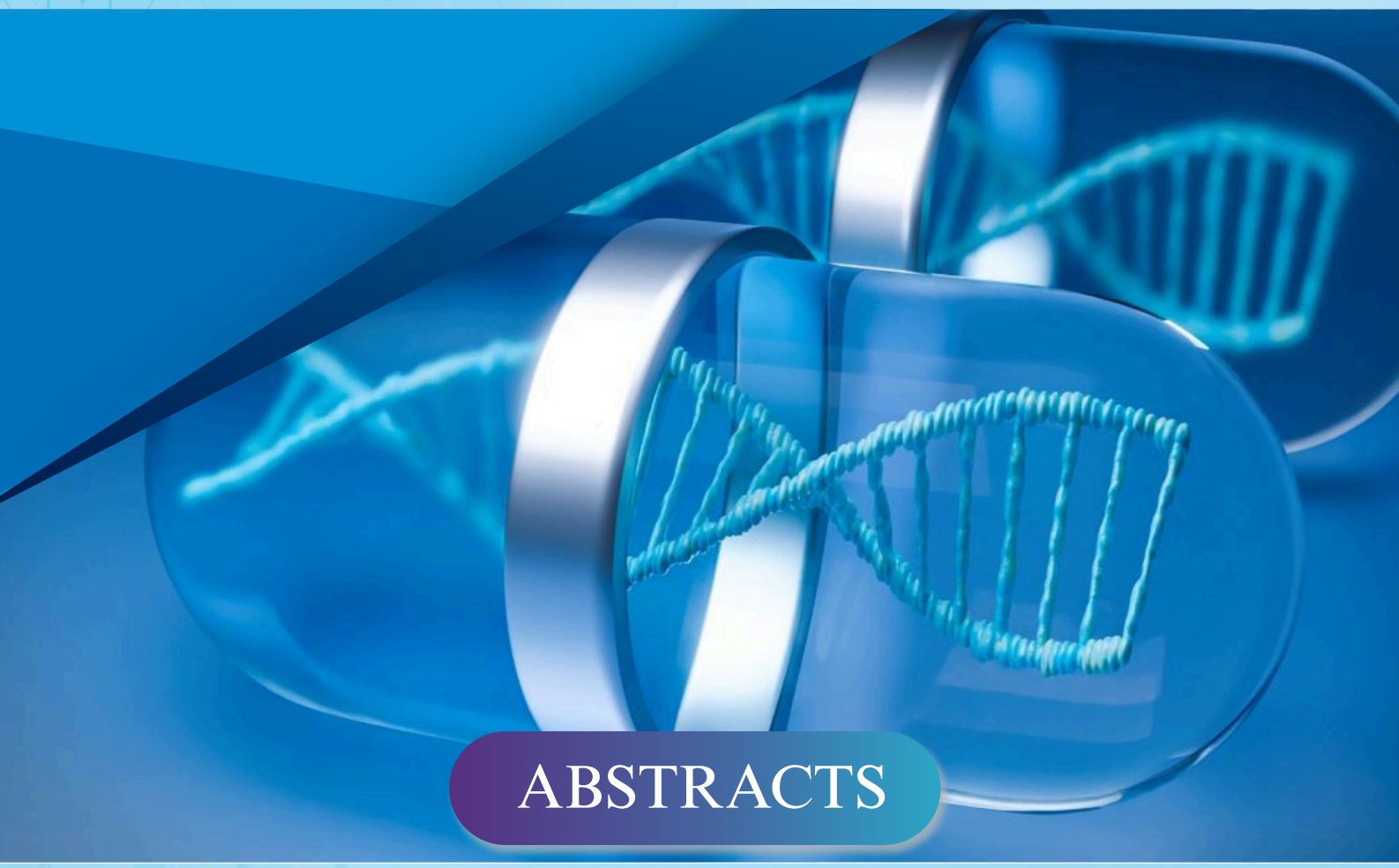

ABSTRACTS

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ABSTRACTS- PHARMA INNOVATOR AWARD

PIO001

PEGylated Stealth Liposomes for Pulmonary Delivery of Tepotinib in Lung Cancer

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Introduction: Conventional lung cancer chemotherapy suffers from poor solubility, non-specific distribution, and systemic toxicity. Tepotinib, a selective MET inhibitor for NSCLC, is available only as oral tablets. This study presents the first PEGylated stealth liposomes for pulmonary Tepotinib delivery, offering: (1) prolonged lung residence, (2) direct targeting minimizing systemic exposure, and (3) sustained tumor-site release. **Methods:** Stealth liposomes were prepared by thin-film hydration with extrusion, incorporating DSPE-PEG 2000. Optimization used Face-Centered Central Composite Design (FCCCD, Design-Expert® 13) with DPPC and cholesterol as independent variables. Entrapment efficiency (EE%), defined as percentage of drug encapsulated in liposomal bilayer relative to total drug used, was the primary response. **Results:** Optimized formulation (mean ± SD, n=3): EE% 86.05 ± 5.0%, particle size 169.6 ± 5.0 nm, PDI 0.274 ± 0.02, zeta potential -15.2 ± 2.1 mV. *In vitro* release: 56.0 ± 3.0% over 48h versus 90.0 ± 2.0% in 10h for pure drug (n=3), confirming sustained release profile. **Conclusion:** Tepotinib stealth liposomes demonstrated superior characteristics for targeted lung delivery through: (1) PEGylation preventing opsonization for prolonged lung residence, (2) optimal size (169.6 nm) enabling deep penetration and cellular uptake, (3) high EE% (86.05%) ensuring adequate drug payload, and (4) sustained release maintaining therapeutic concentrations while reducing systemic exposure. These formulation characteristics provide a strong foundation for potential enhancement of therapeutic efficacy and reduction of systemic toxicity in lung cancer therapy compared to conventional oral Tepotinib.

Keywords: Tepotinib, Stealth Liposomes, Lung Cancer, Pulmonary Delivery, FCCCD

PIO002

Development and Characterisation of Vilazodone HCl-loaded Nanostructured Lipid Carrier-based Thermosensitive In-Situ Gel for Potential Nose-to-Brain Delivery

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Introduction: Oral Vilazodone HCl exhibits poor brain bioavailability due to extensive first-pass metabolism and limited blood-brain barrier (BBB) permeation. This study presents a novel dual-system formulation integrating nanostructured lipid carriers (NLCs) within a thermosensitive in-situ gel for intranasal administration. This innovative approach is designed to facilitate direct nose-to-brain transport via olfactory and trigeminal neural pathways, potentially bypassing BBB limitations and hepatic metabolism. **Methods:** NLCs were prepared using Compritol® 888 ATO (solid lipid), Capryol™ 90 (liquid lipid), and Tween® 80 (surfactant) via high-shear homogenisation (5,000–19,000 rpm) followed by high-pressure homogenisation (300–1,200 bar). The optimised NLC dispersion was incorporated into a thermosensitive matrix of Poloxamer 407/188 and chitosan. Formulations were characterised for particle size, polydispersity index (PDI), entrapment efficiency (EE%), and in-vitro drug release (n=3). **Results:** The optimised NLC (Batch 13) demonstrated particle size of 102.9 ± 4.2 nm, PDI of 0.253 ± 0.02, and EE of 92.4 ± 2.8%. In-vitro release studies revealed distinct profiles: pure Vilazodone HCl exhibited rapid release (>80% within 1 h), NLC formulation showed sustained release (>95% within 8 h), whilst the NLC-loaded in-situ gel demonstrated prolonged controlled release (>95% within 24 h), indicating successful sustained release characteristics. All data expressed as mean ± SD (n=3). **Conclusion:** The developed NLC-based in-situ gel exhibited optimal nanoparticle characteristics, high entrapment efficiency, and controlled release behaviour. The formulation's nanoscale dimensions (<150 nm) and sustained release profile suggest potential for enhanced nose-to-brain delivery via direct neural pathways, warranting further in-vivo evaluation for brain targeting efficacy.

Keywords: Depression, In-Situ Gel, Nanostructured Lipid Carriers, Nose-to-Brain Delivery, Vilazodone HCl

PIO003

Development and Optimization of Tucatinib-Loaded Hybrid Lipid-Polymer Nanoparticles for Targeted Breast Cancer Therapy

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Introduction: Conventional breast cancer chemotherapy faces challenges including poor aqueous solubility, non-specific distribution, and systemic toxicity. While Tucatinib, a HER2-selective tyrosine kinase inhibitor, shows clinical promise, no hybrid lipid-polymer nanoparticle (HLPNP) formulations exist. This study presents the *first-reported Tucatinib-loaded HLPNP* featuring a PLGA polymeric core with PEGylated lipid shell for enhanced stability and prolonged circulation—distinct from conventional Tucatinib tablets or other nanocarrier approaches. **Methods:** HLPNPs were formulated via nanoprecipitation, integrating PLGA 50:50 core with Lipoid® S-100 and DSPE-mPEG 2000 lipid shell, stabilized by Poloxamer 188. Optimization employed Box-Behnken design (Design-Expert® 13) evaluating lipid, polymer, and surfactant concentrations. **Results:** Synthesized HLPNPs exhibited particle size 99–235 nm, zeta potential −13 to −19 mV, and PDI 0.1–0.4. The optimized formulation showed (mean ± SD, n=3): entrapment efficiency 86 ± 5%, particle size 99.80 ± 5 nm, PDI 0.234 ± 0.1, and zeta potential −19.0 ± 1.2 mV. Critically, *in-vitro* release demonstrated 80 ± 3% over 48 hours versus pure Tucatinib control releasing 90 ± 2% within 10 hours, confirming sustained release capability. **Conclusion:** Tucatinib-loaded HLPNPs provide a stable nanoscale system with high encapsulation efficiency and sustained release compared to free drug, offering promising potential for improved breast cancer therapy.

Keywords: Tucatinib, Hybrid Lipid-Polymer Nanoparticles, Breast Cancer, Targeted Drug Delivery

PIO004

Development of dexamethasone-loaded multilayer nanofiber-based ocular inserts (mlnoi) for effective treatment of ocular inflammation

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Introduction: Ocular inflammation is the immune response or irritation affecting parts of the eye. Nanofibers offer better ocular surface retention and sustained drug release than conventional formulations and other nanocarriers, making them especially effective for treating ocular inflammation. We developed a multilayer nanofiber-based ocular insert (MLNOI) for sustained and localized delivery of Dexamethasone, a potent corticosteroid with well-established anti-inflammatory efficacy. **Method:** The inserts were fabricated via a sequential electrospinning of polyvinyl alcohol (PVA), Polycaprolactone (PCL), and PVA. This configuration was optimized to achieve enhanced mechanical stability, bioadhesion, and sustained drug release. The polymeric solution was evaluated for viscosity & conductivity however, the prepared nanofiber inserts (1 cm^2) were evaluated for their physicochemical characteristics, SEM, ATR-IR, DSC, and XRD analyses were conducted to assess morphology and solid-state properties. *In-vitro* drug diffusion, *Ex-vivo* (goat cornea) and *In-vivo* studies were performed. Sterility, isotonicity, and ocular irritancy (HET-CAM) test were performed. Stability studies were performed under accelerated conditions per ICH guidelines. **Results:** Physicochemical characterization confirmed uniform fiber morphology, thickness (0.11-0.13mm), and encapsulation efficiency (~ 93%). *In-vitro* release exhibited biphasic release pattern sustained over 24h (~94 %). MLNOI exhibited prolonged permeability across goat cornea. The formulation passed sterility test, isotonicity, and HET-CAM tests, confirming ocular safety. *In vivo* studies showed prolonged ocular residence time compared to standard eye drops and rapid recovery from inflammation. and stability tests confirmed formulation robustness over four weeks. **Conclusion:** These findings support the potential of the developed MLNOI as a safe, and effective alternative for managing ocular inflammation.

Keywords: Dexamethasone; Electrospinning; MLONI: (Multilayer Nanofiber-based Ocular Insert); Drug delivery; Inflammation.

PIO005

Development, characterization, and in vitro cytotoxicity of Rutin-loaded lipid polymer hybrid nanocarriers (LPHN) in glioblastoma multiforme

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Introduction: Lipid–polymer hybrid nanoparticles (LPHNPs) represent an advanced drug delivery platform capable of achieving sustained and targeted drug release at tumor sites by integrating the biocompatibility of lipids with the mechanical stability of polymers. In the present study, Rutin-loaded lipid–polymer hybrid nanoparticles were developed to enhance the therapeutic potential of rutin for the treatment of glioblastoma multiforme (GBM), an aggressive brain tumor with poor prognosis. **Methods**: Rutin-loaded LPHNPs were prepared by emulsification–ultrasonication using Compritol® 888 ATO, Span® 80, and Pluronic® F-68, followed by characterization in terms of particle size distribution (Zetasizer), entrapment efficiency, and drug loading capacity. The nanoparticles were further characterized using ATR-FTIR, DSC, PXRD, and TEM. *In vitro* drug release and cytotoxicity studies were performed in U-87 MG glioblastoma cells. **Results:** The optimized RUT-LPHNPs exhibited a mean particle size of 173.8 ± 1.66 nm, a PDI of 0.276 ± 0.01, and a zeta potential of –33 ± 0.25 mV, indicating good colloidal stability. High entrapment efficiency (84.75 ± 2.13%) and drug loading (9.36 ± 0.42%) were achieved. Solid-state analyses confirmed successful encapsulation and partial amorphization of rutin without degradation, while TEM revealed spherical morphology. RUT-LPHNPs demonstrated enhanced and sustained drug release (75.60 ± 2.83% at 24 h) compared to pure rutin. *In vitro* studies showed dose-dependent cytotoxicity, increased apoptosis, and reduced intracellular ROS levels. **Conclusion:** Collectively, these findings demonstrate that RUT-LPHNPs provides a promising new formulation that overcome the therapeutic limitations of rutin through nanoscale encapsulation and sustained release, highlighting their promise for GBM therapy.

Keywords: Lipid-polymer nanoparticles, Rutin, Glioblastoma, Cytotoxicity, Sustained release

PIO006

Development and Evaluation of Terazosin-Based Topical Gel for Enhanced Healing of Diabetic Foot Ulcers

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Introduction: Diabetic foot ulcers (DFUs) are a serious complication of diabetes marked by impaired angiogenesis and delayed wound healing. There is no single definitive or universally accepted curative treatment for DFUs, and current therapies primarily focus on wound management and system control rather than complete disease reversal. Terazosin hydrochloride, an α_1-adrenergic receptor antagonist, has shown pro-angiogenic and cytoprotective effects. This study focuses on drug repurposing of terazosin and developing a terazosin-based topical gel and evaluating its wound healing potential through in vitro and in vivo studies. **Methods:** Terazosin-based gel was formulated and evaluated for physicochemical properties. In vitro drug release studies were conducted using diffusion methods. In vitro biological evaluations of the drug were performed on fibroblast cell lines using cytotoxicity assay, colony formation assay, and scratch assay to assess cytotoxicity, proliferative capacity, and cell migration. The wound healing potential was further evaluated in streptozotocin-induced diabetic rats using an excision wound model. Wound contraction rate, epithelialization time, and histopathological changes were assessed. Skin irritation studies were conducted to ensure topical safety. **Results:** The optimized terazosin gel exhibited well optimized physicochemical characteristics and sustained drug release. In vitro studies

demonstrated that terazosin showed positive effects on fibroblast cell viability, enhanced colony formation, and significantly improved cell migration in scratch wound assays, indicating its pro-healing potential. In vivo studies revealed accelerated wound contraction, reduced epithelialization time, and improved collagen deposition and angiogenesis. No signs of skin irritation or toxicity were observed. **Conclusion:** Terazosin-based gel demonstrated significant in vitro and in vivo wound healing potential, supporting its promise as an effective topical therapy for diabetic foot ulcers.

Keywords: Diabetic foot ulcer, Fibroblast cell line, Scratch wound assay, Terazosin hydrochloride, Topical gel, Wound healing

PIO007

Molecular Docking and Molecular Dynamics Simulations Studies of the Interactions between Tilorone Dihydrochloride with Human Stimulator of Interferon Genes (hSTING)

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Introduction: Suppression of cGAS/cGAMP/STING disrupts cytosolic DNA sensing mechanisms in cancer cells. STING agonists can reactivate the cGAS/STING pathway to induce interferon release and anticancer immunity. Therapeutic delivery of the natural ligand (cGAMP) is challenging due to poor cell penetrability and instability. Tilorone Dihydrochloride (Tilorone) is an antiviral agent with interferon-inducing properties. Our preliminary cell viability study revealed that tilorone exhibits significant cytotoxic effects against cancer cells, compared to other tested interferon inducer drugs. This study was conducted to study the interactions of tilorone with hSTING using *in-silico* models. **Method:** Effects of different interferon inducer drugs on the viability of MDA-MB-231 breast cancer cell line were studied by the MTT assay. Molecular docking was performed using Autodock 4.2 software. 3D structure of protein (4KSY) with reference ligand molecule cGAMP was retrieved from RCSB protein data bank. The optimized ligand and reference molecules were docked on the active site of the protein. For molecular dynamics simulation studies, ligand root mean square deviation (RMSD), RMSD vs. time, root mean square fluctuation (RMSF) vs. residue, number of hydrogen bonds vs. time, and radius of gyration vs. time, as well as Solvent Accessible Surface Area (SASA) vs. time, were studied using GROMACS software. Ligand-protein stability was checked for 200ns. **Results:** Tilorone exhibited the most potent antiproliferative effects against the MDA-MB-231 cell line, compared to other interferon inducers. Docking studies revealed the dock scores of cGAMP and tilorone to be -8.19 and -6.49 Kcal/mol, respectively. Tilorone showed unique binding interactions with hSTING. Tilorone also showed lesser fluctuations in RMSD, RMSF, and ROG plots of the complex, compared to cGAMP. Tilorone-STING complex also exhibited stable H-bond formation throughout the simulation period. Protein complex with tilorone also showed lower SASA values. **Conclusion:** Preliminary cell viability studies and *In-silico* docking and dynamics studies revealed that tilorone is cytotoxic to cancer cells and establishes favourable interactions with human-STING compared to natural ligand cGAMP. Further studies focused on the biological evaluation of anticancer effects of tilorone in cell-based assays, and animal models are important to validate the clinical or translational significance of tilorone as an immunotherapeutic anticancer drug.

Keywords: Tilorone, hSTING, molecular docking, molecular dynamics

PIO008

From Nature to Networks: Computational Discovery of Plant-Based Therapeutics for Breast Cancer

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Introduction: Breast cancer is one of the most prevalent malignancies worldwide and remains a major therapeutic challenge due to drug resistance, toxicity, and the high cost of conventional treatments. Plant-derived bioactive compounds, particularly those reported for antibacterial and antiviral activities, have attracted increasing attention for their potential anticancer effects. These plants are rich in secondary metabolites such as tannins, glycosides,

terpenoids, and saponins, which are known to modulate multiple molecular targets involved in cancer progression. **Methods:** In this study, an integrative in silico approach was employed to investigate the therapeutic potential of selected plant-derived phytoconstituents against breast cancer. Network pharmacology analysis was performed to identify bioactive compounds, their associated targets, and enriched signaling pathways. Protein–protein interaction network analysis was used to identify key genes associated with apoptosis, cell proliferation, inflammation, and other cancer-related processes. Molecular docking studies were conducted to evaluate the binding affinity of selected phytochemicals with key breast cancer–related targets. ADME profiling and Molsoft analysis were carried out to assess pharmacokinetic properties and drug-likeness. Molecular dynamics simulations were performed to examine the stability of the top protein–ligand complexes. **Results:** Network analysis revealed multiple genes involved in apoptosis, cell proliferation, inflammatory signaling, and tumor progression. Molecular docking identified three top phytoconstituents with high binding affinities, exhibiting docking scores of −11.2, −11.1, and −10.9 kcal/mol for top 3 compounds respectively. ADME and Molsoft analyses indicated favorable drug-like properties, while MD simulations confirmed the stability of the lead complexes. **Conclusion:** This study demonstrated the multi-targeted anticancer potential of plant-derived phytochemicals against breast cancer and provided a strong computational foundation for further experimental validation.

Keywords: Breast cancer, Phytochemicals, Network pharmacology, Molecular docking, Molecular dynamics simulation

PIO009

An Integrative Bioinformatics and Molecular Simulation Approach to Decipher the Role of *p*-propoxybenzoic Acid Against Adenocarcinoma

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Introduction: To investigate the anti-adenocarcinoma potential of p-propoxybenzoic acid (*p*-PBA) by targeting hydrolase enzymes using network pharmacology and molecular simulations. **Methods:** Association of hydrolase enzymes with adenocarcinoma and *p*-PBA was initially established. A protein-protein interaction (PPI) network was constructed to identify significantly interacting proteins, which were further subjected to Gene Ontology (GO) and Kyoto Encyclopedia of Genes and Genomes (KEGG) enrichment analyses. A bioactive-target-pathway was constructed to characterize pathways involved with *p*-PBA. Gene expression patterns and survival of hydrolase enzymes in adenocarcinoma were analyzed using TIMER 2.0. Molecular docking was performed to assess the binding interactions of *p*-PBA with PARP1, MMP9, and HDAC1. Molecular dynamics (MD) simulations were carried out for unbounded state and the ligand-protein complex state of MMP to evaluate structural stability and binding persistence. **Results:** Hydrolase enzymes, including PARP1, MMP9, and HDAC1, were identified as common targets of abietic acid and adenocarcinoma. GO and KEGG enrichment analyses of PPI-derived proteins revealed significant enrichment in adenocarcinoma-related biological processes, cellular components, molecular functions, and signaling pathways. The bioactive-target-pathway validated the association of *p*-PBA with adenocarcinoma-associated pathways. The gene expression and survival analysis indicated significant associations between hydrolase enzyme upregulation and decreased survival in adenocarcinoma subtypes. Molecular docking revealed strong interactions of *p*-PBA with PARP1 (-9.1 kcal/mol), MMP9 (-9.8 kcal/mol), and HDAC1 (-9.5 kcal/mol). MD simulations confirmed the dynamic stability of the *p*-PBA and MMP9 complex without a significant conformational disruption. **Conclusion:** *p*-PBA demonstrated significant interactions with hydrolase enzymes and adenocarcinoma associated pathways.

Keywords: *p*-propoxybenzoic acid; network pharmacology; molecular dynamics simulation; hydrolase enzymes; adenocarcinoma

PIO010

Decoding the Structural and Signaling Landscape of Vanshlochan through Integrated Material Characterization and Network Pharmacology

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Introduction: Vanshlochan, a traditional silica-rich natural drug derived from *Bambusa bambos* (L.) Voss [Poaceae], has been widely used in Ayurveda for bone-related disorders. However, systematic structural elucidation and pathway-level mechanistic understanding remain limited. This study aimed to comprehensively characterize the structural attributes of Vanshlochan and integrate these findings with network pharmacology to elucidate its molecular signaling relevance in bone biology. **Methods:** Structural elucidation was performed using inductively coupled plasma–optical emission spectroscopy (ICP-OES) for elemental profiling, X-ray diffraction (XRD) for crystallinity and phase analysis, X-ray photoelectron spectroscopy (XPS) for surface chemical states, nuclear magnetic resonance (NMR) spectroscopy for molecular environment assessment, and thermogravimetric/differential thermal analysis (TGA/DTA) for thermal stability evaluation. Experimentally derived structural and elemental data were incorporated into a network pharmacology framework, followed by pathway enrichment analysis to identify key biological signaling pathways. **Results:** ICP-OES confirmed silicon as the predominant element with trace levels of bone-relevant minerals. XRD revealed a largely amorphous siliceous matrix with minor crystalline domains, while XPS identified characteristic silicate and aluminosilicate chemical states. NMR and TGA/DTA analyses demonstrated stable silicate frameworks and high thermal resilience. Network pharmacology analysis showed significant enrichment of osteogenic signaling networks, with dominant association to the Wnt signaling pathway, a critical regulator of bone formation and osteoblast differentiation. **Conclusion:** This integrated structural and network pharmacology study establishes Vanshlochan as a structurally stable, silica-based natural drug with strong association to Wnt-mediated osteogenic signaling, providing mechanistic support for its traditional use in bone health.

Keyword: Vanshlochan, network pharmacology, structural elucidation, bone health

PIO011

Nardostachys jatamansi Extract Improves Functional Outcomes in Traumatic Brain Injury by Modulating Myeloperoxidase Activity

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Introduction: Traumatic brain injury (TBI) causes cognitive and motor disabilities due to oxidative stress and inflammation, with myeloperoxidase (MPO) leading to secondary damage. *Nardostachys jatamansi*, a medicinal herb with antioxidant and anti-inflammatory properties, shows neuroprotective potential. This study evaluated its neuroprotective efficacy in a rat model of TBI and explored a possible molecular mechanism using in-silico docking targeting MPO. **Methods:** Ethanolic extract of *Nardostachys jatamansi* roots and rhizomes was prepared by Soxhlet extraction and subjected to phytochemical screening. Wistar rats were divided into five groups: control, TBI, and three extract-pretreated TBI groups (100, 200, and 400 mg/kg/day) for seven days. TBI was induced using Marmarou's weight-drop method. Functional assessment was conducted 24 hours post-injury, followed by estimation of oxidative stress (malondialdehyde and nitrite), antioxidative (reduced-glutathione) markers, MPO activity, and histopathological evaluation. Molecular docking of 54 phytoconstituents against MPO was performed and compared with a reference inhibitor. **Results:** Phytochemical analysis confirmed the presence of alkaloids, flavonoids, terpenoids, saponins, tannins, and phenolic compounds. TBI caused significant functional disabilities, increased oxidative stress, reduced antioxidative markers, increased MPO activity, and marked neuronal damage. Pretreatment with *Nardostachys jatamansi* dose-dependenty, significantly improved functional outcomes, reduced MPO activity and oxidative stress while restore anti-oxidative mechanism as well as preserved neuronal integrity. Docking studies revealed that several phytoconstituents exhibited a strong binding affinity toward MPO, comparable to that of the reference inhibitor. **Conclusion:** *Nardostachys jatamansi* exhibits significant neuroprotective effects against TBI, potentially mediated through attenuation of oxidative stress and modulation of MPO activity.

Keywords: *Nardostachys jatamansi*, Traumatic brain injury, Neuroprotection, Oxidative stress, Myeloperoxidase, Molecular docking

ABSTRACTS – ORAL PRESENTATIONS

NAO001

Design, Optimization, and Therapeutic Evaluation of a Methylcobalamin-loaded Hydrogel for Accelerated Oral Ulcer Healing

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Introduction: Oral ulcers are painful lesions, impairing oral function. Methylcobalamin (MC), an active form of Vitamin B_{12}, supports mucosal repair and reduces inflammation. However, its rapid clearance and poor mucosal retention limit efficacy. This study aimed to develop and evaluate MC-loaded Carbopol (MC-CP) hydrogel for improved ulcer healing. **Methods:** MC (1% w/v) was incorporated into CP (3.75%w/v) matrices in simulated salivary fluid (SSF; pH 5.8) via the dispersion method. pH, %swelling, %porosity, %moisture content, %fluid absorbency, and %matrix erosion was measured. Surface morphology was assessed by FE-SEM and AFM; wettability by contact angle; and rheological/mechanical properties were determined. *Ex vivo* mucoadhesion was performed on porcine buccal mucosa. *In vitro* drug release was studied in SSF (pH 5.5, 5.8, and 6.8) and quantified using HPLC. Antioxidant and anti-inflammatory activities were evaluated by DPPH and BSA assays. *Ex vivo* skin permeation studies were performed using Franz diffusion cells. **Results:** The MC-CP gel exhibited a pH of 5.8±0.2, a %swelling of 199±17%, and a %porosity of 94±0.72%, respectively. FE-SEM/AFM confirmed a porous matrix with nanoscale roughness. The contact angle of 45°±2 indicated favorable mucoadhesion. The gel exhibited a viscosity of 1420±85 cP, a tensile strength of 8±0.06 MPa, and sustained drug release of 76±0.4% over 12 h. Strong antioxidant (84±2%) and anti-inflammatory (80±2%) activities were observed. *Ex vivo* permeation confirmed significant buccal delivery (222±58 µg/cm²/h) and retention of 69±11 µg/g. **Conclusion:** MC-CP Gel demonstrated potential as a mucoadhesive system for enhanced oral ulcer healing.

Keywords: Buccal Permeation; Drug Delivery; Hydrogel; Methylcobalamin; Oral ulcer

NAO002

SeDeM-Guided Development of Pediatric Lamotrigine Orally Disintegrating Minitablets With *in Vitro* and *in Vivo* Evaluation

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Introduction: Pediatric lamotrigine therapy is limited by the lack of age-appropriate dosage forms, as conventional tablets (25–200 mg) are difficult for children to swallow and splitting them often leads to dose variability. This study focused on developing orally disintegrating minitablets (ODTMTs) using the SeDeM system to ensure improved processability, dosing accuracy, and patient compliance. **Methods:** Lamotrigine exhibited poor flow and compressibility (IGC = 3.568) on SeDeM evaluation. Six co-processed excipients were screened, among which PHARMABURST® 500 showed superior flow (PI = 0.833) and compressibility (IGC = 6.10). Minitablets were prepared via direct compression and assessed for weight variation, hardness, friability, wetting behavior, disintegration, and dissolution. ATR-FTIR and DSC confirmed drug–excipient compatibility. Pharmacokinetic evaluation was performed in rabbits. **Results:** The optimized formulation demonstrated uniform weight (24.5 ± 0.64 mg), appropriate hardness (2.5 ± 0.06 kg/cm²), friability <1%, rapid wetting (6 s), and fast disintegration (10 s). Drug release reached 98.88% within 25 minutes. In vivo studies revealed enhanced bioavailability with a 2.1-fold increase in AUC, higher Cmax (93.69 µg/mL), and reduced Tmax (1 h) compared to pure drug. **Conclusion:** The SeDeM-based development of lamotrigine ODTMTs achieved improved

manufacturability, rapid disintegration, and superior bioavailability, offering a stable and child-friendly dosage option for pediatric epilepsy.

Keywords: Lamotrigine, Minitablets, SeDeM, Co-processed Excipients, Pediatric Epilepsy

NAO003

Formulation and Characterization of an Apremilast-Loaded Transferosomal Gel for the Treatment of Psoriasis

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Introduction: Apremilast is a phosphodiesterase-4 inhibitor used in the treatment of psoriasis and is classified as a BCS class IV drug with low solubility and permeability. Currently available oral formulations are associated with systemic side effects, highlighting the need for an alternative delivery approach. The present study aimed to develop an Apremilast-loaded transferosome-based gel for enhanced topical anti-psoriatic efficacy. **Methods:** The optimized transferosomal formulation was incorporated into a Carbopol 934 gel and evaluated for vesicle size, polydispersity index, zeta potential, entrapment efficiency, morphology, pH, drug content, and spreadability. In vitro drug release, ex vivo permeation, and in vivo anti-psoriatic studies were performed. **Result:** The optimized formulation exhibited a vesicle size of 134.6 nm, entrapment efficiency of 84.01%, and zeta potential of -20.20 mV. Sustained drug release (38.12% over 30 h) was observed compared to the drug suspension (80.12%). The gel showed suitable pH (6.8 ± 0.09), good spreadability, and high drug content (98.16 ± 0.13%). *Ex-vivo* studies demonstrated nearly a two-fold increase in skin permeation. *In vivo* evaluation revealed significant reductions in PASI scores, spleen index, and histopathological alterations ($p < 0.05$). **Conclusion:** Overall, the Apremilast-loaded transferosomal gel demonstrated enhanced skin permeation, sustained release, and improved anti-psoriatic efficacy, suggesting its potential as a safer and effective topical therapy for psoriasis.
Keywords: Apremilast, Transferosomes, Topical drug delivery, Psoriasis, Skin permeation

NAO004

Enhanced Dermal Targeting of Apremilast via Ultradeformable & Cubic Liquid Crystalline Nanoparticles: A Strategy to Improve Permeability, and Psoriasis Therapy

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Introduction: Psoriasis is a chronic, immune-mediated inflammatory skin disorder with a strong genetic predisposition. Apremilast, a USFDA-approved phosphodiesterase-4 (PDE-4) inhibitor, modulates intracellular inflammatory signaling and is clinically effective in psoriasis management. However, its therapeutic efficacy via topical delivery is limited by poor skin permeation. Cubosomes are lipid-based, biocompatible nanostructures and transferosomes are ultra-deformable vesicular carriers that enhance dermal penetration and sustained drug delivery. **Methods:** Apremilast-loaded cubosomes were prepared using a top-down approach, while transferosomes were formulated via the thin-film hydration technique. A 3^3 Box–Behnken factorial design was employed for systematic optimization. Optimized nanoformulations were incorporated into a xanthan gum–based gel for topical application. **Results:** Optimized cubosomes and transferosomes exhibited mean particle sizes of 126.22 nm and 155.88 nm, zeta potentials of −22.67 mV and −21.23 mV, and entrapment efficiencies of 75.64% and 84.27%, respectively. In vitro release studies demonstrated sustained drug release up to 24 h (88.44% and 84.23%). Ex vivo permeation showed enhanced drug transport (76.34% and 78.45%). Both formulations remained stable at 25 °C and 4 °C. In vivo evaluation using an imiquimod-induced psoriasis model revealed significant

reduction in erythema and scaling, corroborated by histopathological improvement in hyperkeratosis and inflammation. **Conclusion:** The developed cubosomal and transferosomal apremilast gels demonstrate enhanced skin permeation, sustained release, and superior antipsoriatic efficacy, highlighting their potential as effective topical nanotherapeutic systems for psoriasis management.

Keywords: Psoriasis, Apremilast, Transferosomes, Cubosomes, Imiquimoid Induced Psoriasis.

NAO005

Erythromycin and Adapalene Loaded Cubosomal Gel for Topical Application in the Treatment of Acne

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Introduction: Acne vulgaris is commonly treated with topical erythromycin and adapalene, which can cause irritation. A novel cubosomal nanoparticle system was developed to overcome this, utilizing its unique structure for high drug loading, sustained release, and better skin penetration. This study aimed to create a combined erythromycin-adapalene cubosomal gel to simultaneously target bacteria and comedones involved in acne, while reducing side effects. Methods: Cubosomes were prepared using GMO and Pluronic F127, with optimization via statistical design. The formulation was characterized for particle size, charge, and drug loading, with structure confirmed by TEM. The final gel was tested for drug release, skin penetration, and antibacterial activity against C. acnes. Anti-inflammatory efficacy was evaluated in a C. acnes-induced mouse ear model, assessing swelling and histopathology. **Results:** The optimized cubosomes exhibited a nanosized particle diameter of 125.6 nm, zeta potential of -25.6 mV, PDI of 0.823, and entrapment efficiency of 86.5%. TEM confirmed the cubic nanostructure. The gel showed sustained release (82.5% over 8 hours) and effective skin penetration (74.5%). It demonstrated superior antibacterial potency with an MIC of 0.039 mg/ml. In vivo, the cubosomal gel (Group VI) was most effective, reducing ear thickness to 23.14% by Day 7 versus a peak of 371% in the disease control. Histopathology revealed near-complete restoration with minimal immune infiltration. **Conclusion:** The erythromycin-adapalene cubosomal gel is an advanced, well-tolerated topical therapy providing sustained, targeted delivery with potent antibacterial and anti-inflammatory effects against *C. acnes*-induced acne.

Keywords: Acne vulgaris, Cubosomes, Sustained drug release, *Cutibacterium acnes*, Anti-inflammatory activity.

NAO006

Re-Engineering Ipriflavone for Bone Regeneration Using Nano-Enabled Drug Delivery and Biomaterial Approaches

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Introduction: Ipriflavone, a synthetic isoflavone with selective estrogen receptor modulating activity, exhibits osteogenic potential in osteoporosis; however, its clinical application is limited by extremely poor aqueous solubility and low oral bioavailability. This work aimed to re-establish the therapeutic relevance of ipriflavone through mechanistic validation and nano-enabled drug delivery and biomaterial strategies. **Methods:** Network pharmacology, protein–protein interaction analysis, molecular docking, and molecular dynamics simulations were used to elucidate osteoporosis-related targets of ipriflavone. In vitro osteogenic activity was evaluated in MG-63 osteoblast-like cells. In vivo efficacy was assessed using a dexamethasone-induced zebrafish osteoporosis model. Nanocrystals, nanoemulsions, and solid lipid nanoparticles were developed to enhance solubility and bioavailability. Pharmacokinetic studies were conducted in Wistar rats, and ipriflavone-loaded scaffolds were evaluated for bone regeneration. **Results:** Computational studies confirmed strong interactions of ipriflavone with estrogen receptors and bone-regulatory proteins. In vitro studies demonstrated enhanced osteoblast differentiation and mineralization. Zebrafish studies showed significant recovery of vertebral bone length. Nanoformulations achieved particle sizes below 200 nm and significantly improved oral bioavailability, with solid lipid nanoparticles

showing the highest enhancement. Ipriflavone-loaded scaffolds exhibited controlled release and promoted osteogenic activity. **Conclusion:** Nano-engineering and biomaterial-based strategies effectively overcome the biopharmaceutical limitations of ipriflavone, enabling its translational application for systemic osteoporosis therapy and localized bone regeneration.

Keywords: Ipriflavone, Osteoporosis, Nanotechnology, Bone regeneration, Drug delivery

NAO007

Bio-Fabricated Silver Nanoparticles from *Linum usitatissimum*: A Green Nanoplatform Exhibiting Potent Antioxidant and Anti-Inflammatory Activity

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Introduction: Green nanotechnology has emerged as a sustainable and eco-friendly approach for developing biocompatible therapeutic agents. *Linum usitatissimum* leaf extract acts as an effective capping agent due to the presence of phenolic compounds, flavonoids, proteins, and polysaccharides containing hydroxyl, carbonyl, and amide functional groups. These biomolecules adsorb onto the nanoparticle surface through coordination and hydrogen bonding, forming a protective organic layer that prevents agglomeration, enhances colloidal stability, and preserves the nanoscale dimensions of the silver particles. **Methods:** In this study, silver nanoparticles were biosynthesized using ethanolic leaf extract of Linum usitatissimum as a natural reducing and stabilizing agent. The synthesized Lu-AgNPs were characterized using UV–Visible spectroscopy to confirm surface plasmon resonance, Fourier-transform infrared spectroscopy (FTIR) to identify functional groups involved in nanoparticle reduction and stabilization, and X-ray diffraction (XRD) to determine crystalline structure. In vitro antioxidant activity was evaluated using hydrogen peroxide scavenging, reducing power, phosphomolybdate, and superoxide radical scavenging assays, while anti-inflammatory activity was assessed through protein denaturation and proteinase inhibition methods, with standard drugs used for comparison. **Results:** Formation of silver nanoparticles was visually confirmed by a characteristic brown color and analytically by a sharp UV–Visible absorption peak at approximately 415 nm. FTIR analysis revealed phytochemical functional groups responsible for nanoparticle stabilization, and XRD patterns confirmed the crystalline, face-centered cubic nature of the nanoparticles. The biosynthesized Lu-AgNPs demonstrated significantly enhanced antioxidant activity and strong anti-inflammatory effects, exhibiting superior free-radical scavenging potential and effective inhibition of protein denaturation compared to standard reference compounds. **Conclusion:** The findings highlight Linum usitatissimum leaf extract as an efficient bioreductant for green synthesis of silver nanoparticles, supporting their potential application as safe, effective, and eco-friendly nanomaterials for biomedical and therapeutic research.

Keywords: Anti-inflammatory activity, Antioxidant activity, Green synthesis, Linum usitatissimum, Silver nanoparticles.

NAO008

Optimization Of Hot Melt Extrusion Process For Taste Masking Of Non-Steroidal Anti-Inflammotary Drug For Pediateric Application

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Introduction: Palatability of oral formulations remains a critical challenge in paediatric drug delivery, where bitterness and unpleasant organoleptic properties often compromise compliance and therapeutic efficacy. Taste masking, therefore, constitutes a pivotal strategy in designing effective paediatric formulations. **Materials and Methods:** A Quality by Design (QbD)-guided approach was employed to identify critical formulation and process parameters influencing taste perception and drug release of bitter drugs such as Paracetamol which are most prescribed drugs for Paediatric patients. HME technique is adopted for taste masking by using polymers along with few novel excipients along with cocoa powder to mask the taste of bitter drugs. Dispersible tablets were developed to balance effective taste masking with desirable dissolution profiles. Optimization was achieved

through factorial experimental design, enabling the identification of optimal conditions that maximized palatability without compromising bioavailability. The taste-masked formulations were assessed using in vitro dissolution studies and chemical analysis to ascertain the right content of drug and to assess the stability by assessment of related substances. **Results**: Results demonstrated significant suppression of bitterness alongside rapid drug release, ensuring both acceptability to the paediatric population and therapeutic reliability. **Conclusion:** HME can be utilized effectively to develop platform technology which is commercially viable approach which can be used for effective taste masking process and improving adherence in paediatric population.

Key Words: Hot melt extrusion, Taste Masking, QBD

PCO001

A Prospective Observational Study on Risk Factors and Drug Utilization Patterns in Women with Pregnancy Induced Hypertension

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Introduction: Pregnancy induced hypertension is a condition in which high blood pressure develops after 20 weeks of pregnancy in women who previously had normal blood pressure. It is a common problem in pregnancy and can affect both the mother and the baby if not properly managed. Early diagnosis and regular antenatal care play an important role in reducing complications and improving outcomes. This study aimed to delineate the risk factors and assess the drug utilization patterns among women diagnosed with Pregnancy-Induced Hypertension (PIH), and to evaluate their consequent impact on maternal and fetal outcomes. **Method:** A prospective observational study was executed at a tertiary healthcare facility, enrolling pregnant women diagnosed with PIH. Comprehensive data encompassing demographic variables, clinical parameters, and treatment regimens were meticulously collected. Advanced statistical analyses including one-way ANOVA, logistic regression, and Pearson correlation were employed to ascertain the associations between risk factors and therapeutic outcomes. **Results:** The findings demonstrated that factors such as advanced maternal age, increased body mass index, and pre-existing comorbidities were significantly correlated with heightened PIH severity. Pharmacological interventions using labetalol and nifedipine were observed to effectively modulate blood pressure, with a notable association with improved maternal and neonatal outcomes and a reduced incidence of adverse effects. Early intervention emerged as a critical determinant in mitigating the progression of complications. **Conclusion:** The study confirms that early identification of risk factors and timely initiation of appropriate antihypertensive treatment are crucial for improving maternal and fetal outcomes in pregnancy-induced hypertension. These findings support the use of standardized, evidence-based treatment protocols to reduce complications associated with hypertensive disorders of pregnancy.

Keywords: Drug utilization in PIH, Gestational Hypertension, Hypertensive disorders in pregnancy, Preeclampsia, Pregnancy-induced hypertension.

PCO002

DNA Methyltransferase 1 (DNMT1) Inhibitor Olsalazine Enhances the Anti-cancer Activity of Paclitaxel in Breast Cancer

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Introduction: Because aberrant methylation of tumor suppressor genes frequently promotes tumor formation and progression, elevated DNMT expression is strongly linked to poor clinical outcomes in breast cancer. Breast cancer has been linked to disturbed epigenetic regulation, specifically DNA hypermethylation caused by DNA

methyltransferase 1 (DNMT1). The goal of the current study was to determine whether the DNMT1 inhibitor Olsalazine and the common anti-cancer drug Paclitaxel could have a synergistic effect. **Method:** The MTT assay was used in in vitro studies to measure synergistic cytotoxicity. Colony formation, the scratch wound–healing assay, AO/EB dual staining, and flow cytometry were used to measure cell proliferation, migration, apoptosis, and cell-cycle progression, respectively. The combined therapeutic efficacy of Olsalazine and paclitaxel was evaluated in vivo using a DMBA-induced breast cancer model in Wistar rats, along with biochemical and antioxidant parameter analyses and histopathological examination of tumor tissue using H&E staining. **Results:** Studies conducted in vitro on the MDA-MB-231 cell line demonstrated that paclitaxel along with Olsalazine increased cytotoxicity. There was an increase in apoptosis and a decrease in cell migration and proliferation. Paclitaxel in combination with Olsalazine demonstrated improved antioxidant levels, decreased tumor size, and increased anti-cancer activity in in vivo studies. **Conclusion:** DNMT1 inhibition by Olsalazine significantly enhanced the anti-cancer efficacy of paclitaxel by promoting apoptosis and inhibiting proliferation and migration of breast cancer cells. Both in vitro and in vivo findings support the potential of this combination therapy as a promising epigenetic-based strategy for improved breast cancer treatment.

Keywords: Breast cancer, DNMT1 inhibitor, Olsalazine, Paclitaxel, Synergistic anti-cancer activity

PCO003

Mechanistic Exploration of the Antidiabetic Potential of *Woodfordia fruticosa* using in-silico approach: Network Pharmacology, molecular docking, and Molecular dynamic simulations

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Introduction: Type 2 diabetes mellitus (T2DM) is a multifactorial metabolic disorder influenced by both genetic predisposition and lifestyle factors, primarily characterized by insulin resistance. Existing therapeutic approaches, including drug-based treatments and lifestyle modification, are often constrained by long-term adverse effects and economic burden. As a result, there has been growing interest in natural products as alternative treatment strategies due to their relative cost-effectiveness, accessibility, and safety. *Woodfordia fruticosa* (L.), commonly referred to as red bell bush, is a medicinal plant extensively utilized in traditional medicine for the treatment of metabolic and inflammatory conditions. It contains a wide range of bioactive compounds, such as polyphenols, flavonoids, and tannins. **Method:** In this study, an integrated approach involving network pharmacology, molecular docking, and molecular dynamics (MD) simulations was applied to investigate the molecular mechanisms underlying the antidiabetic effects of *Woodfordia fruticosa* in T2DM. **Results:** Network pharmacology analysis identified PPARG as a major hub gene among predicted therapeutic targets, emphasizing its critical involvement in the pathogenesis of T2DM. Molecular docking results demonstrated that key phytoconstituents of *Woodfordia fruticosa* exhibited strong binding interactions with PPARG, with several compounds displaying favorable docking scores. Additionally, MD simulation analyses confirmed the structural stability of the top phytoconstituent–protein complexes, indicating their potential biological efficacy. **Conclusion:** In conclusion, the findings of this study offer mechanistic insights into the antidiabetic activity of *Woodfordia fruticosa* and provide scientific support for its traditional use in T2DM management.

Keywords: Type 2 diabetes mellitus, *Woodfordia fruticosa*, Network Pharmacology, Molecular Docking, Molecular Dynamics

PCO004

Modulation of PI3K/AKT Signaling by DPP-4 Inhibitors as a Therapeutic Strategy in Alzheimer's Disease

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Introduction: Alzheimer's disease (AD) is a progressive neurodegenerative disorder marked by cognitive decline, memory loss, and neuronal degeneration. Its pathology involves cholinergic dysfunction, amyloid-β (Aβ) accumulation, neuroinflammation, and impaired survival signaling pathways. Recent evidence suggests that antidiabetic drugs may exert neuroprotective effects beyond glycemic control. Teneligliptin, a dipeptidyl peptidase-4 (DPP-4) inhibitor, has shown anti-inflammatory properties, making it a potential candidate for AD management. **Methods:** In-silico molecular docking was performed using PyRx and Discovery Studio to assess the binding affinity of Teneligliptin with key AD targets, including AChE, BChE, GSK3β, PI3K, and AKT. For in-vivo studies, thirty-five Wistar rats were divided into five groups: normal control, disease control ($AlCl_3$-induced), standard (Donepezil), and Teneligliptin-treated groups (4 mg/kg and 8 mg/kg). Treatments were administered orally for 28 days. **Results:** Teneligliptin demonstrated strong binding affinity with multiple AD targets in docking studies. Behavioral assessments using the Novel Object Recognition Test and Morris Water Maze showed significant improvement in learning and memory. Biochemical analysis revealed reduced levels of AChE, BChE, Aβ, and GSK3β, along with increased PI3K and AKT levels. Histopathological examination of hippocampal and cortical regions showed improved neuronal integrity in treated groups. **Conclusion:** Teneligliptin exhibits significant neuroprotective effects in Alzheimer's disease by modulating multiple pathological pathways. Its ability to reduce neuroinflammation, amyloid burden, and cholinergic dysfunction while enhancing neuronal survival highlights its potential as a novel therapeutic option for AD beyond its antidiabetic role.

Keywords: (DPP-4) inhibitor 1, Alzheimer's disease (AD) 2, Neuroprotective therapy 3

PCO005

Toxicity evaluation of farming-derived fipronil residue in the zebrafish model

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Introduction: Pesticides are considered an important asset for crop protection and growth. In 2020, India used more than 61,000 tonnes (t) of pesticides, as reported by FAO 2022. In India, insecticides contribute to 76% of all pesticides. India has the largest area devoted to rice farming and ranks second in the world in terms of production. Fipronil (phenyl-pyrazole) insecticide is used as a wide-spectrum insecticide on a variety of crops, including rice. It binds to allosteric sites of GABAA receptors and glutamate gated chloride (GluCl) channels of insects as an antagonist and disrupts their central nervous system. Fipronil is strictly controlled globally due to its relatively harmful metabolites and its threat to human health and many animals; however, the maximum residue levels (MRLs) of fipronil and its metabolites vary between nations. **Method:** This study evaluates fipronil-tainted rice and irrigation water-induced neurotoxicity, genotoxicity, cardiotoxicity, teratogenicity, and oxidative stress in the zebrafish model. **Result:** In silico molecular docking identified 43 toxicity associated protein targets of fipronil, with strong binding affinities observed for HSP90AA1, EGFR, and PTGS2, implicating fipronil in various toxicological pathways. Behavioral tests indicated anxiety-like and aggression-like behaviors, while histopathological analysis showed degenerative changes in the brain, heart, and embryonic tissues. Genotoxic effects were confirmed by micronucleus formation and erythrocyte damage, with pronounced cardiotoxicity marked by myocardial degeneration and elevated cardiac biomarkers. Teratogenic outcomes included developmental abnormalities, reduced hatching rates, and apoptosis in critical regions. Furthermore, oxidative stress markers, such as increased lipid peroxidation and altered antioxidant enzyme activity, confirmed cellular damage. **Conclusion:** The study highlights the broad spectrum of toxicity induced by fipronil, emphasizing the need for stricter pesticide regulation and further research on long-term health risks associated with its chronic exposure.

Keywords: Zebrafish, Toxicities, Fipronil-tainted rice, Fipronil-tainted irrigation water, oxidative stress

PCO006

Investigating Therapeutic Potential of Trans-Cinnamic Acid in Mitigating Alzheimer's Disease

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Introduction: Alzheimer disease (AD) is a progressive neurodegenerative disorder and the leading cause of dementia, accounting for approximately 60–80% of dementia cases worldwide. It is characterized by memory loss, cognitive decline, and behavioural impairment. Current pharmacological treatments, including acetylcholinesterase inhibitors such as donepezil, offer only symptomatic relief and have limited efficacy in altering disease progression. Therefore, the identification of alternative neuroprotective agents is of significant interest. Trans-cinnamic acid (TCA) is a plant-derived phenolic compound found in cinnamon, fruits, and grains, and has been reported to possess antioxidant and neuroprotective properties. The present study aimed to evaluate the effects of TCA on cognitive function and biochemical parameters in a scopolamine-induced rat model of AD. **Methods:** Male Wistar rats were orally administered TCA at doses of 40, 80, and 120 mg/kg daily for 18 days. Scopolamine (1 mg/kg) was administered from days 10 to 18 to induce cognitive impairment. Behavioural assessments were conducted using the passive avoidance test and elevated plus maze. Biochemical analyses included estimation of brain acetylcholinesterase (AChE) activity and oxidative stress markers such as malondialdehyde (MDA), superoxide dismutase (SOD), catalase, and reduced glutathione (GSH). **Results:** Scopolamine significantly impaired memory retention and increased brain AChE activity and oxidative stress compared to controls ($p < 0.001$). TCA treatment dose-dependently improved cognitive performance, with 80 and 120 mg/kg significantly reducing escape latency times. These doses also normalized AChE activity and antioxidant enzyme levels, comparable to donepezil. Brain catalase activity increased from 117.4 ± 2.11 U/mg in scopolamine-treated rats to 361.2 ± 0.52 and 367.5 ± 1.27 U/mg following 80 and 120 mg/kg TCA treatment, respectively. **Conclusion:** The findings indicate that trans-cinnamic acid attenuates scopolamine-induced cognitive deficits, possibly through anti-cholinesterase and antioxidant mechanisms. TCA shows promise as a potential neuroprotective agent for AD, warranting further investigation.

Keywords: Alzheimer's disease, trans-cinnamic acid, scopolamine-induced cognitive impairment, neuroprotection

PCO007

Clinical Audit of Antifungal Therapy Adherence to Hospital Guidelines and Quantitative Drug Utilization Evaluation of Antifungal Drugs in Critical Care Setting

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Introduction: Invasive fungal infections (IFIs) increase morbidity and mortality among critically ill patients. Optimized antifungal use and adherence to institutional guidelines are essential for antifungal stewardship and resistance prevention. This study evaluated compliance with institutional antifungal prescribing guidelines and quantified antifungal drug utilization in critical care settings. **Methods:** A prospective observational study was conducted at a tertiary care hospital from September 2024 to January 2025, including 82 adult critical care patients receiving systemic antifungal therapy. Compliance with institutional antifungal guidelines was assessed based on indication, dose, duration, and drug selection. Antifungal utilization was quantified using Defined Daily Dose (DDD/100 bed-days) and Prescribed Daily Dose to DDD (PDD/DDD) ratios. Statistical analyses included Chi-square tests, Fisher's exact test, and Mann–Whitney U tests. **Results:** Overall, 69.57% of prescriptions adhered to

institutional guidelines, while 30.4% were non-compliant due to cost constraints, patient-specific factors, incorrect dosing, adverse effects, and limited review time. Fluconazole showed the highest consumption (114,350 mg over 320 prescription days), whereas caspofungin had the lowest (2,500 mg over 43 days). The highest PDD/DDD ratio was observed with fluconazole (1.79), indicating doses higher than the standard. Voriconazole, anidulafungin, and caspofungin demonstrated ratios closer to recommended values (1.1–1.16). However, the absence of comparable DDD/100 bed-day data from similar institutions limits contextual evaluation of these utilization patterns. **Conclusion:** The study demonstrates moderate adherence to antifungal prescribing guidelines and variable utilization patterns across agents. The lack of standardized benchmarks restricts comparative interpretation. These findings underscore the need for strengthened antifungal stewardship efforts, periodic audits, and the development of standardized consumption metrics in critical care settings.

Keywords: Adherence to guidelines, Antifungal therapy, Clinical audit, Critical care, Drug utilization evaluation

PCO008

Establishing a Sustained Imiquimod-Induced Psoriasis Mouse Model: Methodological Refinement, Reproducibility, and Limitations

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Introduction: The imiquimod (IMQ)-induced mouse model is widely used for studying psoriasis pathogenesis and evaluating anti-psoriatic therapies due to its simplicity and rapid induction of inflammation via Toll-like receptor 7/8 activation. However, conventional IMQ protocols typically induce an acute, self-resolving inflammatory response that poorly reflects the chronic and relapsing nature of human psoriasis. In addition, methodological variables influencing reproducibility, including animal sourcing, remain underappreciated. This study aimed to refine and optimise the IMQ-induced mouse model to sustain chronic inflammation, while identifying key factors that affect experimental outcomes. **Methods:** The dorsal skin (2 × 3 cm) of BALB/c mice was shaved on Day 0, followed by daily topical application of Aldara® 5% IMQ cream from Day 1 to Day 15. Treatment commenced on Day 9 and continued until Day 15. Disease progression was monitored daily using photographs and a modified Psoriasis Area and Severity Index (PASI) to assess erythema, scaling, and skin thickening. Histopathological evaluation of dorsal skin samples was performed to evaluate epidermal hyperplasia, keratinocyte proliferation, and immune cell infiltration, with inflammatory severity quantified using Baker's scoring system. **Results and Discussion:** Prolonged IMQ application resulted in sustained erythema, scaling, and skin thickening, with persistently elevated PASI scores. Histological analysis demonstrated pronounced epidermal hyperplasia, hyperkeratosis, acanthosis, and inflammatory cell infiltration, confirming maintenance of a psoriasis like phenotype. Unlike conventional IMQ models, which typically restrict IMQ exposure to 5-7 days or discontinue application once treatment is initiated, the refined model preserves the inflammatory state throughout the experimental timeline. Notably, differences in disease onset and severity were observed depending on the source of BALB/c mice. Conclusion: This refined IMQ-induced mouse model sustains chronic inflammation and highlights animal sourcing as a critical determinant of reproducibility. The optimised protocol offers a more translationally relevant platform for evaluating long-term anti-psoriatic therapies.

Keywords: Animal source variability, Chronic inflammation, Imiquimod-induced mouse model, PASI scoring, Psoriasis

PCO009

Public Health Challenges and Healthcare Access Inequities in the Alang Ship Breaking Industry

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Introduction: The Alang Shipbreaking Yard in Gujarat, India, is the world's largest ship recycling facility, accounting for nearly 50 percent of global ship dismantling. While the industry generates large-scale employment, it relies predominantly on workers from marginalized and socio-economically disadvantaged backgrounds. These workers are exposed to hazardous substances such as asbestos, heavy metals, polychlorinated biphenyls (PCBs), and toxic fumes, leading to significant occupational health risks. Coupled with poor living conditions and social exclusion, these exposures contribute to pronounced health inequities, making Alang a critical site for examining public health challenges in hazardous informal labour. **Methods:** This study adopts a qualitative public health perspective based on primary as well as secondary data analysis. Peer-reviewed literature, government reports, policy documents, and reports from labour and public health organisations related to the Alang shipbreaking industry were systematically reviewed. A thematic analytical approach was used to examine occupational health risks, living conditions, healthcare access, and structural determinants influencing worker health outcomes. **Results:** The findings reveal a high prevalence of chronic respiratory illnesses, skin disorders, musculoskeletal injuries, and occupational cancers among shipbreaking workers. Health vulnerabilities are further intensified by overcrowded housing, inadequate sanitation, unsafe drinking water, and limited access to nutritious food. Informal employment arrangements and caste-based marginalization restrict access to health insurance and social security benefits. Healthcare infrastructure in Alang remains inadequate; the local hospital lacks specialized capacity to address occupational illnesses. **Conclusion:** The study highlights that health inequities in the Alang Shipbreaking Yard arise from the intersection of hazardous work environments, socio-economic disadvantage, and systemic gaps in healthcare access. Addressing these challenges requires strengthening healthcare infrastructure, enforcing occupational safety standards, expanding social protection for informal workers, and developing migrant health monitoring systems. Ensuring equitable healthcare access is essential for health justice and the sustainable functioning of the shipbreaking industry.

Keywords: Alang Shipbreaking, occupational health, healthcare access, public health, migrant workers.

PAO001

Develop And Validate Stability Indicating Analytical Method for Determination of Trametinib Using RP-HPLC

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Introduction: Trametinib is primarily used to treat certain types of cancer, including melanoma, non-small cell lung cancer, and anaplastic thyroid cancer, particularly in patients with specific genetic mutations. In the current application, RP-HPLC method for the determination of trametinib will be developed and validated. **Methods:** To develop and validate a simple, accurate, economical, rapid, and precise RP-HPLC method for the determination of trametinib by using YMC Pack ODS-A (150x4.6mm), 3.0µ column with mobile phase consisting of 0.01 M potassium dihydrogen phosphate buffer: acetonitrile in the ratio of (45:55) v/v. The flow rate was kept at 1.0 ml/minute and Wavelength maxima was carried out at 243 nm. Column oven temperature was maintained at 30˚C and sample temperature was maintained at 15˚C. Standard solution was prepared about 20 µg/ml of Trametinib and the run time was 20 min under these conditions. **Results:** The calibration curve was plotted with a range from 10- 30 µg/mL, The LOD and LOQ values of Trametinib were found to be 0.45 µg/mL and 1.38 µg/mL respectively. The percentage recovery of Trametinib was found to be within the limits. The developed RP-HPLC method was validated according to the ICH guidelines for specificity, LOD, LOQ, linearity, accuracy, precision, intermediate precision, and robustness. **Conclusion:** The chromatographic conditions ensured effective resolution and precise quantification, making the method reliable for determining trametinib in pharmaceutical drug or formulations. The developed and validated RP-HPLC method is simple, rapid, and economical, providing accurate and precise determination of trametinib in bulk and dosage forms.

Keywords: Trametinib, RP-HPLC, Method Development, Validation.

PAO002

Development and Validation of an Eco-friendly RP-HPLC Method for the Quantification of Lurasidone in Complexed Nano-formulation with Forced Degradation Studies

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Introduction: Lurasidone hydrochloride has exhibited poor aqueous solubility and undergoes extensive first-pass metabolism, resulting in low oral bioavailability (<20%). Encapsulating LRD into nano-carrier systems is a promising strategy to enhance solubility and enable targeted and sustained delivery. This study aimed to develop a simple, sensitive, and environmentally friendly HPLC method for the quantification of LRD in nanoformulations. An AQbD approach was employed to develop and validate the method in accordance with ICH Q2 (R1) guidelines. **Methods:** The chromatographic separation was achieved using a C18 column with a mobile phase comprising ammonium acetate buffer (30 mm, pH 3.5), methanol, and acetonitrile in the ratio of 14:68:18% (v/v), at an optimised flow rate of 0.82 mL/min. Detection was carried out using a UV detector at 230 nm. Forced degradation studies were performed to evaluate the stability-indicating capability of the method under various stress conditions. **Results:** The optimised method demonstrated excellent linearity (r^2 = 0.9999) over the concentration range of 0.5 to 4.0 µg/mL. The LOD and LOQ were 40.48 ng/mL and 122.68 ng/mL, respectively, indicating high sensitivity. The method demonstrated satisfactory precision, accuracy, selectivity, and robustness, with RSD values of less than 2%. Forced degradation studies confirmed that LRD remained stable under the tested stress conditions. **Conclusion:** The developed HPLC method is precise, accurate, selective, sensitive, and stability-indicating. Furthermore, assessment using multiple greenness-assessment tools, including GAPI, complex-GAPI, AGREE, and BAGI, confirmed the environmental sustainability and practical applicability of the method.
Keywords: AQbD, Degradation, Greenness, Lurasidone hydrochloride.

PAO003

Synthesis and Biological Evaluation of Some Substituted Thiazole and Pyrazole Derivatives as Potential Anti-Inflammatory, Antioxidant and Antimicrobial Agents

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Introduction: Heterocyclic chemistry is an important branch of organic chemistry that deals with compounds containing heteroatoms such as nitrogen, oxygen, or sulfur within ring systems. These compounds are widely present in natural products, pharmaceuticals, agrochemicals, and polymers, and exhibit diverse biological properties. Among various heterocycles, thiazole and pyrazole derivatives have attracted considerable interest due to their broad pharmacological activities, including antimicrobial, anti-inflammatory, antioxidant, and anticancer effects. Therefore, the synthesis of new thiazole and pyrazole derivatives is of significant importance for the development of biologically active heterocyclic compounds. **Method:** In the present study, a series of substituted thiazole and pyrazole derivatives were synthesized using standard reflux, condensation, and cyclization techniques. The synthesized compounds were purified by recrystallization and monitored by thin-layer chromatography. Structural characterization was carried out using melting point determination, FT-IR spectroscopy, 1H and 13C NMR spectroscopy, mass spectrometry, and elemental analysis. The biological activities of the synthesized compounds were evaluated through in-vitro anti-inflammatory activity using the HRBC membrane stabilization method, antioxidant activity by the DPPH free radical scavenging assay, and antimicrobial activity by the agar well diffusion method. **Results:** All synthesized compounds were obtained in moderate to good yields and showed characteristic spectral data confirming their structures. Biological evaluation revealed that thiazole derivatives 4b and 4f exhibited significant anti-inflammatory activity, while compounds 3b

and 3d showed good to excellent antioxidant potential. **Conclusion:** Antimicrobial studies indicated that compounds 4b and 4e were the most active against *Escherichia coli* and *Staphylococcus aureus*, with compound 4c showing notable activity against *S. aureus*. Overall, the presence of electron-withdrawing substituents enhanced biological activity, suggesting these heterocycles as promising leads for further optimization.

Keywords: Aldehyde, Chalcones, Anti-inflammatory, Antioxidant, Antimicrobial

HNO001

In-Silico Evaluation of Phytoconstituents from *Morus alba*, *Feronia limonia*, and Berberine as Potential ACE Inhibitors

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Introduction: Cardiovascular diseases (CVDs), especially atherosclerosis, are a leading cause of global mortality, highlighting the need for safer and more effective therapies. This study investigates a polyherbal oral cardiotonic formulation containing *Morus alba*, *Feronia limonia*, and berberine, focusing on their molecular interactions with angiotensin-converting enzyme (ACE), a key regulator of cardiovascular function. **Methods:** The crystal structure of human ACE (PDB ID: 1O8A) was obtained from the RCSB Protein Data Bank and prepared using BIOVIA Discovery Studio. Phytoconstituents from fruits and leaves of *Morus alba and Feronia limonia* and Berberine were retrieved from PubChem. Molecular docking was performed using PyRx (AutoDock Vina), and binding interactions were visualized using Discovery Studio. **Results:** Among the 20 compounds evaluated, Atalantoflavone (–9.5 kcal/mol) and Moracin P (–9.3 kcal/mol) from *Morus alba* exhibited strong binding affinity toward ACE. Limonin (–10.1 kcal/mol) and a triterpenoid compound (–9.7 kcal/mol) from *Feronia limonia* also showed significant binding potential. Berberine displayed consistent interaction with docking score (-8.3) on the catalytic site. The reference drug Captopril showed lower docking score of –5.5 kcal/mol, indicating comparatively weaker binding. **Conclusion:** The screened phytoconstituents showed strong ACE-inhibitory potential, outperforming Captopril in docking studies and indicating valuable cardioprotective compounds in *Morus alba*, *Feronia limonia*, and berberine. These results support the development of a polyherbal cardiotonic formulation, with future network pharmacology and experimental studies needed to confirm multi-target mechanisms and therapeutic potential.

Keywords: ACE, Berberine, *Feronia limonia*, Molecular Docking, *Morus alba.*

HNO002

Formulation and Evaluation of Herbal Skin Cream for Hyperpigmentation

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Introduction: Hyperpigmentation is a common dermatological disorder caused by excessive melanin synthesis due to ultraviolet exposure, inflammation, hormonal imbalance, or oxidative stress, resulting in dark patches and uneven skin tone. synthetic depigmenting agents may cause irritation, sensitivity, and safety concerns, increasing interest in safe herbal alternatives. This study aimed to formulate and evaluate a polyherbal anti-hyperpigmentation cream using selected medicinal plants with proven skin-beneficial properties. **Methods:** Hydroalcoholic extracts of *Curcuma longa*, *Mangifera indica*, and *Azadirachta indica* were prepared using

Soxhlet extraction, while aqueous extracts of *Cucumis sativus* Linn., *Phyllanthus emblica*, and *Chrysopogon zizanioides* extract were obtained by decoction. Fresh *Aloe vera* pulp was directly incorporated. The formulation ratio consisted of *Curcuma longa* (1 g), *Mangifera indica* (1.5 g), *Azadirachta indica* (1 g), *Cucumis sativus* Linn. (0.75 g), *Phyllanthus emblica* (0.7 g), *Chrysopogon zizanioides* (1 g), and *Aloe vera* pulp (2 g). A water-in-oil emulsion cream was developed to enhance stability, spreadability, and dermal penetration. The formulation was evaluated for organoleptic properties, pH, homogeneity, spreadability, and stability. Product efficacy was assessed through phytochemical screening and skin irritancy studies. **Results:** Phytochemical analysis confirmed flavonoids, alkaloids, carbohydrates, glycosides, tannins, and saponins. The cream exhibited smooth consistency, good homogeneity, acceptable stability, and skin-compatible pH. Reduction in pigmentation was determined by visual assessment of lightening of dark patches, improved uniformity of skin tone, enhanced moisturizing effect, and absence of irritation. **Conclusion:** The polyherbal cream showed synergistic depigmenting potential and suitability for hyperpigmentation management.

Keywords: Cream, Hyperpigmentation, Melanin, Polyherbal, Synergistic Effect.

HNO003

Targeting PI3K/Akt-Mediated Inflammatory Signaling in Inflammatory Bowel Disease: An Integrative Network Pharmacology and Experimental Study

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Introduction: Inflammatory Bowel Diseases (IBD) are recurrent inflammatory conditions that occur in the gastrointestinal tract and affect people worldwide. With the concourse of an innovative approach known as network pharmacology, it is now possible to study intricate connections between bioactives, targets, illnesses, and genes. In line with this, the study aimed to elucidate the mechanistic role of two major bioactives, Aegeline and Nodakenin in mitigating inflammatory bowel disease through a network pharmacology approach, *in vitro* and *in vivo* studies. **Methods:** Network pharmacology and molecular docking approach of Aegeline and Nodakenin was carried out. *In silico* studies of both compounds were performed to elucidate their probable mechanistic role in combating IBD. *In vitro* studies on RAW 264.7 and Caco-2 cells were conducted to explore their anti-inflammatory activity on LPS-stimulated inflammation in cells. Further *in vivo* studies were performed to evaluate the effectiveness of aegeline and nodakenin on DSS-induced IBD. Various biochemical and oxidative stress parameters, as well as gene expression studies of specific genes, were assessed. Histopathological changes were observed using H&E stain and PAS stain. **Results:** Mice in the DSS group depicted that higher doses of aegeline and nodakenin significantly prevented the colon shortening. The decline in levels of MDA, MPO, nitric oxide illustrated the anti-oxidant activity. Aegeline and Nodakenin at higher dose demonstrated the downregulation of EGFR, PI3K, AKT, MTOR as compared to DSS group, conferring its great anti-inflammatory potential in combating colitis. **Conclusion:** Taken together, aegeline and nodakenin presumably alleviated colitis by targeting EGFR-mediated PI3K/AKT pathway.

Keywords: Inflammatory bowel disease, ulcerative colitis, network pharmacology, aegeline, nodakenin.

HNO004

Development and In Vitro Evaluation of a Doxycycline-Epigallocatechin Gallate-Loaded Polymeric Scaffold for Antibacterial Wound Applications

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Introduction: Bacterial infections significantly impair chronic wound healing by prolonging inflammation, promoting the formation of biofilms, and disrupting normal cellular repair processes. Prolonged use of high doses of synthetic antibacterial agents can further contribute to bacterial resistance, cytotoxicity, and the persistence of biofilms. Integrating synthetic antibacterials with bioactive herbal compounds represents a promising strategy to

enhance antibacterial efficacy while supporting wound-healing–related cellular responses. In this study, doxycycline (DOX) and epigallocatechin gallate (EGCG) were co-incorporated into a polymeric scaffold to achieve combined antibacterial, anti-inflammatory, and antioxidant effects. **Method:** Drug-loaded scaffolds were fabricated using the solvent casting method and optimized by employing a central composite design. The optimized formulation was evaluated for physico-mechanical properties, in vitro drug diffusion, antibacterial activity, and cytocompatibility using keratinocyte (HaCaT) and fibroblast (NIH 3T3) cell lines. **Results:** FTIR analysis indicated no significant chemical interactions between the scaffold components. A validated HPLC method enabled simultaneous estimation of EGCG and DOX, with retention times of 4.4 and 5.1 min, respectively. Scaffold optimization was performed using tensile strength and antibacterial activity (zone of inhibition) as response variables. Antibacterial studies against *Escherichia coli*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* demonstrated enhanced antibacterial activity for the combined DOX–EGCG scaffold compared to individual components. Cytocompatibility studies confirmed non-toxic effects on HaCaT and NIH 3T3 cells. Additional in vitro assays suggested improved anti-inflammatory activity and enhanced wound-healing–related cellular responses. **Conclusion:** The optimized DOX–EGCG-loaded scaffold exhibited enhanced antibacterial activity, favorable cytocompatibility, and supported wound-healing–associated cellular functions in vitro. The non-disintegrating scaffold structure may additionally provide physical protection and moisture support, indicating its potential applicability as a multifunctional wound dressing.

Keywords: Doxycycline, Epigallocatechin, Scaffold, Antibacterial, Delayed wound.

HNO005

Enhancing Dermal Delivery of Herbal Actives Through Optimized Hydrogel Systems for Effective Management of Eczema

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Introduction: Eczema is a chronic skin inflammation that occurs in 15–20% of children and 2–5% of adults worldwide. Topical traditional therapies are limited by inadequate dermal penetration and long-term side effects. Herbal medicines, widely used in Indian traditional systems such as Ayurveda, contain bioactive phytoconstituents with anti-inflammatory, antioxidant, and skin-protective properties, offering a safer therapeutic alternative. Therefore, the present study aimed to develop and optimize herbal drug-based hydrogel formulation to enhance dermal delivery and therapeutic efficacy in eczema management. **Methods:** The formulation was prepared with Carbopol 934 and optimized by Response Surface Methodology. Evaluation comprised of physicochemical characterization (pH, viscosity and spreadability), in vitro drug release, and ex vivo skin permeation/retention study using animal skin. Safety was tested with cytotoxicity assays and inflammatory cytokine expression through RT-PCR. In vivo efficacy was demonstrated in a dinitrochlorobenzene-induced eczema model, involving clinical and histopathological analysis. **Results:** The optimized hydrogel exhibited suitable mechanical properties with a viscosity of 14,872 cP, pH of 6.32, and good spreadability 76%, indicating structural strength for dermal application. In vitro studies showed sustained drug release, while ex vivo analysis confirmed 48% drug retention in skin after 4 hours, indicating enhanced dermal bioavailability rather than rapid release. In vivo studies demonstrated significant downregulation of inflammatory cytokines and marked improvement in skin structure. Stability studies revealed no significant changes in formulation parameters. **Conclusion:** The prepared herbal hydrogel is a stable, safe and an affective dermal delivery system with enhanced skin penetration and anti-eczema activity and it is considered as one of the promising alternatives for eczema management.

Keywords: Eczema, Herbal Drug, Topical formulation, Skin Drug Delivery, In vitro and in vivo evaluation

HNO006

Network Pharmacology, Molecular Docking, and Molecular Simulations Insights into the Potential of Selected Flavonoids for Alzheimer's Disease

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Introduction: Alzheimer's disease (AD), the most prevalent cause of dementia, is characterized by progressive cognitive decline and memory impairment and remains devoid of effective disease-modifying therapies. Flavonoids are well studied for their antioxidant, anti-inflammatory, and multi-target neuroprotective properties, suggesting their potential utility in AD management. The present study aims to evaluate selected flavonoids as prospective anti-Alzheimer's agents using integrated *in silico* approaches. **Methods:** An in-house flavonoid library was curated based on reported pharmacological relevance to AD. Comprehensive *in silico* ADMET analysis was performed to assess drug-likeness, pharmacokinetic behaviour, blood–brain barrier (BBB) permeability, predicted metabolic stability, CYP450-mediated biotransformation, and degradation liability. Metabolic hotspot mapping and phase-I/phase-II degradation pathway predictions were conducted to infer intrinsic clearance and biotransformation tendencies. Compounds satisfying predefined screening criteria were shortlisted and subjected to network pharmacology analysis to identify disease-associated targets and mechanistic pathways. Molecular docking and molecular dynamics simulations were subsequently used to evaluate binding affinity and interaction stability with key AD-related targets. **Results:** Twelve flavonoids successfully passed ADMET screening, demonstrating favourable BBB permeability, acceptable predicted metabolic stability, and low to moderate degradation risk. Network pharmacology revealed 224 overlapping targets between the flavonoids and AD, identifying BACE1 as a key hub gene implicated in AD pathogenesis. Gene Ontology and KEGG enrichment analyses highlighted modulation of synaptic transmission, oxidative stress response, neuroinflammatory signalling, apoptosis regulation, and kinase-mediated pathways. Molecular docking identified cardamomin and sakuranetin as top candidates with strong binding affinities (−8.2 and −8.7 kcal/mol, respectively), while molecular dynamics simulations confirmed stable ligand–protein complexes. Degradation profiling indicated limited CYP450-mediated metabolic vulnerability and controlled phase-II conjugation for these leads. **Conclusion:** The study suggests that selected flavonoids represent promising multi-target therapeutic candidates for AD. Further validation through *in vitro* BBB models, metabolic stability assays, and *in vivo* pharmacokinetic studies shall be conducted.

Keywords: Alzheimer's disease, Flavonoids, *In-silico* study, Neuroprotection, PharmacokineticsS

HNO007

Synergistic Isoflavone Nanotherapeutics: DoE Optimization Guided by Network Pharmacology and Molecular Interactions in Neurodegeneration

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Introduction: Neurodegenerative disorders such as Alzheimer's and Parkinson's diseases feature oxidative stress, neuroinflammation, mitochondrial dysfunction, and neuronal loss. Single-target therapies show limited efficacy, necessitating multi-target strategies with optimized delivery. Biochanin A and genistein were selected based on: documented neuroprotection via ERβ activation and antioxidant effects, GRAS (Generally Recognized as Safe) status as soy isoflavones, target overlap with neurodegeneration genes, and complementary physicochemical properties enabling synergy. However, poor aqueous solubility (<0.1 mg/mL), low oral bioavailability (1-5%), and rapid first-pass metabolism limit clinical translation. **Methods:** Network pharmacology identified shared targets of biochanin A and genistein that intersect with neurodegeneration disease genes. These targets were analyzed through protein-protein interaction networks, GO/KEGG pathway enrichment, and molecular docking validation. Box-Behnken Design optimized nanoparticles to improve bioavailability, offering advantages over traditional rational formulation approaches by efficiently modeling complex interactions with fewer experiments. **Results:** Network analysis identified multiple shared targets regulating key pathways including PI3K-Akt signaling, neuroinflammation, and apoptosis. Molecular docking confirmed strong binding affinity of both isoflavones to critical neurodegeneration targets like ERβ and APP proteins. The optimized nanoparticles demonstrated significantly enhanced solubility, drug encapsulation, narrow size distribution, and controlled release profile, predicting substantially improved brain delivery compared to free drug solutions. **Conclusion:** BBD-guided nanoformulation, informed by network pharmacology and docking, establishes synergistic biochanin A-genistein nanotherapeutics. This design-driven approach rationally enhances bioavailability while validating multi-target neuroprotection, providing a scalable framework for neurodegeneration translation.

Keywords: Network pharmacology, Molecular docking, Design of Experiments (DoE), Biochanin A, Genistein, etc.

HNO008

Fabrication and Characterization of Curcumin loaded Ionic Complex to Combat Bacterial Infections

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Introduction: Antimicrobial resistance poses a critical challenge to the public healthcare sector both worldwide and nationwide, exacerbated by the limited discovery of newer antibiotics. Amongst many different approaches, repurposing natural compounds in treating bacterial virulence embodies a promising strategy for fighting resistance to conventional antibiotic therapy. The present study demonstrates the application of curcumin in treating bacterial infections. Curcumin is known for its proven antimicrobial, anti-inflammatory and antioxidant efficacy. However, due to its low bioavailability and poor solubility, its application is limited. Addressing these challenges, we designed a biopolymer based ionic complex for efficient encapsulation and controlled release of curcumin. **Methods:** Polyelectrolyte complex formation between two oppositely charged biopolymers, chitosan and pectin was used in fabricating ionic complex for curcumin loading. The curcumin loaded complex (Cur-(CH-Pec)) was further characterized with solid state characterization. The fabricated Cur-(CH-Pec) was evaluated for its particle size encapsulation efficiency and evaluation of its drug release kinetics. **Results:** FTIR studies exhibited the confirmation on the formation of the polyelectrolyte complex. The curcumin-biopolymer complex demonstrated a particle size of 617 ±43 nm with adequate stability. In addition to this successful encapsulation of curcumin (87.35±0.33) was accomplished in the chitosan-pectin biopolymer complex. Additionally, curcumin biopolymer complex exhibited significant antibacterial efficacy against *Staphylococcus aureus* and *Escherichia coli*. Further, curcumin loaded ionic complex exhibited higher retention to the skin and demonstrated no dermal toxicity on rodent model. **Conclusion:** Overall, study highlights the potential of biopolymer based complexes as an effective drug delivery system for loading a poorly soluble molecule, curcumin.

Keywords: Curcumin, biopolymer ionic complex, Antimicrobial, Controlled Release, Natural Product

AIO001

Rational Design and Synthesis of Novel Tacrine-Based Analogues Targeting Telomerase as Anticancer Agents

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Introduction: Telomerase, a ribonucleoprotein enzyme also referred to as telomere terminal transferase, plays a crucial role in preserving chromosomal stability by maintaining telomere length. Aberrant activation of telomerase is observed in the majority of human malignancies and is a key contributor to unlimited cellular proliferation. In contrast, normal somatic cells exhibit minimal or no telomerase activity, making this enzyme an attractive and selective molecular target for anticancer therapy. The present study aims to design, synthesize, and biologically evaluate a series of novel acridine-based analogues as effective telomerase inhibitors, with particular emphasis on their therapeutic potential against lung cancer. **Methods:** A ligand-based quantitative structure–activity relationship (QSAR) approach was employed using previously reported ethenesulfonyl fluoride derivatives (Chen

et al., 2018) as reference compounds. Contour map analysis guided the rational design of new acridine analogues. Molecular design and optimization were performed using the Maestro interface (Schrödinger LLC, New York, USA; academic release 2020–2021). **Results:** The designed compounds were synthesized and subsequently assessed for their anticancer potential through telomerase-targeted in-vitro studies. The synthesized acridine derivatives were structurally confirmed using mass spectrometry, ^{1}H NMR, ^{13}C NMR, and single-crystal X-ray diffraction analyses. In-vitro biological evaluations, including MTT cytotoxicity and apoptosis assays, were conducted using 5-fluorouracil and BIBR-1532 as reference standards. **Conclusion:** Several designed compounds demonstrated superior antiproliferative and pro-apoptotic activity compared to conventional telomerase inhibitors, highlighting the effectiveness of strategic molecular modification in enhancing telomerase inhibitory potential.

Keywords: Telomerase, *h*TERT, anti-cancer, apoptosis inducer, QSAR

AIO002

Exploring phytochemical candidates against urolithiasis via ADMET study, network pharmacology, molecular docking, and MD simulation from *Paederia foetida*

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Introduction: *Paederia foetida* is an herb with traditional medicinal use. In this study, we employed network pharmacology and in silico methods to explore its role in preventing kidney stones. Phytochemicals of *Paederia foetida* (274 compounds) were retrieved from literature and databases. Their ADMET properties and drug-likeness (Lipinski's rule) were evaluated. Putative targets were predicted using SwissTargetPrediction. Kidney stone-related genes were compiled from DisGeNET, CTD, OMIM, GenCLip 3, and GeneCards. **Methods:** The intersection of phytochemical targets (274 compounds) and disease genes yielded 417 common targets. A protein–protein interaction network was constructed using STRING and visualised in Cytoscape. Gene enrichment analysis was conducted with ShinyGO. Molecular docking was used to assess the binding of key compounds to major kidney stone-related proteins. Molecular dynamics (MD) simulations were used to evaluate the stability of docked complexes. **Results:** Network analysis revealed core targets including AR, ESR1, CYP2C19, G6PD, and ACHE. Pathway analysis suggested that *Paederia foetida* modulates signalling pathways implicated in stone formation. Campesterol emerged as a principal bioactive compound; docking showed strong binding to Human microsomal Cytochrome P450 (CYP), indicating potent anti-kidney stone activity. MD simulations confirmed stable interactions. **Conclusion:** This comprehensive in silico study indicates that *Paederia foetida* contains compounds, particularly campesterol, with promising anti-kidney stone activity via multi-target mechanisms. These findings lay the groundwork for future experimental validation and development of novel nephrolithiasis therapeutics.

Keywords: Campesterol; Kidney stone; Molecular docking; Network pharmacology; *Paederia foetida*

AIO003

Deciphering Tofacitinib's Multi-Target Mechanisms in Psoriasis via Integrated Network Pharmacology - Molecular Docking Approach

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Introduction: Psoriasis, a chronic auto-immune disease which involves dysregulated immune responses, particularly via the Janus Kinase/Signal Transducer and Activator of Transcription (JAK-STAT) pathway,

cytokine and chemokines signalling pathway causing inflammation and T helper 17 (Th17) cell differentiation. It is red, scaly plaque with wax like barrier. Tofacitinib, a JAK inhibitor, demonstrates clinical efficacy, yet its multi-target mechanisms remain underexplored. Network pharmacology and molecular docking offer systematic approaches to map drug-disease interactions at molecular levels. This study integrates network pharmacology along with molecular docking to elucidate tofacitinib's therapeutic actions in psoriasis, identifying hub genes, enriched pathways and binding affinities. **Methods**: Psoriasis-associated genes were curated from GeneCards, MalaCards and Open targets and Tofacitinib-associated targets were curated from BindingDB and SwissPrediction. The overlapping targets were uploaded to StringDB for construction of protein-protein interaction network and further biological enrichment was predicted using DAVID bioinformatics tools. The binding affinities were assessed via molecular docking approach using Autodock Vina tool and interactions were visualized using biovia discovery studio visualizer. **Results:** Protein-Protein Interaction (PPI) networks revealed key hubs like JAK1, JAK3, STAT3, Interleukin-6 Receptor (IL-6R) and Tumor Necrosis Factor (TNF). Further enrichment analyses highlighted ontological terms such as immune response, inflammatory response, interleukin-23-mediated signalling pathway, interleukin-12 receptor complex and KEGG pathways (Th17 cell differentiation, JAK-STAT signalling pathway, cytokine-cytokine receptor interaction, Toll-like receptor signalling pathway). Molecular docking studies revealed significant interactions of tofacitinib with key targets associated with psoriasis. **Conclusion:** These findings indicate tofacitinib's pleiotropic modulation of psoriasis pathways via hub targets, validated using molecular docking. This computational framework supports biomarker discovery and explains tofacitinib's therapeutic actions in psoriasis.

Keywords: JAK-STAT Pathway, Molecular Docking, Network Pharmacology, Psoriasis, Protein-Protein

AIO004

Cyano-pyrimidine Chalcone Hybrids: Molecular Design, Synthesis, and Anticancer Potential via LSD1 Inhibition

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Introduction: Cancer remains a leading cause of morbidity and mortality worldwide, with millions of new cases and deaths reported each year. Conventional anticancer therapy faces multiple challenges including limited efficacy and associated with multiple adverse effects. LSD1 represents a key epigenetic regulator in cancer progression. Targeting LSD1 with small-molecule inhibitors has emerged as a promising anticancer strategy. So, our study aimed at exploration of novel, potent and safe anticancer agents, targeting LSD1. **Methods:** In this study, a series of novel cyano-pyrimidine chalcone derivatives were designed, synthesized and characterized with various spectroscopic techniques. The synthesized compounds were evaluated against HT29 colon cancer and A-549 lung cancer cell lines via SRB assay. Also LSD1 inhibition assay of most potent compound was performed using Cayman chemical LSD1 inhibition kit. **Results:** Molecular docking studies against LSD1 indicated favorable binding interactions, with docking scores < -7 kcal/mol. Among all, compound **VIIC** proved most active anticancer agent, and was further evaluated for *in vitro* LSD1 inhibitory activity, yielding an IC_{50} value of 0.333 µM, far better than standard tranylcypromine (IC_{50} of 22.3 µM). The *in silico* ADMET evaluation of these derivatives demonstrated acceptable metabolic stability in human liver microsomes with minimal inhibition of cytochrome P450 enzymes (CYPs). **Conclusion:** The results suggest that compound **VIIC** can serve as a promising lead for the development of anticancer agents.

Keywords: LSD1, Chalcone, Cyano-pyrimidine, Cancer

AIO005

Design and Evaluation of Estradiol-Pyrimidine Derivatives as COVID-19 Inhibitors

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Introduction: Estrogen, a steroid hormone vital for female sexual/reproductive health, bone density, cardiovascular function, and cognition, occurs naturally in both sexes but at higher levels in females. Recent research highlights its role in COVID-19 pathogenesis, prompting the design of novel estradiol-pyrimidine analogs as potential inhibitors of SARS-CoV-2 proteins. **Methods**: Analogs were screened via *in silico* approaches including molecular docking (targeting Mpro and ACE2), ADMET profiling, 100-ns MD simulations, and MM-GBSA binding free energy calculations. Stability was assessed through RMSD and RMSF analyses. The approach was validated by synthesizing a representative compound, characterized via NMR and mass spectrometry. **Results**: Derivatives exhibited strong docking scores. LIG323 showed the best affinity for Mpro, while LIG217 excelled against ACE2. MM-GBSA binding energies were -30.85 kcal/mol (LIG323-Mpro) and -49.17 kcal/mol (LIG217-ACE2). MD simulations confirmed complex stability, with low RMSD fluctuations and minimal RMSF in binding pockets, indicating firm ligand-protein interactions. **Conclusion**: These estradiol-pyrimidine analogs demonstrate promising antiviral potential against COVID-19 targets. *In silico* validation, supported by synthesis and characterization, predicts strong *in vitro* activity in future assays, justifying further experimental validation for novel therapeutics.

Keywords: Estradiol-Pyrimidine analogs, Estrogen, Molecular Dynamic Simulation, *In silico*, Synthesis

ABSTRACTS -POSTER PRESENTATION (NEXT-GEN FORMULATIONS, NANOTECHNOLOGY AND BIOTECHNOLOGY)

NAP001

Formulation, Optimization and Evaluation of Paclitaxel and Pemetrexed Co-loaded Liposomes for Lung Cancer

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Introduction: As per Global Cancer Observatory report published in 2024, lung cancer accounted for 12.4% of total cancer incidences and 18.7% of cancer deaths in year 2022. Non-small cell lung cancer is a type of lung cancer posing a significant challenge globally. Paclitaxel and pemetrexed are broad-spectrum anticancer agents that have demonstrated synergistic apoptotic effects in phase II clinical trials of lung cancer treatment. However, paclitaxel and pemetrexed co-loaded formulation is not available. **Methods:** Pre-formulation studies for both the drugs were conducted by analytical techniques based on infra-red, mass, nuclear magnetic resonance and ultra-violet spectroscopies. Drug-excipient compatibility studies were performed for a period of 60 days. Dual drug co-loaded liposomes were formulated by incorporating paclitaxel and pemetrexed into lipid and water phases, respectively. Box-Behnken Design based formulation optimization was conducted by performing 17 trials. Micromeritic characteristics and zeta potential was recorded for each batch. Entrapment efficiency was determined by reversed phase chromatography. **Results:** Mass spectroscopy confirmed identities of both the drugs as $[M+H]^+$ peaks appeared at the m/z values of 854.5 for paclitaxel and 428.2 for pemetrexed. The drug-excipient compatibility studies showed no incompatibility between drugs and excipients. Chromatographic methods for quantification of both the drugs demonstrated linearity in the rage of 100 ppm to 300 ppm. The particle size of formulated liposomes was below 250 nm, polydispersity index was below 0.3 and zeta potential was between -20 mV to -30 mV. **Conclusion:** The optimized paclitaxel and pemetrexed co-loaded liposomes demonstrated potential to be effective in lung cancer therapy.

Keywords: Non-small cell lung cancer, Liposomes, Co-delivery

NAP002

Formulation, Development and Characterization of Vitamin E TPGS-loaded Relugolix Niosomes

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Introduction: Relugolix exhibits poor oral bioavailability (12%), due to low aqueous solubility, limited intestinal permeability, and P-glycoprotein efflux, classifying it as BCS Class IV drug. These combined limitations result in low gastrointestinal absorption and necessitate higher therapeutic doses, increasing the risk of systemic adverse effects. To overcome these challenges, the present study aims to develop Vitamin E TPGS-loaded Relugolix Niosomes to enhance solubility, improve membrane permeability, inhibit P-gp efflux, and ultimately improve oral bioavailability. **Methods:** Niosomes were prepared by thin-film hydration method and optimized using Central Composite Design (CCD), with Span 60 and cholesterol as independent variables and vesicle size and entrapment efficiency as dependent variables. Vesicle size, PDI, zeta potential, morphology, FTIR, DSC, XRD, entrapment efficiency, drug loading, *in-vitro* release (dialysis membrane method) and *ex-vivo* studies were assessed. *In-vivo* pharmacokinetic simulation studies were done by using Simulation Software. **Results:** The optimized formulation showed vesicle size 204.1 nm, PDI 0.142, and zeta potential -24.8 mV, indicating stability. Entrapment efficiency was 88.68% with 9.29% drug loading. *In-vitro* studies showed 80.45% release upto 24hrs (sustained release) and *ex-vivo* showed a 87.4% release in 24hrs with 3.4-fold increase in intestinal permeation (Papp: 4.37×10^{-1} cm/s). *In-vivo* pharmacokinetic simulation study shows a 5.96-fold increase in oral bioavailability. **Conclusion:** Vitamin E TPGS-loaded Relugolix Niosomes demonstrated enhanced permeability, sustained drug release, and stability, offering a promising oral delivery strategy that effectively addresses the major biopharmaceutical limitations of Relugolix.

Keywords: Relugolix; Niosomes; Vitamin E TPGS; P-gp inhibition; Oral bioavailability enhancement

NAP003

Formulation Development and Evaluation of Silodosin Loaded Nanostructured Lipid Carrier

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Introduction: Silodosin exhibits low bioavailability due to poor permeability, extensive first pass metabolism and high P-gp efflux. Nanostructured lipid carrier (NLCs) offers promising strategy to increase permeability through GIT, improving encapsulation, by-pass first pass metabolism, inhibit P-gp efflux, increase stability and release behaviour. The present work aimed to utilize NLCs to improve oral bioavailability. **Methods:** Silodosin loaded NLCs were prepared by nanoprecipitation method using Precirol ATO 5 as solid lipid and Capmul MCM C8 as liquid lipid. A 3^2 Central Composite Design assessed the effects of total lipid content and concentration of Soluplus on particle size and Entrapment Efficiency. The optimized formulation was evaluated for particle size, zeta potential, GC, DSC, TEM morphology, *in-vitro* drug release, *ex-vivo* and *in-vivo* pharmacokinetic studies predicted using simulation software. **Results:** The optimized formulation exhibit particle size of 165.4nm and zeta potential of -21mV, indicating good dispersion stability. GC graph shows that formulation in safe limit of residual solvent. DSC confirmed that conversion of Silodosin from crystalline to amorphous form in optimized formulation. TEM revealed spherical NLCs. *In vitro* release study shows 95.48% release up to 24 hrs. *Ex-vivo* studies show cumulative 96.2% release in 21hrs. *In-vivo* pharmacokinetic simulation study shows 1.257 folds increase in oral bioavailability. **Conclusion:** Silodosin loaded NLCs indicates superior in-vitro and ex-vivo drug release and in-vivo pharmacokinetic study compared to marketed capsule formulation. It increases the permeability and oral bioavailability.

Keywords: NLC, Oral Bioavailability, Lipid Carriers, Permeability, Pharmacokinetics

NAP004

Formulation, Development and Evaluation of Metronidazole Loaded Vaginal Sponge

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Introduction: Bacterial vaginosis is a recurrent vaginal infection associated with *Gardnerella vaginalis* and its biofilm formation, which reduces the effectiveness of conventional treatments. Metronidazole is the preferred drug, but its low solubility in limited vaginal fluid and the short residence time of existing formulations restrict local availability. This study aimed to develop solid dispersion-loaded and PNVCL-based vaginal sponges to improve solubility, retention, and localized therapeutic efficacy of Metronidazole. **Methods:** Solid dispersion (SD) was optimized by screening polymers through kneading, fusion, and solvent evaporation methods. The optimized SD was incorporated into a chitosan–HPMC matrix and lyophilized to obtain the first sponge system. For the second system, PNVCL [Poly (N-vinyl caprolactam)] was synthesized by free-radical polymerization using AIBN (Azobisisobutyronitrile), purified by dialysis, and further optimized by an OVAT Approach. Drug was then mixed with PNVCL, chitosan solution, glycerol and cryoprotectant before lyophilization. Both formulations were evaluated for physicochemical properties, swelling, mucoadhesion, *in-vitro* release, antimicrobial activity, *ex-vivo* permeation, histopathology and stability. **Results:** SD-loaded sponge showed improved Drug release around 91%, while PNVCL-based sponge demonstrated higher swelling compared to SD-sponge and stronger mucoadhesive force, indicating improved fluid uptake and longer residence time. Both systems showed antimicrobial activity against *Bacteroides fragilis* and were confirmed safe in histopathology. Stability studies showed no major changes during storage. **Conclusion:** The developed formulations enhanced the intravaginal delivery of Metronidazole, with the solid dispersion sponge achieving improved drug release and the PNVCL sponge providing stronger swelling and retention.

Keywords: Metronidazole, Vaginal sponge, Solid dispersion, PNVCL, Bacterial vaginosis

NAP005

Formulation Development and Evaluation of Fast Dissolving Microneedles of Ibandronate Sodium Monohydrate

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Introduction: Ibandronate sodium is a potent bisphosphonate used in the management of postmenopausal osteoporosis. However, it's extremely low oral bioavailability is primarily due to poor permeability, along with gastrointestinal and food-dependent absorption. A fast-dissolving microneedle transdermal delivery system can effectively bypass the GI barriers with improved systemic uptake. **Materials and methods:** Polymeric microneedle (MN) arrays were fabricated using a micro-moulding approach, utilizing carboxymethyl cellulose and Amylopectin as the primary structural polymers. A 3^2 factorial design was applied to optimize the ratios of the polymers. Axial fracture force and *in-vitro* dissolution time were considered as key quality measurements. Optimized MNs were characterized for shape, strength, Ibandronate content, *in-vitro* dissolution and release rates, *ex-vivo* absorption, histopathology, and *in-vivo* pharmacokinetics in Wistar rats. Quantitative analysis was performed using validated HPLC methods. **Results:** The optimized MN formulation (CMC 38.55 mg; AP 78.04 mg) exhibited strong mechanical strength (AFF 2.61 N) and completely dissolved in about 2 minutes. SEM analysis confirmed well-defined microneedles with sharp tips, each exhibiting a tip height of 6 µm. The formulation revealed 98.33% Ibandronate content and attained about 91% release in 150 minutes, following zero-order kinetics. *Ex vivo* studies demonstrated significantly enhanced Ibandronate permeation (95.75%) with the MN patches compared to the non-MN controls. *In vivo* studies demonstrated a much higher Cmax (637.2 ng/mL) and a 2.66-fold increase in relative bioavailability upon administration as compared to the market oral tablet. Histopathology indicated the preservation of skin integrity with uniformly formed microchannels. **Conclusion:** Fast-dissolving Ibandronate microneedle system developed by us offers a highly effective and minimally invasive option for patients. It appears as a superior alternative to conventional oral and injectable therapies, offering enhanced bioavailability and tremendous potential in the management of osteoporosis.

Keywords: Ibandronate, Transdermal, Microneedles, Bioavailability enhancement

NAP006

Formulation, Development and characterization of SUN-NE-1 *in-situ* gelling ophthalmic solution

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Introduction: SUN-NE-1, a non-steroidal anti-inflammatory pro-drug is water insoluble and is available as an ophthalmic suspension. However, suspensions often cause ocular irritation, foreign-body sensation, and inconsistent drug availability due to particulate nature. It very low aqueous solubility further limits its therapeutic efficacy. The present work aimed to develop a clear ophthalmic solution of SUN-NE-1 using hydroxypropyl-β-cyclodextrin (HPβCD) to enhance solubility, and further convert it into an *in-situ* gel to improve its ocular retention and obtain sustained release. **Methods:** SUN-NE-1 solutions (0.1–0.3% w/v) were formulated using 7-10% HPβCD, octoxynol-40 as solubilizer, mannitol as tonicity agent and pH was adjusted to 7.4. Optimization of the formulation variables was done using central composite design. The optimized solution was incorporated into a sodium alginate–HPMC–based *in-situ* gel. The optimized formulation was characterized by DSC, FTIR, XRD, viscosity, clarity, in-vitro release, *ex-vivo* transcorneal permeation, sterility, HET-CAM irritation testing, and stability studies. **Results:** HPβCD enhanced solubility and enabled formation of clear solution without precipitation. The optimized *in-situ* gel exhibited desirable gelling time (11 s), high clarity (% Transmittance-95.7%), zero-order drug release kinetics. The stability study conducted for a period of 6 months indicated no significant change in the pH, %Transmittance and assay suggesting that the developed formulation is stable. The

formulation was non-irritant as indicated by HET-CAM test and showed superior transcorneal permeation compared to suspension. **Conclusion:** A stable, clear SUN-NE-1 ophthalmic solution based in-situ gel was successfully developed, providing enhanced solubility, improved ocular retention and sustained release.

Keywords: SUN-NE-1, HPβCD, Ophthalmic solution, *In-situ* gel, Transcorneal permeation

NAP007

Design, Development and Evaluation of Irinotecan Hydrochloride Trihydrate Loaded Zinc Oxide Nanoformulation for Cancer

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Introduction: Cancer is one of the most fatal diseases causing 9.7 million cancer deaths worldwide in the year 2022. Irinotecan is a topoisomerase I inhibitor used in the treatment of several types of solid tumors such as for lung, colo-rectal and pancreatic cancers. Zinc oxide nanoparticles has been identified as useful strategy to target cancer cells due to their reactive oxygen species based apoptotic efficiency. **Methods:** Pre-formulation studies included spectroscopic characterization of the drug and drug-excipient compatibility studies. Zinc oxide nanoparticles were prepared by inducing particle size reduction of marketed bulk by probe sonication method. Irinotecan hydrochloride trihydrate was dissolved in water and loaded onto the zinc oxide nanoparticles by stirring the formulation for 2 hr. The prepared formulation was examined for particle characteristics and entrapment efficiency.
Results: Mass spectroscopy demonstrated $[M+H]^+$ peak at m/z value 587.35 and absorption maxima at 255 nm, confirming the identity of the drug. Standard curve of the drug plotted by ultraviolet-visible spectroscopic method demonstrated linearity in the range of 2 ppm to 14 ppm with regression coefficient of 0.9997. Overall the irinotecan-loaded formulation demonstrated particle size below 200 nm, polydispersity index below 0.3 and zeta potential of about -11 mV. The entrapment efficiency of the formulation was found to be above 80%. **Conclusion:** Irinotecan hydrochloride trihydrate loaded zinc oxide nanoformulation demonstated potential for effectively targeting the tumor cells.

Keywords: Nanoparticles, Probe Sonication, Box-Behnken, Size Reduction

NAP008

Metal-Organic Framework-Based Delivery Systems for Antimicrobial and Antibiofilm Activity: A comprehensive Review

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Introduction: Antimicrobial resistance and biofilm-associated infections represent significant global healthcare challenges, necessitating innovative therapeutic approaches beyond conventional antibiotics. Metal-organic frameworks (MOFs) have emerged as promising drug delivery platforms owing to their exceptionally high surface area, tunable porosity, and multifunctional capabilities for sustained antimicrobial release. This review focuses on current research on MOF-based delivery systems for antimicrobial and antibiofilm applications. **Methods:** A comprehensive literature review was conducted using PubMed and Scopus databases, focusing on peer-reviewed articles published between 2019-2024. Studies investigating various MOF types including ZIF-8, UiO-66, MIL-series, and Cu/Ag-based frameworks for antibacterial and antibiofilm drug delivery were systematically analysed for mechanisms, efficacy, and therapeutic outcomes. **Results:** MOFs demonstrate multiple antibacterial mechanisms: controlled release of bioactive metal ions (Zn^{2+}, Cu^{2+}, Ag^+), encapsulation and sustained delivery of antibiotics, reactive oxygen species generation through photodynamic and chemodynamic therapy, and physical

disruption of bacterial membranes. ZIF-8-based systems achieved drug loading efficiencies up to 46% with ciprofloxacin and demonstrated pH-responsive release in acidic infection microenvironments. Photosensitive MOF nanoparticles conjugated with polymyxin B effectively eradicated *Pseudomonas aeruginosa* biofilms through synergistic photodynamic-antibiotic therapy at low antibiotic doses. Zn-MOFs and Co-MOFs exhibited MIC values of 0.08-0.64 mg/mL against *S. aureus* and *P. aeruginosa* with antibiofilm IC_{50} values of approximately 0.013 mg/mL. **Conclusion:** MOF-based delivery systems offer versatile, targeted, and stimuli-responsive platforms for combating antimicrobial resistance and biofilm-mediated infections. Future research should focus on enhancing biocompatibility, optimizing release kinetics, and advancing clinical translation of these promising nanomaterials.

Keywords: Antimicrobial resistance, Biofilm eradication, Drug delivery, Metal-organic framework, ZIF-8

NAP009

Hyaluronic Acid Nanoparticles Loaded with Tetrandrine in Vitamin E-Modified Contact Lenses for Dry Eye Disease.

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Introduction: Dry eye disease (DED) represents a significant global healthcare challenge affecting 5-34% of individuals worldwide, it is characterized by tear film stability, hyperosmolarity, and chronic inflammation. Current treatments exhibit inherent limitations, including poor bioavailability, short corneal residence time, and frequent dosing that compromise patient. This research introduces a novel nanotechnology-based platform combining tetrandrine-loaded hyaluronic acid nanoparticles (HANPs) embedded in vitamin-E-modified pHEMA contact lenses to address these challenges and provide sustained, targeted anti-inflammatory therapy. **Methods:** Tetrandrine-loaded HANPs were formulated using ionic gelation and characterized for particle size, polydispersity index, zeta potential, and entrapment efficiency. pHEMA contact lenses were synthesized through photo-polymerization with vitamin-E TPGS as a diffusion modifier. **Results:** Chitosan-stabilized tetrandrine-HANPs with particle size of 478.3 nm, zeta potential of -25.6 mV, and entrapment efficiency of 65.8%, were obtained. ATR-FTIR overlay spectrum confirmed successful drug encapsulation. *In-vitro* drug release studies showed desired release kinetics. The pHEMA contact lens formulation was successfully prepared, with clear optical properties and ideal mechanical characteristics suitable for therapeutic contact lens applications. **Conclusion:** This research successfully achieved formulation development and characterization of HANPs loaded with Tetrandrine and pHEMA Contact Lens with a Vitamin E modification to create an innovative hybrid platform for DED that could significantly improve bioavailability compared to traditional drops. Ongoing research will focus on optimising the formulation and evaluating its *in-vivo* efficacy of this next generation ocular delivery system in preclinical models of DED to establish the clinical efficacy of this system.

Keywords: Dry eye disease, Hyaluronic acid nanoparticles, Tetrandrine, Vitamin-E-modified contact lenses,

NAP010

Tiny Needles, Big Impact: Nanosuspension of Psoralea corylifolia L. for Efficient Skin Delivery

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Introduction: Vitiligo is a chronic dermatological condition characterized by depigmented patches resulting from melanocyte dysfunction or loss. Existing treatment strategies often suffer from poor efficacy, systemic side effects, and low patient compliance. *Psoralea corylifolia L*. has shown potential in stimulating melanocytes and promoting repigmentation. However, its therapeutic use is limited due to poor aqueous solubility, low bioavailability, and skin irritation when administered topically or orally. **Method:** A microneedle-based nanosuspension (NS) delivery system of *Psoralea corylifolia L* was developed to overcome these limitations. The NS was prepared using a combination technique involving solvent–antisolvent precipitation coupled with ultrasonication. The formulation was optimized using a Box–Behnken Design, with key formulation variables evaluated for their effects on particle size and entrapment efficiency. The optimized formulation was characterized and subsequently incorporated into microneedles for transdermal delivery evaluation. **Results:** The optimized *Psoralea corylifolia L*. NS demonstrated a particle size of 125.8 nm and an entrapment efficiency of 90.5*Ex vivo* permeation studies showed significantly enhanced drug permeation with the MN-assisted system compared to conventional formulations. **Conclusion:** The developed microneedle-based NS of *Psoralea corylifolia L*. offers a promising, targeted, and safer transdermal delivery approach for vitiligo management.

Keywords: Vitiligo, Psoralea corylifolia (Bakuchi), nanosuspension, microneedles, Box–Behnken Design

NAP011

CRISPR-Based Nanocarrier System for Targeted Delivery of Anticancer Agents

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Introduction: Cancer treatment often faces limitations such as poor drug specificity, systemic toxicity, and multidrug resistance. Recent advances in biotechnology have enabled gene-editing tools like CRISPR-Cas9 to be incorporated into pharmacological strategies for targeted therapy. This study focuses on the development of a CRISPR-integrated lipid-polymer hybrid nanocarrier designed to enhance tumor-specific drug delivery and gene modulation. **Methods:** A lipid-polymer hybrid nanoparticle system was formulated using a double-emulsion solvent evaporation technique. CRISPR-Cas9 plasmids targeting the oncogene KRAS were encapsulated along with doxorubicin. Particle size, zeta potential, morphology, and encapsulation efficiency were evaluated using DLS and TEM. Cellular uptake and gene-editing efficiency were assessed in MCF-7 breast cancer cell lines through flow cytometry and qPCR. Cytotoxicity and apoptosis induction were analyzed using MTT assay and Annexin-V staining. **Results:** The developed nanocarrier showed a mean particle size of 145 ± 12 nm with a uniform spherical morphology and high encapsulation efficiency for both CRISPR plasmids (78%) and doxorubicin (84%). Significant cellular uptake was observed within 4 hours of incubation. Gene-editing analysis confirmed a 62% knockdown of KRAS expression. Combined CRISPR-doxorubicin delivery resulted in a 3.2-fold increase in cytotoxicity compared to free doxorubicin. Apoptosis assays revealed enhanced late-apoptotic cell populations, indicating synergistic anticancer activity. **Conclusion:** The CRISPR-integrated nanocarrier system demonstrated efficient dual delivery of genetic and chemotherapeutic agents with superior anticancer efficacy. This platform offers a promising interface for developing precision cancer therapeutics with reduced systemic toxicity.

Keywords CRISPR-Cas9, Nanocarriers, Targeted Drug Delivery, Pharmacogenomics, Cancer Therapy

NAP012

Development and Evaluation of Gold Nanoparticle Mediated Targeted Delivery of Berberine using Microneedles

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Introduction: Pancreatic ductal adenocarcinoma (PDAC) is one of the most complicated cancers to treat, as it is often diagnosed in its advanced stages, exhibits poor drug penetration, and shows marked resistance to existing conventional chemotherapy. Insufficient targeted delivery compromises expected therapeutic outcomes. This study aims to develop a targeted therapeutic nanoplatform using berberine-loaded gold nanoparticles (BER-AuNPs) conjugated with cetuximab for the management of PDAC via microneedles. **Methods:** Placebo gold nanoparticles were synthesized using the citrate reduction method, where trisodium citrate was used as the reducing agent. The optimized batch was obtained by adjusting the reaction pH to 7, which yielded stable and uniform nanoparticles. Berberine was incorporated onto AuNPs at a 1:5 drug-to-nanoparticle ratio, and the formulation was characterized for particle size, zeta potential, drug content, and entrapment efficiency. Cetuximab was then attached to the berberine-loaded AuNPs using an incubation method, and the resulting nanoconjugate was loaded onto a microneedle array, which was evaluated for *in vitro* drug release. **Results:** BER-AuNPs synthesized were monodispersed with a particle size of 225nm, and a zeta potential of -26.7nm, consistent with surface adsorption of the cationic drug, resulting in an entrapment efficiency of 87.67%. FTIR confirmed the loading of berberine, and *in vitro* studies demonstrated its sustained release. **Conclusion:** This research has successfully established a systematic approach for developing a cetuximab-conjugated, berberine-loaded gold nanoparticle system intended for PDAC-targeted therapy. Further parts of the research will focus on *ex vivo*, cellular uptake, and cytotoxicity studies.

Keywords: Berberine, Cetuximab, Gold Nanoparticles, Pancreatic ductal adenocarcinoma, Targeted

NAP013

Formulation, Optimization and Evaluation of a Once-Daily Controlled Porosity Osmotic Pump Tablet of Hydralazine Hydrochloride

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Introduction: Hydralazine hydrochloride is a direct-acting vasodilator used for hypertension management, but its short elimination half-life (2–6 hours) and extensive first-pass metabolism require multiple daily dosing, leading to fluctuating plasma concentrations and poor adherence. Controlled Porosity Osmotic Pump (CPOP) tablets provide robust, pH-independent system capable of delivering drugs at a controlled, zero-order rate through osmotic pressure. Developing a once-daily osmotic formulation of Hydralazine HCl can maintain sustained plasma levels and improve therapeutic outcomes. **Methods:** Methods involved formulating core tablets by direct compression using Dextrose as osmogen, PVP K-30 as binder, applying a cellulose acetate–PEG 400 coating using the dipping method and optimizing the formulation using 3^2 Central Composite Design**.** The optimized formulation was evaluated for in-vitro drug release, effect of pH and agitation on drug release and SEM. **Results:** Central Composite Design (CCD) optimized Dextrose and PEG 400 levels, achieving 68-69% release at 12 hours and 98–99% at 24 hours. The optimized batch followed zero-order kinetics (R^2 = 0.9957). In-vitro release studies confirmed that drug release was unaffected by changes in media pH or hydrodynamic conditions. SEM confirmed uniform pore formation on the membrane surface after dissolution. Dissolution, the sole stability parameter, showed f_1<15 and f_2>50, indicating an unchanged release profile post ambient temperature storage. **Conclusion:**

The developed once-daily CPOP tablet showed sustained, predictable and pH-independent drug release for 24 hours, with stable performance and improved potential for patient compliance in hypertension management.

Keywords: Controlled Porosity Osmotic Pump (CPOP), Hydralazine Hydrochloride**,** Sustained Release Table

NAP014

Formulation Strategies for Long-Acting Injectables (LAIs)

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Introduction Drug delivery through the parenteral route is required when the administration through oral route is constrained by poor bioavailability, high first pass metabolism or p-glycoprotein efflux, gastrointestinal degradation or irritation. Drugs with short biological half lives are delivered through intravenous infusion to ensure constant plasma levels. Conventional formulations often need multiple daily dosing particularly for short half-life drugs leading to fluctuations in plasma concentration resulting in poor patient compliance and suboptimal therapeutic outcomes. **Methods** Long-Acting Injectables (LAIs) address these challenges by delivering drugs directly into systemic circulation from localized depots, bypassing first-pass hepatic metabolism and gastrointestinal degradation to enhance bioavailability. Approaches include microspheres/microcapsules, mesoporous silica nanoparticles (MSNs), micelles, nanocrystals, microcrystals, in-situ/preformed gels and osmotic/pH-responsive mechanisms. These systems frequently employ biodegradable materials such as PLGA and lipids enable controlled release via erosion and diffusion, minimizing initial burst while sustaining therapeutic concentrations. **Results** LAIs treat chronic diseases like schizophrenia, HIV/AIDS, diabetes, narcotic addiction, hormonal deficiencies, and cancers, where consistent drug levels are vital. They improve adherence with single injections maintaining concentrations for weeks/months. This successfully overcomes the issues of plasma concentration peaks and troughs associated with short-half-life drugs, providing a more consistent, predictable therapeutic effect and reducing the risk of undesirable side effects. Marketed products include Risperdal Consta®, Invega Sustenna®/Trinza® (antipsychotics), and Cabenuva® (HIV). **Conclusion** Long-Acting Injectables (LAIS) offer solutions to challenges of poor oral bioavailability and frequent dosing by providing sustained release from depots using biodegradable materials like PLGA and lipids.

Keywords: Long-Acting Injectables (LAIs), Parenteral delivery, Depot systems

NAP015

Microneedle Loaded Nanocarriers: Addressing Challenges for Transdermal Delivery

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Introduction Existing drug formulations are limited by route-specific barriers. Oral administration frequently leads to GI degradation and poor bioavailability. Injectable methods are limited by their invasive nature, pain and professional administration need. Meanwhile, nasal delivery faces rapid clearance through mucociliary and nasolacrimal duct, making therapeutic levels difficult to maintain. As a result of which transdermal route and specifically microneedles are used. **Methods** Microneedles are tiny needles that permeate stratum corneum without causing pain or bleeding. They efficiently create microchannels in the skin's epidermis or dermis layer which addresses challenge of transdermal needle bypassing skin's natural barrier. There are mainly four types of Microneedles- Solid Microneedles, Hollow Microneedles, Coated Microneedles and Dissolving Microneedles. Biodegradable microneedles are fabricated by micro-molding/solvent casting, 3D Printing and Laser ablation. Targeted nanocarrier like liposomes, cubosomes, neosomes etc. are loaded into soluble microneedles, a minimally invasive, painless way of drug targeting to the CNS can be achieved. Marketed transdermal patches used are Neupro, EMSAM. **Results** Microneedles are associated with avoidance of hepatic metabolism, GI side-effects and degradation. It's non-invasive nature provides long term therapy makes it an attractive route for drug delivery. The nanocarriers provides additional benefits of solubility enhancement, site specific targeting, sustained or controlled release, protection of drug degradation. **Conclusion** Together this type of Microneedle-loaded

Nanocarrier overcomes challenges of transdermal systems in delivery of several therapeutics with maintaining steady plasma concentration, improved systemic availability, decreased systemic side effect and patient compliance.

Keywords: Microneedles, Nanocarriers, Transdermal

NAP016

Design and Development of Dissolvable Microneedles for Transdermal Co-delivery of Vitamins D3 and K2 loaded Nanostructured Lipid Carriers

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Introduction: Vitamin D deficiency is experienced globally leading to bone diseases like osteoporosis and rickets, generally treated with oral supplements despite its poor bioavailability. Vitamin K2 works with vitamin D3 by reducing calcium-phosphate deposition and preventing arterial calcification, but its low bioavailability limits effectiveness. Nanostructured Lipid Carriers integrated with dissolvable microneedles can be used to enhance delivery, bioavailability, and controlled release of both vitamins, improving therapeutic outcomes and patient compliance. **Methods:** Vitamins D3 and K2 were characterized and checked for purity using physical appearance, solubility, melting point and ATR-FTIR. Analytical method was developed using UV Spectroscopy and HPLC. NLCs were formulated by hot homogenization method using Glyceryl Dibehenate (solid lipid) and Oleic acid (liquid lipid). NLCs were characterized for parameters like particle size, PDI, zeta potential, entrapment efficiency and drug release. NLCs were then loaded into polymer-plasticizer solution prepared using PVA, PVP and PEG 400. Microneedles were then characterized for needle penetration and in vitro drug release. **Results:** Analytical methods for Vitamins D3 and K2 showed excellent linearity. Optimized NLCs batch showed desired particle size(487.1nm) and zeta potential (-26.2mV) with sustained drug release. Microneedles with the desired thickness and hardness with intact needles was achieved and sustained *in vitro* drug release was obtained. **Conclusion:** The characterization of nanostructured lipid carriers and dissolvable microneedles can be considered as an effective method for delivering Vitamins D3 and K2 pertaining to the *in vitro* studies. Further to test the viability of the NLC-Microneedle based system, *in vivo* studies will be conducted.

Keywords: Arterial calcification, Microneedles, Nanostructured Lipid Carriers, Vitamin D3 deficiency, Vitamin K2

NAP017

Development and Evaluation of Microneedle-Based Delivery System Containing Levodopa-Carbidopa Nanoparticles for Management of Parkinson's Disease

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Introduction: The therapeutic efficacy of Levodopa-carbidopa therapy is restricted due to rapid peripheral metabolism of levodopa, degradation of levodopa in the gastrointestinal tract, the hepatic first-pass metabolism, and the short t1/2 (~50 min). These effects lead to poor and variable bioavailability. In order to improve bioavailability, drugs are encapsulated within chitosan nanoparticles for sustained release and incorporated into dissolving microneedle system, for transdermal drug delivery and to avoid gastric degradation and first pass

metabolism, thus maintaining stable therapeutic levels. **Method:** The drug was identified and deemed analytically suitable by performing preformulation studies, including melting point, ATR-FTIR, and HPLC calibration. Desired nanoparticle characteristics such as particle size, PDI, zeta potential were obtained from placebo trials which were prepared by ionic gelation method. The preferred conditions were further used as factors at different levels to develop drug-loaded nanoparticles followed by optimization following 3x2 full factorial design. The optimized batch was used for incorporation into microneedles made up of PVA and characterized further. **Result:** The results of the pre-formulation studies confirmed that the drugs and excipients used in the study were identified correctly and are pure grade. The placebo studies provided an adequate chitosan: TPP ratio to create stable nanoparticles loaded with drugs. Optimized nanoparticles showed particle size of 170.6 nm with positive zeta potential values +41.2 mV, indicating good stability. Further, the optimized batch was loaded in microneedle shown good extended release, thereby achieving the research objectives. **Conclusion:** The levodopa-carbidopa chitosan nanoparticle-loaded microneedle system created in this research project effectively bypasses the oral absorption barrier and provides sustained release effect, the transdermal method of drug delivery shows strong potential of more patient compliance for management of PD.

Keyword: Carbidopa, Chitosan Nanoparticles, Levodopa, Microneedle, Sustained release

NAP018

DoE-Driven Formulation and Characterization of Long-Acting Mavacamten Microspheres

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Introduction: Mavacamten is a first-in-class, selective cardiac myosin inhibitor approved for the symptomatic treatment of obstructive hypertrophic cardiomyopathy, offering a target-oriented approach to decreasing hypercontractility. Long-acting parenteral systems based on poly(lactic-co-glycolic acid) microspheres can enhance adherence and maintain stable drug exposure in chronic cardiovascular therapy. **Methods:** Mavacamten-loaded PLGA microspheres were prepared by emulsion solvent evaporation using three different polymer grades, PLGA 50:50 3E, 75:25 3E and 75:25 5E. The preformulation included the determination of melting point (≈224°C) and FT-IR analysis to confirm the identity of the drug. Particle size, percent yield, drug loading, entrapment efficiency, and accelerated in vitro release were studied for both placebo and drug-loaded batches. Further detailed investigation of critical parameters was performed by applying a screening and optimization designs, following the DoE approach. **Results:** Mean particle sizes for placebo microspheres ranged from 29µm for 50:50 3E to 32.8µm for 75:25 3E. Entrapment efficiency varied from a maximum of 68.5% with PLGA 50:50 3E to a minimum of 57.2% with 75:25 3E. Percentage yield was highest for 75:25 3E (88.5%) and lowest for 75:25 5E. Accelerated in vitro release demonstrated retarded release from 50:50 3E microspheres, whereas the burst effect was reduced in 75:25 5E. **Conclusion:** Successfully, mavacamten was incorporated into long-acting microspheres displaying promising entrapment and controlled-release behaviour upon emulsion solvent evaporation using selected PLGA grades. Results obtained justified studies in animal models to optimize pharmacokinetics.

Keywords Emulsion solvent evaporation, Hypertrophic cardiomyopathy, Long-acting injectable, Mavacamten, PLGA microspheres.

NAP019

Formulation development and evaluation of Ribociclib via Hyaluronic acid coated Lipid-Polymer Hybrid Nanoparticles for Non-small cell lung cancer

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Introoduction: Non-small cell lung cancer (NSCLC) accounts for ~85% of lung cancers and frequently overexpresses CD44, making hyaluronic acid (HA)-targeted nanocarriers a promising strategy to improve delivery of the poorly soluble CDK4/6 inhibitor ribociclib. This work aimed to develop HA-coated lipid-polymer hybrid nanoparticles (HA-LPHNPs) of ribociclib for targeted therapy of NSCLC. **Methods:** Ribociclib-loaded LPHNPs were prepared by nanoprecipitation using PLGA as polymer and a phospholipid as lipid shell, followed by coating of HA. Formulations were optimized by Box-Behnken design. Particle size, PDI, zeta potential, entrapment efficiency, and morphology (TEM) were evaluated. In vitro drug release was studied in pH 7.4 and pH 5.5 buffers. Cellular uptake and cytotoxicity were assessed in A549 NSCLC cells. **Results:** Optimized HA-LPHNPs showed particle size 183.6 ± 8 nm, PDI 0.208 ± 0.02, zeta potential −19.6 ± 3 mV, and entrapment efficiency 86 ± 4%. TEM revealed spherical, core-shell morphology, while XRD confirmed amorphous dispersion of ribociclib in the matrix. Ribociclib release was sustained up to 72 h (78.5 ± 3.1% at pH 5.5 vs 49.2 ± 2.7% at pH 7.4; $p < 0.01$). HA-LPHNPs exhibited 2.4-fold higher uptake and ~3-fold lower IC_{50} in A549 cells compared with non-coated LPHNPs, while blank nanoparticles were non-toxic **Conclusion:** HA-coated ribociclib LPHNPs achieved nano-range size, high loading, controlled release, and CD44-mediated enhancement in uptake and cytotoxicity in NSCLC cells, supporting their potential as a targeted nanocarrier system for lung cancer therapy.

Keywords: Ribociclib, Lipid–polymer hybrid nanoparticles, Hyaluronic acid targeting, Non-small cell lung cancer, CD44-mediated drug delivery

NAP020

Piezoelectric Atomized Cloud Dryer (PACD): A Novel Technology for Continuous Nanoparticle Production

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Introduction The development of cost-effective and scalable nanotechnology platforms is essential for enhancing drug delivery, especially for poorly soluble and unstable pharmaceutical molecules. Existing top-down and bottom-up nanoparticle fabrication technologies face major limitations such as high energy requirement, poor robustness, solvent handling issues and lack of continuous operation. The Piezoelectric Atomized Cloud Dryer (PACD) has been developed as an innovative alternative to overcome these challenges. **Methods** PACD operates on piezoelectric atomisation combined with controlled hot-air drying and wet electrostatic precipitation. A mesh-type ultrasonic piezoelectric transducer generates nano-sized droplets from a drug–carrier solution. These droplets undergo rapid solvent evaporation in a temperature-controlled drying chamber to form nanoparticles. The particles are subsequently captured using a wet electrostatic precipitator containing a drug-saturated aqueous medium to prevent aggregation. Key process parameters such as voltage, airflow, feed viscosity and drug-to-polymer ratios were optimised. **Results** PACD successfully produced nanoparticles of multiple drug–carrier systems including albendazole, Eudragit E100, stearic acid, PLGA and polyvinyl acetate. Particle sizes ranging from 50–900 nm with acceptable PDI values were obtained with good reproducibility. The continuous operation demonstrated stable nanoparticle output and higher yield compared to conventional batch processes. The modular design enabled easy scale-up using multiple atomiser units. **Conclusion** PACD provides a robust, affordable and scalable platform for continuous nanoparticle production. Its simple design, versatility with various drug–excipient combinations and low infrastructural requirements make it suitable for industrial adoption, addressing key limitations of existing nanotechnology-based processing methods.

Keywords: cloud drying, continuous processing, electrostatic precipitation, nanoparticle synthesis, piezoelectric atomisation.

NAP021

Formulation, design and characterization of baclofen sustained release tablets for muscle spasms

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Introduction- Baclofen is a centrally acting muscle relaxant. The present study aims to develop SR tablets of Baclofen using hydrophilic and hydrophobic polymers independently to understand their individual influence on drug release behavior**. Methods**- SR tablets were prepared by direct compression. Hydrophilic polymers, like HPMC K15M and HPMC K100M, were used as matrix formers to control swelling, gel layer formation, and diffusion-mediated release. Separately, hydrophobic polymers such as Carnauba wax were incorporated to create a water-repellent matrix and retard drug release through erosion and reduced permeability. A Design of Experiment (DoE) approach will be employed to optimize polymer type and concentration. Standard pre-compression and post-compression evaluations were conducted. Drug release kinetics will be interpreted using mathematical models to determine the predominant mechanisms. **Results**- This will demonstrate that hydrophilic polymers produce controlled release primarily through swelling and diffusion, with higher viscosity grades yielding stronger gel layers and slower release. Hydrophobic polymers generated a more erosion-controlled profile, with Carnauba wax showing greater retardation. Optimized formulations from both polymer groups sustained drug release, aligning with therapeutic objectives. **Conclusion**- the study establishes that both hydrophilic and hydrophobic polymers, when optimized individually, can produce effective SR tablets of Baclofen, reducing dosing frequency and enhancing patient compliance.

Keywords-Baclofen, Carnuba wax, DoE optimization, HPMC k15M, HPMC k100M.

NAP022

Formulation, Optimisation and Evaluation of W/O/W Multiple Emulsion of Sumatriptan Succinate for Enhanced Oral Bioavailability

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Introduction: Multiple emulsions particularly water-in-oil-in-water (W/O/W) systems, offer a promising approach for improving oral bioavailability of drugs with limited permeability and extensive first-pass metabolism. Sumatriptan Succinate BCS class III drug an antimigraine agent exhibits low oral bioavailability due to rapid hepatic metabolism and poor permeability across GIT. The present study aimed to develop a stable W/O/W multiple emulsion of sumatriptan succinate to enhance its oral absorption leading increase bioavailability. **Methods:** Preformulation and excipient compatibility studies over sumatriptan succinate carried out using Melting point apparatus, DSC, FTIR and UV Spectroscopy. Design expert version 13 was used for screening and optimization of formulation. Multiple Emulsions were prepared by a two-step emulsification technique using Ultra-Turrax and High-speed stirrer (Eurostar, IKA®). Evaluation of formulations included Globule size, Viscosity, pH, Conductivity, Zeta potential, Entrapment Efficiency, In-vitro drug release, Ex-vivo permeation studies and In-vivo permeation in rat. **Results:** The optimised formulation exhibited a mean Globule size near 11 µm, Viscosity 116 cps, pH 7.2, Zeta potential around −35 mv, Entrapment Efficiency 83%, In vitro release 95.32 %, Ex vivo permeation cumulative drug permeation of about 93% at 24h across goat intestine and In-vivo permeation in rats increased Cmax, prolonged half-life and approximately 1.7-fold improvement in relative bioavailability**. Conclusion:** This Study proved that Sumatriptan Succinate Multiple Emulsion (W/O/W) could be a promising approach to increase it's oral bioavailability.

Keywords: Bioavailability Enhancement, Multiple Emulsion, Sumatriptan Succinate, W/O/W system.

NAP023

Development and Evaluation of Simvastatin Loaded Chitosan Nanoparticles for Diabetic Wound Healing

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Introduction: Diabetic wounds affect nearly a quarter of diabetic patients, due to impaired angiogenesis, inflammation, oxidative stress, and delayed regeneration. Conventional topical treatments offer only symptomatic relief, often resulting in chronic ulcers. Simvastatin has demonstrated excellent wound healing potential because of

its angiogenic and anti-inflammatory properties. However, its poor water solubility limits topical application. Nanocarrier systems, such as chitosan nanoparticles, improve solubility, stability, and enable sustained release. **Methods:** Simvastatin-loaded chitosan nanoparticles were prepared using the ionic gelation technique, where chitosan in dilute acetic acid was mixed with the drug solution and crosslinked with TPP, with Tween 80 added for stability. The prepared nanoparticles were evaluated for particle size, zeta potential, PDI, entrapment efficiency, and in vitro drug release. **Results:** Preformulation studies confirmed the purity and compatibility of Simvastatin with excipients. The optimized Simvastatin chitosan nanoparticles measured 249 nm in particle size, with a strong stability of +35 mV, an entrapment efficiency of 72.8%, and a sustained release of up to 85% at 10 hours. **Conclusion:** Chitosan nanoparticles loaded with simvastatin were developed and optimized as per desired objectives with sustained release.

Keywords: Nanoparticles, Diabetic wounds, Ionic gelation, Chitosan, Topical.

NAP024

Formulation and Evaluation of Solid Dispersion-Based Sublingual Tablets of Haloperidol

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Introduction: Poor solubility and extensive first-pass metabolism limit the oral bioavailability of presently available haloperidol tablets. Developing a solid-dispersion-based sublingual tablet may overcome these barriers and improve the bioavailability. This study was aimed to formulate solid dispersion based sublingual tablets of haloperidol for rapid drug release and enhance solubility. **Methods:** Preformulation study, carrier selection and compatibility study was conducted using UV spectroscopy, FTIR, DSC and XRD. Solubility enhancement of haloperidol drug was carried out by Micronisation and solid dispersion techniques. A design of experiments (DOE) approach was used to Screen and optimize solid dispersion-based haloperidol sublingual tablets and were evaluated for hardness, friability, drug content, disintegration time, and in-vitro dissolution. Optimized formulation was compared with marketed formulations for drug release study. **Results:** Micronisation improved solubility from 4.16 mg/100 mL to 7.06 mg/100 ml. Solid dispersion of haloperidol and β-cyclodextrin (1:0.32) showed the solubility enhancement (9.11 mg/100 mL) and confirmed inclusion-complex formation. Tablets containing this optimized dispersion showed rapid disintegration (<30 s), uniform drug content (>98%), and significantly faster dissolution (35% at 20 min) compared with marketed product and pure drug. **Conclusion:** Solid dispersion of haloperidol β-cyclodextrin markedly improved haloperidol solubility and enabled development of a fast-disintegrating sublingual tablet with enhanced drug release. The optimized formulation shows strong potential as a rapid and patient-friendly alternative to conventional haloperidol therapy.

Keywords: Sublingual tablet, Haloperidol, Solid dispersion, β-Cyclodextrin, Solubility tablets

NAP025

Formulation and Evaluation of Tavaborole loaded Niosomes based Film-forming Topical Solution

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Introduction: Onychomycosis is difficult to treat due to the dense keratinized nail plate, which limits drug permeation and reduce the efficacy of conventional topical Tavaborole solutions because of poor nail penetration, low retention, and frequent dosing requirements. To overcome these limitations, a Tavaborole-loaded Niosomal film-forming solution was developed to improve transungual permeation, enhance drug retention, provide sustained release, and increase antifungal efficacy at the infection site. **Methods:** Niosomes were prepared using thin-film hydration method and optimized through Box–Behnken Design. The optimized Niosomes were characterized for vesicle size, PDI, zeta potential, entrapment efficiency, drug loading, SEM and DSC. The Niosomal film-forming solution was evaluated for film thickness, tape-peel adhesion, water vapor permeability,

pH, viscosity, drug content, and vesicle integrity after incorporation. *In-vitro*, *ex-vivo* release kinetics and antifungal activity (zone of inhibition-ZOI) was evaluated. **Results:** The Niosomal formulation exhibited a vesicle size of 206.8 nm, PDI 0.167, zeta potential -29.7 mV, entrapment efficiency of 85.33% and drug loading 26.71%. Incorporation into a film-forming system resulted in a uniform, rapid-drying, and strongly adherent film. *In-vitro* studies shows sustained drug release (24 hours), while *ex-vivo* permeation showed 2 folds enhancement in drug flux. ZOI studies confirmed enhanced activity against *Trichophyton* species. Stability studies indicated no significant changes in physicochemical properties. **Conclusion:** Tavaborole-loaded Niosomal film-forming solution demonstrated enhanced nail penetration, nail adhesion, sustained transungual delivery, improved drug entrapment, stability, and controlled release offering a patient-friendly approach for onychomycosis treatment.

Keywords: Tavaborole, Niosomes, Film-forming solution, transungual drug delivery, onychomycosis

NAP026

Development, Optimization and Evaluation of Apixaban Loaded Solid Self-Micro Emulsifying Drug Delivery Systems for Enhanced Bioavailability

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Introduction: Apixaban, a factor Xa inhibitor, is widely used for the prevention and treatment of deep vein thrombosis (DVT) and pulmonary embolism (PE). However, its clinical effectiveness is limited by poor aqueous solubility, extensive first-pass metabolism, and low oral bioavailability (<50%). To overcome these limitations, a self-microemulsifying drug delivery system (SMEDDS) was developed. **Methods:** Solid SMEDDS were formulated using pseudo-ternary phase diagrams by the titration method and optimized using a D-optimal design. The optimized formulation was characterized for globule size, polydispersity index (PDI), zeta potential, percentage transmittance, self-emulsification time, cloud point, drug content, FT-IR, DSC, SEM/TEM, *In-vitro* drug release, cell line studies, and *ex-vivo* intestinal absorption. **Results:** The optimized Solid SMEDDS showed a small globule size (32.4 ± 2.1 nm), low PDI (<0.5), negative zeta potential (−22.4 mV), high transmittance (99.80 ± 0.16), and a cloud point of 71 ± 2.13 °C, with drug content of 99.2 ± 0.3% and good flow properties. *In-vitro* dissolution studies demonstrated rapid drug release (97.75 ± 1.64% within 120 min) compared to marketed tablets (39.31 ± 0.74%). Cytotoxicity studies confirmed 89.68% cell viability. *Ex-vivo* intestinal absorption showed enhanced permeation (90.36 ± 0.24% in 120 min). *In-vivo* pharmacokinetic studies in rats revealed a three-fold increase in oral bioavailability compared with marketed formulations. **Conclusion:** Apixaban-SMEDDS significantly improved solubility, dissolution, intestinal absorption, and oral bioavailability while maintaining safety, representing a promising strategy to enhance therapeutic efficacy and reduce dosing frequency.

Keywords: Apixaban, SMEDDS, oral drug delivery, deep vein thrombosis, pulmonary embolism

NAP027

Advancing Lamotrigine Therapy: Piezoelectric Atomized Cloud Drying-Developed Microparticles in Lyophilized Orally Disintegrating Tablets with Characterization and PBPK Simulation for Enhanced Dissolution, Rapid Absorption, and Faster Onset of Action

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Introduction: Epilepsy, a prevalent neurological disorder, is primarily managed with antiepileptic medications like lamotrigine. Despite its clinical effectiveness, lamotrigine has a slow dissolution rate that results in a delayed therapeutic onset. This limitation necessitates the development of better formulation strategies that can increase solubility and speed up drug absorption. **Methods:** An innovative lamotrigine system that does not involve compression was created using lyophilized orally disintegrating tablets (ODTs) containing microparticles made via Piezoelectric Atomized Cloud Drying (PACD). Using DSC and PXRD, the produced microparticles were assessed

for solubility enhancement, particle size, thermal behaviour, and crystallinity. The physicochemical properties, disintegration time, and in-vitro dissolution of the optimized lamotrigine microparticle-loaded lyophilized ODT were evaluated. Absorption characteristics were predicted using PK-Sim® to perform simulations based on PBPK. **Results:** Using PVP K30, the microparticles generated by PACD improved lamotrigine's aqueous solubility from 0.17 mg/mL to 2.62 mg/mL and achieved a drug release exceeding 90% in less than 10 minutes. DSC and PXRD confirmed the amorphization of lamotrigine, which enhanced its solubility and dissolution performance. The microparticles exhibited tiny particle sizes (D90 = 1.851 µm), which contributed to an increased dissolution. The optimized LMP-LODT showed rapid disintegration and drug release, along with features that benefit patients. The PBPK simulations projected a reduced Tmax of 0.66 hours, indicating faster absorption and an earlier attainment of therapeutic levels. **Conclusion:** The combination of PACD-engineered amorphous microparticles and lyophilized ODT technology led to significant enhancements in lamotrigine's solubility, dissolution rate, and pharmacokinetic profile. By facilitating a quicker therapeutic onset, enhancing patient adherence, and potentially diminishing dose-dependent side effects, this method provides a promising alternative to traditional tablet. The optimized Solid SMEDDS showed a small globule size (32.4 ± 2.1 nm), low PDI (<0.5), negative zeta potential (−22.4 mV), high transmittance (99.80 ± 0.16), and a cloud point of 71 ± 2.13 °C, with drug content of 99.2 ± 0.3% and good flow properties.: Lamotrigine, Lyophilized tablet, Microparticle, Orally disintegrating tablet, Piezoelectric atomized cloud drying

NAP028

Development, Optimization and Evaluation of Docetaxel-loaded Nanovesicular Systems for Breast Cancer

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Introduction: Ductal carcinoma in situ (DCIS) amounts to about 20% of the diagnosed breast cancers. Localized drug delivery demonstrates the potential to treat DCIS since uncontrolled cell growth is restricted to the epithelium of mammary ducts. Current study aims at developing two nanovesicular drug delivery systems, i.e., liposomes and transfersomes, and comparative evaluation of their application during DCIS. **Methods:** Preformulation studies included drug characterization based on UV, FTIR, NMR and mass spectroscopies to establish the identity and quality of docetaxel. Quantification of docetaxel was performed by reversed phase HPLC method. The drug loaded liposomes and transfersomes were prepared by combination of film hydration and probe sonication methods. The prepared nanovesicular systems were optimized using design of experiments approach and characterized for particle properties and entrapment efficiency. **Results:** Mass spectroscopy showed base peak at m/z value of 830.40 corresponding to the sodium adduct of docetaxel. Linearity for chromatographic method of quantification was established for the concentration range of 100 ppm to 500 ppm with regression coefficient of 0.999. The FTIR based drug excipient compatibility studies demonstrated chemical stability of mixtures at room temperature, indicating suitability of the selected excipients. The formulated docetaxel-loaded nanovesicular systems showed particle size below 300 nm, polydispersity index below 0.3 and zeta potential of about -20 mV. **Conclusion:** The preformulation studies, fabrication of stable placebo vesicles and design of experiments approach based formulation optimization supports the feasibility of developed liposomes and transfersomes for the localized treatment of DCIS.

Keywords: Tumor, cancer, liposomes, transfersomes, docetaxel

NAP029

Emerging Smart Hydrogel Technologies for Advanced Diabetic Foot Ulcer Care

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Introduction: Chronic diabetic foot ulcers (DFUs) are difficult to treat because of poor angiogenesis, persistent inflammation, frequent infection, and see limited benefit from standard treatment methods such as debridement, antibiotics, and simple dressings. These limitations have driven interest in advanced wound care strategies that can actively interact with the wound microenvironment. **Methods:** This review focuses on newer pharmaceutical approaches involving "smart" stimuli-responsive hydrogel dressings. These hydrogels are commonly prepared from polymers such as chitosan and hyaluronic acid and are designed to resemble the extracellular matrix. Changes in wound conditions such as pH, enzyme levels, reactive oxygen species, and glucose are used to trigger the controlled release of antimicrobials, growth factors, and other bioactive molecules. Recent developments including self-healing polymers, nanocomposite hydrogels, and 3D-printed hydrogel designs are also examined. **Results:** Multifunctional hydrogel systems with different phases have demonstrated the ability to support hemostasis, infection control, inflammation reduction, and tissue recovery. Dissolvable hydrogels carrying growth factors have been shown to accelerate wound healing and improve angiogenesis in diabetic wound models. Advanced hydrogel technologies show clear advantages over traditional dressings in terms of functionality and therapeutic outcomes. **Conclusion:** Although most intelligent hydrogel systems for DFU management are still at the preclinical stage, they demonstrate strong potential as future treatments for complex and advanced diabetic foot ulcers. Continued research and clinical translation may allow these smart dressings to overcome the limitations of conventional wound care approaches.

Keywords: Diabetic foot ulcer, Smart hydrogels, Stimuli-responsive drug delivery, Wound regeneration, Wound Management

NAP030

Development and Characterization of Luliconazole Nanoparticle Loaded Nail Lacquer for treatment of onychomycosis

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Introduction: This study focuses on the formulation and evaluation of a nanoparticle-based nail lacquer containing luliconazole for the effective management of onychomycosis, a chronic fungal nail infection that is difficult to treat due to the dense and poorly permeable keratinized nail plate. Although luliconazole is a potent antifungal agent, its therapeutic efficacy is limited by poor transungual penetration and low drug retention. **Method**: To overcome these challenges, polymeric nanoparticles of luliconazole were prepared using the solvent evaporation method and optimized through a 3^2 full factorial design, where polymer and surfactant concentrations were selected as independent variables. Particle size, entrapment efficiency, and polydispersity index (PDI) were evaluated as response parameters. The optimized nanoparticles were incorporated into a nail lacquer formulation and assessed for drying time, viscosity, non-volatile content, water resistance, and in-vitro drug release using a Franz diffusion cell, along with one-month stability studies to evaluate formulation integrity. **Results**: Preformulation studies using UV spectroscopy and FTIR analysis confirmed compatibility between the drug and excipients. The optimized formulation exhibited a mean particle size of 120.12 nm, zeta potential of 28 mV, PDI of 0.137, and entrapment efficiency of 85%. The nanoparticle-loaded nail lacquer demonstrated uniform film formation, sustained drug release, and improved transungual permeation. **Conclusion**: The results demonstrate the successful development of a stable and patient-friendly luliconazole nanoparticle-based nail lacquer with enhanced transungual delivery and antifungal efficacy, highlighting a promising topical therapeutic strategy for the effective management of onychomycosis.

Keywords: Onychomycosis, nanoparticles, luliconazole, transungual, nail lacquer

NAP031

From Phytotherapy to Smart Nano formulations: AI-Assisted Design of Natural Bioactive Loaded Topical Nanocarriers for Psoriasis

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Introduction: Oxidative stress and keratinocyte hyperproliferation are hallmarks of psoriasis, a chronic immune-mediated inflammatory skin disorder. Conventional topical therapies show limited efficacy due to poor solubility, penetration, and compliance. Phyto actives possessing antioxidant, anti-inflammatory, and immunomodulatory properties can modulate key cytokines such as TNF-α, IL-17, and IL-23 involved in psoriatic inflammation However, their therapeutic potential is often limited by low aqueous solubility, poor dermal absorption, and instability in conventional formulations. **Methods:** This review compiles and critically examines recent research on next-generation Phyto active-based Nano formulations for topical psoriasis therapy, including phytosomes, liposomes, nanostructured lipid carriers, nanoemulgels, and nanogels. It highlights formulation approaches, characterization parameters, and outcomes from in vitro, ex vivo, and in vivo studies. Special emphasis is placed on the integration of artificial intelligence (AI) and machine learning (ML) for optimizing formulation variables, process parameters, and predicting performance outcomes to accelerate formulation development. **Results:** Compared to conventional dosage forms, Phyto active-loaded Nano formulations demonstrate enhanced encapsulation efficiency, improved skin deposition, controlled drug release, and superior physicochemical stability. Preclinical investigations reveal reduced pro-inflammatory cytokine levels, minimized oxidative stress, and restored epidermal homeostasis, confirming their therapeutic promise in psoriasis management. **Conclusion:** The convergence of nanotechnology, herbal therapeutics, and AI-assisted formulation design marks a revolutionary step toward next-generation dermatological care. By bridging traditional phytotherapy with modern pharmaceutics, Photoactive-loaded topical nanocarriers offer a sustainable, patient-friendly, and effective strategy for psoriasis management. Future work should focus on AI-guided optimization, scalable manufacturing, regulatory harmonization, and clinical validation to ensure safe and efficacious phytopharmaceutical products.

Keywords AI-ML technology, Phytopharmaceuticals, Psoriasis, Topical Nano carriers

NAP032

From Symptomatic Relief to Disease Modification: Nano biopharmaceutical Strategies Targeting Amyloid-β and Tau in Alzheimer's Disease

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Introduction: Alzheimer's Disease (AD) is a progressive neurodegenerative disease characterised by irreversible dementia. Major pathological hallmarks include the accumulation of amyloid-β plaques and tau proteins in the cholinergic neurons of the brain. Conventional oral drugs such as donepezil and rivastigmine provide only symptomatic relief and improve cognitive abilities. However, these drugs have limited blood-brain barrier (BBB) permeability, poor bioavailability, and lack specificity. Nanotechnology-driven biopharmaceutical strategies are newer, unexplored, yet promising approaches to overcome these limitations. **Methods:** This review summarises and compares conventional approaches with nanobiopharmaceutical formulations that utilise liposomes, exosomes, polymeric nanoparticles, dendrimers, and ionisable lipoparticles for targeted drug delivery across the BBB, along with improved bioavailability, specificity, and stability, and bypassing first-pass metabolism. Relevant literature was reviewed to recognise systems used to deliver biopharmaceutical innovations like anti-Aβ antibodies, miRNAs, and peptides. **Results:** Evidence from preclinical studies demonstrates that nanocarrier-based delivery systems enhance bioavailability, biocompatibility, and specificity towards the brain region. They also reduce toxicity and improve biological affinity. Additionally, adding specific ligands to the surface of nanoparticles enhances receptor-mediated transport. **Conclusion:** Nanobiopharmaceutical formulations have shown greater potential in achieving disease modification by integrating nanotechnology with biotechnology for targeted and efficacious drug delivery. Nevertheless, further research is required to enhance biocompatibility,

drug-loading capacity, and stability while minimising immunogenicity and toxicity and increasing duration of action. Development of hybrid lipid-polymeric nanoparticles, which combine the advantages of exosomes and conventional liposomes, represents a promising future direction for enhancing therapeutic efficacy in Alzheimer's.

Keywords Alzheimer's Disease, Amyloid-β, Exosomes, Liposomes, Tau

NAP033

Chitosan-Based Nanotopical Drug Delivery: An Updated Insight

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Introduction: The integration of polymer chemistry with nanotechnology has significantly advanced topical and transdermal drug delivery systems. Chitosan, a naturally derived biopolymer, and its derivatives have gained considerable attention for dermatological applications due to their cationic nature, biodegradability, biocompatibility, and strong mucoadhesive properties. These attributes are further enhanced at the nanoscale, making chitosan-based nano-formulations promising carriers for topical drug delivery. **Methods:** This review critically analyzes recent literature on chitosan-based nano-formulations developed for topical drug delivery. Various formulation strategies were evaluated with respect to their ability to modify key physicochemical properties of drugs, including solubility, lipophilicity (log P), stability, cytotoxicity, and drug loading efficiency. Different nano-delivery systems such as chitosan nanoparticles, nanoemulsions, nanogels, hydrogels, and transdermal patches composed of chitosan nanofibers were systematically reviewed. The impact of chemically modified chitosan derivatives, including thiolated, PEGylated, and quaternized chitosan, was also examined. **Results:** Chitosan-based nano-formulations demonstrated enhanced dermal permeation, improved topical bioavailability, effective antimicrobial activity, and controlled drug release profiles. Chemical modification of chitosan further improved mucoadhesion, stability, and permeability, while also enabling higher drug loading efficiencies and reduced cytotoxicity across multiple topical delivery platforms. **Conclusion:** Chitosan and its derivatives represent versatile and effective materials for the development of advanced topical drug delivery systems. Nano-formulation approaches offer significant advantages in optimizing drug physicochemical properties, enhancing skin penetration, and achieving controlled release. These findings support the continued exploration and application of chitosan-based nano-carriers in topical, transdermal, ocular, and vaginal drug delivery.

Keywords: Transdermal drug delivery, Ocular drug delivery, Vaginal drug delivery, Bio-polymer, Muco-adhesion.

NAP034

Transforming Food into Medicine with Biotechnology: A Review on Monacolin K Production Through *Monascus purpureus* Fermentation

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Introduction Biotechnology is being explored to convert traditional foods into therapeutic products. *Monascus purpureus*, used in fermented foods, biosynthesizes Monacolin K (lovastatin), an HMG-CoA reductase inhibitor with cholesterol-lowering effects. Solid-state fermentation has been shown to enhance Monacolin K formation across substrates, supporting functional nutraceutical development. **Methods** A targeted literature review was conducted using PubMed, ScienceDirect, Google Scholar, MDPI, and ResearchGate. Research articles, reviews, and patents on Monascus fermentation, Monacolin K biosynthesis, substrate optimization, metabolic pathways, and nutraceutical applications were examined. Data from cereals, legumes, and reported alternative substrates were compared to evaluate fermentation performance. **Results** Reviewed studies indicate that solid-state fermentation with Monascus purpureus increases Monacolin K levels in rice, barley, and wheat. Outcomes depend on fungal strain, substrate composition, moisture, pH, temperature, and incubation time. Rice is the most studied

substrate and often yields the highest Monacolin K; barley and wheat also show significant production. Several reports note that optimized environmental control enhances beneficial metabolite formation and reduces unwanted by-products such as citrinin. Standardizing processes can reduce citrinin risk and improve product safety and stability overall. **Conclusion** Evidence indicates that *Monascus purpureus*-mediated fermentation is a promising biotechnological route for developing functional foods with medicinal relevance. Monacolin K-enriched fermented substrates align with the "food as medicine" concept and merit further optimization and substrate exploration for commercial adoption. Pilot-scale studies and regulatory evaluation will be critical to translate laboratory findings into safe consumer products. Collaboration with industry partners can accelerate development, quality control, and clinical validation pathways towards commercialization.

Keywords: Biotechnology, Fermentation, Functional foods, Monacolin K, *Monascus purpureus*, Nutraceuticals

NAP035

Formulation and Characterization of Asenapine Maleate Transdermal Spray

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Introduction: Asenapine maleate (ASM), an atypical antipsychotic drug is currently available as sublingual tablets and transdermal patches which suffer from moderate bioavailability, short residence time, and patient non-compliance. A Metered-Dose Transdermal Spray (MDTS) offers is of application, improved permeation and patinas compliance. The present study aimed to formulate and characterize an ASM-MDTS. **Methods:** Preformulation studies were performed for physicochemical profiling of drug and drug–excipient compatibility. The formulation batches were made using Design Expert® Version 13 by full factorial and central composite design. The pressurized filling method was used to fill and seal MTDS containers having drug product concentrate. Formulation were evaluated for Device performance (emitted dose, spray pattern, spray angle and tail-off), product performance (drying time, film formation and crystallization tendency), biological performance (*in-vitro* permeation, *ex-vivo* permeation and *in-vivo* bioavailability, histopathology and skin irritation), and stability studies. **Results:** The optimized formulation exhibited showed uniform spray patent with a consistent emitted dose of 0.05 ml. Ovality ratio values ranging between 1.45 to 1.47, indicating consistent spray pattern. Tail-off studies confirmed uniform emitted dose. Drying time of 63 seconds, forming a smooth and crystal-free film. *In-vitro* and *ex-vivo* permeation of drug was found 44.30% and 43.23% accordingly. *In-vivo* studies demonstrated 1.95-fold higher bioavailability for optimized formula compared to the oral formulation. Histopathology showed no alteration in epidermal structure, and non irritant. Stability studies showed no change in clarity of drug formulation, emitted dose and container–closure integrity. **Conclusion:** The optimized ASM-MDTS demonstrated enhanced permeation, batter skin compatibility, strong stability, and robust device performance, supporting its potential as a superior alternative to current ASM formulations.

Keywords: Asenapine Maleate, Metered-Dose Transdermal Spray, Permeation study

NAP036

Formulation and Optimization of Naratriptan Hydrochloride Dry Powder for Inhalation and Predictive Modelling of Pulmonary Delivery

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Introduction: Naratriptan hydrochloride (NTH) is a selective 5-HT1B/1D agonist used for acute migraine, yet oral dosage forms show delayed onset, variable bioavailability, extensive first-pass metabolism, and limited use during nausea or vomiting. Delivering NTH through a dry powder inhaler (DPI) can provide rapid pulmonary absorption, avoid first-pass metabolism, improve consistency of systemic exposure, and enhance patient convenience. This study aimed to formulate and optimize a DPI of NTH and establish a regression model for

predicting lung deposition. **Methods:** Preformulation studies and drug excipient compatibility study including carrier selection carried out using UV spectroscopy, FTIR, DSC and XRD. Selected Fine and Coarse Carriers along with Drug Used to formulate Dry Powder inhalation batches which were designed by Design Expert version 13 software and evaluated for drug-to-lactose ratio, carrier particle size, and mixing time on formulation performance. Blends were evaluated for flow properties and particle size distribution. Aerodynamic performance was assessed using an andersen cascade impactor. In-vitro lung deposition was predicted by multiple linear regression method. **Results:** The optimized DPI showed fine particle fraction (FPF) of 35.9% and Mass median aerodynamic diameter (MMAD) of 4.23 µm. In-vitro release was observed 67.25%, while ex-vivo permeation showed 69.71% drug permeation in 30 minutes. Emitted dose was 78.9%, with content uniformity of 94.15%. The regression model predicted lung deposition with high accuracy (R^2 = 0.983). Stability indicated minimal changes in performance, with HPMC capsules providing protection. **Conclusion:** Naratriptan Hydrochloride DPI demonstrated rapid drug release. Multi linear regression model predicted satisfactory lung deposition supporting its potential as an alternative to oral therapy and improved migraine treatment outcomes overall.

Keywords: Naratriptan Hydrochloride, Dry powder inhaler, Lung deposition, Multilinear regression

NAP037
Formulation and Evaluation of Essential Oil Loaded Nano Gel Cosmeceuticals for Skin Care

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Introduction Skin, the body's largest organ, protects against pathogens and regulates temperature but is susceptible to acne from clogged follicles and bacteria. Bergamot (Citrus bergamia) and carrot seed (Daucus carota) essential oils offer antibacterial, anti-inflammatory, and antioxidant benefits for acne management. Nanoencapsulation into nanogels enhances penetration, stability, and sustained release, optimizing therapeutic efficacy in cosmeceutical formulations. **Methods** Chitosan (1 g) dissolves in 1% v/v acetic acid with Tween 80 (1% v/v), stirred 2 h at 40°C. Essential oils (bergamot/carrot seed) added at varying ratios, emulsified (400 rpm, 15 min). TPP (1% w/v, 100 ml) cross-links dropwise (500 rpm, 45 min), yielding nanoparticles via ionic interaction. Centrifuged (10,000×g, 5 min), washed (0.1% Tween 80), frozen (-80°C, 2 h), lyophilized (14 h). **Results** The nanoparticle formulations showed optimal particle size, surface charge, and stability with good dispersion and absorption properties. Nanogels exhibited ideal pH, transparency, uniformity, washability, and non-irritant nature. The formulations demonstrated excellent viscosity, spreadability, and moisture retention, ensuring effective drug release and skin hydration. Stability, antioxidant, and antimicrobial studies confirmed strong resistance to degradation, significant free-radical scavenging activity, and potent antibacterial efficacy comparable to standard synthetic drugs. **Conclusion** Essential oil-loaded nanogel cosmeceuticals showed excellent physical stability, moisture retention, and skin compatibility. Antimicrobial and antioxidant studies confirmed protection against infection and oxidative stress. The results support their potential for skincare applications, encouraging further research on formulation enhancement, long-term stability, and clinical validation to expand their therapeutic effectiveness and future scope.

Keywords Nanoparticles, Essential Oil, Antibacterial, Nanogel, Cosmeceuticals

NAP038
Development of Paediatric Formulation of Baclofen for Improved Safety and Palatability

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Introduction The project outlines the development of a paediatric formulation of Baclofen aimed at improving safety and palatability while addressing the limitations of existing therapies for treating spasticity resulting from cerebral palsy. Baclofen is a Biopharmaceutics Classification System (BCS) class III drug with a short biological half-life of 2–3 hours and a distinctly bitter taste. These characteristics necessitate frequent dosing (3–4 times per day), leading to poor patient compliance, significant plasma concentration fluctuations, and swallowing difficulties (dysphagia) in paediatric patients. Therefore, there is a critical need to develop a child-friendly formulation that offers sustained drug release and improved bioavailability. **Methods** An oral jelly formulation containing Baclofen-loaded chitosan microspheres was developed to enhance bioavailability and provide sustained drug release. Chitosan was selected as the polymer due to its biocompatibility and mucoadhesive properties. Baclofen-loaded microspheres were prepared using an optimized emulsification–thermal crosslinking technique. The optimized microspheres were incorporated into an oral jelly base designed to improve palatability and ease of administration. The formulation was evaluated for entrapment efficiency, particle size, physical characteristics, in vitro drug release, ex vivo diffusion through rat stomach mucosa, and in vivo pharmacokinetic performance in rabbits. **Results** The optimized chitosan microspheres demonstrated an entrapment efficiency of 86.16% with an average particle size of 27.67 µm. The resulting oral jelly was smooth, non-gritty, opaque, and possessed a pleasant fruity flavor, making it suitable for paediatric administration. In vitro drug release studies confirmed sustained release, with 93.99% of Baclofen released over 24 hours, whereas the marketed tablet released nearly 100% of the drug within 1 hour. Ex vivo diffusion studies showed strong mucoadhesion to rat stomach mucosa, maintaining drug release (51.66% at 12 hours) even after simulated gastric emptying. Pharmacokinetic studies in rabbits revealed significantly enhanced Cmax, Tmax, AUCtotal, half-life (t1/2), and mean residence time (MRT). The oral jelly exhibited an absolute bioavailability 3.77-fold higher than that of the marketed tablet. **Conclusion** The developed Baclofen-loaded chitosan microsphere oral jelly successfully achieved sustained drug release and significantly enhanced oral bioavailability. The formulation offers reduced dosing frequency, improved safety, enhanced palatability, and better patient compliance, making it a promising therapeutic alternative for the paediatric management of spasticity associated with cerebral palsy.

Keyword Paediatric formulation, Oral jelly, Chitosan microspheres, Sustained release BCS Class III

NAP039

Next-Generation Microneedle Systems Integrating Nanomedicine For Chronic Wound Therapy

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Introduction: Chronic wounds are a big problem in medicine because they take a long time to heal, are at risk of infection, and traditional topical treatments don't work very well. Microneedle (MN)-based drug delivery systems have become minimally invasive platforms that can improve drug delivery to specific areas. Recent evidence suggests that combining nanomedicine with microneedle systems may improve therapeutic outcomes by allowing controlled and sustained release at the wound site. **Methods:** A systematic review of existing preclinical and clinical studies was performed, focusing on microneedle-based methods for wound healing. This study focused on nanomedicine integration systems and analysed the evidence related to solid, hollow, dissolving, and hydrogel-forming microneedles. A comprehensive analysis of critical formulation parameters was performed, encompassing the polymer's composition, mechanical strength, drug loading capacity, and release rate. **Results:** Dissolvable polymeric microneedles made of biocompatible polymers like chitosan and hyaluronic acid can administer compounds intradermally without removal, according to studies. Nanomedicine microneedles allow for better localisation of growth factors, antimicrobials, genes, and stem cell secretomes. Numerous in vivo studies demonstrated heightened angiogenesis, fibroblast proliferation, and wound closure, particularly in diabetic wound models. Innovative advancements such as dual-drug and stimuli-responsive microneedle technologies have enhanced the regulation of drug release. **Conclusion:** Current evidence indicates that nanomedicine-integrated microneedle systems are superior alternatives for the treatment of chronic wounds. However, further clinical studies are required to determine long-term safety and translational feasibility.

Keywords: Microneedles, Dissolvable polymeric microneedles, Nanomedicine, Wound healing, Stimuli-responsive delivery systems.

NAP040

Formulation and Evaluation of Emugel for enhanced topical delivery of Luliconazole using Essential Oil

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Introduction: Luliconazole is an antifungal drug classified under BCS class II, characterized by high permeability but very low water solubility, which compromises its performance in conventional cream formulations and can reduce patient compliance because of low skin retention and the need for repeated application. To overcome these drawbacks, the present work focused on developing a nanoemulsion-based emulgel using essential oil to enhance topical delivery, skin penetration, and therapeutic efficacy of luliconazole. **Methods:** A nanoemulsion was prepared using curcumin oil as the oily phase with Span 80 and Kolliphor ELP serving as the surfactant and co-surfactant, respectively. This nanoemulsion was subsequently incorporated into a suitable gel base to obtain an emulgel, which was then evaluated for particle size, pH, viscosity, drug content, spreadability, texture, and in vitro drug-release behavior **Results:** The optimized emulgel exhibited a small droplet size, skin-compatible pH, high drug loading, and good spreadability, along with appropriate viscosity and texture for topical application. In vitro studies showed sustained drug release with effective antifungal activity, and the optimized formulation remained physically and chemically stable during storage. **Conclusion:** Overall, the nanoemulsion-based emulgel provided improved skin penetration, prolonged retention on the application site, and superior antifungal performance compared with conventional topical formulations of luliconazole. These findings suggest that the developed emulgel is a promising and patient-friendly option for the treatment of topical fungal infections.

Keywords: Essential oil, Emugel, Luliconazole, Topical delivery

NAP041

Nose-To-Brain Delivery of Self-Assembled Curcumin-Nanocochleates For Glioblastoma Treatment

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Introduction: Glioblastoma multiforme (GBM) is an aggressive brain tumor with limited treatment efficacy due to chemoresistance, radiation damage, and surgical invasiveness. Curcumin (CUR), despite anticancer potential against GBM pathways, suffers poor bioavailability. CUR-loaded nanocochleates (NCs), formed via ethanol injection and trapping methods, enable direct nose-to-brain delivery, bypassing BBB for enhanced permeability and reduced side effects. **Method:** The inserts were fabricated via a sequence of Curcumin, Phospholipon 90H, Cholesterol, $CaCl_2$, bovine serum albumin. The goal was to enhance brain bioavailability and neurotherapeutic effectiveness by delivering large doses of CUR to the target region. The Box-Behnken experimental design was used to determine the best NCs formulation, using numerical methods. CUR-NCs were characterized and evaluated for physicochemical properties *viz.* particle size, ζ-potential, drug content and entrapment efficiency, morphology, drug release and permeation, *in vitro* cytotoxicity, and *in vivo* brain pharmacokinetic studies. **Results:** Physicochemical characterization confirmed uniform fiber morphology, particle size, ζ-potential and encapsulation efficiency. *In-vitro* release exhibited biphasic release pattern sustained over 7h (~55%). *Ex-Vivo study's* permeation experiment, **Conclusion:** Researchers developed CUR-NCs using Box-Behnken design for nose-to-brain delivery of curcumin targeting glioblastoma (GBM). Optimized formulations showed nanometric size, ideal ζ-potential, high entrapment efficiency (EE), sustained release, and enhanced permeability over 8 hours. In vivo studies demonstrated superior brain targeting with a high blood-brain ratio, bypassing the BBB for noninvasive therapy. These NCs promise effective GBM treatment but face challenges: i) scaling production due to lipid stability issues, ii) rigorous regulatory approvals hindering market entry, and iii) thorough clinical side effect assessments for commercialization.

Keywords: Curcumin; Nanocochelates; Nose-to-brain; Drug delivery; Glioblastoma.

NAP042

Machine Learning–Guided Coformer Screening For Solubility Modulation Of Metformin Via Cocrystallization

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Metformin hydrochloride, a BCS Class III drug, has a high solubility in water but a low permeability in the intestines, which makes it less suitable for long-term and controlled drug delivery. Modulation of solubility through pharmaceutical co-crystallization presents a rational solid-state approach to achieve extended drug release without altering pharmacological activity. The present study aimed to apply a machine-learning–based strategy for rational coformer selection to design metformin pharmaceutical cocrystals with reduced aqueous solubility and improved controlled-release characteristics. A supervised machine learning model was developed using a dataset comprising 680 API–coformer combinations to predict the probability of cocrystal formation with metformin. Molecular fingerprints were used as descriptors, and a support vector machine (SVM) algorithm was employed for coformer screening. Coformers with high predicted probabilities, predominantly nitrobenzoic acid derivatives, were selected for experimental validation. Cocrystals were prepared using the hot-melt fusion method and characterized by Fourier-transform infrared (FTIR) spectroscopy and powder X-ray diffraction (PXRD). In vitro dissolution studies were conducted to evaluate release behavior, followed by kinetic modeling. Among the screened coformers, 3-nitrobenzoic acid exhibited the highest predicted cocrystallization probability (~0.59). FTIR and PXRD analyses confirmed the formation of a new crystalline phase, indicating successful cocrystal formation. Dissolution studies demonstrated a significantly reduced drug release rate from the metformin cocrystal compared to the marketed formulation. Release kinetics were best described by the Hixson–Crowell model, suggesting erosion-controlled and geometry-dependent drug release. This study demonstrates the effectiveness of machine learning as a predictive tool for rational coformer selection in pharmaceutical cocrystal engineering. The integration of AI-driven modeling with experimental validation provides a cost- and time-efficient approach for modulating drug solubility and achieving sustained release, highlighting the potential of data-driven strategies in modern pharmaceutical development. In the future aspect including The future of pharmaceutical cocrystals lies in advanced computational modeling, green synthesis methods, and expanding therapeutic applications. Additionally, regulatory recognition by agencies like the US FDA and EMA is expected to facilitate the commercialization of more cocrystal-based drugs, addressing bioavailability, stability, and polymorphism challenges. The integration of cocrystals into targeted drug delivery systems, fixed-dose combinations, and nanotechnology-based formulations will open new avenues in personalized medicine and controlled drug release. Beyond pharmaceuticals, nutraceuticals, cosmetics, and agrochemicals may also benefit from cocrystal engineering for improved solubility and stability. With ongoing advancements, cocrystals are poised to become a key technology in next-generation drug formulation and therapeutic innovation.

Keywords: Metformin hydrochloride; Cocrystals; Machine learning; Support vector machine; Coformer screening (3-nitrobenzoic acid); Solubility modulation; Controlled drug release; PXRD; FTIR

NAP043

Preparation and Characterization of Efonidipine Hydrochloride Ethanolate–Amino Acid Co-Amorphous by Spray Drying for Enhanced Solubility

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Introduction: Poor aqueous solubility is a major challenge in the oral delivery of many antihypertensive drugs, leading to inadequate dissolution and low bioavailability. Efonidipine hydrochloride ethanolate, a BCS class II calcium channel blocker, exhibits extremely low water solubility and oral bioavailability below 40%. To overcome these limitations, co-amorphous drug delivery systems using low molecular weight co formers have emerged as a promising strategy to enhance solubility, dissolution, and physical stability. **Method**: In the present study, co-amorphous systems of efonidipine hydrochloride ethanolate were prepared using amino acids such as tryptophan,

histidine, valine, and glycine as co-formers. Spray drying was selected as the method of preparation due to its efficiency, reproducibility, and suitability for scale-up. The drug and selected amino acids were dissolved in an appropriate solvent system and spray dried under optimized processing conditions to obtain uniform co-amorphous powders. The prepared formulations were characterized using X-ray diffraction (XRD), differential scanning calorimetry (DSC), and Fourier transform infrared spectroscopy (FTIR) to confirm amorphization and drug–co-former interactions. **Results**: Solid-state characterization confirmed the successful formation of co-amorphous systems, as evidenced by the absence of crystalline peaks in XRD and the disappearance of the drug's melting endotherm in DSC thermograms. FTIR analysis indicated strong intermolecular interactions between efonidipine and the amino acid co-formers. In vitro dissolution studies revealed a significant improvement in dissolution rate for all co-amorphous formulations compared to the crystalline drug, with the efonidipine–tryptophan system showing the highest dissolution enhancement and improved resistance to recrystallization. **Conclusion**: The study demonstrates that co-amorphization of efonidipine hydrochloride ethanolate with amino acids is an effective approach for enhancing solubility and dissolution behaviour. The efonidipine–tryptophan co-amorphous system, in particular, showed superior performance and holds strong potential for improving oral bioavailability, offering a viable alternative to conventional polymer-based amorphous formulations.

Keywords: Co-amorphous, Amino -acid, Spray-drying, Solubility

NAP044

Formulation and Optimization of Betamethasone Valerate Loaded Emulgel for Enhanced Topical Delivery in the Treatment of Psoriasis

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Introduction: Psoriasis is a chronic autoimmune dermatological condition affecting 2% to 3% of the global population, characterized by the rapid overproduction of skin cells leading to thick, scaly plaques. Current treatments include topical corticosteroids, but their efficacy can be limited by poor skin penetration of hydrophobic drugs. This research focuses on developing an emulgel a novel hybrid of an emulsion and a gel to deliver betamethasone valerate (BV), a potent synthetic corticosteroid. Emulgels enhance drug solubility and skin permeability while providing a non-greasy, patient-friendly application. **Methods:** Pre-formulation studies identified BV as a BCS Class-2 drug with a melting point of 183–184°C. A 2^3 factorial design was utilized for optimization, varying the concentrations of oil (Olive oil), Smix (Tween 80 and PEG 400), and gelling agent (Carbopol 940). Eight batches (F1–F8) were prepared using the phase titration method. Evaluation parameters included pH, viscosity, spreadability, extrudability, and in vitro drug release via spectrophotometric analysis at 259 nm. **Results:** Optimization revealed that the batch with 1.65 ml oil, a 2:15 Smix ratio, and 2.19% gelling agent provided ideal characteristics. The optimized batch showed a viscosity of 251.31 cp and a drug content of 91.34%, closely matching predicted values. pH levels across batches remained skin-compatible (6.37–6.72). In vitro studies showed controlled drug release, with Batch F5 achieving 82.65% cumulative release over 300 minutes. FTIR and DSC studies confirmed the chemical compatibility of BV with the chosen excipients. **Conclusion:** The study successfully formulated a betamethasone valerate-loaded emulgel that offers superior localized drug delivery and controlled release. This formulation provides a promising topical alternative for psoriasis management by improving skin penetration and patient compliance compared to conventional creams.

Keywords: Anti-inflammatory, Corticosteroid, Gel Matrix, Placque Psoriasis, Pseudoternary Phase

NAP045

Preparation and Evaluation of Kojic Acid-Loaded Nanoparticles for Hyperpigmentation

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Introduction: Hyperpigmentation disorders, such as melasma, and post-inflammatory skin conditions, present notable dermatological challenges due to limitations like poor penetration and stability of traditional tyrosinase inhibitors. **Method:** This study developed and optimized Kojic acid-loaded chitosan-collagen nanoparticles through ionic gelation followed by high-pressure homogenization (HPH) to improve dermal delivery and enable sustained release for hyperpigmentation. Various concentrations of chitosan, collagen, and kojic acid were tried to optimize the nanoparticle formulations. Evaluation of nanoparticles was conducted for particle size, Polydispersity Index (PDI), and zeta potential. **Results:** Preformulation studies confirm the drug's identity using Attenuated Total Reflectance-Fourier Transform Infrared spectroscopy (ATR-FTIR), melting point, and a calibration curve in distilled water and Phosphate-buffered saline (PBS) pH 7.4. Nanoparticles were evaluated for particle size, PDI, and zeta potential. Nanoparticles showed optimum results. It is observed that encapsulation efficiency steadily increased with collagen concentration. High-pressure homogenization significantly reduced particle size to <150 nm with PDI <0.3. **Conclusion:** Among the tried batches of nanoparticles, the 15 mg collagen batch showed optimum results of entrapment efficacy. Measurement of entrapment efficacy highlights the importance of optimizing the parameters in microfluidization to obtain higher drug loading. A future *in vitro* release study will validate the therapeutic outcomes.

Keywords: Entrapment efficacy, hyperpigmentation, kojic acid, microfluidization, nanoparticles

NAP046

Dental Nanorobotics: Advancing Therapeutic Strategies in Oral Care

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Background: Nanorobotics has emerged as an advanced interdisciplinary field within pharmaceutical and dental sciences, addressing limitations of conventional dental therapies such as poor site specificity, incomplete disinfection, invasiveness, and patient discomfort. Dental nanobots are nanoscale, untethered systems capable of controlled navigation and site-specific therapeutic action within the complex oral environment. **Scope:** This review focuses on key dental applications of nanorobotics, including management of dentinal hypersensitivity, root canal disinfection, dental anaesthesia, plaque control, and early caries intervention. It highlights core mechanisms such as magnetic guidance, biomimetic mineralisation, targeted antimicrobial activity, and reversible neural modulation that enable precision-based dental treatments. **Key Insights:** Dental nanorobotic systems demonstrate the potential for permanent occlusion of dentinal tubules, effective penetration into complex root canal anatomies for biofilm eradication, injection-free anaesthesia with precise control, and selective plaque removal without damaging oral tissues. Recent experimental studies, particularly from Indian research institutions, indicate promising preclinical outcomes in dental nanorobotics. **Implications and Future Directions:** Nanorobotics in dentistry supports the vision of Viksit Bharat by promoting indigenous innovation, advanced healthcare technologies, and interdisciplinary research. Continued progress in safety evaluation, regulation, and clinical translation may enable affordable, precise, and technologically advanced oral healthcare in a developed India.

Keywords: Dental Nanobots, Nanorobotics, Oral Healthcare, Precision Dentistry, Targeted Drug Delivery

NAP047

Design and Evaluation of Bioadhesive Buccal Patch for Topical Delivery of Tizanidine Using Natural Tamarind Gum

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A centrally acting alpha-2 receptor agonist, tizianidine hydrochloride alters myotonolytic effects on skeletal muscle. Its half-life is about 2.5 hours. The current study's objective is to design and test a bioadhesive buccal patch that uses natural tamarind gum to topically administer tizanidine. Using the solvent evaporation technique, buccal patches containing tizanidine hydrochloride are made by combining different ratios of high-potential matrix cellulose , eudragit, and tamarind gum with the plasticizer polyethylene glycol-400 and permeation enhancers. The drug release handling qualities, physio-mechanical properties, and flexibility of dimethyl sulfoxide were

determined to be satisfactory. The medicine was located with the use of a UV/visible spectrophotometer, and then a compatibility investigation was conducted with the use of FTIR and DSC. Using the solvent evaporation process, buccal patches of tizanidine hydrochloride were prepared using varying ratios of polymer. Various tests for assessment were done, including thickness, weight variation test, folding endurance, swelling index, drug content assay, SEM, ex vivo bioadhesion research, in vitro diffusion study, kinetics of drug release, followed by stability of the formulation. The F10 formulation exhibited the best results, with a cumulative drug release percentage of 86.2% over 12 hours, according to the physicochemical parameters and in vitro release evaluations. This formulation contained a 4:3:3 ratio of hydroxypropyl methylcellulose, eudragit, and tamarind gum, as well as permeation enhancers polyethylene glycol 400 and dimethyl sulfoxide. The study's results show that it is possible to construct a drug delivery system for Tizanidine hydrochloride, which is crucial for both therapeutic effectiveness and patient compliance.

Keyword: Tizanidine hydrochloride, Tamarind gum, buccal patch, spectrophotometer

NAP048

Development of Diclofenac Acid Encapsulated Transgelosome with Enhanced Antioxidant and Anti-Inflammatory Action for Management of Musculoskeletal Pain

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Introduction: Myopathies, joint impairment, and muscle spasm contribute significantly to musculoskeletal inflammation, resulting in muscular soreness and stiffness that hinder mobility. Diclofenac (DA) is a widely used NSAID with non-specific COX inhibitory and antioxidant properties; however, its poor solubility and adverse effects associated with prolonged high-dose therapy limit its clinical utility. This study aimed to develop a DA-loaded transferosomal gel to enhance solubility, reduce dosing frequency, minimise side effects, and provide sustained relief from muscular pain. **Methods:** Transferosomes were prepared by the thin film hydration technique. The optimised formulation attained desirable particle size, polydispersity index (PDI), and zeta potential, with high drug entrapment efficiency. Physiological characterisation, in vitro diffusion studies, ex vivo skin permeation studies, and cellular investigations were performed to evaluate the transferosomal gel. **Results:** The formulation exhibited a cumulative drug release of 92.89 ± 4.21% after 10 h, controlled drug diffusion of 90.68 ± 1.42% over 24 h, and a permeation of 99.57 ± 6.41% over 48 h. Furthermore, cellular studies demonstrated enhanced antioxidant and anti-inflammatory activities compared with a commercially available diclofenac gel. **Conclusion:** The DA-loaded transferosomal gel represents a promising topical delivery system for the effective management of musculoskeletal inflammation, offering sustained drug release and improved therapeutic efficacy.

Keywords: CCD, Diclofenac Acid, Musculoskeletal pain, Transgelosome

NAP049

Development and Evaluation of Hyaluronic acid conjugated Clobetasol Propionate-loaded Chitosan Nanoparticles Hydrogel for Psoriasis Treatment

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Introduction: Psoriasis is a persistent autoimmune dermatosis characterised by hyperproliferation of keratinocytes and inflammatory responses. Current treatment approaches, topical corticosteroids, biologics and phototherapy have undesirable effects like skin atrophy, nephrotoxicity and systemic effects which diminishes long term efficacy of the agent and patient compliance. Consequently, there is a demand for novel drug delivery system to enhance therapeutic efficacy while minimizing adverse effects. **Methods:** The hyaluronic acid (HA)

conjugated clobetasol propionate (CP) loaded chitosan nanoparticle hydrogel was prepared by ionic gelation method. Chitosan, being biocompatible has penetration-enhancing and anti-inflammatory properties was employed as a polymeric carrier. The Chitosan was first dissolved in suitable solvent, to which drug solution and crosslinker was added to form nanoparticles. Further, HA conjugation enabled CD44 mediated targeting in psoriatic skin. The formulation was optimized for particle size, zeta potential, and entrapment efficiency. Furthermore, in vitro and in vivo studies were conducted. **Results:** The optimized formulation exhibited particle size around 150 nm, entrapment efficiency >90% and favourable zeta potential, with TEM confirming spherical morphology. In vitro diffusion studies demonstrated sustained drug release, best fitting the Higuchi release model, indicating diffusion-controlled kinetics. In vivo evaluation using an imiquimod-induced psoriasis model in BALB/c mice revealed significant therapeutic efficacy of hydrogel formulation compared to the marketed formulation. Reduction in Psoriasis Area Severity Index (PASI), decreased spleen weight and favourable histopathological outcomes confirmed its superior anti-psoriatic activity. **Conclusion:** This nanocarrier-based hydrogel system offers robust, targeted and more efficacious alternative to traditional treatment.

Keywords: Chitosan nanoparticle hydrogel, Clobetasol propionate, Hyaluronic acid, Psoriasis

NAP050

Nanotechnology-Enabled Strategies for Targeted Drug Delivery Across the Blood Brain Barrier

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Introduction: The treatment of central nervous system disorders is significantly hindered by the blood–brain barrier (BBB), which limits the penetration of most therapeutic agents into brain tissue. Conventional drug delivery systems often fail to achieve effective concentrations within the brain, resulting in suboptimal therapeutic outcomes. Recent advances in nanotechnology have provided innovative approaches to address these limitations by enabling targeted and controlled drug delivery across the BBB. **Methods:**A systematic narrative peer-reviewed literature was conducted using databases such as PubMed, Science Direct and Google Scholar. Studies focusing on brain-targeted nanocarriers, surface modification strategies, BBB transport mechanisms and preclinical therapeutic evaluations analyzed.**Results:**The reviewed studies demonstrated that nanocarriers including lipid nanoparticles, polymeric nanoparticles, and dendrimers significantly enhance drug transport across the BBB. Surface functionalization with specific ligands promoted receptor-mediated transcytosis, resulting in improved brain accumulation and reduced systemic exposure. Stimuli-responsive nanocarriers enabled controlled drug release within the brain microenvironment. These approaches showed improved therapeutic outcomes in preclinical models of neuro degenerative diseases, brain tumors, and central nervous system inflammation.**Conclusion:**Nanotechnology-based delivery systems improve drug stability, targeting efficiency, and therapeutic precision. Despite promising preclinical findings, challenges such as nanoparticle safety, long-term stability, scalable manufacturing, and regulatory validation remain critical for clinical translation. BBB-penetrating nanocarriers represent a promising platform for effective brain-targeted therapy. Continued optimization and translational research are essential to advance these systems toward clinical application**.**

Keywords: Blood–brain barrier, Nanocarriers, Brain-targeted drug delivery, Central nervous system, Nanomedicine

NAP051

mRNA Vaccine Delivery System Using Lipid Nanoparticles

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Introduction: Innovations in medicine continue to emerge in the form of mRNA vaccines that can effectively prevent infectious diseases. mRNA vaccines provide genetic information that enables the body to trigger an immune response. Moreover, mRNA has a short life span because it can be easily degraded by the body. To overcome this problem, a lipid nanoparticle called an LNP can safeguard the mRNA. Methods**:** In this poster presentation, the composition and mechanism of lipid nanoparticles in delivering mRNA vaccines will be

summarized. The protective roles of ionizable lipids, phospholipids, cholesterol, and PEG lipids in preserving mRNA and enhancing cellular uptake are also included. **Results:** Lipid nanoparticles enhance mRNA stability and enable efficient mRNA uptake by cells. Research has indicated that LNP-based mRNA vaccines elicit high levels of immunity and are safe. Progress in lipid formulation has also improved vaccine efficacy. **Conclusion:** Lipid nanoparticles are a crucial component of the successful implementation of mRNA vaccines. Continued research on novel lipid materials, scalable manufacturing processes, and targeted delivery strategies will further expand the therapeutic potential of mRNA vaccines beyond infectious diseases, paving the way for applications in cancer immunotherapy and personalized medicine.

Keywords: mRNA vaccines, Lipid nanoparticles, Vaccine delivery, Nanotechnology, immunotherapy

NAP052

3d printing for personalised medicine: a revolutionary approach for pharmaceutical drug delivery

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Introduction: Conventional pharmaceutical manufacturing methods often lack the flexibility required to achieve patient-specific dosing and dosage forms. Personalized medicine involves tailoring the therapy as per the needs of the patient based on various factors such as age, genetics, disease state, and drug response. Three-dimensional printing (3D printing) or additive manufacturing has been one of the most promising techniques to overcome this drawback. **Methods:** In this poster, the recent developments of three-dimensional printing, their advantages over conventional methods, as well as, methods used as tools for personalized medicine, such as fused deposition modeling, inkjet printing, and stereolithography, would be evaluated. **Results:** 3D printing provides precise control over dose, geometric size, release pattern, and fixed dose combinations in a single dosage form. 3D printing has shown promise in printing personalized tablets, polypills, modified-release formulations, and patient-friendly dosage forms for pediatrics and geriatrics. Despite its advantages, challenges associated with 3D printing materials and scale-up, quality control, and regulatory issues remain major hurdles in its transition into a clinical reality. **Conclusion:** 3D printing is a transformative approach in the field of personalized medicine, closing the gap between personalized needs and the production of pharmaceuticals. Further research, optimization, and development of the regulatory environment is necessary to enable its increased adoption in practice.

Keywords: 3D printing, drug delivery, modified-release formulations, personalized medicine, pharmaceutical technology

NAP053

Optimization of Sustained Release Cyproheptadine Hydrochloride Tablets Using Different Natural Binders

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Introduction: The research work aimed to evaluate the influence of different natural binders on the formulation of sustained-release Cyproheptadine Hydrochloride tablets. **Methods:** Tablets were prepared using the wet-granulation technique. The prepared granules were evaluated for angle of repose, bulk density, tapped density, Carr's index, and Hausner ratio. Post-compression tests included thickness, hardness, weight variation, friability, drug content, disintegration time and in-vitro dissolution. Dissolution studies were carried out in 0.1 N HCl for 12 hours. **Results:** All formulations showed acceptable flow and compressional characteristics. Among all formulations, batch C6 containing 5% Maize Starch showed superior pre-compression characteristics and sustained-release behavior, achieving 99.74% cumulative drug release at 12 hours. The data showed that Maize Starch enhanced binder functionality by promoting adequate cohesiveness. **Conclusion:** Natural binders significantly influenced the physical properties and release kinetics of Cyproheptadine Hydrochloride sustained release tablets. Maize Starch was identified as the most effective binder compared to Pectin and Gelatin, which providing optimized flow and extended drug release suitable for sustained release dosage development.

Keywords: Cyproheptadine Hydrochloride, Sustained release, Natural binders, Wet granulation

NAP054

A Comprehensive Review of Stimuli-Responsive Sustained In-Situ Gelling Systems for Effective PCOS Management

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Introduction: Effective clinical management of Polycystic Ovary Syndrome (PCOS) demands sustained pharmacological regulation of hormonal and metabolic irregularities. However, conventional localized delivery systems, such as simple solutions or suspensions, are mostly limited by poor retention at the target site due to rapid physiological clearance and vaginal self-cleansing mechanisms. This necessitates the exploration of advanced retention strategies. **Methods:** This review critically evaluates the application of Stimuli-Responsive "In-Situ" Gelling Systems as a superior strategy for prolonged therapeutic activity. The literature analysis focused on "smart" hydrogel systems based on physicochemical triggering mechanisms, specifically thermo-responsive polymers (e.g., Poloxamer 407) that solidify at body temperature, and pH-responsive polymers (e.g., Chitosan, Carbopol) that gel upon contact with specific physiological pH environments. **Results:** The review analyzes rheological parameters that permit these formulations to maintain low viscosity during administration for ease of injectability, followed by rapid *in vivo* gelation to form a robust depot. The versatility of these systems as matrices for diverse payloads, including nanocrystals, microspheres, and liposomes, is highlighted. Findings indicate that by functioning as a controlled-release diffusion barrier, in-situ gels effectively mitigate the "burst release" phenomenon and facilitate extended drug release profiles ranging from days to weeks. Furthermore, these polymers demonstrate biodegradability, ensuring safety during long-term use. **Conclusion:** Stimuli-responsive formulations are identified as a transformative approach in PCOS management, bridging the gap between precision engineering and patient compliance by enabling reduced dosing frequency. However, future perspectives emphasize scaling up manufacturing processes to ensure consistent therapeutic coverage and ease in commercial viability.

Keywords: PCOS, In-situ Gel, Stimuli-responsive, Sustained Release

NAP055

Development and Quality-by-Design–Based Physicochemical Characterization of a Dual-Drug Emulgel for Synergistic Topical Management of Psoriasis

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Introduction: Psoriasis is a chronic inflammatory skin disorder characterized by abnormal keratinocyte proliferation, inflammation, and oxidative stress. Topical drug delivery is preferred due to localized action and reduced systemic side effects. Emulgel systems combine the advantages of emulsions and gels, offering improved stability and patient compliance. This study aimed to develop and physicochemically characterize a dual-drug emulgel for topical management of psoriasis using a Quality by Design (QbD) approach. **Methods:** QbD principles were applied by defining the Quality Target Product Profile and identifying Critical Quality Attributes, including pH, viscosity, spreadability, extrudability, drug content uniformity, and in vitro drug release. Formulations (F1–F8) were prepared using an oil-in-water emulsion followed by gel incorporation. Carbopol 940

served as the gelling agent, liquid paraffin as the oil phase, Tween 80 and Span 60 as emulsifiers, propylene glycol as a penetration enhancer, methyl and propyl parabens as preservatives, and triethanolamine for pH adjustment. Critical process parameters such as stirring speed and homogenization were optimized. **Results:** All formulations showed good homogeneity and skin-compatible pH (6.5–6.9). Viscosity ranged from 12,500 to 19,500 mPa·s, with adequate spreadability (16.5–21.5 g·cm/s) and extrudability (12.0–15.5 g/cm²). Drug content uniformity ranged from 80.5% to 92.0%. In vitro drug release varied between 60.0% and 85.5%, with the optimized formulation meeting predefined quality attributes. **Conclusion:** The QbD-based dual-drug emulgel demonstrated desirable physicochemical properties and sustained release, indicating its potential as an effective topical delivery system for psoriasis management.

Keywords: Dual-drug formulation, Emulgel, Psoriasis, Quality by Design, Topical drug delivery

NAP056

Inhalable Liposomal Garlic Extract formulation for Biofilm Eradication

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Introduction: Garlic extract (GE), rich in organosulphur compounds such as allicin, exhibits broad-spectrum antimicrobial and antibiofilm activity. However, its clinical application against biofilm-forming *Pseudomonas aeruginosa* in pulmonary Cystic Fibrosis (CF) is limited due to poor stability and inadequate lung retention. This study aimed to overcome these limitations by developing a liposomal inhalable dry powder (IDP) formulation of GE to enhance its antimicrobial and antibiofilm efficacy. **Methods:** GE was standardized using UV–visible spectroscopy, FTIR, DSC, and stability-indicating RP-HPLC. GE-loaded liposomes were prepared by the thin-film hydration method and optimized using a Quality by Design (QbD) approach to achieve optimal particle size and entrapment efficiency. Optimized liposomes were freeze-dried with suitable cryoprotectants and characterized for physicochemical properties, morphology, crystallinity, and in vitro drug release. Antibiofilm efficacy was evaluated against biofilm-forming *P. aeruginosa*. Liposomes were blended with inhalable lactose to prepare GE liposome-loaded inhalable dry powders (GEL-IDPs), which were assessed for aerodynamic performance using Twin Stage Impinger (TSI) and Anderson Cascade Impactor (ACI). In vivo lung biodistribution was studied in Sprague–Dawley rats over 24 hours. **Results:** GE-loaded liposomes showed uniformly distributed nanosized particles, high entrapment efficiency, good stability, and sustained drug release up to 24 hours. Compared to plain GE, liposomal GE exhibited significantly enhanced antibiofilm activity, with a two-fold reduction in IC_{50} and superior biofilm inhibition and eradication. GEL-IDPs demonstrated suitable aerodynamic properties for pulmonary delivery (MMAD=4.8 µm, GSD=2.8 µm, FPF=30.54%) and achieved higher lung drug concentrations than GE parenteral solution. **Conclusion:** The GE liposomal DPI significantly improved antibiofilm efficacy and lung retention, indicating strong potential as an adjunct therapy for *P. aeruginosa* biofilm-associated CF infections.

Keywords: Biofilm, Cystic fibrosis, Garlic Extract, Inhalable dry powder, *Pseudomonas*.

NAP057

Nano formulation of Resveratrol for oral administration: A Powerful Antioxidant"

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Introduction: Resveratrol is a natural polyphenolic compound present in grapes and berries. It protects cells from oxidative stress by neutralizing reactive oxygen species and supports healthy metabolic activity. Oral resveratrol shows promise for skin health by acting as a powerful antioxidant, boosting collagen, and protecting against UV damage, and anti-aging. It has very low water solubility hence low bioavailability so formulation of nano lipid

carriers [NLCs] of resveratrol will increase its bioavailability. **Methods:** Resveratrol-loaded NLCs can be developed using emulsification technique using solid lipids such as dynasan, compritol etc , liquid lipids like miglyol, capriyol, olive oil etc, and surfactants and co-surfactants like tween and poloxamers. Optimisation of NLC is based on factorial design and the formulation are lyophilized using cryoprotectants like mannitol, trehalose and sucrose etc. The NLCs are characterized for nanoscale particle size, drug entrapment efficiency and in-vitro drug release followed by preparation of tablets using lyophilized NLCs, which are further evaluated for diameter, hardness, content uniformity. **Results:** Lyophilized NLCs demonstrates improved physical stability, increased % ee and suitability for tablet dosage form and controlled release profile of resveratrol from the NLC system. Overall, the nanoformulation shows strong potential for enhancing oral bioavailability of resveratrol. **Conclusion:** It demonstrates the successful development of a NLC tablet for effective oral delivery. The optimized nanoformulation overcomes the limitations of poor solubility and low bioavailability, highlighting its potential to improve the therapeutic efficacy of resveratrol.

Keywords: Resveratrol, Antioxidant, NLC Tablet, Bioavailability enhancement, Controlled drug release.

NAP058

A Review on Microneedle Insulin Patches: A Novel Approach to Diabetes Therapy

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Diabetes mellitus is a chronic disease characterized by insufficient insulin production or ineffective insulin utilization, posing a major global health concern with increasing prevalence. Conventional insulin administration methods such as subcutaneous injection, although effective, often suffer from poor patient compliance and limited long term acceptability. Over the past decade, transdermal drug delivery systems (TDDS) have emerged as a promising alternative offering noninvasive administration, avoidance of first pass metabolism, and the potential for sustained drug release. Among the various strategies developed, microneedle (MN) patches and needle free formulations represent significant advancements. Microneedles are available in solid, hollow, coated, and dissolvable forms as well as enable efficient transdermal delivery of insulin with enhanced bioavailability compared to traditional hypodermic injections. Studies on dissolving MNs using biocompatible polymers such as gelatin/CMC have demonstrated successful glucose regulation and hypoglycemic effects in animal models. In parallel, needle free patches utilizing ionic liquid-in-oil (IL/O) microemulsions integrated with adhesive matrices have shown excellent stability, compatibility, and sustained insulin release while overcoming the skin barrier. Collectively, these novel transdermal approaches demonstrate higher patient compliance, reduced dosing frequency, and improved pharmacological outcomes, making them a promising direction for future diabetes management and insulin therapy.

Keywords: Diabetes mellitus, Insulin therapy, Transdermal drug delivery system, Microneedle patches, Needle free insulin delivery

NAP059

Formulation and Optimization of Tolvaptan-Loaded Multilayer Nanofibers Mucoadhesive Buccal Patch: A Strategic Approach to Mitigate Hepatotoxicity and Improve Solubility

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Introduction: Oral administration of Tolvaptan is challenged by poor aqueous solubility and risks of severe hepatotoxicity due to extensive first-pass metabolism. This study aims to develop a bilayer electrospun nanofiber mucoadhesive buccal patch to enhance Tolvaptan solubility via amorphization and bypass hepatic metabolism, thereby mitigating liver strain while ensuring systemic delivery. **Methods:** Biphasic patches were fabricated using the electrospinning technique. The drug-loaded mucoadhesive layer was formulated using Polyvinylpyrrolidone (PVP) K-90, selected for its superior fiber-forming viscosity and inherent adhesiveness. A Polycaprolactone (PCL)

backing layer will be used to ensure unidirectional release. Critical process parameters like applied voltage, collector distance, flow rate, and drum speed were optimized to get stable Taylor cone formation. The formulation will be characterized by SEM for morphology, EDS for elemental drug distribution, and DSC to confirm the crystalline-to-amorphous transition. Performance will be evaluated for tensile strength, in vitro dissolution (Apparatus 5), and ex vivo permeation studies. Mucoadhesion will be assessed both in-vitro and in-vivo. **Results:** SEM will help to identify uniform, bead-free nanofibers, DSC thermograms will indicate complete disappearance of the drug's melting peak, confirming the entrapment of Tolvaptan amorphous state. The optimized PVP K-90 matrix demonstrated significant mucoadhesive strength. PCL backing layer will prevent back-diffusion, facilitating directional transport through the mucosa. **Conclusion:** The developed electrospun nanofiber patch will successfully enhance the solubility profile of Tolvaptan. By utilizing the buccal route to circumvent first-pass metabolism, this novel formulation offers a promising therapeutic strategy to improve bioavailability and potentially reduce hepatotoxic risks.

Keywords: Tolvaptan, Electrospun Nanofiber, Hepatotoxicity, Solubility Enhancement

NAP060

Bridging Herbal Therapeutics and Nanotechnology: NLC-Based Centella asiatica for Collagen Enhancement

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Introduction: Centella asiatica is a medicinal herb rich in triterpenoids such as asiaticoside and madecassoside that stimulate fibroblast activity via the TGF-B/Smad pathway, enhancing collagen synthesis. However, conventional formulations show poor solubility, stability, and skin penetration, which can be effectively overcome by nanostructured lipid carriers (NLCs) that improve drug loading, controlled release, stability, and skin permeation. **Methods:** Centella asiatica loaded NLCs are optimized using homogenization–emulsification techniques, wherein solid lipids such as Dynasan, Compritol, and Precirol can be used along with liquid lipids including Miglyol, Capryol, and olive oil. Surfactants and co-surfactants such as Tween and poloxamers can be employed to enhance emulsification stability and nanoscale particle formation. **Results**: Literature findings indicate that NLC-based delivery may produce nanosized, uniformly distributed particles with improved stability, drug entrapment, controlled release, and dermal permeation, while hydrogel characterization may suggest enhanced penetration and collagen-stimulating effectiveness. **Conclusion**: Mentioned methodology leads to successful optimization of Centella asiatica-loaded NLCs and it's conversion into hydrogel, which improves deeper penetration of Centella asiatica for better efficacy. This offers a promising nanotechnological strategy for effective herbal collagen stimulation in pharmaceutics and cosmeceutical applications.

Keywords: Centella asiatica; Nanostructured Lipid Carriers; Herbal Nanotechnology; Collagen Stimulation; Dermal Drug Delivery.

NAP061

Recent Advances in Mucormycosis Treatment: Conventional Therapy, Nano formulations, and New Technologies

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Introduction: Mucormycosis is a rare but life-threatening fungal infection caused by fungi of the order *Mucorales*. It mainly affects immunocompromised individuals, including patients with uncontrolled diabetes, malignancies, organ transplantation, and post-COVID-19 complications. The disease progresses rapidly due to angio-invasion, leading to tissue necrosis and organ dysfunction. Despite the availability of antifungal agents, clinical outcomes remain poor because of delayed diagnosis, limited drug penetration, toxicity, and increasing resistance. Consequently, recent research has focused on innovative drug delivery systems and advanced technologies to improve diagnosis and therapy. **Methods:** This review critically evaluates peer-reviewed articles

published between 2014 and 2024 retrieved from PubMed, Scopus, and Web of Science. Studies related to conventional antifungal therapy, nano-based drug delivery systems, targeted formulations, and emerging diagnostic and therapeutic technologies for mucormycosis were systematically analyzed. **Results:** Conventional management relies on amphotericin B, posaconazole, and isavuconazole, often combined with surgical debridement. However, nephrotoxicity, poor bioavailability, and inadequate tissue targeting remain major limitations. Nanoformulations such as liposomes, solid lipid nanoparticles, polymeric nanoparticles, and nanostructured lipid carriers have demonstrated enhanced solubility, improved tissue penetration, sustained drug release, and reduced toxicity in preclinical and clinical studies. Recent advances also emphasize nanodiagnostics, molecular imaging, and artificial intelligence-assisted tools for early detection. **Discussion and Conclusion:** Nanotechnology-based drug delivery systems offer an effective strategy to overcome limitations of conventional antifungal therapy by improving targeting, safety, and therapeutic efficacy. Although emerging nanoformulations and advanced technologies show strong potential to improve outcomes and early diagnosis, further translational research and clinical validation are required for application.

Keywords: Antifungal therapy; Mucormycosis; Nanotechnology; Targeted drug delivery

NAP062

Solid Dispersion: A Technology for Solubility Enhancement of Poorly Water-Soluble Drugs

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Introduction: Poor water solubility is a major challenge in pharmaceutical drug development. More than 70% of new drug molecules belong to Biopharmaceutical Classification System (BCS) Class II and IV, which show low solubility and poor oral bioavailability. Therefore, advanced formulation strategies are required to enhance drug solubility and dissolution. **Methods:** This review is based on a survey of published scientific literature, including research articles, review papers, and marketed product data. The molecular, thermodynamic, and kinetic principles governing amorphous solid dispersions and nanocrystal systems were critically analysed. Emphasis was placed on polymer selection, stabilization mechanisms, preparation techniques, and characterization methods. **Results:** Amorphous solid dispersions significantly enhance solubility by converting crystalline drugs into an amorphous form and dispersing them in hydrophilic polymer matrices. Polymers play a crucial role in preventing drug recrystallization and maintaining saturation in gastric media. Nanocrystal technology improves dissolution by reducing particle size and increasing surface area. **Conclusion:** Polymer-based amorphous solid dispersions and nanocrystal technologies are effective and well-established strategies for improving the solubility and oral bioavailability of poorly water-soluble drugs. Clear understanding of molecular interactions, thermodynamic stability, and formulation design is essential for developing stable and successful pharmaceutical products.

Keywords: Amorphous solid dispersions, Nanocrystals, poorly water-soluble drugs, Polymers, Bioavailability

NAP063

Design and Translational Potential of Nanotechnology-Based Systems for Melanoma Therapy

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Introduction: Melanoma represents the most aggressive and lethal subtype of skin cancer, characterized by a high mortality rate attributable to its pronounced metastatic potential, rapid progression, and therapeutic resistance. Current clinical management relies primarily on surgical resection, often followed by adjuvant interventions such as chemotherapy, radiotherapy, phototherapy, immunotherapy, or multimodal treatment strategies. Nevertheless, therapeutic efficacy remains suboptimal due to intrinsic limitations of conventional treatments, including poor drug bioavailability, physicochemical instability, rapid systemic clearance, inadequate tumor-site accumulation, and dose-limiting toxicity. Consequently, effective and safe melanoma treatment remains a major clinical

challenge. **Methods:** Recent advances in nanotechnology-based drug delivery systems were systematically evaluated as alternative approaches for melanoma therapy and diagnosis. Diverse nanocarrier platforms, encompassing lipid-based, polymeric, inorganic, carbon-derived, dendritic, and biomimetic nanoformulations, were analysed with respect to their design attributes, delivery efficiency, and therapeutic potential. **Results:** Nanotechnology-enabled systems demonstrated improved protection of therapeutic agents, enhanced tumor targeting, increased intratumoral drug accumulation, and reduced off-target toxicity. Preclinical *in vitro* and *in vivo* studies demonstrated significant suppression of melanoma tumour growth, accompanied by fewer systemic adverse effects, compared to conventional treatments. Moreover, several nanoformulations demonstrated diagnostic capabilities, supporting their potential application in melanoma detection. **Conclusion:** Nanotechnology-based drug delivery platforms provide a compelling strategy to address the limitations of existing melanoma treatments. By improving tumor localization, therapeutic efficacy, and safety, these systems hold substantial promise for advancing systemic melanoma management and further translational and clinical investigation.

Keywords: Controlled drug release, Enhanced permeability and retention (EPR) effect, Targeted drug delivery, Translational nanomedicine, Tumor microenvironment.

NAP064

Rapid Release, Rapid Relief: Formulation and Evaluation of Fast Dissolving Oral Film

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Introduction: Oral dissolving films (ODFs), also known as Mouth disintegrating films, are thin and flexible oral dosage forms that rapidly disintegrate in the oral cavity without the need for water. These systems improve patient compliance, particularly in pediatric, geriatric, and dysphagic populations. ODFs enable rapid drug absorption through the oral mucosa, resulting in faster onset of action and avoidance of first-pass metabolism when compared to conventional dosage forms. **Methods:** The present study focuses on the formulation, evaluation, of fast dissolving oral films as an advanced oral drug delivery system. Films were prepared using suitable film-forming polymers, plasticizers, sweetening/flavoring agents, and solvents. The solvent casting method was used due to its reproducibility, and cost-effectiveness. Various formulation techniques including solvent casting, semisolid casting, hot-melt extrusion, and rolling methods were reviewed. The prepared films were evaluated for physical parameters such as appearance, transparency, and homogeneity, with mechanical characteristics including thickness, tensile strength, folding endurance, in-vitro disintegration, dissolution, and drug content uniformity. **Results:** The formulated oral dissolving films were smooth, transparent, and uniform in thickness. They exhibited rapid disintegration, satisfactory mechanical strength. Comparative evaluation with marketed oral dosage forms demonstrated improved drug release, faster therapeutic action, and enhanced ease of administration. **Conclusion:** Oral dissolving films represent a promising, patient-friendly, and efficient oral drug delivery system. Their rapid onset of action, ease of use, and improved patient compliance make them a suitable alternative to conventional oral dosage forms with broad therapeutic potential.

Keywords: Oral dissolving films, Rapid drug release, Patient compliance, Solvent casting method

NAP065

Formulation And Evaluation of Herbal Nasal Spray for Migrane

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Introduction: Migraine is a neurovascular condition that is chronic and causes intense headache with nausea, photophobia, and phonophobia. First-pass metabolism and poor gastrointestinal absorption of conventional oral therapies are slow and less effective. Non-invasive delivery of drugs intranasally offers a speedy method of administration to the brain by delivering the drug directly into the brain via olfactory and trigeminal pathways.

Analgesic, anti-inflammatory, and neuroprotective herbal bioactives are a promising intervention to manage migraine in patients. **Methods:** The development of herbal nasal spray formulations was conducted on the basis of selected phytoconstituents e.g. *Zingiber officinale, Mentha piperita, Curcuma longa, Withania somnifera,* and *Cannabis sativa* in terms of anti-migraine. The nasal compatibility involved parameters such as pH (5.5–6.5), viscosity, droplet size, isotonicity, and chemical stability. Chitosan and HPMC, which are mucoadhesive, were used to increase the nasal residence time and absorption. Assessment was done through physicochemical characterization, spray pattern, in-vitro diffusion, ex-vivo permeation and pharmacodynamic evaluation. **Results:** Optimized nasal preparations had spray properties, viscosity and fast diffusion of the nasal mucosa. Herbs like curcumin, menthol, and gingerol shows modulation of the neuroinflammatory pathways such as CGRP, TNF-α, and serotonin. Greater mucoadhesion provide increased absorption and therapeutic action at low levels of systemic exposure. **Conclusion:** Herbal nasal sprays are quick, user-friendly, and efficient in the treatment of migraines. Their possibilities to offer quick relief and minimal side effects on the system justify their possible use in the treatment of acute migraine.

Keywords: Herbal nasal spray, Migraine treatment, Nose-to-brain Mucosa, Neuroinflammation.

NAP066

Stimuli-Responsive Drug Delivery Systems for Targeted Therapy in Rheumatoid Arthritis: A Review

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Introduction: Rheumatoid Arthritis is a chronic autoimmune disease in which there is synovial inflammation, joint destruction and various systemic complications. Conventional treatment includes the use of Non-steroidal anti-inflammatory drugs, Corticosteroids, and Disease-modifying Anti-rheumatic drugs. But they are not site specific and often lead to systemic toxicity and poor patient compliance on long term usage. To overcome these limitations, a stimuli responsive drug delivery system can be developed that delivers the drug on the targeted site. **Methods:** This review is based on analysis of published scientific research and review articles focused on stimuli responsive drug delivery system for rheumatoid arthritis. Literature was reviewed to evaluate stimuli responsive carriers such as pH sensitive, enzyme sensitive, and reactive oxygen species responsive systems with nano based drug delivery by utilizing polymeric nanoparticles, liposomes, micelles and hydrogels for targeted therapy in rheumatoid arthritis. **Results:** Stimuli-responsive drug delivery systems demonstrated targeted release of the drug at inflamed tissues by utilizing the pathological triggers such as acidic pH, inflammatory enzymes and elevated reactive oxygen species levels. These systems enhanced the drug accumulation at the disease site, reduced systemic exposure, and improved the therapeutic efficacy. When compared to conventional formulations, nano-based carriers helped to lower the frequency of dosing and increase drug availability. **Conclusion:** Stimuli-responsive drug delivery systems show promising results for overcoming the limitations of conventional therapy. By site specific and stimuli-triggered drug release, these systems have the potential to improve the therapeutic outcomes and reducing the adverse effects.

Keywords: Nanocarriers, pH responsive, Stimuli-responsive, Targeted therapy

NAP067

Microneedle-Mediated Brain Targeting for Antipsychotics: Advances and Perspectives

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Introduction: Antipsychotics Drugs such as brexpiprazole and other Atypical antipsychotic drugs treat major psychiatric conditions such as schizophrenia and depression. However, low systemic availability, the requirement for frequent or high doses, and side effects resulting from extensive drug distribution in the body frequently limit their therapeutic efficacy. A major barrier to achieving effective concentrations in the brain is the Blood–Brain Barrier (BBB), a highly selective interface formed by tightly connected endothelial cells and active efflux

mechanisms. The majority of medications are severely limited in their ability to enter the central nervous system through this protective barrier. Therefore, to reach the brain, conventional oral or injectable formulations must rely on elevated systemic levels, which can raise the risk of metabolic problems, movement-related symptoms, and other clinically significant side effects. To overcome such limitations, an advanced drug delivery system such as Microneedles is used. **Methods:** The rising importance of Microneedle technology as a novel and less invasive platform for improving the brain targeting for antipsychotics is the main topic of this review. We provide an overview of the basic Microneedle platforms, such as dissolving, hydrogel-forming, coated, and hollow systems, and describe how they are used to get over biological barriers and reach therapeutic medication concentrations in the brain. **Results:** Microneedle technology effectively overcomes the restrictive BBB and the skin's stratum corneum, thereby enhancing drug permeation and reducing the high systemic levels associated with conventional oral or injectable antipsychotics. Different Microneedle platforms (dissolving, coated, and hollow) have demonstrated superior brain- targeting effectiveness and increased drug bioavailability for CNS agents in preclinical studies. **Conclusion:** Lastly, we discuss Microneedle-mediated CNS delivery's future prospects, preclinical development, and clinical translation potential, emphasizing its potential for better patient outcomes and medication regimen adherence.

Keywords: Microneedles, brexpiprazole, blood-brain barrier, brain targeting, Antipsychotics

NAP068

Nanosuspension-Based Fast Dissolving Films: A Review of Current Trends and Solubility Enhancement Strategies

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Introduction: A major obstacle to pharmaceutical research is poor water solubility, which frequently results in variable bioavailability and therapeutic failure. The incorporation of nanosuspension technology into fast-dissolving films (FDFs) as a dual-strategy for improving the delivery of hydrophobic active ingredients is examined in this research. This strategy attempts to enhance dissolution kinetics and offer a practical, waterless administration route for paediatric, elderly, and non-compliant patient groups by employing nano-sized particles inside a thin-film matrix. **Methods:** The methodology focused on evaluating top-down and bottom-up nanonization strategies and the selection of optimal film-forming polymers. Pharmaceutical benchmarks such as particle size distribution, polydispersity index, mechanical properties, and *in vitro* disintegration profiles were prioritized during data synthesis to evaluate formulation efficiency. **Results:** According to analysis, nanosuspensions greatly improve saturation solubility by raising the surface area-to-volume ratio. These technologies enable quick disintegration usually in less than 30 seconds and preserve nanoparticle stability when successfully loaded into FDFs. Comparative research shows that FDF-loaded nanosuspensions outperform conventional solid dosage forms in terms of dissolving rates and plasma concentrations. **Conclusion:** The combination of FDF technology with nanosuspensions offers a flexible platform for improving poorly soluble medications. Although the approach successfully resolves issues with patient adherence and solubility, more study is required to maximize drug-loading capacity and moisture sensitivity. This technique offers a strong foundation for oral delivery systems of the future.

Keywords: Bioavailability, Fast Dissolving Film, Nanosuspension, Solubility Enhancement

NAP069

Plant-Mediated Silver Nanoparticles: A Sustainable Approach for Development of Antimicrobial Formulations

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Introduction: The increasing prevalence of antimicrobial resistance has created an urgent need for alternative therapeutic strategies that are both effective and environmentally sustainable. Silver nanoparticles (AgNPs) have gained considerable attention due to their broad-spectrum antimicrobial activity and reduced propensity for resistance development. Green synthesis using plant extracts offers a cost-effective and eco-friendly approach by eliminating toxic reagents while utilizing bioactive phytochemicals as reducing and stabilizing agents. **Methods:** Silver nanoparticles were synthesized using aqueous extracts of five medicinal plants - *Azadirachta indica* (Neem), *Catharanthus roseus* (Vinca), *Glycyrrhiza glabra* (Liquorice), *Ocimum sanctum* (Tulsi), and *Terminalia bellirica* (Baheda). The synthesized nanoparticles were characterized using UV-Visible spectroscopy to confirm nanoparticle formation and were evaluated for antimicrobial activity against *Escherichia coli* and *Bacillus subtilis* using the agar well diffusion method. The potential of these nanoparticles for incorporation into topical formulations is currently being explored. **Results:** UV-Visible spectroscopic analysis demonstrated characteristic surface plasmon resonance absorption peaks in the 420–450 nm range, confirming the formation of silver nanoparticles. Antibacterial evaluation revealed dose-dependent inhibitory activity at 3 mM and 5 mM concentrations. AgNPs synthesized using Vinca and liquorice extracts exhibited comparatively larger zones of inhibition, whereas plant extract controls showed minimal antimicrobial activity. **Conclusion:** The study highlights the effectiveness of plant-mediated green synthesis in producing stable and biologically active silver nanoparticles. These findings support the potential application of phytogenic AgNPs as sustainable antimicrobial agents and provide a foundation for future development of nanoparticle-based topical formulations.

Keywords: Antimicrobial activity, Green synthesis, Silver nanoparticles, Topical formulation, UV-Visible spectroscop

NAP070

Adeno-Associated Virus (Aav): Intelligent Vector Design for Precision Gene Therapy

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Introduction: Adeno-associated virus (AAV) is a member of the Parvoviridae family and, at approximately 25 nm, serves as one of the smallest yet most effective vectors in gene therapy. Distinct from other viral platforms, AAV offers a unique safety advantage: it is inherently non-pathogenic and cannot replicate autonomously, depending instead on a helper virus to function. Its engineered icosahedral capsid acts as a precision delivery vehicle, transporting therapeutic payloads that remain in the nucleus as stable episomes. **Methods:** The core strategy of AAV therapy is gene replacement rather than symptom management. rAAV vectors act as precision delivery vehicles designed to transport a healthy gene directly into the patient's tissues. Once the gene is delivered to the nucleus, it establishes a permanent, independent 'command center' (episome) alongside the patient's own DNA. This allows the cell to immediately start manufacturing the missing therapeutic protein itself, effectively restoring health at the molecular level with a single treatment.**Result:** The efficacy of this mechanism is confirmed by recent FDA approvals, including Zolgensma for Spinal Muscular Atrophy, Luxturna for Inherited Retinal Dystrophy, and Hemgenix for Hemophilia B. Clinical data indicates that single-dose AAV therapies can restore physiological function and significantly reduce disease burden. However, limitations such as restricted cargo capacity (~4.7 kb) and pre-existing neutralizing antibodies in patients remain significant barriers. **Conclusion:** AAV gene therapy marks a significant advancement in the management of monogenic disorders, presenting the potential for curative outcomes rather than symptomatic treatment. Ongoing progress in next-generation capsid engineering—through rational design and directed evolution—will be crucial for improving tissue specificity and minimizing immune responses, thereby broadening the therapeutic scope of AAV vectors for a wider array of complex human diseases.

Keywords: Adeno-associated virus(AAV), gene therapy, Capsid Engineering, Zolgensma

NAP071

Emerging Trends in Sunscreen Formulation Technology

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Introduction: Sunscreens have become both pharmacologically and commercially significant dermatological formulations, supported by rapid advancements in cosmetic science and pharmaceutical innovation. In contemporary formulations, chemical (organic) UV filters—such as avobenzone and oxybenzone—and physical (inorganic) filters like titanium dioxide and zinc oxide are extensively reviewed for their photoprotective mechanisms, safety profiles, and formulation challenges. **Methods:** This systematic review evaluates published literature on formulation design, pharmacokinetics, efficacy assessment, and consumer perception of SPF-based products. It further explores the interplay between SPF labelling, therapeutic performance, and consumer behaviour. Pharmacologically, sunscreens serve as essential agents in preventing ultraviolet-induced oxidative damage, photoaging, and carcinogenesis. The Sun Protection Factor (SPF) is a critical measure if a sunscreen ability The SPF 30 is widely recommended for general daily exposure and blocks approximately 97% of UVB radiation while SPF 50, on the other hand, blocks about 98% of UVB radiation. Ongoing research continues to improve their efficacy, photostability, and safety. **Result:** Sunscreens have emerged as indispensable agents in dermatological care, offering comprehensive protection against ultraviolet-induced skin damage, photoaging, and carcinogenesis. Their efficacy relies on the synergistic integration of chemical and physical UV filters, optimized formulation techniques, and consistent consumer use. Beyond their pharmacological significance, modern sunscreens represent a convergence of healthcare and cosmetic innovation, evolving toward formulations that are photostable, non-irritant, and environmentally responsible. The market trajectory underscores a growing consumer shift toward daily, multifunctional, and sustainable products that align with global awareness of skin health and environmental impact **Conclusion:** Overall, this review highlights the pharmacological mechanisms, formulation innovations, and market relevance of sunscreens, with particular emphasis on the evolution and significance of the Sun Protection Factor.

Keywords: Sunscreen, pharmacological mechanisms, formulation science, market relevance, Sun Protection Factor.

NAP072

Formulation and Evaluation of Nanoemulsion based Eye Drops for Dry Eye Disease

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Introduction: Dry Eye Disease (DED) is a multifactorial ocular disorder characterized by tear film instability, increased evaporation, inflammation, and discomfort, leading to significant visual disturbance and reduced quality of life. Conventional treatments-including artificial tears, gels, and emulsions-provide only temporary relief due to rapid precorneal elimination, limited residence time, and inadequate restoration of all tear film layers. **Methods:** Nanoemulsion-based ophthalmic formulations offer a promising alternative by enabling nanoscale droplet size for enhanced corneal penetration, and superior retention on the ocular surface. Moreover, such nanoscale systems can enhance drug bioavailability and ensure uniform ocular distribution, contributing to better therapeutic control of chronic DED symptoms. The objective is to formulate and evaluate a stable, safe, and effective oil-in-water nanoemulsion eye drop for managing DED. The rationale is to develop a system similar to clinically established formulations capable of replenishing the lipid, aqueous, and mucin layers, thereby providing long-lasting lubrication and tear film restoration. The formulation incorporates an oil phase containing suitable lipids and dual emulsifiers (hydrophilic and lipophilic) for droplet stabilization, an aqueous phase with surfactant for structural integrity, and a polymeric phase containing to enhance viscosity and ocular retention. Methodology involves high-

shear homogenization and high-pressure homogenization/microfluidization to achieve nanosized droplets, followed by physicochemical characterization. **Results:** Analytical evaluations include droplet size, PDI, zeta potential, pH, osmolality, refractive index, viscosity, and stability studies etc. **Conclusion:** Expected outcomes include a kinetically stable, biocompatible nanoemulsion with enhanced residence time, minimal irritation, and improved therapeutic potential for Dry Eye Disease, laying a foundation for advanced clinical translation.

Keywords: Dry Eye Disease, Nanoemulsion, High-pressure homogenization

NAP073

Microencapsulation Of Probiotics: A Future of Stable Probiotics

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Introduction: Probiotics are the live microorganisms, which when administered into the body in adequate amounts give positive response and health benefits like improving digestion, maintain gut microbiota, producing immune response and preventing GIT related disorders. The market for probiotics is a growing market and is currently around 114 billion US dollars (in 2025). However, the main issue with the probiotics is with its shelf life and stability during production, storage, and travel through the digestive system. Factors like heat, moisture, pH, bile salts, digestive enzymes etc. can greatly decrease probiotic viability before they get to the intestines, limiting their health benefit and efficacy. These challenges create the need of adapting different strategic approaches which can protect the probiotics and ensure consistent therapeutic performances. Microencapsulation has been a promising approach to overcome such limitations. Most of the existing marketed products do not employ such microencapsulation techniques resulting into reduced viability and shelf life. **Methods:** some common microencapsulation techniques involve spray drying, lyophilization, fluidized bed drying. Encapsulating materials such as alginate, chitosan, gelatine, and starch-based polymers are used. **Results**: Studies report that microencapsulated probiotics exhibit higher survival during storage and improved resistance to simulated gastric and intestinal conditions compared to non-encapsulated forms, along with better controlled release and efficacy. **Conclusion:** Microencapsulation is a promising next-generation formulation strategy that would enhance probiotic stability, therapeutic performance, efficacy etc. this approach offers strong commercial relevance by enabling high potency, and patient centric probiotic products for future pharmaceutical and nutraceutical applications.

Keywords: Microencapsulation, Probiotics, Stability, Spray drying

NAP074

Development of an Intestinal-Targeted Liquid-Filled Capsule to Enhance Oral Bioavailability of a BCS Class IV Peptide Drug for Obesity

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Introduction: A BCS Class IV peptide drug used for obesity management, a synthetic glucagon-like peptide-1 (GLP-1) receptor agonist, promotes weight loss by suppressing appetite, delaying gastric emptying, enhancing satiety, and exerting sustained central appetite control; however, its oral bioavailability is extremely low (≈1%) due to poor intestinal permeability and enzymatic degradation in the gastrointestinal tract. To overcome these limitations, an enteric-coated liquid-filled capsule formulation was developed to improve intestinal delivery and absorption of the peptide. **Method:** The drug was dissolved in a solvent system containing propylene glycol and Labrasol, while sodium caprate was incorporated as a permeation enhancer to improve both transcellular and paracellular transport across the intestinal epithelium. The formulation was homogenized using vortex mixing followed by sonication to ensure uniform dispersion. Throughout the preparation process, the temperature was maintained below 30 °C to prevent peptide degradation, and the pH was kept above 6 to avoid denaturation and maintain stability. The liquid-filled capsules were further coated with an enteric polymer to protect the peptide from acidic gastric conditions and to enable targeted release in the intestinal region. **Result:** The effectiveness of this formulation strategy was evaluated through intestinal permeability studies using a suitable animal model, which demonstrated enhanced absorption following enteric release. **Conclusion**: Overall, the enteric liquid-filled

capsule approach effectively addressed the poor oral bioavailability of the BCS Class IV peptide drug by protecting it from gastric degradation and enhancing intestinal permeability, thereby showing strong potential to improve oral therapeutic efficacy and clinical outcomes in obesity management.

Keywords: BCS Class IV peptide, Enteric liquid-filled capsule, GLP-1 receptor agonist

NAP075

Formulation, Development and Characterization of Immediate Release Tablets for Schizophrenia

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Introduction: Schizophrenia is a chronic and severe psychiatric disorder characterized by disturbances in thought, perception, emotion, and behaviour. Effective symptom control using oral immediate-release (IR) dosage forms is critical for improving patient outcomes and adherence. Drug X, an antipsychotic agent and a Biopharmaceutics Classification System (BCS) Class II compound, exhibits poor aqueous solubility despite high permeability, resulting in dissolution-rate-limited absorption. The present work aims to develop a stable and pharmaceutically equivalent IR tablet of antipsychotic agent that releases at least 85% of the drug within 30 minutes. **Methods:** IR tablets were prepared using the wet granulation method. Pre-formulation studies included micromeritic evaluation, physicochemical characterization, and drug–excipient compatibility studies. Formulation variables, particularly the type and concentration of super-disintegrant and the particle size of the active pharmaceutical ingredient, were optimized to enhance dissolution and disintegration. Post-compression evaluations included weight variation, hardness, thickness, friability, disintegration time, and drug content uniformity. In vitro dissolution studies were conducted to assess drug release kinetics. Stability and compatibility studies were performed to ensure product integrity over time. **Results:** Optimized formulations demonstrated acceptable mechanical strength, uniform drug content, rapid disintegration, and compliance with pharmacopeial limits. In vitro dissolution testing confirmed an immediate-release profile with more than 85% drug release within 30 minutes. **Conclusion:** Developed IR tablet of Antipyschotic agent provides rapid and reliable drug release with adequate stability and mechanical properties. This patient-friendly dosage form is suitable for effective management of schizophrenia, guided by formulation strategies used for antipsychotics such as quetiapine, aripiprazole, and olanzapine.

Keywords: Antipsychotic agent, Formulation, Immediate Release Dosage, In Vitro Release Profile, Schizophrenia

NAP076

Lipid-Polymer Hybrid Nanoparticles: A Promising Platform for Advanced Topical Drug Delivery

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Introduction: Topical and transdermal drug delivery systems face significant limitations such as poor skin penetration, low drug stability, and inadequate therapeutic efficacy. Conventional lipid- or polymer-based nanocarriers individually suffer from drawbacks including burst release, limited drug loading, and poor structural stability. Lipid-polymer hybrid nanoparticles (LPHNPs) have emerged as a promising next-generation delivery platform, integrating the advantages of both lipid and polymeric systems to offer enhanced stability, controlled drug release, and improved skin permeation. **Methods:** LPHNPs were designed using a polymeric core combined with a lipid outer shell to achieve optimal encapsulation efficiency and sustained drug release. Various formulation strategies, including nanoprecipitation and emulsification techniques, were employed to evaluate particle size, surface charge, drug-loading efficiency, zeta potential measurement, morphology evaluation, and in vitro release studies. **Results:** The optimized LPHNPs exhibited a nanoscale particle size with uniform distribution and enhanced physical stability. The lipid-polymer structure enabled high drug entrapment and controlled release behaviour. In-vitro and ex-vivo studies demonstrated improved skin penetration and prolonged drug retention

compared to conventional formulations. The hybrid system also showed good biocompatibility and minimised burst release, indicating its suitability for topical and transdermal applications. **Conclusion:** Lipid-polymer hybrid nanoparticles represent a versatile and efficient platform for drug delivery in dermatological applications. Their structural flexibility, enhanced permeation capability, and controlled release behaviour make them promising candidates for treating skin infections, inflammatory disorders, and localised diseases.

Keywords: Lipid-polymer hybrid nanoparticles, topical drug delivery, controlled release, skin permeation

NAP077

Nanotechnology-Driven Therapy for Lung Cancer

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Introduction: Lung cancer is still one of the deadliest diseases in respiratory medicine. Non-small cell lung cancer (NSCLC) is responsible for the highest number of cancer-related deaths. Disease heterogeneity, late-stage diagnosis, and limited specificity in conventional therapies are the primary challenges to poor clinical outcomes. Recent advancements in nanotechnology and immunotherapy have opened promising perspectives to overcome such limitations and boost therapy efficacy. **Methods:** A systematic literature review was conducted focusing on studies that investigate nanotechnology-based drug delivery systems for lung cancer, with particular emphasis on nanosuspension and liposomal formulations. Relevant preclinical and clinical research articles were identified, screened, and analyzed to evaluate formulation strategies, pulmonary delivery approaches, therapeutic efficacy, and safety outcomes. Key findings were critically organized and summarized in order to provide a clear and focused understanding of the role of nanosuspensions and liposomes in lung cancer therapy. **Results:** Most of the conventional treatments against lung cancer often bear high off-target toxicity, have poor specificity, and are burdened with a high recurrence rate. Improved targeting, with less systemic toxicity and superior therapeutic outcome, has been observed in both preclinical and clinical studies with nanotechnology-based drug delivery systems, including nanoparticles, liposomes, solid lipid nanoparticles, and nanoemulsions. Pulmonary delivery of nanoformulations has shown particular promise. At the same time, emerging immunotherapies targeting tumor–immune interactions offer completely new opportunities to manage early-stage NSCLC. **Conclusion:** Nanomedicine has so far markedly improved lung cancer therapy by overcoming major shortcomings of conventional therapies. While challenges still exist in large-scale production and clinical translation, the combination of nanotechnology with conventional and immunotherapeutic approaches holds great promise for addressing.

Keywords: Drug delivery system, Immunotherapy, Lung cancer, Nanomedicine, Nanoparticles, Non-small cell lung cancer (NSCLC)

NAP078

Nanocrystal-Mediated Hair Follicle Targeting: Enhancing Penetration, Retention, and Therapeutic Outcomes in Topical Antibacterial and Anti-Inflammatory Therapy

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Introduction: Topical treatment of hair follicle-associated disorders such as acne vulgaris and bacterial folliculitis is constrained by the skin's barrier properties and poor delivery into the follicular niche. Hair follicles offer a direct route for deep drug penetration and sustained localized therapy, bypassing much of the stratum corneum and serving as a drug reservoir. Nanocrystals carrier-free submicron drug particles have emerged as a promising strategy to overcome these limitations by enhancing solubility, follicular penetration, and intrafollicular retention. **Methods:** Nanocrystals are typically prepared using top-down (e.g., media milling & high-pressure homogenization) or bottom-up (e.g., controlled precipitation) techniques to yield stable nanosuspensions optimized for hair follicle entry. These are incorporated into topical carriers such as gels or hydrogels. Due to their small size and high surface area, nanocrystals can traverse the follicular orifice via the trans-appendageal route and form localized drug depots within hair follicles. **Results:** Studies demonstrate that nanocrystal formulations

significantly enhance drug accumulation in hair follicles compared to conventional products. For example, azelaic acid nanocrystals (~200–500 nm) showed superior follicular deposition versus commercial formulations, with further enhancement when combined with physical techniques. Nanocrystal systems also exhibited meaningful anti-inflammatory and antibacterial activity relevant to acne therapy. **Conclusion:** Nanocrystal-based delivery is an effective nanocarrier strategy for targeting hair follicles, improving penetration, retention, and therapeutic outcomes in bacterial and inflammatory follicular disorders. This approach supports sustained local drug release and holds promise for future clinical translation.

Keywords: Nanocrystal, Nanosuspension, Drug Delivery, Hair Follicle

NAP079

Novel formulation strategies for Nebulized Drug Delivery in Lung compromised Diseases

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Introduction: Nebulized drug delivery is essential for the patients with compromised lung function like cystic fibrosis, bronchiectasis, ventilator- associated pneumonia, nontuberculous mycobacterial infection, and severe COPD. Increase in the advancement of formulation for technologies and designing some of devices have increased the therapeutic scope of nebulized products beyond small hydrophilic drug which includes liposomal formulations, nanoparticle, etc. Some traditional jet and ultrasonic nebulizer were designed for general use; however, newer vibrating mesh offers markedly higher delivery efficiency. **Method**: Inhalation therapy for pulmonary fibrosis also challenges in formulating nebulized medicine, new formulation approaches like liposomes, lipid/polymer nanoparticle, mucus penetrating system, dry concentrates and biologic compatible and examined in a way that the formulations should matched with inhalation devices like mesh nebulizer and adaptive aerosol delivery systems. **Result**: Aerosol therapy basically delivers the drug directly to diseased region of lung, allowing faster action in less dose and minimized systemic side effects. Further some newly induced system such as liposome nanoparticle and vibrating mesh nebulizer improves pulmonary residence time, which protects and fragile biologics, and enhance dose consistency, with successes like liposomal amikacin and inhaled tobramycin. **Conclusion**: Inhalation therapy represents a promising approach for the treatment of pulmonary fibrosis by enabling targeted drug delivery to the lungs decreasing the systemic exposure.

Keywords: Aerosol drug delivery, Pulmonary fibrosis, Liposomal drug delivery, Mesh nebulizer technology

NAP080

Nano-Formulations for Wound Healing: Comparative Analysis of Emerging Delivery Systems and Therapeutic Potential

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Introduction: Wound healing is a complex physiological process requiring controlled delivery of bioactive agents to facilitate tissue regeneration, hemostasis, and antimicrobial protection. Traditional topical formulations suffer from poor bioavailability, rapid degradation, and inadequate penetration into wound tissue. Nanotechnology offers promising solutions through engineered nano-delivery systems that enhance therapeutic efficacy, prolong drug residence time, and minimize systemic toxicity. This review systematically examines diverse Nano formulations for wound healing applications and their comparative advantages. **Methods:** A comprehensive literature review was conducted using PubMed, Google Scholar, and ScienceDirect databases to identify studies on nano-formulations in wound healing published between 2018-2025. Focus was placed on electrospun nanofibers, lipid-based vesicles (liposomes, niosomes, transferosomes), inorganic nanoparticles (silver, zinc oxide, gold), and polymer-based nanoparticles (PLGA, chitosan). Formulations were evaluated based on antimicrobial efficacy, biocompatibility, wound closure rates, and tissue regeneration potential reported in literature. **Results:** Literature

analysis revealed distinct advantages across Nano formulation types: electrospun nanofibers provide sustained release and structural support; lipid vesicles enable transdermal penetration and immunomodulation; silver/zinc nanoparticles demonstrate potent antimicrobial activity; and polymer nanoparticles offer tunable release kinetics. Comparative studies indicate 15-40% faster wound closure with nano-formulations versus conventional dressings, with reduced bacterial colonization and improved collagen synthesis. **Conclusion:** Nano-formulations represent a paradigm shift in wound therapeutics. Hybrid and multi-functional nano-systems combining antimicrobial, anti-inflammatory, and regenerative properties emerge as most promising for next-generation wound care products.

Keywords: Nano formulation, Nanofibers, Nanotherapeutics, Wound healing

NAP081

3D Printing Technologies in Drug Delivery: Design, Performance, and Translational Challenges

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Introduction: Three-dimensional (3D) printing has emerged as an advanced manufacturing strategy in drug delivery, providing precise control over dosage form geometry, composition, and release characteristics. In contrast to conventional pharmaceutical manufacturing often lacks the flexibility required for personalized therapy and complex delivery systems, resulting in suboptimal drug release, limited targeting efficiency, and variability in therapeutic outcomes. The convergence of 3D printing with micro and nanotechnology has further expanded its applicability by enhancing drug stability, bioavailability, targeting efficiency, and overall therapeutic performance across multiple routes of administration. **Methods:** Key pharmaceutical 3D-printing technologies, including fused deposition modeling (FDM), selective laser sintering (SLS), stereolithography (SLA), and multi-material inkjet printing, were systematically evaluated based on their printing mechanisms, material constraints, achievable resolution, and compatibility with active pharmaceutical ingredients. **Results:** Each printing modality exhibited distinct advantages and limitations depending on the intended application. Extrusion and inkjet-based systems demonstrated high flexibility for personalized oral and transdermal formulations, whereas laser and light-based techniques offered superior precision for implantable and tissue-engineered systems. The incorporation of micro and nanoscale materials significantly enhanced drug loading efficiency, enabled controlled and site-specific release, and improved therapeutic efficacy. Nonetheless, challenges related to limited material availability, polymer–drug incompatibility, process-induced drug degradation, standardisation of quality control, and regulatory compliance remain critical barriers to clinical translation. **Conclusion:** 3D printing has unlocked innovative avenues for targeted and sustained drug release and the advancement of personalized medicine. Future interdisciplinary research efforts will be critical for driving the development of clinically translatable drug delivery systems, ensuring safety, efficacy, and scalability.

Keywords: Controlled drug release, Implantable drug delivery, Personalized medicine, Pharmaceutical fabrication, Targeted drug delivery

NAP082

From Plaques to Precision: CRISPR-Cas9 in Alzheimer's Therapy

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Introduction: Alzheimer's is a neurodegenerative disease with symptoms of memory loss, neuronal damage with the accumulation of beta amyloid protein (AβP), with the neurofibrillary tangles form by accumulation of tau proteins. Currently, medications show only relief rather than cure of it. However, disease modifying technique like CRISPER-Cas 9 can be seen as new gene editing technology has emerged as a promising tool for AD. **Method:** CRISPER-Cas 9 is a genome and epigenome based editing in Eukaryotes can be seen. AD associated gene like APP, APOE and so on. Epigenome like dCas 9 can regulate the normal function of the body. The m RNA and sg RNA (single guide) based delivery enables dcas 9 expression with reduced genomic toxicity and efficient editing with the minimal off target exposure. Formulations with lipid nanoparticle based vesicle

encapsulate the cas 9 m RNA and sg RNA with biodegradable polymers, forms complex via amphiphilic peptide assembly. **Result:** Cas 9 helps the target gene and shows decrease in AβP and APP level, decrease neuronal cell death and epigenome shows effects with disease modifying promoters without DNA damage. The nanoparticles show the stability of DNA and protect sg RNA from degradation. It can facilitate the endocytosis into the target cells and improve brain activity. **Conclusion:** Cas9 shows strong foundation for the next generation, aimed for the halting or to reverse progression of the AD, offering a future path toward disease-modifying therapy.

Keywords: APOE, APP, CRISPER-Cas 9 in AD, lipid nanoparticle, m RNA and sg RNA

NAP083

Advances in Liposomal Drug Delivery Systems for Targeted Cancer Therapy: Design Strategies and Therapeutic Perspectives

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Introduction: Conventional delivery systems fail to overcome biological barriers such as rapid clearance, low solubility, and nonspecific distribution. Liposomal drug delivery systems have emerged as promising nanocarriers due to their biocompatibility, ability to encapsulate both hydrophilic and lipophilic drugs, and potential for surface modification to enhance tumor targeting. **Methods**: This review summarizes recent advances in liposome-based drug delivery systems for cancer therapy. Various formulation strategies including PEGylation, ligand-mediated targeting, and stimuli-responsive liposomes were evaluated. Emphasis was placed on pH-, temperature-, and hypoxia-sensitive liposomes, as well as actively targeted systems utilizing ligands such as folate, transferrin, and antibodies. **Results**: Engineered liposomes demonstrated enhanced drug stability, prolonged circulation time, and improved accumulation at tumor sites via the enhanced permeability and retention (EPR) effect. Targeted and stimuli-responsive liposomes showed superior intracellular delivery and therapeutic efficacy while minimizing systemic toxicity. Several liposomal formulations have successfully progressed to clinical use, validating their translational potential in oncology. **Conclusion**: Liposomal drug delivery systems represent a versatile and effective platform for cancer therapy. Advances in surface modification, targeting strategies, and stimulus-responsive designs have significantly improved therapeutic outcomes. Continued optimization and clinical translation of these systems hold strong promise for achieving safer, more efficient, and personalized cancer treatment.

Keywords: Liposomes; Targeted drug delivery; Cancer therapy; Stimuli-responsive systems; Nanocarriers; Controlled drug release

NAP084

Enhancing Oral Bioavailability Through Drug-Coformer Mesoporous Silica Hybrid System

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Introduction: Poor aqueous solubility remains a significant obstacle in the development of oral dosage forms, frequently leading to slow dissolution, limited bioavailability, and suboptimal pharmacokinetic profiles. Consequently, the development of effective strategies to enhance solubility and dissolution is essential for improving therapeutic efficacy. Drug–coformer systems, particularly coamorphous formulations, have emerged as promising approaches to improve solubility and physical stability by preventing the recrystallization of amorphous drugs. Recently, the incorporation of these systems into mesoporous silica (MPS) has attracted considerable interest as an advanced formulation strategy. **Methods:** In this approach, poorly water-soluble drugs are combined with suitable coformers to generate amorphous systems, which are subsequently loaded into mesoporous silica carriers. Stabilization of the amorphous state is achieved through a combination of strong intermolecular interactions between the drug and coformer and the nanoconfinement effect provided by the mesoporous silica matrix, collectively enhancing dissolution performance. **Results:** This dual-stabilization strategy is expected to improve drug loading capacity, dissolution behaviour, and release characteristics compared with conventional

crystalline and amorphous formulations. The nanoconfinement effect within mesoporous silica promotes homogeneous drug dispersion, enhances physical stability, and enables controlled drug release, thereby supporting improved permeability and pharmacokinetic performance. **Conclusion:** Coamorphous drug–coformer systems integrated within mesoporous silica offer a versatile and promising platform for improving the oral bioavailability of poorly water-soluble drugs and therefore therapeutic effectiveness.

Keywords: Coamorphous, Encapsulation, Mesoporous Silica, Stabilisation, Therapeutic effectiveness

NAP085

Innovations in Ocular Therapy: Drug Delivery Using Medical Devices

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Introduction: Ocular diseases like glaucoma, diabetic retinopathy, and age-related macular degeneration can lead to severe vision loss if left untreated and require prolonged therapy. The management of these conditions is complicated by the anatomy and the physiological barriers of the eye. Traditional topical therapies have low bioavailability and fast elimination. Intravitreal injections are effective alternative dosage forms but are invasive. As a solution, innovations for drug delivery through medical devices have been developed. **Method:** The ocular drug delivery devices deliver a controlled and sustained-release dosage of medicament. The poster focuses on extraocular systems like ocular rings and inserts, medicated lenses, punctual plugs, and intraocular implants in biodegradable or non-biodegradable forms. Extraocular therapy is less invasive and is placed on the ocular surface. Intraocular implantable drug delivery devices, on the other hand, are invasive and act directly on the site of action by surpassing the ocular barrier. The mechanisms involve passive diffusion through matrix, microsphere and polymer erosion, and nanochannel-mediated transport, which release medication slowly over months or years. **Result:** Medical device based delivery offers reduced dosing frequency, improved patient compliance, consistent diffusion rates, enhanced bioavailability, and reduced repeated intravitreal injections. With the help of these devices, molecules which were impractical to administer over the past years, can be delivered. **Conclusion:** Ophthalmic medical devices have revolutionized ocular therapy by integrating device engineering with therapeutic formulation. Their advancements in the therapy have the capability to improve chronic ocular conditions to a significant level.

Keywords: Biodegradable implants, Glaucoma, Implantable ocular devices, Medical devices, Ocular barriers

NAP086

Digital Twin–Assisted Nanomedicine: Advancing Personalized Drug Delivery Through Predictive Modeling

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Introduction: Nanomedicine offers significant advantages for targeted and controlled drug delivery; however, its clinical translation is often hindered by complex pharmacokinetics, nano–bio interactions, and marked interpatient variability. Traditional experimental and population-based modeling approaches are insufficient to fully predict individual therapeutic outcomes or to support rational personalization of nanocarrier-based therapies. This review aims to critically evaluate the emerging paradigm of digital twin–assisted nanomedicine and its role in advancing personalized drug delivery through predictive, patient-specific modeling frameworks. **Methods:** A comprehensive analysis of recent literature was conducted focusing on digital twin concepts in biomedical research and their integration with nanomedicine. Emphasis was placed on physiologically based pharmacokinetic modeling, systems pharmacology, and artificial intelligence–driven analytics for simulating nanocarrier absorption, distribution, metabolism, and clearance. Applications across major therapeutic domains were systematically examined. **Results:** Digital twins enable the creation of virtual, data-driven replicas of patient-specific biological

systems, allowing dynamic simulation of nano–bio interactions, protein corona formation, tissue-specific accumulation, and interindividual variability. Integration with physiologically based pharmacokinetic and artificial intelligence models enhances predictive accuracy for therapeutic efficacy and safety. Applications in oncology, neurological disorders, inflammatory diseases, and RNA-based therapies demonstrate the potential of digital twins to guide nanocarrier selection, formulation optimization, dose individualization, and treatment scheduling prior to clinical administration. **Conclusion:** Digital twin–assisted nanomedicine represents a pivotal advancement in predictive modeling, enabling a shift from population-based approaches toward truly personalized drug delivery. Continued development of adaptive, real-time digital twins capable of learning from continuous patient data is expected to further transform precision therapeutics.

Keywords: Digital twin technology, Nanomedicine, Predictive pharmacokinetics, Personalized drug delivery, Physiologically based pharmacokinetic modelin

NAP087

Advances in Nanotechnology-Enabled Oral Films: Current Trends, Challenges, and Future Directions

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Introduction: Oral films have gained significant attention as convenient, fast-dissolving drug delivery systems suited to paediatric, geriatric, and dysphagic populations. However, their use can be limited by poor solubility, permeability, or instability of many drugs. Nanotechnology-enabled oral films integrate nanosystems—such as nanoparticles, nanoemulsions, and nanosuspensions—within polymeric matrices to enhance solubility, stability, and therapeutic performance. This review summarises advancements in nanotechnology-based oral films and highlights their potential to overcome limitations of conventional formulations. **Methods:** Nanotechnology-enabled oral films are commonly prepared using solvent casting, hot-melt extrusion, or emerging 3D-printing approaches. In solvent casting, nanosystems—nanoparticles, nanosuspensions, or nanoemulsions—are dispersed within hydrophilic polymers like HPMC, PVA, or pullulan, followed by casting and drying. Hot-melt extrusion provides solvent-free processing and improved content uniformity, while 3D printing enables precise deposition and customization. Reported studies were compared based on nanocarrier type, incorporation strategy, polymer compatibility, film characteristics, and performance outcomes. **Results:** The reviewed studies demonstrate substantial improvements in drug solubility, dissolution rate, stability, and bioavailability when nanosystems are incorporated into oral films. Advancements such as solvent casting with nanosuspensions, hot-melt extrusion, and 3D printing have improved uniformity and scalability. Despite promising findings, challenges include nanocarrier instability, aggregation, moisture sensitivity, and limited clinical data. **Conclusion:** Nanotechnology-enabled oral films represent a promising next-generation platform for delivering poorly soluble drugs with enhanced therapeutic outcomes and patient acceptability. Future work should prioritise long-term stability studies, scalable manufacturing, regulatory evaluation, and clinical validation to support commercial translation.

Keywords: Nanotechnology, Oral Films, Nanoparticles, Nanoemulsion Films, Nanosuspensions

NAP088

Polymeric Nanoparticle-Loaded Nanofibers for Sustained Delivery of Herbal Bio-actives in Diabetic Wound Healing

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Introduction: Diabetic infected wounds provide a significant clinical challenge due to compromised angiogenesis, chronic inflammation, microbial infection, and delayed tissue regeneration. In contrast to typical wounds that undergo systematic healing phases, chronic diabetes wounds remain ensnared in a chronic inflammatory condition, resulting in improper healing outcomes. Traditional medicines frequently lack enduring antibacterial efficacy and tissue regeneration, hence requiring alternate treatment approaches. **Methods:** This review summarises current studies about herbal therapies for chronic wound management, focussing on the

synergistic effects of *Nigella sativa* and *Centella asiatica plant extract*. A thorough analysis was conducted on literature regarding wound pathophysiology, herbal bioactives, polymeric nanoparticle delivery methods, and nanofiber wound dressings. A particular focus was placed on sustained-release biodegradable polymeric nanoparticles and their integration into nanofibrous scaffolds. **Results:** *Nigella sativa* demonstrates significant antibacterial, anti-inflammatory, and antioxidant properties, making it beneficial in managing infection and inflammation in diabetic wounds. *Centella asiatica* facilitates angiogenesis, stimulates fibroblast proliferation, and augments collagen synthesis, ultimately improving tissue regeneration. Their combination has a dual therapeutic impact by targeting both infection management and wound healing. Encapsulation within biodegradable polymeric nanoparticles enhances stability, bioavailability, and prolonged release, whereas the integration of nanofibers provides increased surface area, moisture retention, oxygen permeability, and targeted drug delivery. **Conclusion:** The combined administration of *Nigella sativa* and *Centella asiatica* via polymeric nanoparticles integrated into nanofiber dressings is a promising and innovative strategy for managing diabetic infected wounds. This nanoengineered herbal approach provides superior therapeutic effectiveness, prolonged drug release, and better wound healing compared to traditional treatments.

Keywords: Chronic wound, *Nigella sativa*, *Centella asiatica*, Polymeric nanoparticles, Nanofiber

NAP089

Lipomer Based Mixed Micellar Peptide Delivery for Treating Osteoporosis

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Introduction: Oral peptide delivery offers high patient compliance but is limited by poor bioavailability. This study developed an in-house lipomer (P-lipid) based mixed micellar nanosystem for oral delivery of Salmon Calcitonin (sCT) and evaluated its intestinal permeation, enteric protection and biodistribution through *in-vitro, ex-vivo* and *in-vivo* studies. **Methods:** Native sCT was characterized using HPLC, UPLC, FTIR, Circular Dichroism (CD), TGA and DSC. sCT-loaded mixed micelles were prepared by thin-film hydration using an in-house P-lipid at its critical micellar concentration and characterized for size, drug content and structural properties. Intestinal permeability was assessed using non-everted gut sac and Caco-2 assays. For oral delivery, micelles were adsorbed onto mesoporous carriers and filled into capsules, followed by optimization of enteric coating. Capsules were evaluated for disintegration time and USP IV dissolution compliance, with enteric release visualized by X-ray imaging, followed by in vivo organ distribution and histopathological analysis to assess structural changes in vital organs. **Results:** Lipomer-based mixed micelles (size:150-200 nm; PDI:0.4-0.6) were successfully developed and showed a 2.08-fold increase in Caco-2 permeability compared to free sCT. Enteric-coated capsules exhibited negligible acid uptake (0.33%) and released contents in jejunum within 2-3h. Dissolution studies showed minimal drug release in acidic media (4%) and sustained release in basic media (92%). Biodistribution indicated spleen accumulation with no significant off-target deposition in vital organs. **Conclusion:** This study demonstrated a lipomer-based mixed micellar system for oral delivery of sCT, achieving enhanced intestinal permeability, effective enteric protection and targeted intestinal release. The formulation minimized gastric degradation and showed favorable *in-vivo* biodistribution, highlighting its potential to improve oral bioavailability of therapeutic peptides.

Keywords: Enteric Capsules, Lipomer, Micelles, Nanosystem, Salmon Calcitonin (sCT)

NAP090

Polymer Lipid Hybrid Nanoparticles based Drug Delivery for Oral Cancer therapy

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Introduction: Oral cancer, predominantly oral squamous cell carcinoma (OSCC), remains a significant clinical challenge due to poor drug localization, rapid systemic clearance, and dose limiting toxicities associated with conventional chemotherapy. These limitations often result in inadequate therapeutic response and increased adverse effects. Polymer lipid hybrid nanoparticles (PLHNPs) have emerged as a promising drug delivery system to address these challenges by improving drug targeting and retention at the tumor site. **Method:** PLHNPs are designed by combining polymeric carriers, which provide structural stability and controlled drug release, with lipid components that enhance biocompatibility and membrane permeability. These hybrid nanocarriers can be incorporated into gels or mucoadhesive formulations for localized application within the oral cavity. Surface modification strategies may further enable selective targeting of cancer cells, while nanoscale dimensions support improved tissue penetration and cellular uptake. **Results:** PLHNP based delivery systems demonstrate improved drug encapsulation efficiency, protection of unstable drug molecules, and prolonged residence time at the site of application. Studies have reported enhanced intracellular uptake of chemotherapeutic agents along with sustained drug release profiles. When formulated as topical or gel based systems, PLHNPs allow direct tumor site delivery, reducing systemic exposure and improving therapeutic efficacy in oral cancer models. **Conclusion:** Polymer lipid hybrid nanoparticles represent an advanced and versatile drug delivery platform for oral cancer therapy. Their ability to enhance localized drug delivery, improve therapeutic outcomes, and minimize systemic side effects highlights their potential clinical value. Although challenges such as formulation complexity, stability, and scalability persist, continued advancements in polymer science, lipid engineering, and nanoparticle fabrication are expected to support future clinical translation.

Keywords: Oral cancer, Polymer lipid hybrid nanoparticle, Nanocarrier

NAP091

Nanocrystal-Based Drug Delivery Strategies for Improved Breast Cancer Therapy

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Introduction: Breast cancer is one of the most prevalent cancers in women worldwide, characterized by complex physiology and diverse molecular subtypes. Conventional chemotherapies are often hindered by poor aqueous solubility, systemic toxicity, and multi-drug resistance. Therefore, it is crucial to develop more effective, safe, and customized management plans for BC. The application of nanoparticle-based systems, specifically nanocrystals based delivery system has received significant attention in drug development due to their enhanced dissolution rate and improved water solubility, making them effective in overcoming issues related to drug hydrophobicity, thereby improving drug bioavailability and treatment effectiveness. **Methods** The development of these systems involves top-down milling to bottom-up precipitation techniques, tailored to achieve optimal particle size and stability. **Results:** Recent advances in preparation techniques have facilitated research on drug surface properties, leading to valuable surface engineering strategies. Surface modification can stabilize drug nanocrystals, making them suitable for versatile drug delivery platforms. Functionalized ligands further enhance the potential for targeted delivery, enabling precision medicine. Critically, the evaluation of their pharmacokinetics, biodistribution, and toxicity profiles demonstrates that nanocrystals can improve the safety and efficacy of anticancer agents in breast cancer. **Conclusion:** The future outlook for nanocrystals in breast cancer management remains highly promising. It represents a transformative advancement in oncology, providing a more precise and potent alternative to traditional breast cancer treatments.

Keywords: Nanomedicine, Targeted Delivery, Surface Engineering, Bioavailability, Solubility Enhancement

NAP092

Targeting the Pilosebaceous Reservoir: Nanocarrier-Driven Topical Therapy for Folliculitis

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Introduction: Folliculitis is a follicle-centered infectious–inflammatory dermatosis sustained by microbial persistence within the pilosebaceous unit, most often in a sebum-rich, occluded follicular canal with constrained immune access. Conventional topical antibiotics and antiseptics frequently fail to reach deep intrafollicular niches or maintain adequate exposure, contributing to relapse and selection pressure for resistance. Effective therapy therefore requires high local concentrations and prolonged residence specifically within infected follicles. M**ethods:** Recent experimental and preclinical studies on nanocarrier-mediated topical delivery for folliculitis were systematically evaluated. Nanocrystals, lipid-based nanoparticles, and polymeric nanocarriers were compared by particle size and surface attributes, sebum interaction, follicular deposition/retention, and antimicrobial performance. Evidence from in vitro assays, ex vivo skin/follicular penetration studies, and in vivo folliculitis models was benchmarked against creams and ointments. **Results:** Conventional formulations showed limited follicular entry, short residence time, and sub-therapeutic intrafollicular levels, aligning with incomplete bacterial reduction and recurrence. In contrast, nanocarriers consistently increased follicular accumulation, improved depthwise penetration, and prolonged drug retention, enabling sustained antimicrobial activity. Multiple studies reported greater bacterial load reduction and reduced dosing frequency versus conventional topical vehicles. **Conclusion:** Nanocarrier-enabled follicular targeting is a mechanistically grounded strategy to overcome intrafollicular delivery barriers in folliculitis. By enhancing localized exposure and retention at the infection site, these systems may improve outcomes, reduce relapse, and support antimicrobial stewardship.

Keywords: Folliculitis, Follicular Retention, Topical nanocarriers, Nanocrystals

NAP093

Microneedle systems for Transdermal Drug Delivery: Fabrication, Applications, and Challenges

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Introduction: Transdermal drug delivery is one of the most promising delivery route that offers distinct advantages such as by-passing of hepatic first-pass metabolism, the maintenance of plasma drug levels, increased safety, and higher patient compliance. However, the applicability of this approach is largely limited due to barrier properties of the stratum corneum, diverse physicochemical properties of the drugs, and safety considerations. While many approaches have been explored for overcoming the transdermal absorption of drugs, microneedles enable painless drug delivery through the formation of aqueous conduits, enhancing drug flux, providing precise drug control, higher drug loading and shortening lag time without adversely impacting the skin structure. **Methods:** Microneedles, which are typically 0.1-1 mm in length, form transitory microchannels in the skin thereby allowing the movement of therapeutic molecules to reach deeper layers of skin with less pain and greater user acceptance. Materials such as silicon, stainless steel, or polymers are used to construct these devices. It exists in numerous forms like solid, coated, hollow, dissolving and hydrogel. **Result**: They facilitate easy self-administration, increase the variety of molecules that can be administered through the skin, and provide the possibility of both quick and prolonged drug release. **Conclusion**: Although microneedle systems show significant promise, several challenges must still be addressed to ensure consistent therapeutic performance, reliable long-term drug release, and cost-effective large-scale manufacturing. To successfully transition microneedle technologies from laboratory research to widespread clinical and commercial applications, further advancements in material selection, fabrication techniques, and device design are required. When these factors are carefully considered, microneedles represent a transformative approach with the potential to substantially enhance both intradermal and transdermal drug delivery.

Keywords: Drug delivery, fabrication techniques, microneedle, polymer, transdermal

NAP094

Intranasal Nanocarrier Systems for Alzheimer's Disease: Focus on Core-Shell Nanoparticles

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Introduction: Alzheimer's disease (AD) is a multifactorial neurodegenerative disorder and the principal etiological cause of dementia worldwide, imposing a substantial and escalating public health burden. Existing pharmacotherapies are largely symptomatic and provide limited clinical benefits, as their efficacy is restricted by poor permeability across the blood–brain-barrier (BBB), inadequate cerebral drug exposure and dose-limiting systemic adverse effects. These constraints have accelerated the development of nano drug delivery approaches to deliver efficient and targeted brain delivery to enhance therapeutic outcomes for the patients. **Methods:** This study systematically reviews intranasal nanocarrier-based drug delivery strategies for AD, with emphasis on polymer-based core-shell nanoparticles. Focus is placed on formulation design, polymer selection and functional characteristics of core-shell nanostructures for intranasal administration. Core-shell nanoparticles are fabricated using high-energy methods like ultrasonication or low-energy techniques such as nanoprecipitation, solvent evaporation. Method selection is dictated by drug physicochemical properties, polymer composition and targeted brain delivery requirements. **Results:** This literature demonstrates that core-shell nanocarriers offer significant advantages over conventional single-component nanocarriers. The polymeric core enables sustained and controlled drug release, while the outer shell enhances mucoadhesion, epithelial permeability and protection against enzymatic degradation within the nasal cavity. These synergistic properties result in prolonged nasal residence, enhanced brain bioavailability and superior nose-to-brain targeting efficiency. **Conclusion:** Overall, various nanocarrier systems, especially core-shell nanoparticle through non-invasive route offers a promising and flexible platform for improving brain-targeted therapy in AD. Their multifunctional design supports enhanced drug delivery performance and therapeutic potential. Nevertheless, ongoing research and improvement are crucial to resolve formulation issues and enable effective clinical translation.

Keywords: Alzheimer's disease (AD), Blood-Brain-Barrier, Core-shell nanoparticles, Nose-to-brain transport

NAP095

Formulation Development and Optimization of a Paediatric-Friendly Mouth Dissolving Film of Ferrous Bisglycinate

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Introduction: The present investigation aims to develop, optimize, and evaluate a paediatric-friendly mouth dissolving film (MDF) containing ferrous bisglycinate. Conventional oral iron dosage forms are often associated with limitations such as poor patient compliance, gastrointestinal adverse effects, and variable bioavailability, which may be effectively addressed through the MDF drug delivery approach. The optimised MDF is expected to enhance iron bioavailability, minimize gastrointestinal intolerance, and improve therapeutic adherence in paediatric patients with iron deficiency anaemia, a common consequence of childhood malnutrition. Ferrous bisglycinate was selected as the iron source because it has improved intestinal absorption, reduces interactions with dietary inhibitors, and demonstrates superior gastrointestinal tolerability compared with conventional inorganic iron salts. **Methods:** MDF was formulated using different polymers and plasticisers by the solvent casting method. The formulated film was evaluated for various parameters like disintegration time, thickness, tensile strength, Young's modulus, % elongation, % assay and pH. Further, Pullulan with PEG 400 was optimized using Design Expert software by factorial design. The optimised formulation was further evaluated for various parameters**. Results:** Amongst different polymer and plasticiser combinations, MDF with Pullulan and PEG 400 exhibits the target product profile. The statistical analysis reveals that the concentration of pullulan and the concentration of PEG 400 significantly influence the evaluated responses. **Conclusion:** The systematic optimization strategy adopted in this study supports the development of a robust MDF which may be extended to the delivery of other essential micronutrients for paediatric nutritional interventions.

Keywords: Mouth dissolving film, Ferrous Bisglycinate, Formulation, Optimization, Paediatric

NAP096

Chronotherapeutic Drug Delivery in Diabetic Peripheral Neuropathy: Aligning Circadian Pain Biology with Pharmaceutical Design

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Introduction- Diabetic peripheral neuropathic pain (DPN) is one of the most common complications of diabetes, often worse at night which interferes with sleep and daily activities. Such day-night variation in pain suggests that biological rhythms may play an important role in the experience of neuropathic pain as well as patient response to therapy. However, most drugs used for DPN are given based on fixed dosing schedules, which do not take into account the timing of symptoms. **Methods-** This review discusses the published literature about circadian rhythms and their role in neuropathic pain associated with diabetes. Studies pertinent to pain chronobiology, traditional pharmacotherapy, and drug delivery strategies for time-based therapy were reviewed to identify limitations and unmet needs of current treatment strategies. **Results-** There is evidence that circadian regulation is important in the perception of neuropathic pain and symptom severity in DPN. Conventional dosing methods are often not well matched to timing of symptoms and this contributes to poor control of pain and tolerability. Although a number of approaches to drug delivery have been investigated to aid in chronotherapy, practical and biological complexity have limited their application in DPN. **Conclusion**- This review emphasizes the need to understand the circadian influences on diabetic neuropathic pain and the implications of this for drug therapy. Improved correlation between the biology of pain and pharmaceutical Formulation may provide improved management of DPN. A chronotherapy-based view offers a rational framework to overcome the treatment of current limitations while highlighting the strong need for more advance research to be done in this area.

Keywords: Chronotherapy Circadian rhythm Neuropathic pain, Diabetic peripheral neuropathic pain, Drug delivery systems, Time-dependent therapy

NAP097

Development and Characterization of Ion-Activated Ocular In Situ Gel Containing Difluprednate

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Introduction: The poor bioavailability and therapeutic response exhibited by conventional eye drops due to rapid precorneal elimination of the drug may be overcome by the use of an in-situ gelling systems that are instilled as drops into the eye and undergo a sol-to-gel transition in the cul-de-sac which improves patient compliance as the dosage regimen is one drop of the dosage form twice a day. The loss of drug overcomes due to the immediate gel formation between the eye membrane and the drug being entrapped simultaneously in sol–gel transition in the cu-de- sac. **Methods:** The present work describes the formulation and evaluation of an ophthalmic delivery system of a corticosteroid, difluprednate based on the concept of ion-activated in situ gelation. It was formulated and optimized with 3^2 factorial designs (design of experiment®) with the help of key ingredients like gellan gum, HPMC E15, and chromophore rh 40. **Results:** The optimized in-situ gel exhibited desirable characteristics, including clarity, appropriate viscosity, neutral pH, suitable gelation time and isotonicity. The developed formulations f6 exhibited sustained release of drug from formulation over a period of 6hrs thus increasing residence time of the drug. **Conclusion:** These results demonstrate that the developed system is an alternative to conventional ophthalmic drops, with better patient compliance, and is industrially oriented and economic.

Keywords: Difluprednate, HPMC E15, Ion activated gelation mechanism, Gellan gum, STF

NAP098

Artificial Intelligence-Driven Transdermal Patches: A New Paradigm in Personalized Medicine

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Introduction: Pain is an unpleasant sensory experience linked with tissue damage. Neuropathic pain is a chronic pain condition that originates from a primary lesion or dysfunction in the nervous system. Transdermal patches like Lidoderm (5% lidocaine patch) are widely prescribed in the management of neuropathic pain, especially for postherpetic neuralgia (PHN) because they deliver the medication locally through the skin. However, current patches release the drug in fixed doses for varying pain levels and are unable to adapt to patient physiology. **Method:** We proposed an AI-powered smart transdermal patch that works as an adaptive delivery system for localised neuropathic pain. The embedded biosensors in the patch detect key parameters in pain from the skin and underlying tissue, transfer this data to an artificial intelligence model which will estimate the pain intensity and calculate the required dose to release at the site. A mobile application tracks pain trends and key metrics which can be assessed by the medical professional for future treatment plans for the patient. **Results:** This AI-integrated personalized patch will combat the current issue of non-adaptive dosing, fixed drug release and drug wastage, thereby increasing its longevity compared to current patches in the market. **Conclusion:** This approach aims to improve pain relief and optimize drug use in chronic neuropathic pain. It has the potential to increase patch longevity, reduce drug misuse and enhance patient adherence thus transforming long-term pain management.

Keywords: Biosensors, Chronic pain, Lidocaine, Neuropathic Pain, Transdermal patch

NAP099

PAMPA-Based Comparative Assessment of Nasal Permeability of Intranasal Formulations

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Introduction: Parallel Artificial Membrane Permeability Assay (PAMPA), adapted for nasal conditions, has been reported as a rapid *in vitro* screening tool for evaluating passive drug permeability across lipid barriers. In the context of nose-to-brain drug delivery, early assessment of formulation-dependent permeability is crucial for selecting rational formulations prior to advanced biological studies. **Method:** In the present study, an established nasal PAMPA model was employed to compare the nasal permeability of two intranasal formulations developed for brain-targeted delivery: a solution and a microemulsion. The assay was conducted under simulated physiological conditions of the nasal cavity using phosphatidylcholine-coated artificial membranes and simulated nasal fluid (pH 6.4) as the acceptor medium. Each formulation was placed in the donor compartment, and drug transport across the artificial membrane was quantified by calculating the apparent permeability coefficient (Papp). **Result:** The nasal PAMPA model successfully differentiated the permeation behavior of the two formulations. At 15 min, the apparent permeability coefficient Papp of the microemulsion and solution was 31.91 $\times 10^{-6}$ cm/s and 49.60 $\times 10^{-6}$ cm/s, respectively, demonstrating a clear formulation-dependent difference in passive nasal permeability across the artificial lipid barrier. **Conclusion:** Although the nasal PAMPA model does not replicate biological factors such as mucociliary clearance, enzymatic degradation, or active transport mechanisms, the results demonstrate its practical utility as a rapid, reproducible, and cost-effective screening tool. The findings support the use of nasal PAMPA for early-stage evaluation and optimization of intranasal formulations prior to *ex vivo* and *in vivo* permeability studies.

Keywords: PAMPA, Permeability, Nose-to-brain, Targeted delivery, Intranasal.

NAP100

Stimuli-Responsive Polymeric Nanocarriers for Controlled Transdermal Drug Delivery: Advances, Challenges, and Future Prospects

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Introduction: Transdermal drug delivery system is very suitable approach as it offers advantages such as sustained release, bypassing first pass metabolism, and enhanced patient compliance; however, their efficacy is restricted by the skin barrier and a lack of precise control over drug release. Stimuli-responsive polymeric nanocarriers are capable of overcoming these limitations by detecting small biological changes and responding more effectively than conventional polymers. **Methods:** This review focuses on stimuli-responsive polymeric nanocarriers designed based on triggered-release mechanisms by integrating polymers responsive to endogenous (pH, enzymes, temperature, redox and glucose) and exogenous (light, ultrasound, and electrical stimuli) factors. Thus, polymers which are responsive to this stimuli were selected for the development of stimuli responsive TDDS. **Results:** The stimuli responsive polymeric nanocarriers results in enhancing TDDS by enabling site specific and controlled release of the drug. pH and temperature responsive polymeric nanoparticles provides better drug release in inflamed or diseased skin, also, enzyme and redox responsive system trigger drug release in response to the enzyme and redox conditions. Thus, this nanocarriers improve drug stability, decreases skin irritation, increase drug retention, and reduce systemic exposure compared to conventional transdermal formulations, resulting in improved therapeutic efficacy. **Conclusion:** A promising development in regulated transdermal drug delivery is stimuli-responsive polymeric nanocarriers. Despite of significant advancement has been made, issues related to formulation complexity, long-term stability, scalability, and regulatory approval are still there. It is important to address these issues through ongoing research and optimization to enable clinical implementation and fully realize the potential of smart polymer-based TDDS.

Keywords: Stimuli responsive polymers, Polymeric nanocarriers, Transdermal drug delivery

NAP101

Challenges in the Treatment of Dermatophytosis: Resistance, Recurrence and Therapeutic limitation

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Introduction: Dermatophytosis is one of the most common superficial fungal infections in the globe, that affecting the skin, hair, and nails. Due to the availability of many antifungal agents, effective selection of suitable drug candidate becomes difficult in the last couple of decades. The main cause of antifungal resistance, prolongation of treatment courses, recurrence of the infection on frequently, development of side effects and abuse of antifungal–steroid combinations are the significant factors causing treatment failure and discomfort among patients. These problems are more critical in tropical and developing countries. **Methods:** Peer-reviewed review articles, research papers, and clinical studies from reputable scientific sources were all included in the extensive literature study. The information gathered focused on the limitations of current medications, fungal resistance mechanisms, and available therapeutic options. **Results:** It has shown that resistance to commonly employed antifungal classes in particular azoles and allylamines, long durations of therapy, presence of side effects in special groups. Incomplete cure and the development of resistant dermatophyte strains often result in recurrent and chronic infections. **Conclusion:** Due to fungal resistance, limited treatment options, and high recurrence rates, dermatophytosis remains a therapeutic problem, to improve dermatophytosis treatment outcomes and lessen the disease's impact on public health, the sensible use of antifungals and the look for safer and more potent treatments are essential.

Keyword: Antifungal agent, Dermatophytosis, Drug resistance, Superficial fungal infection, Therapeutic challenges

NAP102

Review on Conversion from Liquid to Solid: Industrially Viable Formulation Strategy for Enhanced Pharmaceutical Manufacturability

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Introduction: Liquid drug systems are widely used in due to advantages in dose uniformity, rapid absorption, and suitability for lipophilic drugs. Despite several benefits offered by liquid and soft-gel formulations; it possesses manufacturing and stability challenges, formulation leakage, complex sealing processes, higher production costs, and limited compatibility with high-speed manufacturing. These limitations generate need to convert liquid drug systems into solid dosage forms suitable for filling into hard gelatin capsules. **Methods:** This review focuses on formulation strategies employed to transform liquid drugs into free-flowing solid powders. Several research and review article and patent documents were reviewed systematically using appropriate keywords to screen relevant literature to review this topic. **Result:** Adsorption of liquid drugs onto suitable carriers is the most widely explored and commercially viable technique. Key solidification methods discussed include adsorption onto porous carriers, liquid-solid conversion, and spray-drying techniques. Porous carriers enable high liquid loading while maintaining acceptable flow and compressibility, whereas spray-drying allows rapid solvent removal and formation of uniform solid particles. The resulting solidified drug systems are blended with excipients like carriers, disintegrants, glidants, and lubricants to achieve optimal capsule filling performance. Selection and optimization of adsorption carrier and other excipients are based on micromeritics properties of solid powder to be filled in capsule, and in-vitro tests of final dosage form. **Conclusion:** This review highlights critical quality attributes (CQAs) and critical process parameters (CPPs) essential for successful conversion of liquid drug systems into solid-filled hard gelatin capsules, providing valuable guidance for improving formulation stability, manufacturability, and commercial feasibility.

Keywords: Liquid-to-solid conversion, Adsorption on porous carriers, Improved manufacturability, Stability enhancement

NAP103

Enhancing Anti-Reflux Therapy Using Floating Multiple Unit Pellet Systems: A Comprehensive Review

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Introduction: Gastroesophageal reflux disease (GERD) is a chronic gastrointestinal disorder characterized by the reflux of gastric contents into the esophagus, leading to heartburn and irritation. GERD affects more than 800 million people globally and often requires long-term therapy. Conventional oral formulations exhibit limitations like short gastric residence time, variable bioavailability, dose dumping, and reduced therapeutic effectiveness, particularly for drugs that are preferentially absorbed in the stomach or exhibit pH-dependent solubility. Commonly prescribed drugs like proton pump inhibitors (PPIs), as well as H_2-receptor antagonists, require sustained gastric presence to achieve optimal acid suppression and symptom control. Floating delivery offering gastro-retentive sustained release of drug suits for GERD management. **Method:** Floating Multiple Unit Pellet Systems (MUPS) have gained considerable attention, compared to monolithic systems, offering uniform drug distribution, reduced risk of dose dumping, and minimized inter- and intra-subject variability. This review evaluates articles searched from PubMed, Scopus, and Web of Science with appropriate keywords to shortlist the relevant literature. **Result:** Formulation of floating MUPS involves low-density polymers, gas-generating agents, drug-loaded cores, and polymeric coatings. MUPS can be developed by extrusion-spheronization, fluidized bed coating, and hot-melt extrusion. Floating MUPS significantly enhance bioavailability of GERD drugs, prolong gastric residence time, and provide sustained acid suppression. Improved therapeutic efficacy, reduced dosing frequency, and better symptom control have been consistently reported. **Conclusion**: Floating gastro-retentive

MUPS represent a promising and advanced drug delivery platform for GERD management. This review work may motivate the budding formulation scientists to explore industrially oriented formulation technique for enhanced anti-reflux therapy.

Keywords: Enhanced Therapeutics, Floating drug delivery system, Gastroesophageal reflux disease (GERD), Gastro-retentive drug delivery system (GRDDS), Multiple unit pellet system (MUPS)

NAP104

A Review on Integrated Gastro-Retentive Platforms with SMEDDS: A Hybrid Strategy for Enhanced Oral Bioavailability

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Introduction: Gastro-retentive drug delivery systems (GRDDS) are specialized oral platforms designed to prolong stomach residence time for improving absorption of drugs with narrow absorption windows, pH-dependent solubility, or requiring localized gastric action. Conventional GRDDS approaches have demonstrated enhanced gastric retention; however, bottlenecks are like poor dissolution of lipophilic drugs, limited control over release rates, and instability of molecules in gastric media. Self-micro-emulsifying drug delivery systems (SMEDDS) are lipid-based formulations that spontaneously form fine microemulsions upon contact with gastrointestinal fluids. SMEDDS offers enhance solubilization and dissolution of lipophilic drugs, mitigate food effect variability, and can significantly improve bioavailability. **Method:** Integrating SMEDDS within gastro-retentive matrices or adsorbing them onto suitable porous carriers creates a hybrid platform that combines prolonged gastric retention with enhanced solubilization capacity. This review evaluates compares literature searched from PubMed, Scopus, and Web of Science using appropriate keywords. **Result:** The liquid SMEDDS can be solidified via adsorption onto porous carriers and incorporated into gastro-retentive tablets that may float or swell to provide sustained release. Studies have demonstrated that SMEDDS adsorbed on carriers like Fujicalin® exhibit rapid dissolution in acidic media and improved drug release, while the gastro-retentive matrix prolongs residence time and controls release kinetics. Selection and optimization of lipid components, adsorbents, and appropriate polymers facilitate modulation of release profiles and mechanical integrity. **Conclusion:** The integration of SMEDDS with gastro-retentive platforms offers a promising hybrid oral delivery strategy, providing enhanced bioavailability for poorly soluble drugs and an innovative framework that can inspire young formulation scientists toward next-generation GRDDS research.

Keywords: SMEDDS, Gastro-retentive drug delivery, Porous adsorbents, Poorly soluble drug

NAP105

Formulation Development and Characterization of Dual-Release Multi-Particulate Systems (MUPS)

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Introduction: Chronic respiratory conditions like COPD demand therapies that offer both rapid relief and sustained support, yet current Anti-COPD drug formulations provide only an immediate mucolytic effect with no extended coverage, leading to frequent dosing and reduced compliance. Leveraging the versatility of multi-unit particulate systems, a dual-release sachet can harmonize fast onset with prolonged therapeutic action within a single, patient-friendly dosage form. **Methods:** Preformulation included drug–excipient compatibility, particle-size distribution and bulk-density evaluation. IR pellets were developed through wet granulation, extrusion at 40–50 rpm, spheronization at 750 rpm for 2.5–4 minutes, and drying at 50°C, followed by HPMC E5 seal coating in a fluid-bed processor. The SR component was obtained by applying a delayed-release coating of Eudragit L100/S100 over IR cores. The detailed study explored variation in formulation composition as well as the process related parameters to formulate MUPS with desired formulation characteristics. **Results:** The optimized IR pellets demonstrated good flow, uniform sphericity, and acceptable impurity levels, forming a stable foundation for delayed-release coating, whereas SR component facilitated delayed and controlled release of drug from MUPS.

The developed formulation was optimized systematically to achieve predefined dissolution limits as ≥34% at 2 h, ≥57% at 6 h, ≥87% at 8 h. **Conclusion:** The systemic development and optimization of IR and SR components of MUPS, the final dual-release formulation exhibited a biphasic release profile with desired dissolution targets, ensuring rapid onset, extended therapeutic effect, and improved patient adherence.

Keywords: COPD, Dual-release formulations, Mucolytic effect, Multiple unit pellet system

NAP106

pH-Responsive Nanocrystals for Enhanced Topical Antifungal Delivery

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Introduction: Nanocrystals have gained considerable attention in drug delivery systems due to their ability to enhance the solubility, dissolution rate, and bioavailability of poorly water-soluble drugs. They are composed of drug molecules which offers high drug loading efficiency and improved stability while providing targeted drug release. Poor aqueous solubility remains a major challenge in drug delivery leads to limiting the clinical applicability of many antifungal drugs and thus Nanocrystal formulation overcome these limitation and enhanced topical drug delivery. Further surface functionalization can be done to obtain pH-responsive nanocrystals. **Methods:** Nanocrystals can be prepared using bottom-up techniques such as anti-solvent precipitation, spray drying and top-down techniques such as media milling or bead milling. Surface modification and functionalization strategies will allow the development of pH-responsive nanocrystals by combining functional groups that respond to environmental pH changes. These approach will improve dispersion stability and allow stimuli-responsive behavior suitable for topical applications. **Results:** Various researchers had developed pH-responsive nanocrystals and proved the drug stability at targeted physiological conditions. In topical delivery these significantly enhance skin penetration which leads to increase local drug concentration and improve therapeutic effectiveness against fungal infections. **Conclusion:** Overall, pH-responsive nanocrystals represent an effective platform for improving the delivery of poorly soluble drugs and will overcome the limitations of conventional formulations.

Keywords: Nanocrystals; pH-responsive; Surface functionalization; topical; antifungal

NAP107

Gene and mRNA Therapeutics in Oral Cancer: Emerging Drug Delivery Platforms and Translational Challenges

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Introduction: Oral squamous cell carcinoma (OSCC) is an aggressive tumor characterized by high recurrence and resistance to conventional therapies. Gene and mRNA-based therapies have recently gained attention as a precision therapy that are capable of modulating oncogenic pathways, restoring tumor suppressor functions, and enhancing anti-tumor responses. However, their effectiveness and clinical translation are dependent on safe and effective drug delivery approaches. **Methods:** This review systematically evaluates recent approaches in gene-based drug delivery systems for OSCC. Literature was surveyed focusing on non-viral drug delivery nanocarrier approaches, which mainly include LNPs, polymeric nanoparticles, hybrid nanostructures, and stimuli-responsive drug delivery platforms, which are specifically designed to improve stability, cellular uptake, and tumor-specific targeting. **Results:** Novel delivery systems have demonstrated enhanced protection of nucleic acids from degradation, improved intracellular trafficking, and controlled release at tumor sites. Targeted and microenvironment-responsive nanocarriers enable selective accumulation in oral tumors while minimizing systemic toxicity. Emerging strategies integrating mRNA therapeutics with immunotherapy and gene-editing technologies show significant promise in preclinical and early translational studies. **Conclusion:** Gene and mRNA-based drug delivery platforms represent a transformative approach for the precision therapy of oral cancer. Continued optimization of carrier design, targeting efficiency, and scalability is essential to bridge the gap

between preclinical success and clinical application, ultimately improving therapeutic outcomes for oral cancer patients.

Keywords: Oral cancer, gene therapy, mRNA therapeutics, drug delivery systems, nanocarriers

NAP108

Electrospun Nanofiber Based Formulation for Wound Healing: Challenges and Future Perspectives

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Introduction: Wound healing is a complex biological process which basically requires protection, infection control and support for cell and tissue regeneration. Most conventional wound healing formulations serve as passive barriers, unable to avoid microbial infection or actively promote healing, particularly in chronic wounds. To overcome these limitations, much attention has been paid to nanofiber-based wound healing formulation. Among the various techniques for nanofiber fabrication, electrospinning is considered one promising approach due to its ability to produce nanofibers similar to the extracellular matrix of skin. The present review discusses a nanofiber-based formulation developed by E-spinning technique for faster wound healing. **Methods:** The nanofiber can be fabricated using natural, synthetic or hybrid polymers through the electrospinning. Nanofibers provide high surface area, interconnected porosity and modifiable mechanical properties. They can be loaded with other antibacterial agents or bioactive molecules, which enhance wound healing. Researchers have shown that several studies have been conducted relating to the evaluation of their effectiveness in wound management. **Results:** Researchers have reported that the presence of nanofiber prepared by electrospinning enhanced cell adhesion, proliferation and migration the accelerating the closure of wounds. Moreover, composite and drug-loaded nanofiber shows excellent antimicrobial activity through inhibition of microbial growth. Further controlled and sustained drug release provided enhanced healing outcomes in the different phases of wound repair. **Conclusion:** Electrospinning-fabricated nanofiber-based wound healing formulation have great potential and thus represent a promising approach toward wound healing. Future efforts should improve standardization of preparation method and advances in formulation.

Keywords: Electrospinning, Fabrication, Tissue regeneration, Wound healing

NAP109

Mirtrazapine Loaded Nanosponge for Buccal Delivery

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Introduction: The present study aims to develop and evaluate Mirtrazapine (MTZ)-loaded nanosponges for buccal drug delivery in order to enhance drug release and achieve sustained therapeutic action. Nanosponges, owing to their porous structure and nanoscale size, offer improved solubility, controlled drug release, and better mucosal retention, making them suitable carriers for buccal administration. **Methods:** MTZ-loaded nanosponges were prepared using the emulsion solvent diffusion method, employing ethyl cellulose as the polymer and dichloromethane as the organic solvent. A 3^2 factorial design was applied to systematically investigate the effect of polymer concentration and cross-linker concentration on critical formulation parameters such as particle size, entrapment efficiency (%EE), and cumulative drug release (%CDR). The formulations were characterized using FTIR spectroscopy to assess drug–excipient compatibility, scanning electron microscopy (SEM) for surface morphology, particle size analysis, and saturation solubility studies. The optimized nanosponge formulation was incorporated into a buccal tablet, followed by in-vitro drug release studies and stability testing as per ICH Q1A(R2) guidelines. **Results:** The optimized MTZ nanosponge formulation exhibited a mean particle size of approximately 270 nm with an entrapment efficiency exceeding 85%. A significant enhancement in drug release was observed compared with pure MTZ. SEM analysis confirmed the formation of a highly porous nanosponge

structure, while FTIR studies indicated no chemical interaction between the drug and excipients. The buccal tablet containing MTZ nanosponges demonstrated improved and sustained in-vitro drug release when compared with a marketed mucoadhesive tablet. Stability studies showed no significant changes in physical appearance, drug content, or release profile during the study period. **Conclusion:** The study successfully demonstrated that MTZ-loaded nanosponges prepared by the emulsion solvent diffusion method can effectively enhance drug release and provide sustained delivery via the buccal route. The optimized formulation exhibited desirable physicochemical properties, good stability, and superior in-vitro performance, indicating its potential as an effective buccal drug delivery system.

Keywords: Mirtrazapine , Nanosponges , Buccal drug delivery, Emulsion solvent diffusion, Sustained release

NAP110

AI-Enhanced Nanotheranostics: A Paradigm Shift in Precision Oncology and Personalised Patient Care

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Introduction: Cancer treatment often faces hurdles like systemic toxicity and poor drug targeting. Nanotheranostics, combining diagnostic and therapeutic functions, offers a transformative solution. This review explores how Artificial Intelligence (AI) is utilised to optimise these formulations for enhanced personalised care. **Methods:** A systematic literature search was conducted via PubMed and ScienceDirect, focusing on studies from 2020 to 2025. The analysis targeted the synergy between machine learning and multifunctional nanocarriers for precision delivery. **Results:** Evidence shows that AI accelerates the discovery of biocompatible materials and improves the precision of ligand-receptor targeting. AI-driven analysis of real-time data allows for immediate treatment adjustments, significantly minimising adverse drug reactions. This integration leads to higher efficacy and reduced side effects compared to traditional methods. **Conclusion:** The integration of AI into nanotheranostic research represents a crucial step towards precision medicine. For the clinical pharmacist, mastering these technologies is essential for bridging the gap between biotechnology and patient care. Strengthening AI-led research can significantly improve clinical outcomes and reduce the global healthcare burden of oncological diseases.

Keywords: Artificial Intelligence, Biotechnology, Nanotheranostics, Oncology, Personalised Medicine

NAP111

Complexed Anti-EGFR Loaded Nanofiber Mat for Improved Locoregional Oral Cancer Therapy

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Introduction: Conventional treatment modalities such as surgery, radiotherapy, and systemic chemotherapy are often associated with severe adverse effects, poor patient compliance, and the development of drug resistance. a nanofiber-based chemotherapeutic delivery system incorporating an anti-EGFR drug–cyclodextrin inclusion complex was developed to address these limitations. Cyclodextrin complexation was employed to improve the solubility and stability of the anti-EGFR agent, while electrospun nanofibers were utilized as a localized and sustained drug delivery platform. The nanofibrous matrix offers advantages such as high surface area, tunable porosity, and close contact with the tumor site, making it a promising carrier for oral cancer therapy. **Method:** The nanofiber mats were developed using electrospinning. The anticancer efficacy and biological activity of the developed complexed nanofiber formulation were systematically evaluated using *in vitro* oral cancer cell line (KB 3-1) models. Cytotoxic and antiproliferative effects were assessed using the MTT assay, while the scratch assay was employed to investigate the inhibitory effect of the formulation on cancer cell migration. Nuclear morphological changes associated with apoptosis were visualized using DAPI staining. Furthermore, apoptosis induction and alterations in cell cycle progression were quantitatively analyzed using flow cytometry-based

apoptosis and cell cycle assays. **Results:** The results demonstrated enhanced solubility, cytotoxicity, significant inhibition of cell migration, increased apoptotic cell population, and cell cycle arrest in cancer cells treated with the nanofiber-based anti-EGFR cyclodextrin complex compared to the free drug. **Conclusion:** Overall, this study underscores the potential of the nanofiber mat of anti-EGFR therapies as an effective and targeted approach for improving oral cancer treatment outcomes.

Keywords: Oral cancer**,** Anti-EGFR therapy**,** Cyclodextrin inclusion complex**,** nanofibers**,** *in vitro* anticancer activity

NAP112

Reimagining Paediatric Mini-Tablets: Innovations in Design, Acceptability and Future Directions

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Introduction: The development of age-appropriate oral dosage forms remains a major challenge in paediatric pharmacotherapy, as paediatric formulations should be safe, acceptable, flexible, and easy to administer. Mini-tablets have regained interest as a patient-focused solid dosage form due to their small size, dose adaptability, and potential to improve medication adherence. Recent progress in pharmaceutical sciences and manufacturing technologies has expanded the application of mini-tablets beyond traditional tablet designs and therapeutic uses. **Methods:** This review systematically evaluates recent literature on paediatric mini-tablets, with particular emphasis on formulation strategies, selection of functional excipients, advances in manufacturing and compression technologies, and evidence from clinical and in-use acceptability studies. In addition, current limitations and emerging opportunities influencing the design, evaluation, and implementation of mini-tablets are critically discussed. **Results:** Findings from published studies indicate that mini-tablets can be safely administered and are generally well tolerated across a broad paediatric age range, including infants and young children. Innovations such as precision tooling, polymer-based functional coatings, and multi-particulate delivery approaches have enabled improved dose accuracy, flexibility, and controlled drug release. Moreover, the adoption of digital and model-guided formulation tools has supported more rational and efficient product development. **Conclusion:** Current regulations for paediatric formulations have been reviewed thoroughly. However, challenges related to low-dose content uniformity, effective taste masking, and absence of standardized paediatric dissolution methodologies continue to restrict wider application. Overall, mini-tablets represent an evolving and patient-centric oral dosage form with considerable potential in paediatric medicine, requiring continued innovation and regulatory alignment for future clinical translation applications.

Keywords: Mini-tablets, Paediatric formulation, Pharmaceutical innovation

NAP113

Sertaconazole Nitrate in Film Forming Spray: Advances in Topical Antifungal Formulation

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Introduction: Fungal skin infections are highly widespread and require topical drug delivery systems that provide longer residence time, improved penetration, and better patient compliance. Film-forming sprays offer a non-touch, uniform, fast-drying application with prolonged drug retention and reduced dosing compared to traditional formulations. Sertaconazole nitrate is an imidazole-class antifungal drug with low systemic absorption, making it safe for topical use. **Methods:** Film-forming sprays are prepared using the solvent evaporation method, also known as the in-situ film-forming spray method, in which the drug and film-forming polymer are dissolved in a volatile solvent system along with suitable excipients to obtain a homogeneous solution. The formulation variables are optimized to achieve appropriate formulation characteristics. **Results:** The developed film-forming spray demonstrates rapid film formation with uniform, transparent, and flexible films on skin application. Optimization identifies polymer concentration and solvent composition as critical factors influencing spraying ability, drying

time, and film integrity. The optimized formulation exhibits acceptable viscosity, pH, and spray performance, along with prolonged drug release in in-vitro studies. **Conclusion:** Film-forming spray systems represent a promising topical delivery approach for treatment of fungal infections, offering prolonged skin residence time, and improved patient compliance. The use of suitable film-forming polymers and optimized formulation variables contributes to desirable film characteristics and sustained drug release. This demonstrates its potential as an effective and easy-to-use alternative to conventional topical antifungal dosage forms, supporting their further development in topical antifungal therapy.

Keywords: Film-forming spray, Sertaconazole nitrate, Anti-fungal, Topical drug delivery

NAP114

An Overview on AI-Based Nexgen Digital Platform for Predicting Tablet Formulation Design

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Traditional tablet development largely depends on iterative experimental trials, which may limit design flexibility and increase development timelines. Any new composition or change in material attributes, consumes lot of precious time for tablet design and development by experienced formulation scientists. The developed formulations must meet the minimum desirable quality standards as per pharmacopoeia as well as individual targets set by multi-national reputed pharmaceutical industries. Unique design creation by trial-and-error experiments leads to wastage of man, material, money and time. The demand for patient-centric oral dosage forms has increased significantly due to diverse patient needs related to age, dose flexibility, swallowability, and treatment adherence. This review focuses on artificial-intelligence based next-gen digital platforms that supports a structured and rational approach to tablet design with a focus on desired quality attributes. A knowledge-based and model-assisted framework digitally design tablets by integrating formulation variables, tablet geometry, and mechanical characteristics. The software enables virtual evaluation of tablet properties such as size, shape, mass distribution, and functional performance, allowing designers to assess product attributes prior to actual manufacturing. Using a machine learning models, the system predicts early-stage decision aligning the quality-by-design principles, helps to optimize excipient blends and manufacturing parameters for scalable, high-quality tablets. It minimizes early risk by identifying capping, sticking, or poor compressibility and flags potential issues such as inadequate powder cohesion or excessive elasticity, ensuring robust tablet designs from the outset. In conclusion, such AI-based digital platform enables predictive and science-based tablet design, streamlines development processes, and facilitates the creation of next-generation.

Keywords: Digital platform, AI-enabled software, NextGen tablet design, Predicting tablet attributes

NAP115

Development And Optimization of Polymeric Nanoparticles for Autoimmune Dermatological Diseases Using Box–Behnken Design

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Introduction: Autoimmune skin diseases require targeted and sustained delivery of therapeutic agents to reduce inflammation with reduced systemic side effects. Triamcinolone acetonide (TAA), an effective corticosteroid exhibits poor skin penetration and rapid removal needs frequent dosing. Polymeric nanoparticles provide a promising approach to improve drug retention with controlled release at the disease site. **Methods:** Preformulation studies such as differential scanning calorimetry for compatibility study, FTIR analysis for drug characterization, and spectrometry for drug content analysis were performed. Drug-loaded chitosan nanoparticles were formulated by precipitation method whereby process involves dissolving the drug in an organic solvent and chitosan in an acidic aqueous medium, followed by the addition of a stabilizer. The organic phase is added to the aqueous phase under stirring, whereby nanoparticle precipitation occurs upon dropwise addition of STPP through ionic

crosslinking. The developed nanoparticles were evaluated for particle size analysis, polydispersity index, zeta potential, and entrapment efficiency. Box–Behnken design was employed for optimization, whereby Surfactant Concentrations, Precipitating agent Concentrations, and Homogenization Speed were explored as significant independent factors. **Result:** The optimized formulation of drug-loaded chitosan nanoparticles demonstrated a particle size of 277.2 nm with a polydispersity index of 0.359, indicating uniform size distribution. The zeta potential of +11 mV reflects adequate electrostatic stabilization. **Conclusion:** The optimized chitosan nanoparticles were successfully developed with enhanced physicochemical stability. The sustained and targeted dermotherapy potential will be confirmed ex-vivo analysis. These findings support its suitability as a promising platform for improving treatment outcomes in autoimmune skin diseases.

Keywords: Triamcinolone acetonide, Chitosan nanoparticles, Dermatotherapy, Autoimmune skin diseases

NAP116

Novel Biomimetic Delivery Strategy Integrated with Cold Plasma for Precision Therapy of Psoriasis

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Introduction: Despite the availability of systemic and biologic therapies for psoriasis, their use is often limited by adverse effects and poor skin localization. Cold atmospheric plasma (CAP), a non-invasive modality with RONS generation, has emerged to modulate skin inflammation. However, its integration with nanomedicines remains underexplored. This study presents a novel biomimetic nanocarrier (BNCs) coupled with CAP for psoriasis management through multi-targeted action, addressing complexity of psoriatic pathology. **Materials:** Baricitinib (BR), purchased from Dhamtec, India. Phospholipid and sphingolipid were gifted by Lipoid. Imiquimod cream (5% w/w; Glenmark, India). In vivo studies were performed using Swiss albino mice. CAP was generated using in-house-built atmospheric pressure plasma jet. **Results**: The developed BNCs using the QbD approach showed a particle size of 98.6 ± 5.4 nm, PDI 0.298, and zeta potential -18.2 mV, confirming uniform, stable vesicles with sustained release. The BNCs-nanogel exhibited shear-thinning rheology, ideal for topical use. Ex vivo, BNC-nanogel showed higher drug retention (2.1-fold in SC, 1.5-fold in VE). The dermatokinetics evaluation demonstrated higher and prolonged drug accumulation with increased Cmax in the epidermis and dermis as compared to FD gel. In vivo, its combination with CAP markedly reduced erythema, scaling, and thickness, with downregulated cytokines (TNF-α, IL-6, IFN-γ) and Ki-67, confirming effective localized psoriasis therapy. **Conclusion:** The strategic use of skin-lipid-based nanocarriers enhances skin targeting, and CAP, via RONS generation, offers dual therapy addressed multiple disease pathways. This rational design advances therapy for safer and effective psoriasis management with the integration of non-invasive cold plasma in biomedical applications.

Keywords: Psoriasis; Biomimetic nanocarriers; Cold atmospheric plasma; Reactive oxygen and nitrogen species (RONS); Topical immunotherapy

NAP117

Formulation Development and Evaluation of Medicated Lozenges of Amisulpride

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Introduction: This study focuses on the formulation and evaluation of medicated lozenges containing Amisulpride, a drug used for the effective management of emesis, also known as vomiting. The research addresses

the challenge of the drug's poor aqueous solubility to ensure effective delivery. **Method:** To improve solubility, a complexation approach was employed using β-cyclodextrin via the solvent evaporation method. Lozenges were prepared using the heating and congealing method with excipients such as sucrose, isomalt, HPMC E5, stevia, ginger, and citric acid, selected based on compatibility and functionality studies. For systematic optimization, a 3^2 full factorial design was utilized, with sucrose and HPMC E5 levels serving as independent variables. **Results:** In the solubility studies, a 1:2 ratio of drug-to-carrier demonstrated the most significant improvement. The optimized formulation exhibited a disintegration time of 9.41 minutes and a hardness of 10.7 kg/cm². Additionally, the formulation showed cumulative drug release behaviour that supports product stability. **Conclusion:** The results demonstrate the successful development of stable and patient-friendly Amisulpride lozenges with enhanced solubility. This work highlights the importance of rational formulation design and provides an effective strategy for developing novel dosage forms for emesis management in clinical practice.

Keywords: Amisulpride, Lozenges, β-cyclodextrin, Factorial design, Emesis managemenz

NAP118

Development and Characterization of Long-Acting Biodegradable Dexamethasone Implants for Age-Related Macular Degeneration

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Introduction: Age-related macular degeneration (AMD) is a leading cause of irreversible vision loss, often requiring repeated intravitreal injections that increase patient burden and risk of complications. Long-acting biodegradable implants capable of sustained corticosteroid delivery may improve therapeutic outcomes and patient compliance. This study focuses on the development of electrospun dexamethasone-loaded biodegradable implants for prolonged intravitreal drug delivery in AMD. **Methods:** Dexamethasone-loaded nanofiber cylindrical implant fabricated by electrospinning. Poly(lactic-co-glycolic acid) (PLGA; Resomer® RG 456S) and polycaprolactone (PCL; Mw 80,000) were used as biodegradable matrices. Implant morphology and thermal properties were evaluated using scanning electron microscopy (SEM) and differential scanning calorimetry (DSC). *In-vitro* drug-release studies were conducted in phosphate buffer (pH 7.4) at 37 °C. Drug content uniformity, surface wettability, injectability, intravitreal placement in an *ex-vivo* goat eye model, and accelerated stability at 40 °C/75% RH were assessed. **Results:** Dexamethasone-loaded implants were successfully fabricated using both polymers, exhibiting uniform morphology and well-defined cylindrical structures. PLGA implants demonstrated sustained drug release for up to 6 months, while PCL implants provided extended release for approximately one year. DSC analysis confirmed the thermal stability of both polymer systems under physiological conditions. All implants showed adequate mechanical integrity for intravitreal injection. *Ex-vivo* studies confirmed successful injection and stable intravitreal positioning in goat eyes. Implants were stable at accelerated conditions. **Conclusion:** Electrospun biodegradable dexamethasone implants were successfully developed and characterized, demonstrating prolonged drug release, mechanical robustness, and injectability. These long-acting intravitreal implants show strong potential as sustained therapeutic platforms for the management of AMD.

Keywords: AMD, Biodegradable implants, Dexamethasone, Electrospinning, Sustained drug delivery

ABSTRACTS -POSTER PRESENTATION (PHARMACOLOGY, CLINICAL PHARMACYAND PATIENT CARE)

PCP001

Protective Effects of Syringic Acid on Joint Inflammation and Damage in a Rat Model of Rheumatoid Arthritis

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Introduction: Rheumatoid Arthritis **(**RA) represents a persistent autoimmune disorder characterized by the inflammation of the synovial joints, which subsequently results in the deterioration of cartilage and the erosion of bone. Treatment options include glucocorticoids, disease-modifying antirheumatic drugs (DMARDs), analgesics, non-steroidal anti-inflammatory drugs (NSAIDs), and anti-cytokine treatments, which can be taken alone or in combination. Despite the availability of these therapies, they often fall short in effectively addressing the complexities of RA. **Method:** This study investigated the anti-arthritic efficacy and mechanisms of syringic acid (SA), a natural phenolic compound, in a Complete Freund's Adjuvant (CFA)-induced arthritis rat model. Arthritis was induced in Wistar rats, which were then orally treated with SA (50, 100, 200 mg/kg) or prednisolone for 28 days. Paw swelling, arthritic index, body weight, motor functions, cytokine levels, Nuclear factor kappa B (NF-κB), Tumor necrosis factor alpha (TNF-α), Interleukin-6 (IL-6), Interleukin-1 beta (IL-1β), antioxidant enzyme activities, histopathology, and radiological changes were assessed. Molecular docking studies were also performed. **Results:** SA significantly reduced paw swelling and arthritic index, improved body weight and motor functions, and modulated inflammatory cytokines (NF-κB, TNF-α, IL-6, IL-1β) and oxidative stress markers dose-dependently. Histopathological and radiological analyses confirmed SA's protective effects on joint integrity. Docking studies showed strong binding affinities of SA to NF-κB and TNF-α. **Conclusion:** SA exhibits significant anti-inflammatory and anti-arthritic properties in CFA-induced RA, modulating cytokine pathways and reducing oxidative stress. These findings suggest that SA has potential as a therapeutic agent for RA and warrant further clinical investigation.
Keywords: Inflammatory cytokines, Joint inflammation, Paw swelling, Rheumatoid arthritis, Syringic acid

PCP002

Assessment of Gynaecological Health Awareness Among Young Women: A Cross-Sectional Study Across Eleven Institutes

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Introduction: Gynaecological health awareness among young women is essential for early identification and prevention of reproductive health issues. Poor understanding of gynaecological conditions may contribute to delayed diagnosis, inadequate menstrual hygiene, and neglect of early symptoms. This study aimed to assess awareness and knowledge regarding gynaecological health among young women aged 18–25 years across eleven institutes. **Methods**: A cross-sectional questionnaire-based study was conducted among 1100 participants selected according to eligibility criteria. Participants aged 18–25 years were included, and those having terminal illnesses or conditions affecting participation were excluded. A structured and validated questionnaire was used to evaluate awareness, knowledge, menstrual hygiene practices, symptoms, and demographic variables. Data were analysed to assess overall awareness and its association with demographic characteristics. **Results**: Overall, participants demonstrated low levels of gynaecological health awareness. A significant proportion lacked adequate knowledge about common gynaecological conditions, preventive practices, and indications for medical consultation. Awareness levels varied across demographic groups. **Conclusion**: The study indicates a substantial gap in gynaecological health awareness among young women. There is a need for targeted health education initiatives, improved institutional awareness programmes, and early intervention strategies to promote better reproductive health outcomes.

Keywords: Awareness, Cross-Sectional Study, Demographics, Gynaecological Health, Young Women

PCP003

Target-Based Approach for Heart Failure

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Introduction: Heart failure is a complex clinical syndrome arising from impaired cardiac contraction or relaxation, commonly driven by pathological stressors such as chronic sympathetic stimulation. Epigenetic regulators, particularly bromodomain-containing protein 4 (BRD4), play a key role in inflammation and oxidative stress–mediated cardiac remodelling. N, N-dimethylacetamide (DMA), a known BRD4 inhibitor, has demonstrated anti-inflammatory and antioxidant properties. The present study evaluated the cardioprotective potential of DMA in an experimental model of isoproterenol-induced heart failure in rats. **Methods**: Heart failure was induced in rats by subcutaneous administration of isoproterenol (5 mg/kg) for 14 days. DMA was administered concurrently at low, moderate, and high doses. Electrocardiographic parameters, arterial blood pressure, and serum cardiac injury markers, including lactate dehydrogenase (LDH), creatine kinase-MB (CK-MB), and creatine kinase-NAC (CK-NAC) were assessed. Molecular expression of BRD4 and nuclear factor kappa B (NF-κB) was analysed, along with histopathological evaluation of myocardial tissue. **Results**: DMA treatment, particularly at moderate and high doses, significantly improved ECG parameters and arterial pressure compared with the isoproterenol control group. Serum levels of LDH, CK-MB, and CK-NAC were markedly reduced. DMA significantly downregulated BRD4 and NF-κB expression. Histological analysis revealed attenuation of cardiomyocyte hypertrophy and reduced collagen deposition. **Conclusion**: DMA confers significant cardioprotection in isoproterenol-induced heart failure, primarily through inhibition of BRD4-mediated inflammatory and oxidative pathways, highlighting its potential as a novel therapeutic strategy for heart failure.

Keywords: Heart failure; N, N-dimethylacetamide; BRD4; Isoproterenol; Inflammation

PCP004

Dyclonine Suppresses Calcineurin-Nuclear Factor of Activated T Cell 3 Signaling in Cardiac Hypertrophy

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Introduction: The calcineurin–NFAT (nuclear factor of activated T cells) pathway is one of the most well-established signaling mechanisms driving pathological cardiac hypertrophy. Elevated TRPV3 has been shown to increase calcineurin-NFATc3 signaling, thereby increasing brain natriuretic peptide and levels of inflammatory cytokines, such as TNF-α and IL-6, further driving NF-κB-mediated hypertrophy. **Methods:** Our research shows the efficacy of dyclonine, a TRPV3 inhibitor, in the isoproterenol-induced rat model of cardiac hypertrophy. The findings of this study indicate that dyclonine reduced the severity of isoproterenol-induced cardiac hypertrophy. **Results:** Dyclonine was observed to improve a range of factors, including inflammatory cytokines, pathway-specific proteins, antioxidant enzymes, cardiac biomarkers, hemodynamic parameters, morphometric parameters, ECG readings, and histopathological changes in cardiac tissue. **Conclusion:** Dyclonine disrupts downstream calcineurin-NFATc3 signaling, preventing the expression of hypertrophy-response genes, including BNP. Results show that TRPV3 inhibition via dyclonine is a promising targeted therapeutic approach for cardiac hypertrophy.

Keywords: Calcineurin, Dyclonine, Hypertrophy

PCP005

Anxiolytic Efficacy of Idebenone in Mice: A Molecular and Computational Approach

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Introduction: Anxiety disorders are highly prevalent neuropsychiatric conditions in which neuroinflammation, oxidative stress, and microglial activation play central pathogenic roles. Idebenone, a quinone-based antioxidant with established neuroprotective properties, may offer therapeutic benefit by modulating inflammatory and redox pathways. **Methods:** Male Swiss albino mice were subjected to restraint stress for ten days to induce anxiety-like behaviour. Idebenone (100, 200, and 400mg/kg, p.o.) was administered, and behavioural outcomes were assessed using the elevated plus maze, open field test, light-dark transition test, and marble burying test. Brain and spleen tissues were analysed for NF--κB, NLRP3, and IL-1β levels using ELISA, alongside antioxidant markers (SOD and catalase). Microglial activation was assessed by Iba-1 immunohistochemistry. Molecular docking and molecular dynamics simulations were performed to evaluate idebenone interactions with NLRP3 and Iba-1. **Results:** Idebenone produced dose-dependent anxiolytic effects, with the 400mg/kg dose significantly improving behavioural parameters comparable to diazepam. Treatment markedly reduced NF-κB, NLRP3, and IL-1β levels in both the brain and spleen, while restoring antioxidant enzyme activity. Immunohistochemical analysis revealed reduced microglial activation following idebenone treatment. Computational studies demonstrated stable binding of idebenone to NLRP3 and Iba-1 proteins. **Conclusion:** Idebenone exhibits significant anxiolytic in restraint stress-induced anxiety through modulation of neuroinflammation, oxidative stress, and microglial activation, supporting its potential as a novel therapeutic candidate for anxiety disorders.

Keywords: Anxiety, Idebenone, NLRP3 inflammasome, Oxidative stress, Microglial activation.

PCP006

Prevalence of Anemia Among College Girls Aged 18-25: A Cross-Sectional Study Across 12 Institutions of Gandhinagar

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Introduction: Anemia is a silent yet critical public health concern among young women, often going undiagnosed despite its impact on energy, academic performance, and long-term health. that impacts individuals across both developing and developed nations, irrespective of age. The World Health Organization (WHO) says that a person has anemia if their haemoglobin levels drop below 12.0 g/dL for women and 13.0 g/dL for men. **Method:** This observational cross-sectional study was conducted among females aged 18–25 years from 12 educational institutes in Gandhinagar, Gujarat. To assess the prevalence, severity, and symptoms of anemia and its association with knowledge, BMI, menstrual cycle, and gynaecological conditions. Eligible participants underwent haemoglobin estimation, and data were collected using a structured self-designed questionnaire, followed by educational sessions on anemia and reproductive health. **Result:** The study revealed a high prevalence of anemia with varying degrees of severity. It also highlights a need for improved menstrual hygiene practices and gynaecological awareness. The study also highlights a gap in knowledge about reproductive health, gynaecological disorders and routine medical check-ups. **Conclusion:** These findings highlight the urgent need for targeted nutritional interventions, iron supplementation, and regular health education to reduce the burden of anemia and enhance overall well-being in young women.
Keywords: Anemia, Prevalence, Young Girl

PCP007

Neuroprotection by Gamma-Oryzanol in BCCAO-Induced Ischemia: Modulation of the Nrf2/NF-Kb Axis

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Introduction: Cerebral ischemia-reperfusion (I/R) injury induces severe oxidative stress, neuroinflammation, and neuronal degeneration, largely mediated through suppression of the Nrf2 antioxidant pathway and activation of NF-κB inflammatory signaling. Gamma-oryzanol (ORY), a natural antioxidant complex from rice bran oil, possesses strong free radical-scavenging and anti-inflammatory properties. This study investigated the neuroprotective potential of ORY in a bilateral common carotid artery occlusion (BCCAO) model of global cerebral ischemia in rats. **Methods**: Animals were divided into six groups. Normal control, Disease control, ORY pre-treatment (100 and 200 mg/kg), and ORY post-treatment (100 and 200 mg/kg). Pre-treatment was administered for 7 days prior to ischemia and continued for 7 days after reperfusion, while post-treatment was given from Day 0 to Day 7. Behavioral assessment was performed using the Open Field Test. Biochemical estimations of SOD, CAT, MDA, Nrf2, NF-κB, and TNF-α were performed on Day 15, along with histopathological evaluation. **Results**: Disease control rats showed significant behavioral deficits, elevated lipid peroxidation, reduced antioxidant levels, decreased Nrf2, and increased NF-κB and TNF-α. Gamma-oryzanol significantly restored antioxidant enzyme activity, reduced MDA levels, enhanced Nrf2 activation, and suppressed NF-κB-mediated inflammation. Histology confirmed reduced neuronal degeneration and improved cortical architecture in treated groups. The highest protection was observed with ORY 200 mg/kg in both pre- and post-treatment conditions. **Conclusion**: These findings demonstrate that Gamma-oryzanol confers robust neuroprotection against cerebral ischemia-reperfusion injury through its antioxidant, anti-inflammatory, and Nrf2-activating mechanisms, supporting its potential therapeutic role in ischemic brain disorders.
Keywords: Cerebral Ischemia, Nrf2, NF-κB, Gamma Oryzanol, Neuroprotection

PCP008

Exploring the Antidepressant Potential of Silibinin and its Augmentation with SSRIs/SNRIs in Swiss Albino Mice

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Introduction: Depression is a prevalent psychiatric disorder marked by persistent low mood, behavioral impairment, and reduced functional capacity. Limitations of existing antidepressant therapies, including delayed onset and suboptimal response, underline the need for alternative or supportive therapeutic options. Silibinin, a major consistent of Silybum marianum, is well documented for its antioxidant, anti-inflammatory, and neuroprotective properties, making it a promising candidate for evaluation in depressive models. This study investigates the antidepressant potential of Silibinin alone and in combination with standard antidepressants Sertraline as Selective serotonin reuptake inhibitor (SSRI) and Venlafaxine as Selective norepinephrine reuptake inhibitors (SNRI) using validated murine models. **Methods:** Male Swiss albino mice subjected to a chronic mild stress (CMS) protocol and evaluated through behavioral paradigms, and allocated into control, disease control, standard, and treatment groups. Behavioral assessments included the Forced Swim Test (FST), Tail Suspension Test (TST), Sucrose Preference Test (SPT), Actophotometer, and Coat State scoring following intraperitoneal drug administration. **Results:** Silibinin-treated groups exhibited significant behavioral improvement reflected by reduced immobility, increased locomotor activity, enhanced sucrose preference, and improved grooming scores. Importantly, combination groups receiving Silibinin with Sertraline or Venlafaxine demonstrated superior behavioral responses compared to monotherapy. **Conclusion:** The study indicate that Silibinin has substantial antidepressant activity and that its combination with conventional antidepressants may enhance behavioral outcomes with synergistic augmentation potential. The study supports further exploration of Silibinin as a complementary therapeutic option in depression management.
Keywords: Antidepressant activity, Sertraline, Silibinin, Stress, Venlafaxine

PCP009

The Future of Therapeutics: Advancing Patient Care Through Clinical Pharmacy Practice

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Introduction: Clinical pharmacy has become a vital component of modern healthcare by ensuring the rational, safe and effective use of medications to optimize patient outcomes. As healthcare systems increasingly adopt patient-centered approaches, clinical pharmacists provide essential expertise in pharmacotherapy, bridging the gap between drug knowledge and individualized patient needs. Their contributions strengthen medication safety, reduce therapy-related risks and enhance overall quality of care. **Methods:** This review synthesizes current literature on the roles and interventions of clinical pharmacists in diverse clinical settings. It examines evidence from studies evaluating medication therapy management (MTM), therapeutic drug monitoring, pharmacovigilance activities and interprofessional collaboration. The review also explores the integration of digital health tools, clinical decision support systems and pharmacogenomic data in advancing clinical pharmacy practice. **Results:** Findings indicate that clinical pharmacists significantly improve therapeutic outcomes through optimized medication selection, dosage adjustment and monitoring of complex treatment regimens. Their interventions reduce drug-related problems such as interactions, duplications, non-adherence and inappropriate prescribing. Evidence demonstrates reduced hospital stay durations, lower readmission rates, enhanced antimicrobial stewardship and improved chronic disease management. Clinical pharmacists also play a key role in patient education, empowering individuals to participate actively in their treatment. **Conclusion:** Clinical pharmacy enhances patient care by promoting safe, evidence-based medication use and supporting interdisciplinary healthcare delivery. Strengthening clinical pharmacy services and integrating advanced digital tools can further improve patient safety, therapeutic precision and healthcare system efficiency.

Keywords: Clinical Pharmacy, Pharmacotherapy, Pharmacogenomics, Patient Care, Therapeutic Drug Monitoring

PCP010

Assessment of Menstrual Hygiene Practices Among College Girls: A Cross-Sectional Study Across 12 Institutions of Gandhinagar

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Introduction: In Indian society, menstruation is frequently viewed as dirty. Many girls face difficulties as a result of a lack of awareness, especially in rural and excluded groups. Therefore, proper education and awareness are crucial. Providing knowledge at an early age encourages better hygiene practices and reduces the challenges of millions of women. This study aims to assess the menstrual hygiene practice among college-going girls aged 18-25 years based on study stream, socioeconomic status and residence. **Method:** A cross-sectional study was conducted across 12 colleges, enrolling female college students aged 18-25 years who voluntarily participated. Participants were informed about the study. Then the written informed consent was obtained from all participants. Data were collected using a validated Data Collection Form and Questionnaire. An awareness session on menstrual health was conducted by the investigators. Additionally, an expert-led session on menstrual awareness was also provided to the participants. **Result:** Out of the total 970 participants, more than half of the participants demonstrated poor menstrual hygiene practices, while over 40% reported average practices, and only about 5% followed good practices. Poor hygiene practices were notably more common among non-science students compared to those from the science stream. More than half of the participants experienced back and leg pain during menstruation. Additionally, around 40% of participants reported changing sanitary pads three times per day. **Conclusion:** The study highlights poor menstrual hygiene practices across a variety of educational institutions, socioeconomic backgrounds, and academic disciplines. Only a small fraction of participants practice proper hygiene, hence poor hygiene is common. The findings emphasize the need for better menstrual health education, and awareness campaigns tailored to different socioeconomic and educational levels.

Keywords: Menstruation, College Girls, Menstrual hygiene, Young girls, Menstrual hygiene practices

PCP011

Dysfunctional Mitophagy (PINK1/Parkin Pathway) as A Driver of Neuroinflammation

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Introduction: The PINK1/Parkin pathway plays a pivotal role in identifying and eliminating dysfunctional mitochondria through mitophagy. Increasing evidence suggests that disruption of this pathway not only compromises mitochondrial integrity but also acts as major upstream trigger of neuroinflammation in PD. **Methods:** This review draws upon findings from cell-culture studies, rodent models of PD, and investigations using human Induced Pluripotent Stem Cell (iPSC)-derived dopaminergic neurones. These models collectively assess mitochondrial function, mitophagy efficiency, activation of inflammatory pathways such as cGAS–STING and NLRP3, microglial metabolic responses, and effects of pharmacological enhancement of mitophagy. **Results:** Loss-of-function mutations in PINK1 or Parkin lead to accumulation of damaged mitochondria, accompanied by increased production of mitochondrial reactive oxygen species, oxidised lipids, and mitochondrial DNA (mtDNA). These mitochondrial components function as DAMPs that activate cGAS–STING signalling and stimulate the NLRP3 inflammasome, resulting in caspase-1 activation and pyroptotic cell death and further suppresses mitophagy, generating self-perpetuating cycle of mitochondrial injury. Additionally, impaired PINK1/Parkin signalling drives microglia towards a glycolytic, pro-inflammatory metabolic state. Experimental enhancement of mitophagy in animal and iPSC models reduces IL-1β release, attenuates microglial activation, and preserves dopaminergic neurones. **Conclusion:** Impairment of the PINK1/Parkin pathway drives a harmful cycle of defective mitophagy, mitochondrial stress, and inflammatory activation in PD. Rather than arising as late consequence of neuronal loss, this dysregulation functions as an early and central contributor to chronic neuroinflammation and dopaminergic degeneration. Targeting PINK1/Parkin axis and restoring mitophagy therefore represents a promising strategy for interrupting inflammatory signalling and supporting neuronal survival in PD.

Keywords: PINK1/Parkin axis, mitophagy failure, mitochondrial DAMPs, cGAS–STING pathway, NLRP3 inflammasome.

PCP012

From Painful Nights to Restful Sleep: Clinical Insights on Total Knee Replacement (TKR) Outcomes

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Introduction: End-stage knee osteoarthritis is often associated with chronic pain and disturbed sleep, which severely diminish quality of life. Total knee replacement (TKR) is widely performed to alleviate pain and restore function; however, its impact on postoperative sleep quality remains underexplored. **Method:** A prospective observational study was conducted in 46 patients undergoing primary TKR at Hi-Tech Hospital, Gandhinagar, Gujarat. Pain was assessed using the Oxford Knee Score (OKS), and sleep quality using the Pittsburgh Sleep Quality Index (PSQI) at baseline (preoperative) and 1 month postoperatively (30 ± 1 days). Statistical analysis was performed using MS Excel (version 2501) and SPSS software. **Result:** The mean age of participants was 65.9 ± 15.1 years, with a mean BMI of 27.4 ± 3.9. Preoperatively, patients reported severe pain (mean OKS: 11.4 ± 4.5) and poor sleep (mean PSQI: 12 ± 3.6). At 1-month follow-up, pain levels showed a significant reduction (OKS: 31 ± 7.1), and sleep quality markedly improved (PSQI: 5.7 ± 2.4). P-value is less than 0.05. **Conclusion:** TKR significantly reduces pain and enhances sleep quality within the first postoperative month. The observed

correlation highlights the importance of effective pain management in optimizing sleep recovery and overall quality of life. Incorporating sleep assessment into postoperative evaluation can provide a more holistic measure of functional recovery in patients undergoing TKR.

Keywords: Oxford Knee Score, Pittsburgh Sleep Quality, Total Knee Replacement.

PCP013

Advancements in Therapeutic Intervention for Traumatic Brain Injury

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Introduction: Traumatic Brain Injury is a major global health concern associated with significant morbidity, mortality, and long-term neurological disability. It is a complex neurological condition triggered by an immediate mechanical impact, followed by a multifaceted cascade of secondary injury driven largely by dysregulated neuroimmune signalling. These secondary events are characterized by neuroinflammation, oxidative stress, mitochondrial dysfunction, blood-brain barrier disruption, excitotoxicity, and progressive neuronal cell death. The injury may result from falls, traffic accidents, sports injuries, gunshot wounds, or combat-related events. Clinically, traumatic brain injury presents with a wide spectrum of manifestations ranging from concussion and cerebral contusions to intracranial hematomas, diffuse axonal injury, skull fractures, seizures, and long-term neurodegenerative disorders. Conventional management strategies primarily focus on symptomatic relief and acute stabilization rather than targeted modulation of the underlying pathophysiological mechanisms. **Methods:** A systematic literature review was searched using Google Scholar, Science Direct and PubMed to identify peer-reviewed journals published until November 2025. The search included keywords such as Traumatic Brain injury, Neuroinflammation, Mitochondrial dysfunction, Drug repurposing, Targeted therapeutic interventions. **Results:** Recent advances, have explored several promising therapeutic opportunities, including repurposing anti-inflammatory and neuroprotective agents each demonstrating the potential to improve clinical outcomes. Additionally, emerging interventions include mitochondria-targeted therapeutic strategies, microglia-targeted therapeutic approaches, and gene-based therapeutic interventions aim to mitigate neuroimmune-mediated secondary damage and enhance neurological recovery. **Conclusion:** Together, these approaches support the development of target-based therapeutic interventions that modulate neuroimmune and molecular pathways underlying secondary injury and ultimately promises to improve clinical outcomes post injury.

Keywords: Traumatic Brain injury, Neuroinflammation, Mitochondrial dysfunction, Drug repurposing, Targeted therapeutic interventions.

PCP014

Myeloperoxidase as a Therapeutic Target for Oxidative Neurodegeneration in Alzheimer's Disease

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Introduction: Alzheimer's disease (AD) is defined by a gradual decline in cognitive function, mostly resulting from heightened oxidative stress, chronic neuroinflammation, and escalating neuronal damage. Recently, myeloperoxidase (MPO), an oxidative enzyme generated mostly by activated microglia and invading immune cells, has come to light as a significant factor in neurodegenerative disease. Strong oxidants like hypochlorous acid are produced by increased MPO activity. These oxidants cause lipid and protein degradation, interfere with mitochondrial integrity, and exacerbate diseases linked to tau and amyloid. Therefore, blocking MPO is a possible technique to lessen oxidative damage and stop inflammatory pathways linked to the development of AD.
Methods: A comprehensive literature review was conducted using PubMed and Google Scholar to locate pertinent research on MPO, oxidative stress, and Alzheimer's disease. To compile the most recent information on MPO expression, catalytic activities, and its role in inflammatory and degenerative signaling, publications were

evaluated. The interaction between MPO activity, amyloid aggregation, and tau pathology, as well as oxidative damage pathways and microglial activation, was given special attention. "Myeloperoxidase," "oxidative stress in Alzheimer's disease," "MPO inhibition," "microglial activation," "neuroinflammation," and "oxidative neurodegeneration" were among the search terms. The therapeutic potential of MPO inhibitors was also examined. **Results:** The synthesis of available evidence is anticipated to show that MPO plays a pivotal role in driving oxidative stress, neuronal injury, and inflammatory responses in AD. Suppressing MPO activity may reduce neuroinflammation, preserve neuronal function, and support improved clinical outcomes. **Conclusion:** Current findings indicate that MPO represents a promising therapeutic target, and its inhibition could help limit oxidative neurodegeneration and potentially slow the progression of Alzheimer's disease.

Keywords: Alzheimer's Disease, Myeloperoxidase, Mitochondrial dysfunction, Neuroinflammation, Oxidative Stress

PCP015

Tight Junctions, Leaky Gut and The Tryptophan–Kynurenine Pathway: Linking Intestinal Barrier Dysfunction to Neuroinflammation

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Introduction: Leaky gut, characterized by disruption of intestinal tight junctions and translocation of microbial products such as lipopolysaccharide (LPS) into the circulation, has emerged as a key driver of gut–brain axis dysfunction. Altered tryptophan metabolism via the kynurenine pathway links peripheral inflammation to central neurotoxicity and neuroprotection. This review explores how leaky gut–induced immune activation reshapes kynurenine metabolism and contributes to cognitive decline. **Methods:** Literature search was done using PubMed, Scopus and Google Scholar, focusing on studies related to intestinal permeability, tight junction proteins, their organization, kynurenine pathway enzymes (IDO, TDO, KMO) and their downstream metabolites in relation to neuroinflammation and behavior. **Results:** Evidence indicates that increased intestinal permeability promotes dysbiosis, LPS leakage and pro-inflammatory cytokine release, which upregulate indoleamine 2,3-dioxygenase and shift tryptophan metabolism toward neurotoxic metabolites such as 3-hydroxykynurenine and quinolinic acid. These metabolites enhance oxidative stress, disrupt blood–brain barrier integrity and activate microglia, leading to synaptic dysfunction and cognitive decline. Conversely, neuroprotective metabolites like kynurenic acid may counteract excitotoxicity, though their levels are often insufficient in chronic inflammation. **Conclusion:** Leaky gut–driven activation of the kynurenine pathway represents a crucial molecular bridge between peripheral inflammation and brain dysfunction. Understanding the balance between neurotoxic and neuroprotective kynurenine metabolites may enable identification of early biomarkers and personalised interventions. Targeting intestinal barrier integrity, gut microbiota and key kynurenine pathway enzymes offers a promising multi-target approach for preventing or attenuating leaky gut–associated cognitive and neuropsychiatric disorders. Accordingly, this review focuses on the role of barrier-protective phytoconstituents—particularly polyphenols, selective modulators of kynurenine-pathway enzymes, and kynurenic-acid–mimetic agents—in preserving intestinal integrity and restraining the pathological diversion of tryptophan metabolism toward neurotoxic kynurenine metabolites in leaky-gut–associated cognitive decline.

Keywords: Gut-Brain axis, Intestinal Permeability, Kynurenine Pathway, Leaky Gut, Quinolinic Acid

PCP016

Therapeutic Drug Monitoring of Carbamazepine and Oxcarbazepine in Saliva: A Cross-Sectional Observational Study

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Introduction: Therapeutic Drug Monitoring (TDM) involves measuring drug concentrations in biological fluids to maintain effective and safe therapeutic levels. Saliva is a promising alternative to plasma due to its non-invasive collection and ability to reflect unbound drug levels. Carbamazepine and oxcarbazepine require close monitoring because of their narrow therapeutic index. This study aimed to estimate salivary concentrations of these drugs and correlate them with medication adherence, seizure-free periods, and toxicity. **Methods:** This prospective, cross-sectional, multicenteric observational study was conducted over a period of six months. Saliva samples were collected using passive drooling and stored under appropriate conditions simultaneously, data were collected through face-to-face interviews using a structured case record form. Drug concentrations in saliva were analysed using spectrofluorimetry. **Results:** 14 participants met the inclusion criteria; 73% were male and 27% female. Most participants were aged 41–50 years. Study revealed that 10 (normal), 2 (sub-therapeutic range), and 2 (toxic range), which were correlated with hepatic enzyme levels and attack-free period. According to the Morisky Medication Adherence Scale, 57.14% of participants demonstrated moderate adherence and observed a significant correlation between attack-free interval. Participants who were highly adherent towards their anti-epileptic medicines experienced comparatively fewer attacks than those who were mildly adherent. **Conclusion:** Saliva is a reliable and non-invasive alternative to plasma for TDM. This study demonstrates a strong association between salivary drug concentrations, medication adherence, and seizure control, supporting the role of TDM in individualising therapy for epilepsy.

Keywords: Therapeutic drug monitoring, Carbamazepine, Oxcarbazepine, Saliva, Medication adherence, Seizure-free period.

PCP017

The Glymphatic System: A Critical Pathway for Waste Clearance and Its Dysfunction in Alzheimer's Disease

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Introduction: The accumulation of misfolded proteins, specifically amyloid-beta (Aβ) and hyperphosphorylated tau, is the defining pathology of Alzheimer's disease (AD). Recent years have highlighted the glymphatic system as the brain's primary mechanism for clearing interstitial waste. This astrocytic-driven perivascular pathway facilitates the bulk flow of cerebrospinal fluid (CSF) into the brain parenchyma, effectively eliminating metabolic byproducts. Given its role in waste clearance, dysfunction of the glymphatic system has emerged as a critical, potentially upstream, factor in AD pathogenesis. **Methods:** This review synthesized current literature demonstrating a robust association between impaired glymphatic function and AD-related pathology. Studies in animal models and human subjects were evaluated, with emphasis on AQP4 localization, CSF-interstitial fluid exchange, sleep-dependent clearance mechanisms, and vascular contributions to glymphatic failure. Additional focus was placed on factors such as aging, inflammation, and vascular stiffness that further compromise glymphatic circulation. **Results:** Key findings consistently show that the efficiency of CSF-interstitial fluid exchange is significantly compromised in AD animal models and human subjects. Mechanistically, this impairment is strongly linked to the mislocalization and reduced expression of the Aquaporin-4 (AQP4) water channel, which is normally polarized to astrocytic endfeet surrounding cerebral blood vessels. Loss of AQP4 polarization severely compromises the driving force for CSF influx. Furthermore, age-related vascular stiffness, chronic sleep deprivation, and inflammation are identified as key factors exacerbating glymphatic clearance failure, leading to a vicious cycle of waste accumulation and neuroinflammation**. Conclusion:** Emerging evidence positions glymphatic impairment as a novel mechanistic driver of AD progression and a promising early diagnostic marker. Therapeutic strategies focusing on AQP4 re-polarization, sleep optimization, vascular health, and modulation of CSF dynamics may offer new avenues for disease modification in AD.

Keywords: Glymphatic system, Alzheimer's disease, Aquaporin-4, Neurotoxicity, Neuroinflammation

PCP018

Modulation of TLR-4 and NLRP-3 Pathways by C*ichorium* Extract to Attenuate Cytokine Storm in Tuberculosis

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Introduction: Tuberculosis (TB)–associated hyper-inflammation is often driven by excessive activation of Toll-like receptor 4 (TLR4) and the NLRP3 inflammasome, leading to uncontrolled secretion of IL-1β, IL-6 and TNF-α. Conventional anti-inflammatory drugs reduce symptoms but may compromise host immunity or cause systemic toxicity. Plant-derived bioactive compounds offer a promising therapeutic alternative due to their multitarget actions and improved safety profile. *Cichorium* plant extract, rich in sesquiterpene lactones, flavonoids, and phenolic acids, demonstrates notable immunomodulatory properties. This study explores its potential to modulate TLR4 and NLRP3 activation to control cytokine storm in TB. **Methods:** Phytochemical profiling of *Cichorium* extract was performed using HPTLC. In vitro TB-induced macrophage inflammation models were established in THP-1 cells stimulated with LPS and mycobacterial antigens. The effects of the extract on TLR4 and NLRP3 activation mediated Cytokine release (IL-1β, IL-6, TNF-α) was quantified using ELISA. Molecular docking was conducted to evaluate binding affinity between major phytoconstituents and TLR4/NLRP3 proteins. **Results:** *Cichorium* extract significantly down regulated TLR4 and NLRP3 signaling in activated macrophages. A marked reduction in IL-1β, IL-6 and TNF-α secretion was observed in treated groups. Docking analysis revealed strong interactions of chicoric acid, esculetin, and lactucin with the active sites of both TLR4 and NLRP3, supporting their inhibitory potential. **Conclusion:** *Cichorium* plant phytoconstituents effectively suppress key inflammatory pathways involved in TB-associated cytokine storm. Their dual targeting of TLR4 and NLRP3 suggests a promising natural therapeutic strategy for controlling hyper-inflammation without compromising host defense.

Keywords: *Cichorium* extract, TLR4 inhibition, NLRP3 inflammasome, Cytokine storm, Anti-inflammatory phytochemicals

PCP019

In Silico Assessment of Potassium Competitive Acid Blockers (P-Cabs) for Neuroprotection in Alzheimer's Disease

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Introduction: Alzheimer's disease (AD) is a complex neurodegenerative disorder driven by multifactorial pathologies, including severe neuroinflammation and oxidative stress. With current therapies offering limited disease-modifying effects, drug repurposing has emerged as a vital strategy. The present computational investigation evaluates the putative neuroprotective potential of a Potassium-Competitive Acid Blocker (P-CAB) by modeling its binding affinity to targets within inflammatory signalling pathways implicated in AD pathogenesis. **Methods:** The study utilized a network pharmacology approach to identify potential therapeutic targets. The pathway RAGE/NF-κB was identified by the "KEGG PATHWAY Database" based on the P-CAB related targets and their associated genes. To validate these interactions, molecular docking was performed using "Genetic Optimisation for Ligand Docking (GOLD)" software. The crystal structures of key pathway proteins RAGE (PDB: 6XQ3), NF-κB (PDB: 8TQD), TNF-α (PDB: 2AZ5), and IL-6 (PDB: 1ALU) were retrieved from the Protein Data Bank. P-CAB was prepared and energy-minimized using Chemdraw to generate optimal 3D conformers. Docking protocols were validated by re-docking with co-crystallized native ligands to their respective active sites. The study analyzed binding energies, hydrogen bond formation, and hydrophobic interactions to predict the drug's efficacy compared to standard inhibitors. **Results:** The *in-silico* analysis demonstrated that P-CAB exhibits significant binding affinity toward the identified targets. The ligand formed stable complexes within the active pockets of RAGE and NF-κB, stabilized by critical hydrogen bonds and hydrophobic interactions. These computational findings suggest that P-CAB may effectively disrupt the RAGE/NF-κB Signaling cascade, a

primary driver of neuroinflammation in the AD brain. **Conclusion:** This study provides a structural and mechanistic rationale for repurposing P-CAB as a potential anti-inflammatory agent in Alzheimer's disease. While these computational results are promising, the therapeutic efficacy and cognitive benefits of P-CAB will be validated in future studies using an *in-vivo* studies.

Keywords: Alzheimer's Disease, Molecular Docking, Neuroinflammation, Network pharmacology, P-CAB

PCP020

Neuropharmacological Profiling of *Lantana camara* Linn. for Its Antidepressant- and Anxiolytic-Like Effects Using Chronic Unpredictable Mild Stress Model in Mice

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Introduction: Depression is a mood disorder characterized by persistent sad mood with loss of pleasure in all activities with emotional and physical symptoms. It is highly comorbid with anxiety and approximately 85% of people with depression exhibited symptoms of anxiety as well. In present research paper methanolic extract of leaves of Lantana camara Linn. was evaluated for their antidepressant- and anxiolytic-like potential of using a chronic unpredictable mild stress (CUMS) mouse model. **Materials and Methods:** Depression-like effects in animals were induced using CUMS model over 28 days. Mice were administered methanolic extract of leaves of Lantana camara Linn. at doses of 100, 200 and 400 mg/kg, p.o. with paroxetine (20 mg/kg, p.o.) as the standard drug from 8th day to 28th day. Behavioral tests include, spontaneous locomotor activity **(**SLA), forced swim test (FST), tail suspension test (TST), elevated plus maze (EPM), open field test (OFT) and sucrose preference test (SPT) and biochemical assays like estimation plasma corticosterone and brain serotonin and oxidative stress marker levels. **Results:** Results indicated significant ($p<0.05$) reductions in immobility time across all doses in FST and TST. The high-dose group showed notable improvements in rearing and ambulation in OFT and all doses enhanced the time spent in open arm and open arm entries in the EPM. There was no significant effect was observed in SPT. Biochemically, significant ($p<0.05$) reductions in plasma corticosterone and malondialdehyde levels were observed across all doses, with high-dose groups showing increased serotonin and superoxide dismutase activity. **Conclusion:** In conclusion, the study provides compelling evidence of the antidepressant- and anxiolytic-like potential of Lantana camara Linn.

Keywords: CUMS; Depression; Diosmetin; Lantana camara; Malondialdehyde

PCP021

Patterns and Predictors of Surgical Site Infections in Gynecological Surgeries: An Ambispective Analysis of Prophylactic Antibiotic Use

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Introduction: Surgical Site Infections (SSIs) are a major postoperative complication in gynecological surgeries, influenced by patient factors and variations in antibiotic prophylaxis. Optimizing antibiotic use is vital to reducing infection rates and preventing antimicrobial resistance. **Methods:** An ambispective observational study was conducted among 304 women undergoing gynecological surgeries across multiple hospitals. Data on SSI occurrence, associated risk factors, and antibiotic practices were collected from case records and analysed descriptively. **Results:** The overall SSI incidence was 15.46%. Emergency surgeries showed higher SSIs compared to elective procedures, and open surgeries reported more infections than laparoscopic ones. Major patient-related risk factors included anemia, hypertension, and diabetes mellitus. Preoperative prophylaxis commonly involved cefazolin, ceftriaxone, or amoxicillin-clavulanic acid, while postoperative antibiotics frequently included ceftriaxone and metronidazole. Despite prophylaxis, inconsistent timing and prolonged postoperative antibiotic use were frequent and did not correlate with reduced SSI rates. **Conclusion:** Appropriately timed preoperative antibiotic prophylaxis remains effective in preventing SSIs. However, variations in practice

and unnecessary postoperative antibiotic use compromise outcomes. Strengthening standardized protocols, risk-based assessment, and antibiotic stewardship is essential to minimize SSIs and improve surgical outcomes.

Keywords: Antibiotic Prophylaxis; Antimicrobial Stewardship; Gynecological Surgeries; Risk Factors; Surgical Site Infection (SSI)

PCP022

Pharmacological Evaluation of Mefenamic Acid Derivative for Its Antidepressant and Anxiolytic-Like Potential Using Corticosterone-Induced Depression Model in Mice

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Introduction: In recent years, studies have demonstrated that the serotonergic system, particularly the 5-HT_3 receptor (5-HT_3R), plays a major role in regulating mood and anxiety. The present study investigates the antidepressant- and anxiolytic-like potential of a 5-HT_3 receptor antagonist, (2-((2,3-dimethylphenyl)amino)phenyl)(4-ethylpiperazin-1-yl)methanone) (MP-02), in a mouse model of corticosterone-induced depression that mimics stress-related pathophysiology via dysregulation of the HPA axis. **Methods:** Depression- and anxiety-like behaviour was induced in mice through chronic administration of corticosterone (CORT). Behavioural assessments included spontaneous locomotor activity (SLA), forced swim test (FST), tail suspension test (TST), open field test (OFT), elevated plus maze (EPM), light and dark (L&D) test, and sucrose preference test (SPT). Biochemical evaluations included plasma CORT and serotonin levels, brain inflammatory markers (TNF-α and IL-1β), oxidative stress markers (MDA), and antioxidant enzymes (catalase and SOD). Brain BDNF levels were also quantified. **Results**: Administration of MP-02 significantly reduced immobility time in the FST and TST and increased sucrose preference in the SPT, indicating antidepressant-like activity. MP-02 also enhanced exploratory behaviour in OFT, EPM, and L&D tests, reflecting anxiolytic-like effects. Biochemically, MP-02 modulated plasma CORT and serotonin levels, reduced inflammatory markers (TNF-α and IL-1β), decreased oxidative stress marker MDA, and increased antioxidant enzyme activities (catalase and SOD). However, MP-02 did not produce significant changes in brain BDNF levels. **Conclusion**: MP-02 demonstrates notable antidepressant- and anxiolytic-like effects in corticosterone-induced depression in mice, likely mediated through modulation of serotonergic signalling, inflammation, and oxidative stress. These findings suggest the therapeutic potential of MP-02 in managing depressive and anxiety disorders.

Keywords: 5-HT_3 receptor antagonist, Catalase, Depression, SOD, Oxidative stress

PCP023

Pharmacovigilance and ADR Reporting: Global Methods, Challenges, and Pathways for Improvement

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Introduction: Pharmacovigilance (PV) is a fundamental and vital discipline focused on the detection, assessment, reporting and prevention of adverse drug reactions (ADRs) and other drug-related challenges to safeguard patient health. PV employs diverse methodologies, including spontaneous reporting, active surveillance, and targeted monitoring by drawing data from sources such as healthcare professionals, consumers, patient registries, electronic health records, and clinical trials. **Roadmap for ADR reporting:** Global ADR reporting platforms, such as WHO's VigiFlow, FDA's MedWatch (USA), and EudraVigilance (EU), supported by advanced tools like signal detection algorithms, big data analytics, and AI-enabled platforms, have significantly enhanced pharmacovigilance practices. In India, the Pharmacovigilance Programme of India (PvPI), under the authority of Indian Pharmacopoeia Commission, operates through a robust and extensive network of over 200 Adverse Drug

Monitoring Centres and multi-lingual reporting channels. Despite progress, challenges persist, including underreporting, limited awareness, and infrastructural constraints. Emerging areas of development include patient-centric reporting, integration of real-world evidence, and advanced data analytics. A few strategic solutions involve awareness and training programs, simplified reporting tools (mobile apps such as ADR PvPI), online forms), digitalization, capacity building, digital dashboards linked to electronic medical records, and stakeholder engagement. Future prospects emphasize AI-powered predictive models, global data harmonization, and collaborative frameworks to strengthen drug safety and public health worldwide. **Conclusion:** Strengthening and advancing pharmacovigilance will ultimately improve and enhance patient safety, optimize therapeutic outcomes, and support evidence-based clinical decision-making at national and global levels.

Keywords: Pharmacovigilance, ADR reporting, PvPI, Drug Safety, Simplified reporting tools

PCP024

Impact of Regional-Language Patient Information Leaflets on Knowledge and Understanding of Oral Anticancer Therapy: A Clinical Pharmacy Study

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Introduction: Oral anticancer therapies require long-term adherence and adequate patient understanding to ensure safety and therapeutic success. Inadequate health literacy, especially in regional language-speaking populations, can negatively affect treatment outcomes. Patient Information Leaflets (PILs) prepared in regional languages may enhance patient knowledge, adherence and safe use of oral anticancer medicines. **Methods:** A pre-post interventional study was conducted among patients receiving oral anticancer therapy in the oncology department. Gujarati language PILs were developed, validated and evaluated for drugs including Capecitabine, Gefitinib, Palbociclib and Lenalidomide. Readability of the PILs in English and Gujarati was assessed using Flesch Reading Ease and Flesch-Kincaid Grade Level scores. Patient demographics were documented and a structured questionnaire was used to assess knowledge before and after providing the PIL. Statistical analysis was performed using the Wilcoxon Signed-Rank test, independent t-test and Kruskal–Wallis test. **Results**: The study population predominantly consisted of female patients (65%), with the majority residing in rural areas (88.4%). Capecitabine was the most commonly prescribed oral anticancer drug (39%). Pre-intervention assessment showed that 86.95% of patients had low knowledge regarding their therapy. Post-intervention results demonstrated a significant improvement in patient understanding, with moderate knowledge levels increasing to 78.26% ($p < 0.001$). The Wilcoxon Signed-Rank test confirmed a statistically significant improvement in patient knowledge ($p = 0.004$). However, limited understanding of adverse drug reactions persisted in some patients. **Conclusion**: The study successfully demonstrated that a validated Gujarati Patient Information Leaflet significantly improves patient knowledge regarding oral anticancer therapy. Regional language PILs can serve as an effective educational tool to enhance patient comprehension and adherence. Further simplification and focused education on adverse drug effects are recommended.

Keywords: Anticancer drugs, Patient education, Patient Information Leaflet, Readability, Regional language

PCP025

To Sensitize and Assess Knowledge, Attitude, and Practice (KAP) of Patient Counseling and Utilization of The Drug Information Center (DIC) Among Healthcare Professionals

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Introduction: Drug information services provide evidence-based, unbiased information on drugs and drug therapy in response to verbal or written requests from healthcare professionals and patients, while educating pharmacists on rational drug use. The Pharmacists and Physicians Drug Information Center (DIC) serves as a reliable resource supporting clinical decision-making in tertiary care settings. **Methods:** A six-month questionnaire-based interventional study was conducted at a tertiary care hospital among 357 consenting healthcare professionals. Department-wise sensitization sessions on Patient Counseling and Drug Information Center (PC & DIC) activities were delivered by the DIC preceptor. A self-designed, expert-validated questionnaire assessed knowledge, attitude, and practice (KAP) related to PC & DIC services. Data on patient counseling, drug-related queries, and medication incidents were analyzed. Statistical analysis was performed using Microsoft Excel, with results expressed as percentages. Chi-square testing determined significance at the 95% confidence level. **Results:** Knowledge regarding DIC services was high (81.79%), attitude was moderate (23.24%), and practice was low (9.5%). Most drug-related queries originated from medicine and gynaecology departments (29.36% each), focusing on knowledge updates and patient care. Responses were generally prompt and relied primarily on primary and secondary resources. Common challenges included patient-related barriers, miscommunication-related prescription errors, and increased workload during peak hours. **Conclusion:** Although healthcare professionals demonstrated strong awareness of PC & DIC services, actual utilization remained limited. Strengthening sensitization programs, improving interdisciplinary communication, optimizing workflow, and expanding counseling aids may enhance DIC utilization, reduce medication errors, and improve overall patient safety and quality of care in tertiary healthcare settings and outcomes globally.

Keywords: Drug-related Queries, Knowledge, Attitude & Practice (KAP), Patient Counseling & Drug Information Center (PC& DIC), Prescription Errors, Sensitization

PCP026

Real World Analysis of Usage and Efficacy of Immune Checkpoint Inhibitors in Recurrent/Metastatic Head and Neck Cancer

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Introduction: Immune checkpoint inhibitors (ICIs), including nivolumab and pembrolizumab, have become integral in the management of recurrent and metastatic head and neck squamous cell carcinoma (HNSCC). However, real-world data from low- and middle-income countries remain limited. This study evaluates the clinical outcomes of ICI therapy in patients with recurrent/metastatic HNSCC treated at a tertiary cancer centre in India. **Methods:** This retrospective single-centre study includes 70 patients with histologically confirmed, recurrent or metastatic HNSCC treated between April 2022 to February 2024. Patients received nivolumab (standard 3mg/kg once every 2 weeks or low-dose 40 mg flat dose once every 2 weeks) or pembrolizumab, either as monotherapy or in combination with chemotherapy. Usage patterns, Objective response rate (ORR), Progression-free survival (PFS) and toxicity were evaluated. **Results:** Out of 70 total patients, 63% received nivolumab (48% with standard dose and 52% with low dose) while 37% received pembrolizumab. 77% received a combination of ICI with chemotherapy. The ORR of the entire study was 48.57%. ORR of the standard dose and low dose nivolumab group was 52% each, and for pembrolizumab it was 42.3%. The ORR of the chemo-ICI group was 54%, while it was 31% in the ICI monotherapy group. The median PFS for the entire study group was 4 months (95% CI, 3-6 months). 11% patients experienced immune-related adverse events with grade1/2 severity. **Conclusion:** The usage of both low-dose and standard dose nivolumab demonstrated similar ORR. Chemo-ICI combinations improved response rates over ICI monotherapy.

Keywords: Head and neck squamous cell carcinoma, Immunotherapy, Nivolumab, Pembrolizuma

PCP027

Assessing The Impact of Clinical Pharmacists on Reducing Medication Discrepancies During Patient Admission in The Emergency Department and Transition of Care: A Comprehensive Prospective Interventional Study

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Introduction: Medication discrepancies frequently occur during hospital admission and transitions of care, particularly in emergency departments, increasing the risk of adverse drug events. Clinical pharmacist involvement in medication reconciliation can help identify and resolve such discrepancies. **Methods:** A prospective interventional study was conducted involving 200 patients admitted to the emergency department of tertiary care hospital. Medication reconciliation was performed at 3 checkpoints:Initial admission, interdepartmental transfer, and discharge. Discrepancies were categorised using ASHP (2018) and NCC MERP (2022) guidelines. Discrepancies was discussed with healthcare and intervention was suggested. Pharmacist interventions were evaluated by acceptance rates. **Results:** 57 unintentional medication discrepancies were identified in 50 patients along with one intentional discrepancy.Mainly at interdepartmental transfer (73.6%). Prescribing discrepancy were most common(26.31%).All discrepancies were classified based on ASHP&NCC-MERP categories.According to NCC-MERP categorization discrepancies were found between categories A to D suggested no serious harm.Peak workload was a major contributing factors. **Conclusion:** Clinical pharmacists led medication reconciliation significantly reduced discrepancies,improved medication accuracy, and enhanced patient safety during care transition.

Keywords: Clinical pharmacists, medication, discrepancies, medication, reconciliation, NCC-MERP, ASHP

PCP028

Advanced Formulation and Systematic Development of A Synergistic Polyherbal Emulsion Exhibiting Potent Digestive and Hepatoprotective Efficacy: A Quality-by-Design Approach

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Introduction: The liver is a worldwide health related challenge to affecting metabolic functions and detoxification capacity due to infections, toxins, and metabolic dysfunction. It play a central role in regulating metabolic activities and body temperature, while addressing malabsorption and supporting overall wellness by providing hepatoprotective and digestive therapeutic benefits. **Methods:** Soxhlet extraction (70% ethanol) and steam distillation were used to achieve standardized extracts. QbD methodology defines Critical Material Attributes (CMAs) and Critical Process Parameters (CPPs). A 3^2 factorial design was used to study the oil phase (5-15% w/w), emulsifiers (Tween 80:lecithin ratios), and co-surfactant concentrations. By making full use of high-shear homogenization (10,000 rpm, 15 min), nano-emulsification was achieved. The resultant profile included pH, refractive index, viscosity, droplet size (DLS), zeta potential, rheological behavior, and ICH Q1A accelerated stability (40°C/75% RH, 90 days) definition of Design Space. **Results:** This optimized formulation saw the pH

maintained at 5.9, a viscosity of 295 cP, globule diameter 258 nm (PDI = 0.19), and a zeta potential of -32.9 mV. Pseudoplastic rheology and no visible creaming attested to a solidly built formation design, with less than 2% loss of plant material after The successful identification of controlled space specifications for processing values mands nested sequence-origin attribute until first snap shot used up all available space.p. polyherbal emulsion formulation and improvements. unpublished manuscripts. **Conclusion:** This QbD-driven polyherbal emulsion exemplifies pharmaceutical excellence with assured quality and robustness, poised for clinical translation.

Keywords: Polyherbal emulsion, formulation development, stability, phytoconstituents, oil-in-water emulsion

PCP029

Evaluation of Prescribing Pattern in Infertile Men and Women: A Multi-Center Study

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Introduction: Infertility is an increasing global health concern, requiring evidence-based and rational pharmacological management. This multi-centre retro-prospective observational study aims to evaluate real-world prescribing patterns for infertile men and women, identify common causes of infertility, and assess early treatment outcomes. **Method:** This retro-prospective observational study is being conducted across three infertility centres following Institutional Ethics Committee approval. Men and women aged 18–45 years receiving pharmacological therapy for infertility and providing informed consent are being enrolled. Patient demographics, infertility type and etiology, pharmacological regimens, adjunct medications, and clinical outcomes are being systematically extracted from medical case records. Data are being analyzed using descriptive statistics till date. **Results:** Data from 64 participants analyzed to date include 51 females (79.68%) and 13 males (20.31%). Primary infertility is predominant (82.81%). Idiopathic infertility and PCOS are the leading etiologies among females (27.45% each), followed by endometriosis (15.68%). Oral pharmacotherapy is the most frequently utilized route (76.56%). Letrozole is the most commonly prescribed ovulation-inducing agent in females (78.43%) and the most frequently utilized hormonal modulator in males (69.23%). Prescriptions associated with ovulation achievement predominantly include letrozole. Folic acid (80.39%) and vitamin supplements (39.21%) are frequently co-prescribed as supportive therapy. **Conclusion:** Infertility management across centres is characterized by predominant use of letrozole-based oral regimens, commonly supported by nutritional adjuncts, reflecting contemporary clinical pharmacy-driven prescribing practices. Findings emphasise the need for standardized infertility pharmacotherapy.

Keywords: Infertility, Prescribing pattern, Letrozole, PCOS, Multi-centre study

PCP030

Development and Evaluation of Oral Formulation from Naturally Occurring Fatty Acid Amides for The Management of Trigeminal Neuralgia

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Introduction: Trigeminal neuralgia (TN), a chronic pain condition, is primarily caused by irritation or damage to trigeminal nerve, the fifth cranial nerve responsible for facial sensation. Palmitoylethanolamide (PEA), a natural fatty acid amide with neuroprotective and anti-inflammatory properties, shows therapeutic potential in Trigeminal Neuralgia (TN). However, its poor aqueous solubility limits oral absorption and clinical effectiveness. This study aimed to enhance PEA solubility and develop fast-dissolving tablets (FDTs) for improved patient compliance and

rapid therapeutic action. **Methods**: A solid dispersion of PEA was prepared with hydrophilic carriers to enhance its solubility and dissolution rate, then incorporated into fast-disintegrating tablets via direct compression. Pre- and post-compression parameters, including flow, hardness, friability, disintegration time, drug content, and dissolution, were evaluated. FT-IR confirmed drug–excipient compatibility, and three-month stability studies showed no significant changes. In-vitro neuroprotective assays verified that PEA's biological activity was retained. **Result**: The formulations showed good flow, adequate mechanical strength, and rapid disintegration. Carbopol 974 tablets disintegrated the fastest and delivered the highest drug release. FT-IR analysis confirmed no drug–excipient incompatibility, and stability studies revealed no meaningful changes in physical or chemical properties. In-vitro tests demonstrated that PEA's neuroprotective activity remained intact after formulation. **Conclusion:** Solid dispersion combined with direct compression successfully enhanced PEA solubility and dissolution. The developed FDTs offer rapid disintegration, improved bioavailability, and stable performance, making them a promising option for managing neuropathic pain, especially Trigeminal Neuralgia.

Keywords: Palmitoylethanolamide (PEA), solid dispersion, fast-dissolving tablets, Carbopol 974, Trigeminal Neuralgia, solubility enhancement

PCP031

A Study of Screen Time, Health and Well-being Amongst Paediatric Population with Parental Counselling: A Community-Based Interventional Study

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Introduction: Children today are surrounded by screens, yet many Indian parents are either unaware of formal screen-time guidelines or struggle to apply them in their busy daily lives. As a result, children may receive mobiles and other devices for long periods, and early warning signs such as sleep problems, irritability or eye strain are often missed or ignored. **Methods:** This community-based interventional study is being conducted at three pharmacies in Gujarat among children aged 1–15 years who use screens for at least 30 minutes per day. Parents first complete a detailed questionnaire on screen habits, physical and behavioural symptoms and their own perceptions, then receive one-to-one counselling supported by a colourful, child-friendly bilingual leaflet designed to be easily understood by both children and caregivers; the same tool will be repeated after one month to assess changes in screen use and activity levels. **Results:** Baseline data from 120 children show that most exceed recommended screen-time limits, mainly for entertainment, and commonly experience eye discomfort, headaches, tiredness, poor concentration, anger and fighting behaviour. More than half of parents report needing expert help to manage their child's screen use, underlining a clear counselling gap in routine care. **Conclusion:** This ongoing study addresses two practical problems: low awareness of paediatric screen-time guidance and limited recognition of its health and behavioural consequences. By combining structured data collection with engaging leaflets and personalised counselling, it aims not only to reduce screen time and improve sleep and physical activity at follow-up but also to offer a simple model that can be integrated into everyday community and clinical practice.

Keywords: Paediatric screen time; parental counselling; community pharmacy; behavioural symptoms; child well-being

PCP032

Chemotherapy-Induced Amenorrhea and Menopause in Breast Cancer Patients: Prevalence, Risk Factors, and Impact on Disease-Free Survival

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Introduction: Breast cancer is one of the most commonly diagnosed cancers worldwide. Advances in screening and treatment have reduced mortality, but chemotherapy-induced amenorrhea (CIA) remains a concern, especially for women who wish to conceive after treatment. Identifying risk factors for permanent ovarian suppression can help determine if individualised counselling is needed for fertility preservation options. This study aims to analyse prevalence and risk factors in patients with CIA or chemotherapy induced menopause (CIM) and to compare disease-free survival (DFS) in patients with CIM versus those who did not experience menopause after chemotherapy. **Methods:** An ambispective observational study was conducted over a period of 6 months. A total of 259 patients based on predetermined inclusion and exclusion criteria were included in the study. **Results:** The prevalence of CIA was found to be 83.78%, 64.86% of patients had permanent menopause, and 18.92% of patients experienced resumption of menstruation. Age, tamoxifen use, ER/PR positivity were found to be statistically significant risk factors. DFS was analysed using the Kaplan-Meier method, and the results showed that the mean survival time in the CIM group was 7.8 years, which was longer than in those who did not experience CIM (6.77 years). **Conclusion:** Our study highlights the significant impact of chemotherapy on ovarian function, with higher rates of CIA and CIM in premenopausal women, highlighting the need for fertility preservation. Improved DFS in CIM patients, aligning with prior reported studies. These findings underscore the importance of individualized counselling and long-term follow-up for better reproductive and cancer outcomes.

Keywords: Breast Cancer, Chemotherapy-induced amenorrhea, Chemotherapy-induced menopause, Disease-free survival.

PCP033

Knowledge, Attitude, Perception and Practices Towards Oral Hygiene Products Among Community Pharmacy Customers

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Introduction: Oral hygiene products are widely used for daily oral care and are important in preventing dental and general health conditions. Community pharmacies serve as a major access point for these products and provide an opportunity to assess patient knowledge, attitude, perception and practices related to their use. **Methods:** This ongoing cross-sectional study is being carried out in community pharmacies using a pre-designed, validated questionnaire. Adult participants visiting pharmacies are interviewed after consent. Data collected is analysed using descriptive methods, and scores have been grouped into good, moderate and poor categories. **Results:** Data analysis included 150 participants, of whom 88 (58.7%) were male and 62 (41.3%) were female. The average knowledge score was 2.84 out of 5, attitude score was 16.58 out of 25, perception and practice scores averaged 6.74 and 5.36 out of 10, respectively. The overall mean score was 31.53 out of 50. Based on categorisation, 50 participants (33.3%) had good scores, 89 (59.3%) had moderate scores and 11 (7.3%) had poor scores. Differences observed across domains, suggest variation in understanding, beliefs and everyday use of oral hygiene products. **Conclusion:** The findings from the study suggest that most participants demonstrate moderate levels of knowledge, attitude, perception and practices. The findings highlight a need for patient education and counselling by community pharmacists to promote safe, appropriate and rational use of oral hygiene products.

Keywords: Community pharmacy, KAP study, oral hygiene products, patient counselling, public health

PCP034

Predicting the Risk of Myocardial Infarction and the Impact of Lifestyle Modification: A Population-Based Predictive Analysis

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Introduction: Myocardial infarction (MI) is a major global health burden, with rising prevalence linked to modifiable lifestyle factors. Early identification of high-risk individuals through predictive modelling can significantly improve prevention. **Objectives:** Identify key risk factors contributing to MI using patient-level data,

Develop a predictive model to estimate MI risk, and Assess the impact of lifestyle modification on risk reduction. **Methodology:** A cross-sectional observational study was conducted on 515 MI patients from tertiary care hospitals. Variables included age, gender, BMI, dietary patterns, physical activity, sleep duration, comorbidities, substance use, and socioeconomic status. Statistical analysis and XGBoost machine-learning algorithms were used to develop a risk-prediction model. Simulated lifestyle interventions were applied to compare pre- and post-intervention risk scores. **Results:** MI incidence was highest in the 51–60-year age group with a male predominance. Obesity, sedentary behaviour, irregular meal patterns, low socioeconomic status, and joint-family stress were significant predictors. High rates of Hypertension, Diabetes Mellitus, inadequate sleep, and lack of yoga further increased risk. Individuals denying tobacco or alcohol use also showed notable MI rates, suggesting underreporting or emerging non-traditional risk factors. The XGBoost model demonstrated high predictive accuracy. **Conclusion:** The study highlights shifting MI trends and emphasises early preventive strategies. Lifestyle modification improving activity levels, sleep, diet, and stress significantly reduced predicted risk. PCI, antiplatelets, antihypertensives, and statins remain vital in management, underscoring the need for integrated preventive and clinical care.

Keywords: Body Mass Index (BMI), Extreme Gradient Boosting (XGBoost), Myocardial Infarction (MI), Percutaneous Coronary Intervention (PCI)

PCP035

Study of Potential Drug-Drug Interactions at A Tertiary Care Hospital

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Introduction: Medicines are solutions to any disease and illness, but sometimes when these drugs are given together may react and cause problems (rashes, constipation etc) which may affect or alter patients' quality of life. WHO defines Drug interaction as alteration of effect of one drug by the presence of another drug, food, substance, or by a medical condition. When people take multiple medications, there is a risk of drug interaction which may reduce the effectiveness of drug or may cause harmful side effects. These may be especially concerning for patients with chronic conditions or prescribed with multiple medicines (Polypharmacy). **Methods:** This cross-sectional study is being conducted at two hospital sites in Gujarat in ICU patients of age group 16 and above. After 48 hours of admission in ICU patients' consent is retrieved and patients' data is collected. Once data is collected, it is analysed using tools like Micromedex, Lexicomp and Drugs.com for any drug interaction, its severity, onset and documentation. Drug interaction is informed to concerned medical officer. **Results:** From collected data we have identified many drug-interaction and have communicated them to the concerned medical officer. Many of these were accepted and necessary steps have been taken to avoid potential Drug-Interactions. **Conclusion:** This is an ongoing study being conducted to determine potential drug interactions, its severity, onset and documentation. The study aims to improve patients' overall health by avoiding chances of interaction and reducing the complications that may occur due to the same.

Keywords: Potential Drug-Interactions, Severity assessment, Polypharmacy, ICU patients, Tertiary care hospital

PCP036

A Comprehensive Review on Loop Diuretic Action: Nephron Anatomical Segments and Fluid-Electrolyte Imbalance Pathophysiology in Heart Failure

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Introduction: Heart failure (HF) is a progressive clinical syndrome characterized by the heart's inability to meet the body's metabolic demands, leading inevitably to congestion and fluid overload. Loop diuretics remain the cornerstone of symptom management in acute and chronic HF by promoting robust diuresis. This review systematically explores the pharmacology of loop diuretics, their precise site of action within the nephron, and the

resulting fluid and electrolyte disturbances that constitute the major therapeutic challenge in HF management. A deep understanding of this drug-body interaction, rooted in renal anatomy and HF pathophysiology, is critical for optimizing treatment and minimizing adverse effects. **Methods:** A comprehensive literature search was conducted across PubMed and Scopus databases spanning the last three decades, utilizing keywords such as "loop diuretics," "heart failure," "nephron anatomy," "Na-K-2Cl cotransporter," and "electrolyte imbalance." Studies focusing on the pharmacodynamics, pharmacokinetics, and clinical outcomes associated with high-ceiling diuretic use in patients with established HF were prioritized for inclusion. The gathered evidence was synthesized to construct a cohesive narrative detailing the molecular mechanism, anatomical correlation, and pathophysiological consequences of loop diuretic therapy. **Results:** Loop diuretics exert their potent effect by specifically inhibiting the Na-K-2Cl cotransporter (NKCC2) located on the apical membrane of the cells lining the thick ascending limb (TAL) of the loop of Henle. This anatomical site is responsible for reabsorbing approximately 25-30% of filtered sodium, making its blockade highly effective in promoting natriuresis. However, this inhibition also leads to common, clinically significant adverse effects, including hypokalemia, hypochloremic alkalosis, and hypocalcemia due to the disruption of the normal ion gradients and charge potential across the TAL. Moreover, the chronic use of loop diuretics can activate the renin-angiotensin-aldosterone system (RAAS), potentially exacerbating the underlying pathophysiology of HF. **Conclusion:** Loop diuretics are essential for managing congestion in heart failure, owing to their specific action on the NKCC2 cotransporter in the thick ascending limb of the nephron. While effective, their use mandates careful monitoring of fluid status and electrolytes to mitigate the risk of adverse outcomes like hypokalemia and metabolic alkalosis. Future research should focus on therapeutic strategies that achieve adequate diuresis while maintaining better electrolyte homeostasis and counteracting potential neurohormonal activation.

Keywords: Heart Failure, Loop Diuretics, Nephron, NKCC2, Electrolytes

PCP037

Digital Therapeutics and Software as Medical Devices: Clinical Applications and Regulatory Perspectives Across The USA, EU, and UK

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Introduction: Digital therapeutics (DTx) and Software as a Medical Device (SaMD) are transforming healthcare by offering software-driven solutions for treatment, diagnostics, and monitoring. DTx provides therapeutic interventions for preventing, managing, or treating conditions, while SaMD performs medical tasks independently of physical devices. The rise of chronic diseases, advancements in personalized healthcare, and innovations like artificial intelligence (AI) drive their rapid growth. This review explores the applications, regulatory frameworks, challenges, and future trends of DTx and SaMD. **Methods:** This review analyzed peer-reviewed articles, clinical trials, regulatory guidelines, and product registries. Focus was placed on regulatory pathways established by organizations like the FDA and European Commission. Examples were assessed for therapeutic focus, regulatory approval, clinical validation, and patient impact. Products were categorized into therapeutic, diagnostic, and monitoring applications to demonstrate their diverse roles. **Results:** Highlighted examples include: reSET-O (Pear Therapeutics): A mobile app delivering FDA-approved cognitive-behavioral therapy for opioid use disorder. Omada Health: A platform addressing diabetes and hypertension through personalized coaching. IDx-DR: An FDA-cleared AI tool for autonomous diabetic retinopathy diagnosis. HeartFlow FFRct: Software analyzing coronary CT images to assess blood flow for diagnosing coronary artery disease. Challenges include regulatory complexity, data security, and patient adherence. **Conclusion:** DTx and SaMD offer scalable, personalized, and non-invasive healthcare solutions. However, updated regulatory frameworks and broader acceptance are essential. Future advancements in AI, data security, and harmonized regulations will further unlock their potential to improve patient outcomes in personalized medicine.

Keywords: DTx 1, SaMD 2, Pear Therapeutics 3, Regulatory Frameworks 4

PCP038

Altered Gut Microbiota and Its Association with Mental Health and Well-being in Primary Care

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Introduction: The gut microbiota plays an important role in immune regulation, metabolic function, and maintaining intestinal and brain health. Disturbance of microbial balance due to diet, gastrointestinal disorders, environmental factors, and especially recent antibiotic use, which markedly reduces beneficial bacterial species, which leads to gut dysbiosis. Dysbiosis alters the gut–brain axis by altering neurotransmitter synthesis, increasing intestinal and blood-brain permeability, and promoting systemic and neuroinflammation. These mechanisms are linked with adverse psychological outcomes, including anxiety, depression; sleep disturbances, reduced happiness, and poorer quality of life. Given the widespread use of antibiotics and the increasing prevalence of mental health disorders, understanding the psychological impact of gut dysbiosis is of greater clinical impact. **Methodology:** A comparative cohort study was conducted in November 2025 among primary-care patients using pre-validated questionnaires, including the Diet Assessment Scale, GAD-7, PHQ-9, Oxford Happiness Questionnaire, EQ-5D-5L, and Pittsburgh Sleep Quality Index (PSQI). Data were analysed using independent t-test and Odds ratio. **Result:** Participants with altered gut microbiota showed significantly higher anxiety, depression, and sleep disturbances, along with lower happiness and quality of life. Mean diet scores did not differ significantly, though unhealthy dietary patterns were more frequent in the altered gut group. **Conclusion:** altered gut flora is highly associated with increased anxiety and depression, poorer sleep, lower happiness and quality of life, which emphasis the crucial role of the gut- brain axis in mental health and overall well-being.

Keywords: Antibiotic Exposure, Anxiety, Depression, Gut–Brain Axis, Gut Dysbiosis

PCP039

siRNA in Precision Oncology: Overcoming Undruggable Targets Across Malignancies

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Introduction: Small interfering RNA (siRNA) therapeutics silence cancer-related genes through RNA interference. By directing the RNA-induced silencing complex to degrade complementary mRNA, siRNA suppresses oncogenic proteins and can reactivate tumor-suppressive pathways. Because it can target otherwise "undruggable" molecules, siRNA supports precision oncology tailored to tumor genetics. **Methods:** This review synthesizes studies identified through PubMed, Google Scholar, and major publishers including Nature, Science, Cell Press, and Elsevier. Searches used terms such as *siRNA delivery*, *RNA interference therapy*, and *siRNA clinical trials*, with additional sources gathered from reference lists. Reported methods include lipid nanoparticles, polymer carriers, viral vectors, and chemically modified siRNA (2′-O-methyl, 2′-fluoro, phosphorothioate) to enhance stability and specificity. Stimuli-responsive and pH-sensitive systems improve tumor-targeted release. Preclinical evaluation spans 2D cultures, 3D organoids, patient-derived xenografts, and humanized models, with artificial intelligence increasingly used for sequence and delivery optimization. **Result:** Advancements in delivery platforms reduce nuclease degradation, improve cellular uptake, and limit off-target and immune responses. Modified siRNA exhibits greater stability and more accurate gene silencing, while stimuli-responsive carriers achieve higher intratumoral accumulation. Across preclinical models, these innovations yield stronger oncogene knockdown, reduced tumor growth, and improved synergy with existing therapies. These improvements have enabled several siRNA candidates to reach clinical trials, where early studies show manageable safety profiles and initial signs of antitumor activity. **Conclusion:** siRNA therapeutics are a promising tool in precision oncology. Although delivery and safety challenges persist, continued innovation is accelerating their clinical translation.

Keywords: RNAi, Cancer, siRNA, Chemical modifications, Vehicles

PCP040

Stress Circuit Dysregulation in Anxiety: Pharmacological Insights of *Piper methysticum* in CUMS Model

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Introduction: Chronic stress profoundly alters neural circuits regulating fear, emotion, and cognition, contributing to anxiety disorders characterized by dysregulated amygdala–prefrontal–hippocampal connectivity. Preclinical model of Chronic Unpredictable Mild Stress (CUMS) paradigm reliably reproduce anxiety-like phenotypes, neuroinflammation, and neurotransmitter imbalance. *Piper methysticum*, a traditional anxiolytic plant, exhibits GABAergic properties and is increasingly investigated as a potential modulator of stress circuits. Accordingly, this review focuses on preclinical evidences evaluating the anxiolytic potential of *Piper methysticum* in CUMS-induced anxiety model. **Methods:** Literature search was done using PubMed, Scopus and ScienceDirect, focusing on studies related to the CUMS paradigm, behavioural validation (EPM, OFT), HPA axis dysregulation, inflammatory cytokines, neurotransmitter systems (GABA, 5-HT, DA) and synaptic proteins in relation to stress circuit modulation and anxiety-like pathology. **Results:** The literature characterizes CUMS-induced anxiety by HPA axis dysregulation, neuroinflammation, and impaired synaptic function. Independent studies suggest *Piper methysticum* possesses relevant GABAergic and anti-inflammatory properties that are relevant to anxiety modulation. However, direct evidence evaluating its potential to modulate these specific pathways within CUMS models is lacking, highlighting a critical research gap regarding its precise molecular mechanisms in chronic stress. **Conclusion:** CUMS model reliably produces key behavioural and neuroinflammatory features of human anxiety, supporting its translational relevance. Current evidence suggests that modulation of stress-responsive neural circuits through regulation of neuroinflammation and neurotransmitter systems represents a strong therapeutic strategy. While *Piper methysticum* is effective, future research is needed to clarify its molecular mechanisms under chronic stress conditions to support its therapeutic development.
Keywords: Anxiety, Chronic Unpredictable Mild Stress, Neuroinflammation, *Piper methysticum*, Stress circuit

PCP041

The Gut-Immune Axis: Dysbiosis as A Pivotal Mediator of Autoimmune Pathogenesis

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Introduction: Autoimmune diseases comprise a diverse class of disorders characterised by a failure of immune tolerance. Increasing evidence suggests that dysbiosis of the gut microbiota plays a crucial role in driving this immune imbalance and the subsequent inflammatory attack on host tissues. The gut microbiome is essential for immune regulation, and its disruption can weaken the intestinal barrier and promote abnormal immune responses. Such dysbiosis may contribute to autoimmunity through mechanisms like increased gut permeability and molecular mimicry. This poster highlights key links between gut dysbiosis and major autoimmune diseases. **Methods**: Research was conducted from PubMed, Web of Science, and Google Scholar. Original research, meta-analyses, and clinical trials examining microbial signatures, mechanistic pathways, and therapeutic interventions were selected to carry out this review. **Results:** The reviewed studies consistently demonstrate that autoimmune diseases are linked to clear changes in the gut microbiota, with a loss of beneficial bacteria and a rise in pro-inflammatory microbes. These changes weaken the gut barrier, allowing microbial products to trigger ongoing immune activation. Dysbiosis promotes pro-inflammatory Th17 responses while reducing regulatory T cell activity, which worsens autoimmune disease. Approaches that target the gut microbiota, such as probiotics and dietary interventions, show promise in restoring balance and reducing inflammation; however, responses vary between diseases. **Conclusion:** Alterations in the gut microbiome act as a primary etiological factor in autoimmune pathogenesis, triggering metabolic and immunologic dysregulation instead of simply occurring as a result of it. Targeting the restoration of the commensal ecosystem offers a viable therapeutic avenue. However,

Clinical application requires correlational observations to the establishment of mechanistic causality, alongside the development of standardised protocols for microbial therapeutics.

Keywords: Gut Dysbiosis, Autoimmune Disease, Short-chain Fatty Acids (SCFAs), Autoimmunity, Immune Homeostasis

PCP042

Therapeutic Targeting of α-Synuclein Hotspots: Advances in Peptide-Based and Molecular Strategies for Parkinson's Disease

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Introduction: Parkinsons disease is a progressive neurodegenerative disorder characterized by dopaminergic neuronal loss and pathological accumulation of misfolded alpha synuclein, which forms fibrillar aggregates that disrupts mitochondrial integrity and synaptic communication. Since current therapies of Parkinson's offer only symptomatic relief, there is a critical need for disease modifying strategies that can directly target alpha synuclein. **Methods:** This review summarizes the evidence from molecular docking, MD simulations, in vitro and vivo models employing toxin-induced paradigms of PD. These investigations assess whether peptides, peptidomimetics replicating α-synuclein interfacial motifs, and immunotherapeutic strategies can block the aggregation of alpha synuclein, suppress beta sheet formation, inhibit membrane associated dimerization or enhance microglial clearance of aggregated alpha synuclein. **Results:** Across the literature, peptidomimetic scaffolds that mimic critical α-synuclein interface regions show the ability to disrupt membrane-embedded dimers and suppress oligomer propagation while immunotherapeutic increases the uptake of pathological alpha synuclein by microglia and also increases its lysosomal breakdown. Additionally, positively charged peptide scaffolds and structurally optimized mimetics consistently interact with key C-terminal residues and aggregation-prone NAC residues, stabilizing monomeric conformations, reducing local residue mobility, decreasing and preventing nucleation and fibril elongation. Therefore, these methods combined can stop the prion like transmission of the protein. **Conclusion:** Collectively, the integrated evidence identifies the C-terminal domain, NAC core as a highly druggable regions whose structural manipulation can prevent aggregation, dismantle pathological fibrils, and interrupt intercellular transmission. These convergent findings strongly support the development of targeted peptides, peptidomimetics, and immunotherapeutic as promising disease modifying approaches for Parkinson's disease.

Keywords: Parkinson's disease, Peptide therapeutics, Peptidomimetics, Protein misfolding, Neurodegeneration

PCP043

Preclinical Evaluation of Herbal Extracts in Complete Freund's Adjuvant-Induced Rheumatoid Arthritis in Rats

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Introduction: Rheumatoid arthritis (RA) is a chronic autoimmune inflammatory disorder characterized by progressive joint destruction, immune dysregulation, and systemic complications. Activation of innate immune receptors, particularly Toll-like receptor-4 (TLR-4) and the NLRP3 inflammasome, plays a critical role in cytokine release, oxidative stress, and disease progression. Limitations associated with conventional therapies highlight the need for safer, plant-based therapeutic alternatives. This preclinical study evaluates the anti-inflammatory potential of selected phytochemical-rich plant extracts targeting key inflammatory signaling pathways. **Methods:** Phytochemical profiling was performed using thin-layer chromatography to identify major bioactive constituents. Methanolic extracts of Cichorium intybus root and Kigelia pinnata fruit, along with Cedrus deodara wood oil, were evaluated for phenolic and terpenoid content. Antioxidant activity was assessed using free radical scavenging and reducing power assays. A 2^5 factorial design was employed in a Complete Freund's Adjuvant–induced

arthritis rat model. Extracts were administered orally at doses of 30, 100, and 300 mg/kg for 28 days. Inflammatory biomarkers, hematological indices, oxidative stress parameters, and histopathological alterations were analyzed. **Results:** The extracts demonstrated significant antioxidant activity and dose-dependent anti-inflammatory effects. Treatment at 300 mg/kg significantly reduced pro-inflammatory cytokines, improved hematological parameters, and attenuated oxidative stress. Histopathological analysis revealed reduced inflammatory cell infiltration and minimal connective tissue proliferation. **Conclusion:** These findings indicate that phytochemical-rich extracts exert protective anti-inflammatory effects through modulation of TLR-4 and NLRP3 signaling pathways, supporting their therapeutic potential in rheumatoid arthritis.

Keywords: Rheumatoid arthritis, Phytochemicals, TLR-4, NLRP3 inflammasome, Anti-inflammatory activity

PCP044

Digital Therapeutics (DTx): Transforming Patient Care in The Digital Era

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Introduction: Digital therapeutics (dtx) are clinically recognized, evidence-based software treatments for managing, preventing, or treating illnesses. Digital therapies provide a patient-centered, scalable, and customized approach to healthcare in light of the rising incidence of chronic illnesses, mental health conditions, and prescription non-adherence. Their clinical usage has accelerated due to developments in artificial intelligence, mobile technology, and real-world data analytics. **Methods:** First, by making it possible to continuously monitor clinical parameters like blood pressure, blood glucose, and physical activity, digital treatments enhance the management of chronic diseases. This enables prompt therapy modifications and early diagnosis of disease worsening. Second, by providing digital coaching, feedback systems, and reminders, digital therapeutics improve prescription adherence, which lowers missed doses and improves treatment results. Digital treatments provide organized interventions like cognitive behavioral therapy (CBT) in mental health care, assisting patients in managing illnesses including ADHD, depression, anxiety, and insomnia in a scalable and accessible way. **Results:** The review showed that digital treatments have been effectively used in a variety of therapeutic domains, such as chronic pain, diabetes, mental health issues, cardiovascular illness, and respiratory disorders. Improvements in medication adherence, illness management, patient engagement, and quality of life were demonstrated by clinically verified dtx. **Conclusion:** By adding individualized, data-driven interventions to traditional medication, digital therapies provide a prospective improvement in patient care. Dtx has shown considerable promise to enhance therapeutic outcomes despite obstacles pertaining to data privacy, regulatory complexity, and long-term clinical validation.

Keywords: Digital Therapeutics, Patient Care, Chronic Disease Management, Medication Adherence, Personalized Healthcare

PCP045

A Systematic Review of Artificial Intelligence in Predicting Drug Drug Interactions

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Introduction: Adverse drug reactions resulting from drug-drug interactions (DDIs) represent a significant challenge in clinical pharmacology, particularly with the rising prevalence of polypharmacy. Traditional methods for identifying these interactions, such as clinical trials and post-marketing surveillance, are often time-consuming, expensive, and limited in scope. Recently, Artificial Intelligence (AI) and Machine Learning (ML) have emerged as powerful tools to predict potential interactions by analyzing complex biomedical data. This systematic review aims to evaluate the current state of AI-driven methodologies for DDI prediction, assessing their predictive performance, data sources, and applicability in real-world clinical settings. **Methods:** A systematic literature search was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-

Analyses) guidelines. Databases including PubMed, IEEE Xplore, Scopus, and Web of Science were queried for peer-reviewed articles published between 2018 and 2024. Keywords included "Artificial Intelligence," "Deep Learning," "Drug-Drug Interaction," "Neural Networks," and "Machine Learning." The inclusion criteria focused on studies utilizing computational models to predict DDIs based on structural, genomic, or textual data. Data extraction focused on model architecture, validation datasets (e.g., DrugBank, TWOSIDES), performance metrics (Accuracy, AUC, F1-score), and the implementation of Explainable AI (XAI) techniques. **Results:** The search identified 1,250 initial records, of which 58 studies met the full inclusion criteria. The review reveals a distinct shift from traditional machine learning classifiers (e.g., Random Forest, SVM) toward advanced Deep Learning architectures. Graph Neural Networks (GNNs) and their variants were the most frequently employed models (45% of studies), demonstrating superior performance in capturing molecular structural information. The majority of reviewed models reported high predictive accuracy, with Area Under the Curve (AUC) values frequently exceeding 0.95. However, the results also highlight a critical gap in external validation, as most models were trained on relatively homogenous datasets like DrugBank, potentially limiting their generalizability to novel, real-world drug combinations. **Conclusion:** Artificial intelligence has demonstrated exceptional capability in predicting drug-drug interactions, offering a cost-effective and scalable alternative to traditional screening methods. Deep learning models, particularly graph-based approaches, currently represent the state-of-the-art in this domain. Despite these advancements, the clinical adoption of these tools remains hindered by the "black-box" nature of complex algorithms and a lack of standardized external validation. Future research must prioritize the development of interpretable models (XAI) and the integration of diverse, real-world clinical data to bridge the gap between computational prediction and patient safety.

Keywords: Artificial Intelligence, Drug-Drug Interactions, Deep Learning, Pharmacovigilance, Systematic Review

PCP046

Medication Errors in In-Patient Care: A Patient Safety and Sustainable Healthcare Perspective with Clinical Pharmacist Interventions

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Introduction: Medication errors cause significant preventable patient harm and resource inefficiency. Analyzing error patterns and near-misses identifies system-level vulnerabilities to strengthen patient safety. This study assessed medication error patterns, severity, process stages, high-alert medication involvement, and system gaps addressable through clinical pharmacist-led interventions. **Methods:** A retrospective observational study was conducted in wards and intensive care units of a tertiary care teaching hospital. A total of 454 medication-related incidents reported over three months were reviewed. Non-clinical variables were standardized and missing data labeled. Errors were classified by process stage, location, staff involvement, and severity using the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) Index (Categories A–E). High-alert medication involvement was assessed using descriptive statistics. **Results:** Among 454 incidents, most were NCC MERP Category B (49%), followed by Category C (45%), while clinically significant harm was rare (Category D and E: <3%). Transcription errors predominated, followed by administration errors. High-alert medications were involved in 38% of incidents, commonly potassium chloride, broad-spectrum antibiotics, thyroid hormones, and anticoagulants. General wards and specific intensive care units reported higher frequencies, with medical officers and nursing staff most frequently involved. **Conclusion:** The predominance of near-miss events highlights an active safety reporting culture. However, frequent transcription errors and substantial high-alert medication involvement reveal persistent system-level vulnerabilities. Strengthening standardized prescribing, enforcing independent double-verification for high-risk drugs, and integrating clinical pharmacists into medication reviews are essential to reduce preventable harm and support sustainable in-patient care.

Keywords: Clinical pharmacy, High-alert medications, Medication errors, Patient safety, Sustainable healthcare

PCP047

Monitoring of Adverse Drug Reactions Post Phototherapy in Neonates with Jaundice

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Introduction: Neonatal jaundice, affecting up to 80% of newborns, is primarily managed with phototherapy to prevent kernicterus by converting unconjugated bilirubin into excretable isomers. However, potential adverse drug reactions (ADRs) post-phototherapy, especially in preterm infants, are underreported in resource-limited settings like India. This study aimed to monitor ADRs in neonates receiving phototherapy for physiological jaundice, assess their nature, severity, and causality, and identify risk factors. **Methods:** A prospective observational study was conducted in the paediatric department of Aster RV Hospital, Bengaluru, over six months. Eighty-five neonates (≤28 days old, with physiological jaundice, first-time phototherapy) were enrolled after informed consent. Monitoring occurred for 72 hours post-phototherapy, with demographic, clinical, and ADR data collected. Causality was evaluated using the Modified Naranjo scale, severity was assessed via the Hartwig-Siegel scale, and the data were analysed descriptively. **Results:** Among 85 neonates (55.3% female, 62.35% term, mean birth weight 2.89 ± 0.087 kg), 19 (22.35%) developed 29 ADRs. Common ADRs included rashes (36.84%), weight loss (31.57%), and hyperthermia (31.57%). ADRs were more prevalent in males (57.9%) and preterm neonates (52.63%). Causality assessment revealed 68.42% probable and 31.57% definite. Severity was mild (Level II) in 52.63% and moderate (Level III) in 47.37%. All ADRs were resolved with monitoring. **Conclusion:** Although phototherapy is effective for neonatal jaundice, it induces ADRs in over one-fifth of cases, particularly among preterm males. These findings underscore the need for enhanced pharmacovigilance and tailored protocols to minimise risks and enhance neonatal safety.

Keywords: Adverse drug reactions, Causality assessment, Neonatal jaundice, Phototherapy, Severity assessment

PCP048

A Study of Pediatric Drug Dosing Practices in Respiratory Infections

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Introduction: Children with respiratory infections require special attention when medicines are prescribed. Their bodies are still developing, and age and weight directly influence how medications are absorbed, distributed, and eliminated. Because of this, selecting the correct dose is essential to avoid side effects and ensure effective treatment. Studying real prescribing patterns helps identify whether healthcare professionals are following standard pediatric dosing guidelines in daily practice and highlights areas where improvement may be needed. **Methods:** A study was conducted in two private clinics. Pediatric patients diagnosed with respiratory infections were included, and data were collected from caregivers and medical records using a structured form. Information on age, weight, diagnosis, prescribed drugs, dose, frequency, route, and duration was recorded. Each dose was compared with standard age- and weight-based pediatric dosing references. Data were analyzed using simple descriptive statistics. **Results:** A total of 68 patients were included, with a mean age of 48.10 ± 47.91 months. Infants made up the largest group. Antibiotics were prescribed most often, and most doses matched recommended pediatric guidelines. As the study is still in progress, numbers and results will be revised later. **Conclusion:** Most prescriptions in this study were dosed correctly for children with respiratory infections, which is encouraging for patient safety and successful treatment. Following dosing guidelines helps prevent over- or under-medication, supports faster recovery, and lowers the risk of adverse effects. The findings also highlight the importance of regularly reviewing prescriptions to maintain good clinical practices and continue improving the overall standard of pediatric care.

Keywords: Pediatrics; Respiratory infections; Drug dosing; Prescribing patterns; Dosing guidelines

PCP049

Integrative In Silico Profiling Reveals ERK2, GBA1, and AGE–RAGE Signaling as Core Targets of DNA Polymerase Enzyme Inhibitor in Parkinson's Disease

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Introduction: Parkinson's disease (PD) is a neurodegenerative disorder of a progressive nature, characterized by loss of dopaminergic neurons, abnormalities in mitochondria and the presence of chronic oxidative stress. Recent evidence reveals that defects in genomic maintenance and impaired DNA repair may play a role in the demise of neurons. Inhibition of DNA polymerase enzymes has been considered a potential means of modulating the cellular stress response, thereby leading to the molecular evaluation of their relevance in PD. Accordingly, DPI was examined through a network-based in silico method to understand its mechanistic connections with the genes and the signaling pathways related to PD. **Methods:** The ligand structure of various DPIs was fetched from PubChem. The potential protein targets of DPI were predicted using SwissTargetPrediction. Genes associated with PD were obtained from the KEGG database, and all the disease associations of these genes were gathered using DisGeNET. The overlapping targets of DPI and PD were shortlisted. These targets related to PD were subjected to molecular docking using the GOLD docking platform for the analysis of binding affinity and the interaction profiles. The final step was pathway enrichment of the top-ranked targets using KEGG Mapper to figure out the neurodegenerative signaling routes related to DPI. **Results:** Docking analysis demonstrated that the binding scores were both stable and favorable for various PD-linked targets. Among all the interactions, DPI exhibited a very strong affinity for ERK2 and GBA1, thus, these two proteins can be considered as the most likely be involved in the neuroprotective mechanisms of DPI. The pathway mapping indicated that the AGE–RAGE signaling pathway was the most significantly enriched one, which suggests its involvement in the process of oxidative stress–driven neuronal damage. **Conclusion:** This combined network pharmacology and docking investigation has pinpointed ERK2 and GBA1 as the principal DPI-related targets in PD. The implication of the AGE–RAGE pathway as a source of DPI influence on oxidative-stress-related mechanisms not only explains the finding but also paves the way for DPI as a candidate molecule in PD research, worthy of further experimental validation.

Keywords: Parkinson's disease (PD); DNA Polymerase Enzyme Inhibitor (DPI); AGE–RAGE signaling pathway (AGE–RAGE).

PCP050

Iron-Dependent Cell Death in Parkinson's Disease: Ferroptosisα-Synuclein, Lipid Peroxidation Feed-Forward Loop

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Introduction: Parkinson's disease (PD) represents a relentlessly advancing neurodegenerative condition defined by the targeted loss of dopamine-producing neurons within the substantia nigra pars compacta. Although mitochondrial impairment, reactive oxygen species overload, and the buildup of α-synuclein protein stand as longstanding signatures of PD, recent studies underscore ferroptosisa form of programmed cell death reliant on iron and fueled by lipid peroxidationas a pivotal underlying process. Crucially, ferroptosis likely extends beyond a final execution mechanism, instead fueling α-synuclein dysfunction via reactive aldehydes generated from lipid peroxidation, thereby creating a vicious, self-reinforcing cycle of neuronal toxicity. **Materials and Methods:** This poster is based on a comprehensive review of experimental, preclinical, and postmortem studies investigating ferroptosis-associated pathways in PD. Relevant literature was systematically retrieved from PubMed, Scopus, and Google Scholar. **Results:** Evidence across cellular and animal models indicates that iron dyshomeostasis in PD promotes ferroptosis through excessive lipid peroxidation of polyunsaturated neuronal membranes. Reactive lipid aldehydes, including 4-hydroxynonenal (4-HNE) and malondialdehyde (MDA), covalently modify α-synuclein,

enhancing its misfolding, oligomerization, and aggregation. In turn, aggregated α-synuclein disrupts mitochondrial function and iron handling, exacerbating reactive oxygen species generation and further amplifying ferroptotic signalling. Impairment of key antioxidant defences, including glutathione depletion and reduced glutathione peroxidase-4 (GPX4) activity, accelerates this process. This establishes a bidirectional feed-forward loop in which ferroptosis promotes α-synuclein aggregation, while α-synuclein pathology reinforces ferroptotic vulnerability. Dopaminergic neurons are particularly susceptible due to high intrinsic iron levels, dopamine auto-oxidation, and lipid-rich membranes. **Conclusion:** The ferroptosisα-synucleinlipid peroxidation feed-forward loop represents a mechanistically integrated and pathophysiologically relevant framework for understanding dopaminergic neurodegeneration in PD. Rather than acting solely as a downstream consequence, ferroptosis may function as an upstream driver that accelerates protein aggregation, mitochondrial failure, and neuronal loss. Targeting this vicious cycle through iron modulation, lipid peroxidation inhibitors, and restoration of redox homeostasis offers promising disease-modifying therapeutic opportunities in PD.

Keywords: Ferroptosis, α-Synuclein Aggregation, Lipid Peroxidation, Iron Dyshomeostasis, Parkinson's Disease.

PCP051

Development of a Predictive Model for Seasonal Antimicrobial and Antihistamine Demand Using Machine Learning

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Background: Seasonal variations in infectious and allergic diseases influence drug utilization patterns in India, particularly for antibiotics and antihistamines. While antihistamines are appropriately used for allergic rhinitis and seasonal allergies, antibiotics are frequently irrationally prescribed or consumed for viral and self-limiting respiratory conditions. Indian studies have reported high levels of inappropriate antibiotic use due to over-the-counter availability, patient expectations, and limited awareness of antimicrobial resistance (AMR). To address this growing public health concern, the Government of India introduced the National Action Plan on Antimicrobial Resistance (NAP-AMR). Evaluating real-world seasonal utilization trends of antibiotics in comparison with antihistamines can provide evidence to support rational pharmacotherapy and antimicrobial stewardship. **Objective:** To analyze month-wise and seasonal utilization patterns of antibiotics and antihistamines over two years and generate real-world evidence to strengthen antimicrobial stewardship and support rational antibiotic prescribing in India. **Methodology:** Retrospective digital records from three community pharmacies were integrated from MDB, XLS, and IDF formats into a standardized CSV dataset. Exploratory analysis of 522,968 records assessed data quality. Preprocessing involved null handling, normalization, and drug class standardization. AI-assisted tools enabled pattern recognition, feature engineering, and visualization of seasonal trends, cost distribution, and comparative real-world use of antimicrobials and antihistamines. **Result & Conclusion:** Among 522,968 records, antimicrobial utilization exceeded antihistamine use. Antihistamine consumption peaked during monsoon months, whereas antimicrobial use remained high year-round, indicating possible inappropriate antibiotic use and the need for stronger antimicrobial stewardship.

Keywords: AI, Data Visualization, Antimicrobial Resistance, Antihistamines, Python & Seasonal Trends

PCP052

UTI Outpatient Management and Pharmaceutical Care: Knowledge, Attitude, Practices (KAP), and Antibiotic Trends

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Background: Urinary tract infection (UTI) represents one of the most prevalent bacterial infections, involving the kidneys, ureters, bladder, or urethra. It remains a significant cause of morbidity, particularly in developing regions, and affects individuals of both sexes across all age groups. Diagnosis is routinely established through urine analysis, and UTIs are categorized as uncomplicated or complicated. Escherichia coli is the predominant etiological agent. Antibiotic therapy is the primary treatment modality, contributing to symptom resolution and reduction in recurrence. **Aim and objective:** To evaluate the knowledge, attitude, and practice (KAP) of outpatients diagnosed with urinary tract infections (UTIs), analyse antibiotic prescribing patterns, and identify the most frequently isolated causative bacterial pathogens involved in UTI. **Methodology**: A cross-sectional observational study was conducted among 90 UTI outpatients from two private hospital outpatient departments who met the eligibility criteria. Following study objectives and tools, including a structured KAP questionnaire were developed and conducted,antibiotic prescribing patterns were evaluated using the case report forms (CRFs). Participants completed the KAP questionnaire, scored using a Likert scale.Statistical analysis was performed using descriptive and inferential methods with Microsoft Excel and SPSS. **Results:** Females constituted 88.9% of the study population, with the highest prevalence observed in the 45–54-year age group (30%).While most patients recognized UTI symptoms,only 40% understood the causes, and 33.3% were aware of preventive measures.Attitude assessments showed that many patients were hesitant to discuss symptoms with healthcare providers and practice evaluation indicated adequate hygiene but poor hydration and delayed healthcare seeking. Escherichia coli was the predominant pathogen (71.1%), with Ciprofloxacin and Nitrofurantoin being the most frequently prescribed antibiotics. Analysis (n=90) demonstrated a moderate negative Spearman's correlation between age and KAP scores ($\rho<0$) and a strong positive correlation between educational status and KAP scores ($\rho>0$). **Conclusion:** Urinary tract infections (UTIs) are among the most common bacterial infections. This study reveals that commonly both genders often have lack of knowledge, attitude, and practice (KAP) regarding UTIs, leading to poor hygiene, delayed care, and increased complications. Additionally, culture sensitivity test is the best practice in terms of confirmation of specific causative bacterial pathogens. Educational and awareness programs have proven effective in improving hygiene practices and preventing UTIs. Enhancing awareness of UTI risk factors and prevention strategies can promote positivity in knowledge and practices, ultimately reducing the burden of UTIs and improving quality of life.

Keywords: Knowledge, Attitude and Practice (KAP), Prescribing patterns, Urinary Tract Infection, Outpatient.

PCP053

Diabetic Cardiomyopathy: Current and Future Targets, Beyond Glycemic Control

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Introduction: The diabetes has increased worldwide and doubled over the last two decades. Cardiomyopathy occurred due to abnormal myocardial structure and performance in the absence of other cardiac risk factors, such as coronary artery disease, hypertension, and significant valvular disease. Diabetes affects every organ in the body. **Methods**: Research was conducted from PubMed, Web of Science, and Google Scholar. Original research, meta-analyses, and clinical trials examiningmicrobial signatures, mechanistic pathways, and therapeutic interventions were selected tocarry out this review. **Results:** The reviewed studies consistently demonstrate thatchange in the metabolic status, impaired calcium homeostasis and energy production, increased inflammation and oxidative stress, as well as an accumulation of advanced glycation end products are among the mechanisms implicated in the pathogenesis of diabetic cardiomyopathy. There are many hypotheses and well-evidenced mechanisms by which diabetic cardiomyopathy as an entity develops. Diabetic cardiomyopathy found to be associated with abnormality in cardiac structure and morphological changes like(myocardial hypertrophy, left ventricular dysfunction, myocardial fibrosis), hypertension. The major etiological factors are oxidative stress, RAAS, myocardial hypertrophy, inflammation, myocardial lipotoxicity,mitochondrial dysfunction, microcirculation impairment in the myocardium, abnormal myocardial calcium handling, insulin resistant. **Conclusion:** This review focuses on pathophysiology of diabetic cardiomyopathy, treatment and novel target to develop management strategy.

Keywords: Diabetic cardiomyopathy, Insulin resistance, Oxidative stress, Mitochondrial dysfunction, Cardiac fibrosis

PCP054

TLR4/NF-κB Signaling in Acute Pancreatitis: Insights from L-Arginine Models and Therapeutic Potential of Polyphenols

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Introduction: Acute pancreatitis (AP) is an inflammatory disorder of the pancreas characterized by premature activation of digestive enzymes, oxidative stress, and cytokine-mediated tissue injury. The disease progresses from local acinar cell injury to systemic inflammatory response and may lead to multi-organ dysfunction in severe cases. The L-arginine–induced model is widely used to elucidate molecular mechanisms of pancreatic inflammation, particularly the role of Toll-like receptor-4 (TLR4)/nuclear factor-κB (NF-κB) signaling. **Methods:** In this review, the literature search was conducted using PubMed and Google Scholar to collect information on acute pancreatitis, L-arginine–induced acute pancreatitis, oxidative stress mechanisms, TLR4/NF-κB signaling, and the therapeutic relevance of polyphenolic compounds in pancreatic inflammation. **Results:** The literature suggests that L-arginine administration induces oxidative stress and damage-associated molecular signaling, leading to TLR4 activation and subsequent NF-κB-dependent transcription of pro-inflammatory cytokines, including tumor necrosis factor-α, interleukin-1β, and interleukin-6. Activation of this pathway contributes to inflammatory amplification and pancreatic tissue injury. Polyphenols have been widely reported to exert anti-inflammatory and antioxidant effects by suppressing TLR4 expression, inhibiting NF-κB activation, and reducing reactive oxygen species generation **Conclusion:** The literature suggestsTLR4/NF-κB signaling as a therapeutic target in acute pancreatitis, with polyphenols emerging as promising modulators of pancreatic inflammatory responses.

Keywords: Acute pancreatitis; L-arginine-induced pancreatitis, Polyphenols, TLR4/NF-κB pathway, Oxidative stress

PCP055

Molecular Insights into the Anti-Inflammatory and Metabolic Targets of *Terminalia chebula* in Polycystic Ovary Syndrome: An In Silico Network Pharmacology Approach

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Introduction: Polycystic ovary syndrome (PCOS) represents a common endocrine-metabolic disorder marked by hyperandrogenism, insulin resistance, ovulatory dysfunction, and chronic low-grade inflammation. Dysregulation of AMPK signaling impairs energy homeostasis, while hyperactivation of NF-κB pathways drives inflammatory cascades central to PCOS progression. Phytoconstituents from Terminalia chebula (TC)—gallic acid, corilagin, chebulic acid, ellagic acid, and chebulinic acid—exhibit anti-inflammatory and metabolic properties, justifying in silico exploration of their therapeutic potential against PCOS via network pharmacology approaches. **Materials and Methods:** Ligand structures of TC phytoconstituents were obtained from PubChem. Target predictions employed SwissTarget Prediction. PCOS-related genes were curated from KEGG and DisGeNET databases, with overlapping targets shortlisted. Molecular docking of shared targets used the GOLD platform to determine binding affinities and interaction modes. Top-ranked targets underwent KEGG Mapper pathway enrichment to delineate modulated signaling networks. **Results:** Docking revealed robust binding affinities, particularly of gallic acid and ellagic acid to AMPK activators and NF-κB inhibitors. Enrichment analysis highlighted AMPK pathway activation for metabolic correction and NF-κB suppression for inflammation mitigation, alongside intersections with insulin and androgen signaling, positioning TC compounds as multi-target modulators in PCOS. **Conclusion:** This network pharmacology and docking analysis identifies AMPK and NF-κB as primary TC phytoconstituent-modulated pathways in PCOS. The results support the potential of *Terminalia chebula* compounds in mitigating hyperandrogenism and inflammation, warranting further in vitro and in vivo validation for PCOS therapeutics.

Keywords: Polycystic Ovary Syndrome, PCOS,AMPK, NF-κB, molecular docking, network Pharmacology, *Terminaliachebula*

PCP056

Assessment of Cardiovascular Disease Related Distress and Psychosocial Determinants: A prospective Observational Study

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Introduction: Acute Coronary Syndrome (ACS) is a sudden and life-threatening cardiac condition that is frequently accompanied by psychological distress. Although advancement in therapeutic strategies has improved survival; recovery may remain incomplete if the emotional and psychosocial burden experienced by patients is not addressed. This concern is particularly relevant in ACS due to its abrupt onset and perceived severity. Given the high prevalence of ACS patients in the study setting, assessing distress levels and psychosocial determinants in this population is essential to enable patient-centred and need-based care. **Method:** A prospective observational study was conducted over five months at a tertiary care hospital after ethical approval. A total of 105 ACS patients were enrolled. Data were collected through one-to-one interviews. Distress was assessed using the Cardiac Distress Inventory (CDI) with Indian-adapted factors. Descriptive statistics and non-parametric modelling were used. **Result:** Distress differed significantly across factors ($\chi^2 = 830$, df = 9, $p < 0.001$). Highest distress was seen in Fear and Uncertainty (F-1; median 996), followed by Changes in roles and relationships (F-3; 128) and Overwhelm and Depletion (F-4; 108). Health system challenges (F-7; 16.4) and Pharmacist & Medication management (F-A; 15.4) showed minimal distress. Socioeconomic class was significantly associated with Economic impact (F-B; $p < 0.001$). **Conclusion:** Distress in ACS patients varied across different areas rather than being the same everywhere. Differences between socioeconomic groups were mainly seen in certain factors. These finding show the importance of identifying specific distress areas to provide focused patient specific care.

Keywords: Acute Coronary Syndrome, Cardiovascular distress, Psychosocial determinants, Socioeconomic class

PCP057

Heat Shock Factor 1 Pathway Inhibitors as Next-Generation Modulators of Cellular Stress Responses in Oncology and Beyond

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Introduction: Heat Shock Factor 1 (HSF1) is a master transcription regulator controlling heat shock protein expression critical for cellular proteostasis. HSF1 offers a therapeutic paradox: its activation protects normal cells and is neuroprotective in neurodegenerative diseases, while its inhibition shows promise in cancer treatment. **Methods**: Review was conducted from PubMed, Web ofScience, and Google Scholar. Original research, meta-analyses, and clinical trials examiningmicrobial signatures, mechanistic pathways, and therapeutic interventions were selected tocarry out this review. **Results:** The reviewed studies demonstrate thatthe activation of HSF1 holds therapeutic potential in the treatment of neurodegenerative disorders. Increased levels of HSF1 help reduce α-synuclein toxicity in Parkinson's disease, stop Tau buildup in Alzheimer's disease, and prevent protein clumping in Huntington's disease. HSF1 helps protect the heart from damage caused by heart attacks and sepsis by blocking the activity of the NLRP3 inflammasome, a protein complex involved in inflammation. HSF1 inhibition demonstrates efficacy against multiple malignancies including breast cancer, hepatocellular carcinoma, multiple myeloma, pancreatic cancer, and prostate cancer. Cancer cells exhibit non-oncogenic addiction to HSF1 for survival through enhanced heat shock protein expression, DNA repair, and multidrug resistance activation. **Conclusion:** The HSF1 exhibit remarkable flexibility, leading to distinct biological outcomes that vary according

to the cellular level, cell type, and nature of the stress stimulus. HSF1 modulation represents a precision oncology approach requiring careful patient stratification and combination therapies to maximize efficacy while minimizing toxicity to normal tissues.

Keywords: Heat Shock Factor; Proteostasis; Neurodegeneration: Cancer Therapy; Therapeutic Paradox

PCP058

Therapeutic Potential of Huperzine A as a Multitarget Modulator in Alzheimer's Disease

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Introduction: Alzheimer's disease (AD) is a progressive neurodegenerative disorder marked by cognitive impairment, memory loss, and decline in activities of daily living. Current pharmacological interventions primarily provide symptomatic relief, with acetylcholinesterase inhibitors serving as first-line therapy. However, the multifactorial nature of AD pathogenesis highlights the need for therapeutic agents with broader mechanisms of action. Huperzine A, a natural Lycopodium alkaloid derived from Huperzia serrata, has gained attention for its combined cholinergic and neuroprotective properties. **Methods:** This abstract is based on an integrated review of experimental and clinical studies examining the pharmacological actions of huperzine A. Evidence related to acetylcholinesterase inhibition, mitochondrial protection, oxidative stress regulation, β-amyloid–mediated neurotoxicity, and clinical cognitive outcomes was systematically analyzed. **Results:** Huperzine A functions as a potent, selective, and reversible acetylcholinesterase inhibitor, enhancing cholinergic neurotransmission and improving cognitive performance in patients with mild to moderate AD. Beyond its classical mechanism, preclinical findings demonstrate that huperzine A reduces β-amyloid–induced neuronal damage, mitigates oxidative stress, preserves mitochondrial function, and limits neuronal apoptosis. Additional studies suggest beneficial effects on synaptic integrity and neurotrophic signaling. Clinical trials report improvements in memory and activities of daily living with fewer peripheral cholinergic adverse effects compared with conventional acetylcholinesterase inhibitors. Advances in controlled-release and alternative drug-delivery systems further support its therapeutic potential. **Conclusion:** Huperzine A emerges as a promising multitarget therapeutic agent for Alzheimer's disease, offering both symptomatic cognitive improvement and potential disease-modifying neuroprotection. Continued well-designed clinical trials are essential to define its long-term efficacy and role in AD management.

Keywords: Alzheimer's disease, Huperzine A, acetylcholinesterase inhibition, neuroprotection, cognitive impairment

PCP059

A Cross-Sectional Observational Study to Assess Clinical Manifestations, Risk Factors, Prevalence and Severity of Alcohol Withdrawal Syndrome at a Tertiary Care Hospital.

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Introduction: Alcohol Withdrawal Syndrome (AWS) is a common and Potentially life- threatening Condition Observed in Tertiary Care Hospitals following Abrupt Cessation or Reduction of Prolonged Alcohol use. The Severity of AWS Varies Widely and is influenced by Demographic, Clinical, and Psychiatric factors, Especially Comorbid Depression and Schizophrenia. Limited hospital- based data are available from Indian settings, which calls for a systematic evaluation. **Method:** A cross- sectional observational study was conducted among 120 alcohol- dependent psychiatric patients admitted to a tertiary care hospital. Clinical and demographic data were collected from patient records. The severity of alcohol withdrawal was assessed using the Clinical Institute

Withdrawal Assessment for Alcohol- Revised (CIWA- Ar) scale. Risk factors, clinical manifestations, and psychiatric comorbidities were analysed descriptively. **Results:** Alcohol withdrawal symptoms were observed in approximately 50–60% of alcohol- dependent Patients. Clinically Significant AWS was identified in 38% of the cases, while nearly 12% Developed Severe Clinical Manifestations Such as Seizures and Delirium tremens, with delirium tremens occurring in less than 5% of cases. Middle- aged Males (35–50 years) comprised the Most Affected Group. Major Risk Factors included Chronic Alcohol Use, Previous withdrawal episodes, liver and Cardiovascular disorders, and Psychiatric Comorbidities. Patients with Depression and Schizophrenia showed greater Symptom Severity, increased Suicidal Risk, and longer hospital stays. Among the 120 participants, 94. 16% (N = 113) were Males. Conversely, 5. 83% (N = 07) were Females. A total of 97 participants (80. 83%) were diagnosed with AWS, 8 participants (6. 66%) had AWS with schizophrenia, and 15 participants (12. 5%) had AWS with depression. According to the CIWA- Ar Scale, Most Patients50% exhibited Mild withdrawal symptoms, while 40% experienced Moderate severity, and only 10% presented with Severe withdrawal symptoms. **Conclusion:** AWS remains a significant clinical burden in tertiary care settings. Early identification using standardised tools such as the CIWA- Ar, along with integrated Medical and Psychiatric Management, is essential to Prevent Severe Complications and Improve Patient Outcomes.

Keywords: Alcohol withdrawal syndrome, CIWA- Ar, Depression, Schizophrenia, Prevalence, Severity.

PCP060

A Cross-Sectional Observational Study to Assess Risk Factors, Prevalence and Quality of Life in Pregnant Women with Anemia at a Tertiary Care Hospital

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Introduction: Anemia during Pregnancy Remains a Significant Public Health Concern in Developing Countries and is Associated with Adverse Maternal and Fetal Outcomes. In Addition to Hematological Complications, Anemia Negatively Affects the Physical, Psychological and Social well-being of pregnant women. Assessing its Prevalence, Contributing Risk Factors and Impact on Quality of life is Essential for Improving Antenatal Care. **Method:** A Cross-Sectional Observational Study was Conducted among Pregnant women Diagnosed with Anemia Attending the Outpatient department of a Tertiary care Civil Hospital after Obtaining Ethical Approval. Participants were selected based on Predefined Inclusion and Exclusion Criteria. Demographic, Obstetric and Hematological data were collected from Patient records. Quality of life was assessed using the Quality of Life in Pregnancy (QOL-GRAV) Scale. Descriptive Statistics and Correlation Analysis were performed. **Results:** The Study revealed a High Prevalence of Anemia among Pregnant women, with Iron Deficiency anemia being the Most Common type. Major Risk factors Identified included inadequate Nutritional intake, low socioeconomic Status and lack of Regular Antenatal iron Supplementation. A weak but statistically Significant Negative Correlation was Observed between Advancing Trimester and Quality of life, indicating a Gradual decline in Physical Comfort and Emotional well-being as Pregnancy Progressed. **Conclusion:** Anemia in Pregnancy Continues to impose a Substantial Burden on Maternal health and Quality of life. Early Screening, Nutritional counseling, appropriate supplementation and Strengthened Antenatal Services are Essential to reduce Anemia-related complications and Improve Maternal Outcomes.

Keywords: Anemia, Pregnancy, Prevalence, Quality of life, Risk factors.

PCP061

Artificial Intelligence as a Game-Changer in Modern Clinical Trials

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Introduction: Clinical trials are essential for the development of safe and effective drugs and medical devices; however, they remain costly, time-consuming, and associated with high failure rates. Artificial intelligence (AI) is

increasingly recognised as a transformative approach that is expected to reshape clinical trial design, execution, and evaluation across all phases. **Methods:** In Phases I and II, which represent the learning phase of clinical trials, AI-assisted computer simulation of clinical trials based on pharmacokinetic–pharmacodynamic (PK/PD) dose–concentration–effect models is currently used to optimise study protocols and dose selection. Future developments are anticipated to involve digital twins, representing dynamic virtual patient models capable of simulating personalised treatment responses. Reinforcement learning techniques are expected to allow real-time changes to protocols, supporting data-driven trial designs that can quickly adapt. **Results:** Phase III trials continue to exhibit high failure rates, primarily due to issues with recruitment, methodological flaws, and patient dropout. Currently, AI uses natural language processing to examine electronic health records and aid in enriching clinical trials. Future developments are expected to include cognitive sensing, where AI algorithms work directly on wearable devices for ongoing monitoring, AI-driven agents that can independently manage trial activities, and generative AI methods for creating synthetic data to tackle data shortages and enhance cohort diversity. **Conclusion:** Phase IV centers on post-marketing surveillance and large-scale data analysis, where AI is expected to help identify clinically relevant patterns that human analysts might miss, while future advancements are likely to prioritise explainable AI to support transparent, human-interpretable decision-making and strengthen regulatory trust. Federated learning frameworks and secure data-sharing technologies are anticipated to play a central role in the future of AI-driven clinical trials.

Keywords:AI in clinical trials, AIML, clinical trial simulation, PK/PD

PCP062

Diabetic Osteoporosis and SGLT2 Inhibitors: Pathway Level Modulation and Therapeutic Perspectives

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Introduction: Diabetic osteoporosis (DO) is a skeletal complication by increased fracture risk despite normal or mildly reduced bone mineral density, driven by impaired bone quality, osteocyte dysfunction, chronic inflammation, and metabolic stress. Conventional anti-osteoporotic treatments mainly target bone density and often fail to address diabetes specific mechanisms. Sodium–glucose co transporter 2 (SGLT2) inhibitors, used in type 2 diabetes mellitus (T2DM), improve systemic metabolism and may affect bone quality through interconnected pathways. This review poster highlights mechanistic evidence on the role of SGLT2 inhibitors in diabetic bone pathology, emphasizing key signaling pathways. **Methods:** A narrative review was conducted using Scopus and Google Scholar data. Screening articles with keywords such as diabetic osteoporosis, SGLT2 inhibitors, bone metabolism, osteocyte signaling, mitochondrial dysfunction, and bone immune crosstalk. **Results:** Experimental and preclinical studies suggest SGLT2 inhibitors affect multiple pathways in diabetic osteoporosis, including suppressing AGE–RAGE signaling, activating AMPK–mTOR, and partially restoring Wnt/β-catenin signaling for osteoblast differentiation. They also improve bone quality by regulating RANKL/OPG to reduce osteoclastogenesis and suppress NF-κB–mediated osteoimmune inflammation, with additional effects via ketone signaling and kidney bone endocrine crosstalk. **Conclusion:** SGLT2 inhibitors are a distinct class may indirectly influence diabetic osteoporosis by targeting metabolic, inflammatory, mitochondrial, and osteoimmune pathways that underlie bone quality deterioration. Rather than acting as direct anti-osteoporotic agents, they may serve as metabolic modulators that may improve skeletal resilience in diabetes. Integrating pathway level insights with clinical evidence supports future studies on combination strategies, patient stratification, and long term skeletal outcomes in diabetic populations.

Keywords: Diabetic osteoporosis; sodium–glucose cotransporter 2 (SGLT2); AMP-activated protein kinase–mammalian target of rapamycin (AMPK–mTOR) signaling; type 2 diabetes mellitus (T2DM); Wnt/β-catenin signaling

PCP063

Signaling Pathways Involved in the Pathogenesis of Polycystic Ovary Syndrome: A Review

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Introduction: Polycystic Ovary Syndrome (PCOS) is a heterogeneous endocrine disorder involving reproductive, metabolic, and hormonal abnormalities. Increasing evidence indicates that PCOS pathogenesis results from dysregulation of multiple interconnected signaling pathways rather than a single molecular defect. **Materials and Methods:** A narrative review of recent peer-reviewed literature was conducted using databases such as PubMed, Scopus, and Google Scholar, focusing on signaling pathways implicated in the pathophysiology of PCOS. **Results:** The reviewed studies highlight altered insulin signaling pathways contributing to insulin resistance and metabolic dysfunction. Dysregulation of energy-sensing pathways, inflammatory signaling cascades, oxidative stress–responsive mechanisms, and ovarian steroidogenic pathways collectively drive hyperandrogenism, follicular arrest, and ovulatory dysfunction. Crosstalk among these pathways explains the clinical and molecular heterogeneity observed in PCOS. **Conclusion:** PCOS arises from complex interactions among metabolic, inflammatory, oxidative stress, and reproductive signaling pathways. A pathway-based understanding of PCOS pathogenesis provides valuable insight for identifying potential therapeutic targets and improving disease management.

Keywords: Polycystic Ovary Syndrome; Pathogenesis; Signaling Pathways; Insulin Resistance; Inflammation; Oxidative Stress; Hyperandrogenism

PCP064

The Effect of Leaky Gut on the Central Nervous System through the Kynurenine Pathway

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Introduction: The gut and brain are closely connected through the gut–brain axis. Increased intestinal permeability, commonly known as leaky gut, allows harmful substances from the gut to enter the bloodstream and trigger immune activation. This leads to systemic inflammation, which may influence brain function. Recent evidence suggests that these effects on the central nervous system are mediated through alterations in the kynurenine pathway, the major pathway of tryptophan metabolism involved in neuroinflammation and brain health. **Methods:** A narrative review was conducted by screening articles related to gut permeability and central nervous system disorders. Relevant studies were identified using keywords as leaky gut, gut-brain axis, kynurenine pathway, and neuroinflammation in scopus, and google scholar databases. Studies summarized mechanisms linking gut permeability to brain function via the kynurenine pathway. **Results:** The reviewed literature shows that leaky gut increases systemic inflammation, which activates the kynurenine pathway. This results in higher production of neurotoxic metabolites such as quinolinic acid and reduced levels of neuroprotective compounds. These changes are associated with neuroinflammation and are linked to conditions such as depression, cognitive impairment, and neurodegenerative disorders**. Conclusion:** Leaky gut may significantly influence central nervous system health through activation of the kynurenine pathway. Understanding this link provides new insights into disease mechanisms and highlights the potential role of gut-targeted therapies in preventing or managing neurological disorders**.**

Keywords: Leaky gut; Gut–brain axis; Kynurenine pathway; Neuroinflammation; Central nervous system

PCP065

Systemic Consequences of Traumatic Brain Injury Mediated by Gut-Derived Serotonin: A Review

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Introduction: Most research on traumatic brain injury (TBI) has primarily focused on central nervous system pathology, often overlooking the contribution of systemic physiology. New study shows that gut-generated serotonin regulates metabolic, gastrointestinal, and immunological activities and systemic homeostasis. This review summarizes current studies on peripheral serotonin's role in TBI's systemic pathophysiology and downstream metabolic networks. **Method:** This poster review covers experimental and preclinical findings on traumatic brain damage, gut-derived serotonin, metabolic control, and gut–brain axis connections. To study systemic changes after TBI, fluid percussion injury models, gene expression analysis by RT-qPCR, serotonin measurement, and gut microbiota evaluation were prioritized. **Results:** According to the reviewed research, peripheral serotonin homeostasis is considerably altered by TBI. In the gastrointestinal tract, colonic genes involved in serotonin synthesis and degradation were dysregulated, resulting in an overall reduction in serotonin levels. Temporary downregulation of nitrergic and cholinergic neuronal markers was observed in the colon and duodenum. Downstream tissues, including the liver and adipose tissue, showed altered serotonin-related gene expression. Additionally, TBI led to reduced serotonin levels in the colonic mucosa, circulating blood, and significant changes in commensal gut bacterial populations, which were linked to abnormalities in the colonic serotonin pathway. **Conclusion:** TBI induces widespread disturbances in peripheral serotonin signaling, influencing gut microbiota composition, systemic energy metabolism, and gastrointestinal function. These results emphasize the relevance of systemic physiological systems, especially gut-derived serotonin pathways, in TBI pathogenesis. Understanding brain–gut–metabolic interactions may help build more effective and comprehensive TBI treatments.

Keywords: Traumatic Brain Injury, Gut-Brain Axis, Peripheral Serotonin, Serotonin Downregulation

PCP066

MicroRNA-Mediated Modulation of Neuronal Autophagy Pathways in the Pathogenesis of Alzheimer's Disease

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Introduction: Alzheimer's disease (AD) is a neurodegenerative disorder that impairs memory, causes cognitive decline, and leads to loss of neurons, and its symptoms progressively worsen over time. Deposits of amyloid, plaques and tau proteins that have been hyperphosphorylated are the main pathological features of the disease. Autophagy is a vital cellular process that supports neuronal health by removing aggregated proteins and damaged organelles. Several recent studies point to microRNAs, which are small noncoding regulators of gene expression, as key modulators of autophagy pathways and thus as factors that affect the progression of AD. **Methods:** A narrative review of published literature was conducted usingPubMed and Google Scholar databases. Relevant articles focusing on AD, miRNAs, and autophagy mechanisms were selected and analysed to summarise current knowledge. **Results:** Numerous miRNAs influence autophagy-related mechanisms in AD, with several well-established miRNAs consistently validated in experimental and clinical studies. miR-34a and miR-155 impair macroautophagy (MA) by targeting autophagy-related genes, leading to inefficient clearance of amyloid-β and tau aggregates. miR-30a and miR-181a negatively regulate Beclin-1-dependent autophagy initiation, promoting protein accumulation. Chaperone-mediated autophagy (CMA), responsible for the selective degradation of cytosolic proteins, is regulated by miR-106b and miR-21 and declines with ageing. Mitophagy, essential for mitochondrial quality control, is modulated by miR-27a, miR-137, and miR-195 through regulation of PINK1, Parkin, and mitochondrial dynamics-related proteins. Beyond these, many additional miRNAs contribute to autophagy regulation, underscoring the complexity of miRNAautophagy networks. Their dysregulation triggers

impaired autophagic flux, mitochondrial dysfunction, synaptic damage, oxidative stress, neuroinflammation, and disruption of major autophagy-related signalling pathways, indicating that they might act as the regulators of disease-relevant cellular processes. **Conclusion:** miRNA-mediated regulation of autophagy plays a significant role in the pathophysiology of AD. Disruption of macroautophagy, chaperone-mediated autophagy, and mitophagy contributes to neurodegeneration and disease progression. Targeting miRNAs or autophagy-related pathways may represent a promising therapeutic strategy to restore cellular homeostasis and slow AD progression.

Keywords: Alzheimer's Disease (AD), MicroRNA (miRNA), Macroautophagy (MA), Chaperone-Mediated Autophagy (CMA), Mitophagy (Mitophagy / Mito-autophagy).

PCP067

Autism Spectrum Disorder: From Global Patterns to Experimental Models

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Introduction: Autism spectrum disorder (ASD) begins in infancy and is characterised by restricted, repetitive conduct, interests, or sensory responses and continuous social communication and interaction issues. ASD prevalence among 8-year-olds in 2022 was **1 in 31** across **16 ADDM sites**. Currently no effective treatment is available forASD. Thus, developing new treatments would have tremendous therapeutic and economic benefits. Animal models that explain trauma's cellular and molecular mechanisms are needed for new ASD therapies. **Methods:** Primary literature sources Scopus and Google Scholar were used to find relevant research. Searches for ASD, neuro development disorder, prevalence, animal models, and genetic mutation yielded papers that were thoroughly examined. **Result:** Preclinical autism experiments include Fmr knockout mice, SHANK3 mutant and PTEN mutant mice, and Zebra fish lines. Autism's main genetic aetiology, fragile x syndrome, is modelled in Fmr knockout mice. It lacks Fmr1 gene product and exhibits ASD behaviours. In the SHANK3 mutant mouse model, gene deletion causes autistic-like characteristics such repeated grooming and decreased social interactions. The PTEN mutant mouse model, which has autism-related behavioural impairments and brain enlargement, is used to explore PTEN-related ASD therapies. Zebra fish lines with mutations in high-confidence autism gene risks provide a transparent, genetically tractable vertebrate system to study ASD-linked genes and find therapy targets. ASD is becoming more common worldwide, with significant sex and demographic differences, and genetic models reliably recreate fundamental autism-related behavioural and neurological traits. **Conclusion:** Epidemiological studies and proven animal models offer an adequate translational foundation for ASD pathophysiology and targeted therapy.

Keywords: Autism spectrum disorder (ASD), Neurodevelopment disorder, Prevalence, Animal models, Genetic mutation

PCP068

Beyond Conventional Therapy: CAR T-Cell Approaches in Triple-Negative Breast Cancer

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Introduction: Cancer is a malignant conditioncharacterised by uncontrolled cellular proliferation. It is a leading cause of morbidity and mortality globally, and its global burden of disease (GBD) has emerged as a major threat to global health, particularly that of women. It is a heterogeneous disease with numerous subtypes that vary in their clinical significance and pathological characteristics. Among the different types of breast cancer, TNBC- "Triple negative breast cancer" is the most aggressive one, characterised by a lack of estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor 2 (HER2). **Methods:** A narrative review was performed by surveying relevant literature available in Scopus and Google Scholar. Relevant articles were

identified by searchingkeywords such as TNBC, CAR-T, Immunotherapy, Antigen,Cytokine release syndrome and the retrieved studies were carefully reviewed and analysed. CAR T-cell therapy, a promising cellular immunotherapy for TNBC,has fundamentally altered treatment frameworks. A CAR-T cell is a peripheral blood T cell that has been altered to express a CAR. A single-chain variable fragment or other tumor antigen-specific antibody-derived recognition motif typically makes up the ectodomain of a CAR. Different antigen targetsof CAR-T cellsinclude AXL,CD32A,EGFR,MUC1, and TROP2.The limitations of CAR-T cell therapy can also be said as life-threatening toxicities, which include Cytokine release syndrome (CRS), immune effector cell-associated neurotoxicity syndrome (ICANS), and tumor lysis syndrome (TLS). **Result:** The study highlighted Armoured CAR-T cells, dual-target CAR constructions, logic-gated CARs, and combination methods with oncolytic viruses and immune checkpoint inhibitors as examples of recent advances that are helpful to overcome these limitations. Future perspective includes personalised or tailored design and AI-mediated antigen identification to optimise the treatment. **Conclusion:** This discussion emphasises the growing promise of CAR T-cell therapy as a novel and potentially transformative treatment for triple-negative breast cancer.

Keywords: TNBC, CAR-T, Immunotherapy, Antigen, Cytokine release syndrome

PCP069

Knowledge, Attitude, Practice, Awareness, and Misuse Related to Antibiotic Use and Resistance among Community Members in Ahmedabad, Gujarat: A Cross-Sectional Survey

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Introduction: Antibiotics play an important role in the treatment of bacterial diseases; despite this, their overuse has significantly contributed to the global rise of antibiotic resistance. Poor knowledge, limited awareness, and negative perceptions of antibiotics often contribute to their misuse, such as self-medication, incomplete treatment courses, and use of antibiotics for viral infections. By understanding how community knowledge, attitude, awareness, and practice regarding the use of antibiotics. **Objectives:** To assess knowledge, attitudes, awareness, misuse and practices regarding antibiotic use and their resistance among community members. **Methodology:** A cross-sectional survey was conducted in December 2025 among 272 participants using a convenience sampling method; data were analysed using descriptive statistics. **Results:** The study shows that awareness and appropriate practice differ significantly. Although 87% of people know about antibiotics, only 34% are aware of how they are specifically used to treat bacterial infections. Antibiotic misuse is common; only 54% of patients complete treatment courses, and 68% of patients use antibiotics for viral symptoms. Additionally, a significant percentage of individuals (21.7%) buy antibiotics without a prescription as a kind of self-medication. These results highlight the critical need for public health education that emphasises the risks associated with antibiotic resistance and the importance of seeking professional medical advice**. Conclusion:** There are Significant gaps between knowledge and widespread misuse of antibiotics, which includes self-medication and the treatment of viral infections. These practices directly increase the global threat of antibiotic resistance. To minimise this problem, public health education mainly focuses on professional advice and treatment adherence.

Keywords: Antibiotic use and its resistance, Knowledge-attitude-practice, Awareness, Misuse of antibiotics, Community

PCP070

Brain Border–Associated Macrophages as Emerging Contributors to Alzheimer's Disease Pathology

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Introduction: Alzheimer's disease (AD) is a slow progressing neurodegenerative disorder that mainly affects the elderly population and is characterized by memory and cognitive impairment and behavioural disturbances.The

disease is characterised by the build up of amyloid-β (Aβ) plaques and neurofibrillary tangles in the brain. These abnormal deposits cause interference in communication between nerve cells and leads to the loss of neurons. In addition to these classical traits, neuroinflammation is now seen as a key contributor to disease onset and progression. While microglia, the resident immune cells of the brain, have been extensively studied, recent research are highlighting the significant role of Brain Border–Associated Macrophages (BAMs) in AD pathology. **Method:** BAMs are located at the interface of the central nervous system, including the meninges, choroid plexus, and perivascular spaces, making them as key regulators of immune surveillance and neurovascular integrity which makes them respond to the pathological stimuli within the brain. **Results:** These macrophages help in clearing Aβ deposits from brain; however, under disease condition, they can also increase oxidative stress and amplify inflammatory signalling cascades. This abnormalactivity causes the damage of blood brain barrier and vascular dysfunction, which further speed up the process of neurodegeneration. Moreover, BAMs modulate microglial activation, which may enhance synaptic damage, particularly during the early stages of AD. **Conclusion:** Recent progress in molecular and imaging techniques have shown that BAMs change their behaviour at different stages of disease, underscoring their complex role in AD. Understanding of BAM-mediated mechanism may lead to new treatment approach that would help in controllingneuroinflammation, preserving vascular function, and slowing the progression of Alzheimer's disease.

Keywords: Alzheimer's disease, neuroinflammation, brain border–associated macrophages, microglial activation, neurovascular dysfunction.

PCP071

Evaluating Ketamine's Efficacy in Status Epilepticus: A Systematic Analysis of FAERS Data and Literature Review

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Introduction: Drug repurposing is the process of finding new ways to use existing drugs to treat different diseases. It is a useful method for discovering new medicines. Ketamine is a type of anaesthetic known for more than just its ability to anaesthesia. It is also effective in reducing pain and acts quickly to improve the mood. This study investigated whether ketamine could help treat status epilepticus. It used data from the FDA Adverse Event Reporting System (FAERS) and employed pharmacovigilance techniques. **Methods:** We examined data from FAERS, covering January 2003 to September 2025, to understand the off-label use of anaesthetic drugs. We used pharmacovigilance techniques to explore whether ketamine could help treat status epilepticus. This involved identifying suspected product uses, noting any off-label uses, counting occurrences, ranking them, and comparing them with known drug uses. **Results:** The analysis identified strong disproportionality signals for the off-label use of ketamine in status epilepticus, with key metrics indicating a significant association beyond its approved indication. A qualitative review of the literature supported these findings, underscoring the increasing role of ketamine in managing refractory and super-refractory status epilepticus. **Conclusion:** Ketamine acts on NMDA receptors, which helps in drug-resistant status epilepticus. This makes it a good choice for both first-line and additional treatments. Future research should focus on clinical trials to confirm the safety and effectiveness of ketamine in treating status epilepticus. It is also important to develop new forms and methods of administering ketamine to make it more useful in clinics. The use of ketamine for status epilepticus is promising and supports healthcare goals and new drug development.

Keywords: Ketamine, Drug repurposing, Status epilepticus, Pharmacovigilance.

PCP072

Development of a Lightweight AI Chatbot to Categorize Drug InformationQueries

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Introduction: Drug information queries are crucial components of pharmacy practice. Accurate and timely answers to these queries assist in clinical decision-making and promote the rational use of medicines, directly impacting patient safety and therapeutic outcomes. Artificial intelligence (AI) offers a promising approach in pharmacy services. AI models can support pharmacists and DICs by automating the categorization of queries, assessing their complexity, and delivering structured, evidence-based responses. The aim is to develop and validate a lightweight Al Chatbot that Categorizes DI queries by complexity and give Resources and Basic Structure to optimize pharmacy service. **Methods:** A prospective observational study was conducted across drug information centre, community pharmacy, and surgical hospital. A total of 536 clinically relevant drug information queries were collected and categorized by query type and complexity level. Data cleaning and standardization were performed to remove duplicates and irrelevant entries. Thereafter, a lightweight AI Chatbot was developed and trained using the collected queries. **Results:** Drug interaction queries were most common (122), followed by ADR/toxicity (108) and evaluation-related queries (85). Other queries included dose and administration, pregnancy/lactation, pharmacokinetics, therapeutic strategy, availability/cost, pharmaceutical aspects, and miscellaneous categories. The lightweight AI Chatbot achieved 100% accuracy with a similarity score of 1 for trained drug information queries. An association with a large language model will be performed, followed by validation using new queries and a pilot study to assess user acceptance. **Conclusion**: This AI Chatbot supports pharmacy students and professionals by optimizing drug information services through reduced turnaround time, improved response accuracy, and more effective utilization of drug information resources.

Keywords: Artificial intelligence, Clinical pharmacy, Decision support system, Drug Information Centre, Drug Information Queries.

PCP073

Gut–Brain Axis and Kynurenine Pathway Shifts in the Pathophysiology of Anxiety

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Introduction: Anxiety can occur from both psychological stress and gut stress mediated through the microbiota–gut–brain axis. Gut dysbiosis, mucosal inflammation, and increased intestinal permeability alter tryptophan (Trp) metabolism, which divert it from serotonin and microbial indole production toward the kynurenine pathway (KYP). This shift generates neuroactive metabolites influence glutamatergic signaling, neuroinflammation, and anxiety-related behaviours. **Methods:** This narrative review integrates mechanistic, preclinical, and clinical data exploring: (1) organization of Trp–KYP and its competition with serotonin synthesis (2) HPA-axis and cytokine-mediated regulation of TDO/IDO enzymes(3) gut-derived immune and barrier dysfunction driving KYP activation (4) pharmacological and lifestyle interventions modulating KYP and stress responses. **Results:** Psychological stress enhances HPA-axis activity and cortisol, activating TDO/IDO and increasing KYN/TRP ratios. Elevated kynurenine and neurotoxic metabolites (3-hydroxykynurenine, quinolinic acid) correlate with reduced kynurenic acid and anxiety-like phenotypes in preclinical models. Gut dysbiosis and inflammation further cause IDO/KMO activation cytokine signaling, whichpromotes oxidative stress and microglial activation. **Conclusion:** Stress-induced activation of the Trp–kynurenine pathway acts as a biochemical bridge linking HPA-axis dysregulation, serotonergic depletion, gut barrier dysfunction, and neuroinflammation. Modulating this integrated gut–brain–kynurenine system through enzyme inhibition, exercise, and psychobiotic or dietary interventions offers a promising therapeutic strategy for stress-related anxiety.

Keywords: Kynurenine Pathway, Gut–Brain Axis, HPA-axis, IDO/TDO, Anxiety.

PCP074

Drug Effectiveness, Lifestyle & Hormonal Triggers and Quality of Life in Adults with Migraine: A Prospective Observational Study

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Introduction: Migraine is a common neurological disorder that affects daily functioning and quality of life. Lifestyle and hormonal factors are recognized migraine triggers. This study assessed drug effectiveness along with lifestyle and hormonal triggers and their impact on quality of life in adult migraine patients. **Method:** A 6-month prospective observational study was conducted at two tertiary care hospitals in Gujarat. Adults aged 18–60 years with clinically diagnosed migraine were enrolled after informed consent. Data on demographics, migraine characteristics, medications, lifestyle triggers, and hormonal factors were collected. Headache parameters were assessed at baseline and follow-up, and quality of life was evaluated using the HIT-6 scale. **Result:** Data from 25 participants were analyzed, including 18 females (72%) and 7 males (28%). A migraine history of ≥2 years was reported by 24% of participants. The most common attack duration was 24 hours (32%), with attacks frequently occurring in the morning (44%). Amitriptyline (72%) was the most commonly prescribed medication, flunarizine (60%), propranolol (40%). Follow-up assessment showed reduced migraine frequency (average three attacks), shorter duration (4–6 hours), and moderate pain severity (5/10). No adverse drug reactions were reported. Lifestyle-related triggers included irregular sleep (84%), emotional/work stress (60%), anxiety (56%). Menstrual migraine was observed in 22% of female participants. Lifestyle factors were associated with higher HIT-6 scores, and severe headache-related disability was reported in 32% of patients. **Conclusion:** Migraine burden is influenced by pharmacological response, lifestyle and hormonal factors. Integrating preventive therapy with lifestyle modification may improve treatment outcomes and quality of life.

Keywords: Migraine, Lifestyle factors, Hormonal influences, HIT-6, Quality of life.

PCP075

Gut Microbiota Dysbiosis in Diabetes: Therapeutic and Translational Implications

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Introduction: Dysbiosis of the gut microbiota and dysfunction of the microbiota–gut–brain axis are significant factors in the development of insulin resistance, oxidative stress, chronic inflammation, and impaired glucose homeostasis in diabetes mellitus, a complex metabolic disorder. **Methods**: This review conducted a systematic search and analysis of published literature from PubMed, Google Scholar, and other scientific databases, with a focus on studies investigating gut microbiota composition, gut-brain axis signaling, and probiotic interventions in diabetes. **Results:** Probiotics improve antidiabetic effects by restoring intestinal microbial balance, increasing short-chain fatty acid production, stimulating glucagon-like peptide-1 secretion, improving insulin sensitivity, protecting pancreatic β-cell function, reducing low-grade inflammation and oxidative stress, and strengthening the intestinal barrier. Probiotics also influence metabolic regulation via the gut-brain and gut-hepatic axes, affecting appetite control, energy metabolism, and glucose regulation, with multi-strain formulations frequently performing better than single strains. **Conclusion:** Overall, probiotics are a promising adjunctive approach to diabetes prevention and management; however, strain specificity, interindividual variability, safety concerns, and a lack of large-scale clinical trials highlight the need for additional mechanistic studies and well-designed clinical investigations to enable targeted and effective probiotic-based therapies.

Keywords: Probiotics; Gut–brain axis; Gut microbiota; Type 2 diabetes; GLP-1; Insulin resistance

PCP076

Dysmenorrhea Self-medication Behavioral Survey

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Introduction: dysmenorrhea is a prevalent gynaecological condition that often leads women to adopt self-medication practices. While such practices may provide symptomatic relief, they may also predispose individuals to irrational drug use and adverse effects. This study aimed to evaluate self-medication behaviour in dysmenorrhea and examine its association with pain severity, educational level, medication knowledge, side effects, and sources of information. **Methods**: across-sectional, questionnaire-based online survey was conducted among women aged 15–45 years (N = 300). Pain severity was assessed using a 0–10 visual analogue scale. Descriptive statistics were used to summarise demographic characteristics. Associations between variables were analysed using chi-square tests, an independent samples t-test, and pearson correlation analysis. **Results**: the majority of participants were aged 20–24 years (approximately 42%), followed by those aged 40–45 years (21%). Self-medication was reported by nearly 17% of respondents. Women practising self-medication had significantly higher mean pain scores than non-self-medicated participants ($p < 0.001$). Chi-square analysis demonstrated a significant association between pain severity and self-medication ($p < 0.01$), as well as between self-medication and the experience of side effects ($p < 0.001$), while no significant association was observed with educational level ($p > 0.05$). Pearson correlation revealed a moderately strong positive correlation between pain severity and self-medication behaviour ($r \approx 0.5$, $p < 0.001$) and a significant positive correlation between medication knowledge and self-medication ($r \approx 0.35$, $p < 0.01$). Non-steroidal anti-inflammatory drugs were the most used self-medications (approximately 45%), with previous prescriptions and pharmacist advice being the predominant information sources. **Conclusion:** self-medication in dysmenorrhea is primarily driven by higher pain severity and perceived medication knowledge and is associated with an increased risk of adverse effects. These findings highlight the essential role of pharmacists in promoting rational medication use and safe self-care practices.

Keywords: Dysmenorrhea, non-steroidal anti-inflammatorydrugs, pain severity, self-medication, women's health.

PCP077

Genetic Polymorphisms In HCM: Variant Categories, Geographical Patterns And Genotype- Phenotype Correlation.

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Background: Hypertrophic cardiomyopathy (HCM) is the most common genetically heterogeneous myocardial disorderoften caused due to sarcomeric gene variants. Investing variant-category prevalence alongside genotype-phenotype correlations and geographic patterns in HCM can improve interpretation of genetic testing and improve risk stratification areas that are comparatively less studied.**Methods**: A systematic review was conducted using PRISMA guidelines. Studies (2015-2025)consisting of HCM patients with genetic testing and extractable data on gene categories, genotype status or genotype-phenotype correlation were included. Phenotypic markers assessed includes left ventricular wall thickness (LVWT), obstruction, arrhythmia, sudden cardiac arrest, and heart failure were included in the review.**Results**: Of 1209 studies, 39 were included whichrevealed sarcomeric gene variants predominated and demonstrated the strongest genotype-phenotype associations followed by modifier and phenocopy genes. Next-generation sequencing is the most commonly used genetic testing method (n=15). Among genotype-positive HCM cases, MYBPC3 (35.47%) and MYH7 (31.14%) were the most prevalent sarcomeric genes.Sarcomeric mutations were strongly associated with Arrhythmia (n = 20) and Heart failure (n=17). In contrast, Modifier genes correlated primarily with LVWT (n=12) but had minimal association with lethal events(n=3). Phenocopies were unfairly related to Heart Failure (n=12) with rare LVOTO.**Conclusion**: Genotype-phenotype correlations in HCM are independent in function. Sarcomeric variants dominate arrhythmogenic risk

whereas modifier gene rules thehypertrophy severity. These findings support expanded genetic profiling beyond sarcomeric screening to improve risk stratification.

Keywords: Genetic Modifiers, Genotype-Phenotype Correlation, Hypertrophic Cardiomyopathy, Sarcomeric Genes variants.

PCP078

Emerging Roles of Exosomes in Diabetes Management and in Different Diseases

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Introduction: Exosomes are small extracellular vesicles released by almost all cells in the body. They acts like messengers, carrying proteins, fats etc.Roles incancer:It promotes metastasis via miRNA; In neurodegeneration they basically clear β- amyloid. They modulated inflammation in cardiovascular and immune disorders which serves as biomarkers and therapeutic vectors. Roles in diabetes: In mesenchymal stem cells derived exosomes enhance glucose uptake via AMPK / autophagy protects stem cell through, protects β- cells through pdx-1 and miR-21, and reduces ER stress.M1 macrophage exosomes induce insulin resistance via miR-212-5p/SIRT2, and high glucose exosomes impair secretion and promotes hyperglycemia**. Methods:** Review was conducted by PubMed and google scholar. Original research, meta -analyses, clinical trials examine microbial signature, mechanist pathway and therapeutic interventions were selected to carry out this review. **Results:**Exosomal miR-145-5p and proteins enables early biomarker detection and identification, engineered exosomes regenerates β-cells,and promotes wound healing, it also urges for clinical optimization. Exosomes help spread cancer by carrying miRNAs, finally clears harmful β- amyloid cells in brain diseases, decreases inflammation in heart issues**. Conclusion:** Exosomes could serve as both warning and as a sign of treatments for diabetes and other diseases. Stem cells engineering look promising for healing and cell repair.

Keywords: Exosomes, Extracellular vesicles , Cancer , Diabetes mellitus, AMPK signaling

PCP079

Best Possible Medication History and Patient Medication Knowledge in Diabetes and Hypertension at Community Pharmacies in Gandhinagar

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Introduction: Hypertension and diabetes mellitus are prevalent chronic conditions that require long-term medication therapy. Adequate patient understanding of prescribed medicines is essential to ensure adherence, medication safety, and effective disease control. In community pharmacy settings, pharmacists play an important role in collecting Best Possible Medication History (BPMH), identifying medication-related problems, and providing patient counselling to minimize medication discrepancies and polypharmacy-related issues. **Methods:** A prospective observational study was conducted at selected community pharmacies in Gandhinagar city, Gujarat. Adult patients diagnosed with hypertension, diabetes mellitus, or both were included in the study. Data were collected using a structured data collection form and a medication knowledge assessment questionnaire consisting of seven questions about medication name, indication, dose, frequency, duration, storage and meal timings. Demographic details, disease condition, and knowledge scores were recorded through a structured patient interview. Each question weighing 0 to 3 and the knowledge scores were categorized into poor (0-6), moderate (7-14), and good (15-18). Data were analyzed in frequency and percentage, and chi-square test was applied to test the level of significance. **Results:** A total of 81 patients, with most of participants belonging to age group 50–59 years (51.85%) and the male respondents were (87.65%). Diabetes mellitus was the most common condition (48.15%), followed by hypertension (34.57%), and the co-morbid conditions (17.28%). Most participants were with moderate medication knowledge (71.60%), while 28.40% had good knowledge; no patient had poor knowledge.

Only 43.21% had received pharmacist counselling. No statistically significant association was found between medication knowledge and disease condition (p = 0.71), Gender (p=0.58), age group (p=0.19), education level (p=0.93). The results are based on the data collected so far, and further data collection is in progress. **Conclusion:** The study highlights that although most patients demonstrated moderate to good knowledge regarding their medications, gaps in patient understanding and counselling were identified. This indicates the importance of pharmacist-led educational interventions to improve patient's medication knowledge, ensure safe medicine use, and support better management of chronic diseases such as hypertension and diabetes mellitus.

Keywords: BPMH, medication history, medication related problems, diabetes, hypertension

PCP080

Impact of Continuous Glucose Monitoring on Glycemic Outcomes in Diabetes Mellitus: Evidence from Randomized Controlled Trials

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Introduction: Continuous glucose monitoring (CGM) was introduced to address the limitations of self-monitoring of blood glucose (SMBG)and thereby improve glycemic control. The present review aims to evaluate the effectiveness and safety of continuous glucose monitoring compared with SMBG in patients with type 1 diabetes mellitus (T1DM), type 2 diabetes mellitus (T2DM), and gestational diabetes mellitus (GDM). **Methods:**Upon screening 108 articles a total of 30 articles met the inclusion criteria. Studies were first categorized according to diabetes type and subsequently grouped based on CGM modality into real-time CGM (rt-CGM) and flash CGM systems, including FreeStyle Libre. Comparative analyses were performed between CGM and SMBG within each diabetes and device subgroup. **Results:** Continuous glucose monitoring (CGM) produced moderate overall HbA1c reductions (−0.26%), with greater effects in type 1 (−0.33%) than type 2 diabetes (−0.17%). CGM consistently increased time-in-range by about 7.7 % with similar benefits in type 1 and type 2 diabetes. Time-below-range decreased by a mean of 3.2%. A larger hypoglycemia reduction was observed in type 1 diabetes. Time-above-range and hyperglycemia metrics was also shown to be improved in a few studies, with pooled TAR reductions of 6–11%. The device reported rare serious adverse events (n=2). **Conclusion:** CGM reported moderate but consistent improvements in HbA1c, time-in-range, and hypoglycemia exposure across diabetes types. The evidences from this review strongly supports its use as a more effective glycemic monitoring strategy in appropriate patients of diabetes mellitus.

Keywords: CGM, SMBG, HbA1C

PCP081

Role of Clinical Pharmacist in Improving Medication Adherence and Clinical Outcomes in Patients with Hypertension

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Introduction: Hypertension is a major public health problem and a leading risk factor for cardiovascular morbidity and mortality worldwide. Poor medication adherence remains one of the most significant barriers to achieving optimal blood pressure control, especially in patients receiving long-term antihypertensive therapy. Clinical pharmacists play a vital role in patient-centered care by identifying drug-related problems, improving adherence, and optimizing therapeutic outcomes. **Methods:** This study focuses on evaluating the impact of clinical pharmacist interventions on medication adherence and clinical outcomes in hypertensive patients. Pharmacist-led interventions include patient counseling, medication review, identification of adverse drug reactions, lifestyle modification guidance, and follow-up monitoring. These interventions aim to enhance patient knowledge, address misconceptions regarding antihypertensive therapy, and promote rational drug use. **Result:** Evidence from clinical practice demonstrates that pharmacist involvement leads to significant improvement in medication adherence, better blood pressure control, reduction in drug-related problems, and enhanced quality of life. Collaborative care

between physicians and clinical pharmacists contributes to improved therapeutic decision-making and patient safety. **Conclusion:** In conclusion, the integration of clinical pharmacists into the healthcare team plays a crucial role in improving medication adherence and clinical outcomes in hypertensive patients. Strengthening pharmacist-led patient care services can significantly reduce disease-related complications and healthcare burden associated with uncontrolled hypertension.

Keywords: Hypertension, Clinical Pharmacist, Medication Adherence, Patient Care, Antihypertensive Therapy

PCP082

Hypertension Screening and Awareness Gaps in Rural Communities: Evidence from a Pharmacist-Led Cross-Sectional Epidemiological Study

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Introduction: High Blood pressure often goes undetected in rural areas due to limited screening & lack of awareness. This pharmacist-led study seeks to identify existing gaps in hypertension screening & knowledge to improve community health outcomes & promote timely care. **Methodology:** An epidemiological study was carried out in 2 villages of Gandhinagar during 2023-2025 in which 799 willing participants in home visits. Data was collected through interviews, covering demographics and measurement of BP. BP was measured using a pre-calibrated sphygmomanometer following international standards. Participants were provided with a pharmaceutical care card for potentialHBPM tracking. **Results:** Low response rate of 20.33% (N=799) has been recorded. The Male: Female ratio was 1:1.87. The mean age was 51.15 ±18.10 years. Most of the participants (71%) were vegetarian, while 29% were non-vegetarian. Alcohol consumption was reported by 1.12% of participants, while 17.14% were users of various forms of tobacco. The mean systolic & diastolic BP values were in male 132.21 ± 17.70 mmHg and in female 84.85 ±11.22mmHg. Commonly observed myths included: 'Checking BP can give me a disease,' 'I am young, so I don't need screening,' and 'I have an angry nature, so I don't need BP checking.' **Conclusion:** Despite door-to-door efforts, participation in screening was low, reflecting persistent challenges in engaging rural communities. Elevated blood pressure and common myths delay early detection, highlighting the need for better awareness. Pharmacist-led hypertension clinics can help by providing accessible screening, education, and continued community support.

Keywords: Blood Pressure Screening, Hypertension, Pharmacist-Led Care, Rural CommunityHealth

PCP083

To Explore the Context-Dependent Role of Apoptosis-Inflammation Axis Genes in the Prognosis of Neurodegeneration

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Purpose: To examine the context-dependent role of apoptosis-inflammation axis genes (AIAG) in neurodegeneration. **Methods:** A set of AIAGs including *BCL2*, *TNF*, *PPARG*, and *PTGS2* were selected for the prognostic analysis. Selected genes were subjected to the preparation of a protein-protein interaction (PPI) network using STRING database. The PPI network was analysed through Cytoscape 3.10.3 and a reference gene set (RGS) was identified from the top interacting nodes. The RGS was utilized for the functional enrichment assay (FEA) of gene ontology (GO) datasets (biological processes [BP]; molecular functions [MF]; cellular components [CC]), Kyoto Encyclopaedia of Gene and Genome (KEGG) pathways, and BIOCARTA pathways. The Basic Local Alignment Search Tool (BLAST) was used to identify similarity in functioning residues. A topological analysiswas performed using BisoGenet and role of AIAGs in neurodegenerationwas identified. **Results:** the PPI network of AIAGs exhibited a notable interaction with genes pertaining to inflammation, apoptosis, and

neurodegeneration. The RGS included a set of genes corresponding to the progression of neurodegeneration. The FEA revealed a significant (P-value < 0.001) enrichment of neuro-inflammatory response (GO-BP), glutathione peroxidase activity (GO-CC), IL-17 signalling pathway (KEGG), TNF signalling pathway (KEGG), HIF-signalling pathway (KEGG), and IL1R signal transduction (BIOCARTA). The BLAST analysis and topological analyses validated the role of AIAGs in neurodegeneration. **Conclusion:** The study revealed molecular insights on the role of AIAG in progression of neurodegeneration.

ABSTRACTS -POSTER PRESENTATION (PHARMACEUTICAL ANALYSIS, QUALITY & REGULATORY SCIENCE)

PAP001

Evaluation Of Pharmaceutical Market and Regulatory Overview for Human Generic Drug Product Registration in Australia

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Introduction: Australia's pharmaceutical market is a complex and highly regulated industry, influenced by its distinctive healthcare system, pricing mechanisms, and supply chain structures. This study provides an in-depth analysis of the industry, focusing on critical elements such as the Pharmaceutical Benefits Scheme, Medicare, pricing strategies, and the overall healthcare framework. Understanding these components is essential for evaluating how pharmaceuticals are funded, priced, and distributed within the Australian healthcare system. **Methods:** A significant aspect of this research is the exploration of the pharmaceutical supply chain, covering key processes such as manufacturing, distribution, and the role of various stakeholders in ensuring the availability and affordability of medicines. Additionally, the study examines the regulatory landscape, particularly the evolution and function of the Therapeutic Goods Administration. It delves into the Australian Register of Therapeutic Goods and Good Manufacturing Practice clearance requirements, which are critical for obtaining market approval. Furthermore, this study investigates the dossier submission process for pharmaceutical registration, identifying key regulatory and compliance challenges that companies face when entering the market. It also explores administrative and commercial considerations, including reimbursement policies, market access hurdles, and strategic business decisions affecting pharmaceutical companies. **Results:** The study highlights the intricate balance between strict regulatory requirements and commercial sustainability, which plays a crucial role in shaping market dynamics. By integrating these aspects, the study offers comprehensive insights into the operational and strategic challenges within Australia's pharmaceutical sector. **Conclusion:** It provides a valuable resource for industry professionals, policymakers, and researchers, enabling them to navigate the evolving regulatory and commercial landscape effectively. Understanding these dynamics is crucial for fostering innovation, ensuring compliance, and enhancing patient access to essential medicines in Australia.

Key Words: Therapeutic Goods Administration, Australian Register of Therapeutic Goods

PAP002

Strategic Planning for Dossier Submission of Nebulizer Solution in Europe, South Africa, And Mexico: Approaches to Minimize Regulatory Queries and Comparative Evaluation

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Introduction: Ensuring successful global registration of a nebulizer solution requires a clear understanding of regulatory frameworks and strategic dossier planning. This study focuses on developing an optimized submission strategy tailored to minimize regulatory queries across three key regions: Europe (EMA), South Africa (SAHPRA), and Mexico (COFEPRIS). **Methods**: The European regulatory landscape, known for its highly structured eCTD-based review system and stringent quality expectations, forms the core reference framework. In comparison, South Africa and Mexico demonstrate evolving regulatory pathways, with differences in inhalation specific requirements. The study provides a comparative evaluation of dossier requirements, review timelines, common deficiencies, and data expectations across these regions. By analysing query trends and regulatory gaps, the work identifies region-specific challenges that companies typically face during submission of nebulizer solutions. **Results**: Further, a strategic planning approach is proposed, emphasizing robust pre-submission preparation, structured quality documentation, targeted bridging justifications, and proactive risk mitigation. The importance of effective communication with agencies and lifecycle query management is also highlighted. **Conclusion**: Overall, this research offers a comprehensive roadmap for enhancing dossier readiness and reducing

regulatory objections. The comparative insights and strategic recommendations generated through this study aim to support efficient, compliant, and predictable global submissions of nebulizer solution products across Europe, South Africa, and Mexico.

Keywords: Regulatory Strategy, Nebulizer Solutions, eCTD Dossier, Submission Planning, Quality Documentation

PAP003

Application Of Chemometry and Design of Experiments to Green HPTLC Method For Synchronous Estimation of Multiple Fdcs of Cilnidipine

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Introduction Fixed-dose combinations (FDCs) containing cilnidipine (CIL) with chlorthalidone (CLT) and azilsartan medoxomil (AZL) are widely prescribed for the management of hypertension. Although several RP-HPLC and HPTLC methods have been reported for individual CIL-based combinations, no HPTLC method has been described for the synchronous estimation of multiple CIL FDCs. Moreover, the growing emphasis on green analytical chemistry necessitates the development of eco-friendly, cost-effective, and rapid analytical methods with reduced organic solvent consumption. Hence, the present work aimed to develop a robust, green, and AQbD-driven HPTLC method for the simultaneous estimation of multiple CIL-based FDCs. **Methods:** An analytical quality by design (AQbD) approach was employed to ensure method robustness and reliability. Critical method variables (CMVs) and critical analytical attributes (CAAs) were identified using chemometric tools. A Box–Behnken design was applied to study the response surface relationships between selected CMVs and analytical responses. Chromatographic separation was achieved on silica gel G60 F254 HPTLC plates using a green mobile phase consisting of toluene–ethyl acetate–methanol (6.5:2:1.5, v/v). The optimized method was validated as per ICH Q2 (R1) guidelines. **Results:** The developed HPTLC method demonstrated excellent separation, specificity, linearity, precision, accuracy, and robustness within the defined analytical design space. The AQbD-based optimization ensured controlled method performance with minimal variability. The method was successfully applied to the synchronous estimation of multiple CIL-based FDCs, and the assay results were found to be in good agreement with labeled claims. **Conclusion:** A green, economical, rapid, and robust HPTLC method was successfully developed and validated for the synchronous estimation of multiple CIL-based fixed-dose combinations using the AQbD approach. The method significantly reduces analysis time, solvent consumption, and operational cost, making it highly suitable for routine quality control and regulatory applications in the pharmaceutical industry.

Keywords: Cilnidipine, HPTL, Analytical Quality by Design (AQbD), Green analytical chemistry

PAP004

A Regulatory Perspective on Comparative Analysis on ICH Q12 Old Version Vs New Approach (2020); Implementation Status Across Key Markets Such As US, EU, JAPAN & INDIA

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Introduction: Effective post-approval change management is essential to maintain the quality, safety, and efficacy of pharmaceutical products throughout their lifecycle. Historically, diverse and rigid national regulations created barriers to efficient product updates and global harmonization. The International Council for Harmonisation (ICH) issued the Q12 guideline, *Technical and Regulatory Considerations for Pharmaceutical Product Lifecycle Management*, to address these disparities through a science- and risk-based approach. **Methods:**

This study reviews regional implementation strategies of ICH Q12, focusing on its three key tools: Established Conditions (ECs), Post-Approval Change Management Protocols (PACMPs), and the Product Lifecycle Management (PLCM) document. Regulatory updates from the U.S. Food and Drug Administration (FDA), European Medicines Agency (EMA), Pharmaceuticals and Medical Devices Agency (PMDA) in Japan, and India's Central Drugs Standard Control Organization (CDSCO) were compared to evaluate alignment with Q12 principles. **Results:** The FDA adopted Q12 in 2021, integrating its principles into existing frameworks using comparability protocols. The EMA recognized Q12 in 2020 but remains constrained by Variations Regulation (EC No.1234/2008). Japan incorporated PACMPs into its legal structure under revisions effective in 2021. India, while not an ICH member, introduced draft risk-based guidance in 2024 to initiate Q12-aligned practices for biologics. **Conclusion:** Despite regional challenges, unified application of Q12 enables efficient documentation, reduces redundancy, enhances innovation, and supports continuous medicine supply. Achieving these benefits requires global regulatory collaboration, legislative modernization, and strengthened pharmaceutical quality systems to advance consistent lifecycle management and safeguard public health worldwide.

Keywords: ICH Q12[1], Established Conditions (ECs)[2], Post-Approval Change Management Protocols (PACMPs)[3], Product Lifecycle Management (PLCM)[4], Regulatory Harmonization[5]

PAP005

A Comparative Review of Regulatory Frameworks for Borderline Product Registration in Australia, Philippines, And Singapore

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Introduction: Borderline products are on the border of medicines, medical devices, cosmetics, and other types of products related to health issues. Their regulatory group is usually ambiguous. This misclassification can cause the delay in approval, increase in compliance costs, and dissimilar access to the market in different regions. Proper interpretation of regulatory strategies is hence the key to both regulators and manufacturers. **Methods:** The review is a comparative study of borderline product classification and registration regulations in Australia, Philippines, and Singapore. Critical guidance documents by the European Commission, EMA, TGA, FDA Philippines and HAS were reviewed systematically. Determinants of classification of the intended use, mode of action and risk profile were reviewed. Another commonly used borderline case was drug, device combinations, cosmetic, therapeutic products, crossovers of food supplements, and digital health technology. **Results:** The three jurisdictions use intended use and mode of action as the major basis of classification decision making. Nevertheless, there are some significant distinctions in the clarity of the procedure, evidence requirement and access to formal classification advice. Different pathways had also been noted between registration, dossier expectations, and pre-market consultation. Variation in dependence on ASEAN harmonization also adds to the uncertainty of regulators to manufacturers. **Conclusion:** Borderline products regulation is still complicated and systematized in different jurisdictions. Unpredictable classification procedures pose a problem in accessing the market on a timely basis and predictability of regulating the market. There is a need to have a higher degree of harmonization, risk-based and adaptive classification frameworks, increased transparency, and enhanced regulatory-industry collaboration. These policies will be able to promote innovations and provide proper regulation.

Keywords: Borderline products, Regulatory classification, Product registration pathways, Risk-based regulation, Comparative regulatory frameworks

PAP006

Regulatory Assessment Of Quality and CMC Data for Doxorubicin Liposomal Injection as a Complex Liposomal Parenteral Product

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Introduction: Doxorubicin liposomal injection is considered a complex liposomal parenteral formulation because its therapeutic performance is governed by formulation characteristics and manufacturing controls rather than the active substance alone. The presence of lipid-based carriers, encapsulation mechanisms, and controlled drug release behaviour introduces additional regulatory challenges. As a result, regulatory authorities require an extensive quality and Chemistry, Manufacturing, and Controls (CMC) data package to ensure consistent product quality performance. **Methods:** This work involved a systematic regulatory review of publicly accessible regulatory assessment documents and internationally recognized guidelines applicable to liposomal drug products. The evaluation focused on quality and CMC-related aspects, including critical quality attribute identification, physicochemical characterization, manufacturing process understanding, in-process controls, in-vitro release testing strategies, and stability assessment applied during regulatory review. **Results**: The analysis indicated that regulatory decision-making for doxorubicin liposomal injection is primarily dependent on the depth and robustness of quality data. Parameters such as vesicle size distribution, lipid composition, drug encapsulation efficiency, release characteristics, and sterility assurance were identified as central to demonstrating product consistency. In addition, strong control over raw materials, critical process parameters, and validated manufacturing processes was found to be essential for ensuring reproducible product quality across batches. **Conclusion:** The regulatory evaluation of doxorubicin liposomal injection as a complex liposomal parenteral product is driven by a quality-focused, science-based CMC approach. Comprehensive characterization and well-controlled manufacturing processes play a decisive role in addressing formulation complexity and supporting regulatory confidence in the product's therapeutic performance.

Keywords: Liposomal parenteral, Regulatory quality assessment, CMC data, Complex formulations, Injectable drug products

PAP007

Development And Validation of an RP-HPLC Method For Related Substance Analysis and Forced-Degradation Study of Famotidine

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Introduction: Famotidine is a histamine H_2-receptor antagonist widely used in the treatment of acid-related gastrointestinal disorders. Regulatory guidelines require stringent control of related substances, including process-related impurities and degradation products, to ensure the safety and quality of pharmaceutical products. Although pharmacopeial monographs and reported HPLC methods for famotidine are available, many fail to provide adequate separation of all known impurities, particularly when additional degradation products are formed under stress conditions. Hence, there is a critical need for a selective and stability-indicating RP-HPLC method capable of resolving famotidine and its related substances within a single chromatographic run. **Methods:** A reverse-phase high-performance liquid chromatography (RP-HPLC) method was systematically developed and validated for the quantitative analysis of related substances in famotidine. Method development involved multiple trials with different stationary phases and mobile phase compositions to achieve optimal resolution and peak symmetry. Chromatographic separation was finalized using an Inertsil C18 column with an optimized gradient mobile phase and UV detection. Method validation was performed as per ICH guidelines, evaluating specificity, linearity, accuracy, precision, limit of detection (LOD), limit of quantification (LOQ), and robustness. Forced-degradation studies were conducted under acidic, alkaline, oxidative, thermal, and photolytic conditions to assess the stability-

indicating nature of the method. **Results:** The optimized method successfully achieved clear and complete separation of famotidine from its known impurities (Impurity A–I) and major degradation products, including sulfoxide, F, C, and D impurities. The method demonstrated excellent specificity, with no interference from placebo or excipients, and peak purity values confirmed the absence of co-elution. Validation results indicated satisfactory linearity, precision, accuracy, and robustness across the tested concentration range. Degradation behavior under stress conditions confirmed the suitability of the method for stability studies. **Conclusion:** A robust, precise, and stability-indicating RP-HPLC method was successfully developed and validated for related substance analysis of famotidine. The method meets regulatory expectations and is suitable for routine quality control, Impurity analysis and stability assessment of famotidine in pharmaceutical dosage forms.

Keywords: Famotidine, Forced degradation, RP-HPLC, Related substance analysis, Stability-indicating method.

PAP008

Chromatographic Method Development for determination of fatty acids in edible oils

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Introduction: Fatty acid composition is a critical determinant of the nutritional quality, oxidative behaviour, and authenticity of edible oils. Accurate fatty acid profiling is therefore essential for quality assurance, nutritional evaluation, and detection of compositional deviations in oil matrices. However, the structural diversity and inherent non volatility of fatty acids poses significant analytical challenges, necessitating the development of optimized chromatographic methodologies capable of delivering reliable and reproducible results. **Methods:** The present work describes the systematic development of a robust gas chromatographic method for the determination of fatty acids in edible oil matrices. Fatty acids were converted to their corresponding methyl esters using optimized alkaline methanolysis followed by boron trifluoride-mediated derivatization to ensure complete esterification. Chromatographic conditions were refined through iterative optimization, of stationary phase selection, oven temperature programming, carrier gas flow rate, and injection parameters. Quantitative analysis was performed using flame ionization detector, selected for its high sensitivity, wide linear dynamic range, and consistent response toward carbon-containing analytes. **Results:** The optimized Gas chromatographic-flame ionization detector method achieved efficient baseline separation of saturated, monosaturated, and polyunsaturated fatty acids across a broad range of chain lengths. The method demonstrated excellent, peak symmetry, resolution, and run-to-run reproducibility, enabling clear discrimination of fatty acid profiles based on compositional differences. The developed chromatographic conditions allowed reliable identification and quantification of major and minor fatty acid components within complex edible oil matrices. **Conclusion:** An application ready GC-FID method for fatty acid profiling was successfully developed. The method provides a powerful analytical tool for routine fatty acid determination, offering strong potential for quality control, nutritional characterization, and authenticity assessment of edible oils.

Keywords: Fatty acid profiling, Analytical method, Chromatographic method, Edible Oils, Quality Control

PAP009

Evaluation Of Biofilm Formation Capacity of Normal Skin Micro-Flora In Normal Gravity V/S. Simulated Microgravity Condition

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Introduction: Microgravity acts as a significant physiological stressor that enhances microbial virulence. These microbes often employ biofilm formation as a defence mechanism, which confers high resistance to disinfectants and antibiotics. This heightened resilience is a significant threat to astronaut health as human immunity is compromised during spaceflight. Thus, studying biofilm dynamics in microgravity is essential to mitigate infection risks and ensure crew health during long-term space missions. **Methods:** Strains of *Pseudomonas aeruginosa*, *Escherichia coli*, and *Staphylococcus epidermidis* are cultivated in sterile nutrient broth until the optical density (OD) at 560 nm reaches 0.6 to 0.8. Simulated microgravity (SMG) conditions are established using a Random Positioning Machine (RPM). Planktonic growth and generation time are determined by monitoring OD versus time, corroborated by Colony Forming Unit (CFU) counts. Biofilm formation ability is quantitatively assessed using the Crystal Violet (CV) staining method in a well plate assay. **Results:** It is hypothesized that all strains exposed to SMG will exhibit a significant reduction in planktonic growth rate, but will concurrently demonstrate a statistically significant increase in adherent biofilm mass, as compared to NG samples. **Conclusion:** By quantifying this differential behaviour, the study will provide critical insights into the mechanistic response of opportunistic pathogens to SMG, thus assisting in the design of effective antimicrobial and disinfection protocols for the spacecraft environment.

Keywords: Biofilm formation, Growth kinetics, Microgravity, Opportunistic pathogens, Spectrophotometry.

PAP010

Advancing Transdermal Therapy: Comparing Conventional & Smart Patches

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Introduction: Transdermal drug delivery is a patient-friendly and non-invasive therapeutic approach that bypasses first-pass metabolism and enables controlled drug administration. Conventional transdermal patches have long been used successfully; however, their passive diffusion-based mechanism limits adaptability and broader therapeutic application. With increasing clinical demand for precision and responsiveness, the evolution toward advanced transdermal systems has become essential. **Methods:** This review presents a comparative overview of conventional and smart transdermal patches, highlighting their design principles, mechanisms of action and clinical relevance. Emphasis is placed on the technological evolution from static delivery systems to advanced platforms capable of enhanced skin permeation and controlled drug release. The rationale for comparison lies in understanding how mechanistic limitations of conventional patches are addressed through intelligent design and responsive technologies in advanced systems. **Results:** Conventional patches provide predictable and sustained delivery for low-dose drugs but lack responsiveness to physiological changes. In contrast, smart transdermal patches incorporate Biosensors & microneedles, stimuli-responsive materials, improved permeability, on-demand dosing, and personalized therapy. These advanced patches actively interact with the skin and physiological signals, representing a shift from passive diffusion to adaptive, feedback-controlled drug delivery. **Conclusion:** Conventional patches will continue to play an important role due to their simplicity and cost-effectiveness, while smart transdermal patches represent a transformative toward intelligent, patient-centred drug delivery. The assessment justifies the shift toward better tech for modern patient needs. Indian pharmaceutical innovation supports this transition, contributing to the *Viksit Bharat@2047* vision by promoting Atmanirbhar Bharat and delivering affordable, high-tech healthcare solutions.

Keywords: Biosensors & microneedles, Controlled release, Smart patches, Stimuli-responsive systems, Transdermal drug delivery.

PAP011

Regulatory Evaluation And Harmonization of Labeling for Generic Oral Solid Dosage Forms: A Cross-Jurisdictional Study of the US And EU

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Introduction: Oral solid dosage forms (OSDs) are the most widely used pharmaceutical products, making accurate and patient-centered labeling essential for safe and effective use. Although the United States (US) and European Union (EU) share common public health goals, their regulatory approaches to generic drug labeling differ markedly in legal frameworks, document structure, and communication strategies, creating challenges for cross-jurisdictional compliance and lifecycle label management. **Methods:** This study uses a structured comparative regulatory analysis of labeling requirements for generic OSD products in the US and EU. Guidance documents and templates issued by the FDA and EMA were systematically reviewed, focusing on labeling content and format, submission pathways, packaging requirements, and post-approval labeling change management. **Results:** The analysis identified key differences between the US Prescribing Information (USPI) model under the Physician Labeling Rule and SPL, and the EU SmPC, PIL, and QRD-based framework. US labeling is clinician-focused and digitally integrated, while EU labeling emphasizes patient readability, multilingual accessibility, and standardized presentation. Variations in safety communication and post-approval update timelines affect dossier preparation and lifecycle management for generic OSD manufacturers. **Conclusion:** This comparative evaluation highlights persistent challenges in harmonizing generic OSD labeling across the US and EU, particularly with respect to safety updates, readability expectations, and regulatory procedures. The findings underscore the need for strategic labeling planning to support efficient global submissions and consistent product information. The study provides a regulatory framework that can aid manufacturers in navigating cross-regional labeling requirements and improving harmonization outcomes.

Keywords: Generic Drugs, Labeling Requirements, Oral Solid Dosage Forms, Regulatory Affairs, USFDA, EMA, Harmonization

PAP012

Development And Validation of DBS Based LC-MS/MS Method for Quantification Of Eliglustat in Rat Whole Blood

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Introduction: A deficiency in acid β-glucosidase leads to Gaucher's Disease Type 1 (GD1), a chronic lysosomal storage disorder that results in the buildup of glucosylceramide and glucosyl sphingosine in macrophage-dense tissues. Patients with adult GD1 often use the oral substrate reduction drug eliglustat; however, precise analytical monitoring is necessary due to its metabolism through the CYP2D6 and CYP3A pathways. The application of conventional plasma-based LC–MS/MS methods in pre-clinical studies is constrained by the requirement for invasive sampling and complex logistics. **Methods**: An LC–MS/MS method using dried blood spots (DBS) was developed to measure eliglustat in whole blood from rats. Whatman filter paper were applied with specific

volumes of whole blood, dried under regulated conditions, punched, and extracted using organic solvents like acetonitrile and methanol. Chromatographic separation was achieved using reversed-phase liquid chromatography, and detection was performed with a triple-quadrupole mass spectrometer operating in positive electrospray ionization mode. Whole rat blood was utilized to develop calibration standards and quality control samples. **Results**: Throughout all analytical runs, the novel method demonstrated strong chromatographic resolution along with a consistent and dependable retention time. Method selectivity was determined by verifying linearity across the validated concentration range and the lack of significant endogenous interferences. At the LQC, MQC, and HQC levels, both accuracy and precision remained within the regulatory limits. Assessment of the matrix effect showed no ion suppression or enhancement, and the recovery from dried blood spots remained consistent across concentration ranges. Following injections with high concentrations, no carryover was detected. Stability tests indicated that Eliglustat stayed consistent in DBS samples across all assessed processing and storage conditions. In general, all validation parameters met the criteria for regulatory bioanalytical approval. **Conclusion:** The validated DBS LC–MS/MS technique offers a sensitive, precise, and reliable approach for measuring eliglustat in rat whole blood. The method provides a less invasive and effective alternative to conventional plasma-based assays by reducing sample volume needs and simplifying sample management, making it suitable for serial sampling uses and pre-clinical pharmacokinetic studies.

Keywords: Eliglustat, Dried blood spot, LC–MS/MS, Bioanalytical validation, Gaucher disease Type 1

PAP013

Simultaneous Estimation and Stability Analysis of Efonidipine Hydrochloride Ethanolate and Chlorthalidone in Combined Dosage Form By HPLC

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Introduction: Efonidipine hydrochloride ethanolate (EFO) and Chlorthalidone (CHLOR) is widely clinically used antihypertensive combination still literature review did not reveal robust analytical method for their quantification in combined dosage form. This study presents the development and validation of HPLC method for the determination of both the drugs in the presence of their degradants. **Methods:** A UV spectrophotometric method was used to determine the isosbestic point. HPLC method was developed using C8 column and Acetonitrile: Methanol pH 3.5 (80:20 v/v) as mobile phase. The flow rate was maintained at 0.8 mL/min and detection was carried out at 241 nm. The method was validated using validation parameters and applied for the determination of EFO and CHLOR in marketed formulation and in the presence of its degradant in stress stability study. **Results:** The recovery study of EFO and CHLOR was found to be 100.74 and 100.45, the correlation coefficient for EFO R^2=0.9943 and for CHLOR R^2=0. 9976 respectively. Stress study revealed that both the drugs degraded more than 15% individually as well as in formulation. **Conclusion:** Recovery studies conducted on formulation yielded results that closely aligned with labelled content claims, demonstrating the method reliability in finished product testing. Forced degradation studies, under hydrolytic, oxidative, thermal, and photolytic stress conditions, revealed substantial instability across all test parameters. This stability-indicating aspect of the method provides valuable insight into the degradation behaviour of these compounds.

Keywords: Analytical method, Chlorthalidone, Efonidipine Hydrochloride Ethanolate, Forced degradation, HPLC

PAP014

Therapeutic Drug Monitoring (TDM) Of Immunosuppressive Agents: A Comprehensive Overview

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Introduction: Therapeutic drug monitoring (TDM) is a critical component of clinical management in immunosuppressive therapy due to the narrow therapeutic index, pronounced pharmacokinetic variability and risk of serious adverse effects associated with these agents. This review evaluates contemporary TDM strategies for widely used immunosuppressants, including mTOR inhibitors (everolimus and sirolimus), calcineurin inhibitors (cyclosporin and tacrolimus) and adjunct immunosuppressive drugs employed in transplantation, oncology and autoimmune disorders. **Methods:** Analytical techniques used for immunosuppressant quantification namely liquid chromatography–tandem mass spectrometry (LC–MS/MS), high-performance liquid chromatography (HPLC) and immunoassay-based methods were critically reviewed. Key performance characteristics such as sensitivity, reproducibility and lower limit of quantification (LLOQ) were evaluated in the context of clinical applicability and therapeutic decision-making. **Results:** LC–MS/MS demonstrated superior analytical performance, offering the highest sensitivity and lowest LLOQ, thereby enabling accurate exposure assessment and area-under-the-curve (AUC) estimation. HPLC methods provided acceptable quantification but with comparatively higher LLOQ values. Immunoassays showed satisfactory precision and operational convenience; however, their accuracy was compromised by cross-reactivity with metabolites and structurally related compounds. **Conclusion:** Validated analytical platforms, standardized sampling strategies and robust quality assurance programs are essential for reliable TDM and individualized dosing of immunosuppressive agents. Effective TDM contributes to optimized therapy, improved clinical outcomes and a reduced risk of toxicity and graft rejection.

Keywords: CNI (Calceneurine Inhibitors), Immunosuppressive agents, LC-MS/MS, TDM (Therapeutic Drug Monitoring)

PAP015

Assessment And Comparison of Bioanalytical Approaches for Ciprofloxacin Determination

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Introduction: Pharmacokinetic and bioequivalence studies are often performed on ciprofloxacin, a second-generation fluoroquinolone antibiotic commonly used to treat bacterial infections. For reliable pharmacokinetic assessments and adherence to regulations, ciprofloxacin needs to be precisely measured in biological samples such as plasma, serum, and urine. Focusing on analytical performance and utility, this review provides a critical summary of commonly employed bioanalytical techniques for assessing ciprofloxacin. **Methods:** A comparative assessment of published bioanalytical techniques concentrated on chromatographic, spectroscopic, and evolving analytical methods. Sensitivity, selectivity, limit of quantification, sample preparation needs, and practical viability were some of the parameters evaluated. Among the methods included were capillary electrophoresis, spectrofluorimetric techniques, LC–MS/MS, traditional HPLC–UV methods, and chemometric-assisted spectrophotometric strategies. **Results:** Despite their limited sensitivity at low concentration levels, HPLC-UV techniques are widely utilized due to their convenience and cost-effectiveness. LC-MS/MS is the optimal technique for pharmacokinetic and bioequivalence studies due to its enhanced sensitivity, selectivity, and lower limits of quantification. In comparison to UV-based techniques, spectrofluorimetric methods provided greater sensitivity and required less complex sample preparation. Alternative strategies show potential but were not extensively utilized**. Conclusion:** Ultimately, the selection of an appropriate bioanalytical method for

ciprofloxacin is influenced by the study's objectives, necessary sensitivity levels, available infrastructure, and regulatory considerations. HPLC-UV and fluorescence methods remain beneficial for routine analysis and quality control, despite LC-MS/MS being the preferred method for advanced bioanalysis

Keywords: Ciprofloxacin; Bioanalytical methods; Pharmacokinetics; Bioequivalence; HPLC-UV; LC–MS/MS; Spectrofluorimetry; Biological matrices.

PAP016

Review On Green Analytical Chemistry in Nanotechnology

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Introduction: Green Analytical Chemistry focuses on reducing the environmental impact of analytical work without compromising accuracy and reliability. In recent years, nanotechnology has gained attention to support greener analytical practices. Because of their unique properties, nanomaterials allow sensitive analysis while using smaller sample volumes, fewer chemicals, and less energy. **Methods**: This work reviews recent developments in nano enabled green analytical techniques, including sensing, sample preparation, and catalytic applications. Special emphasis is given to environmentally friendly nanomaterial synthesis methods such as plant-based, microbial, biopolymer assisted, and microwave assisted approaches, and their role in supporting the principles of GAC. **Results**: The use of nanomaterials improves analytical sensitivity and selectivity while significantly reducing solvent consumption, waste generation, and energy use. Green-synthesized nanomaterials have shown reliable performance in environmental and biomedical analysis, enabling rapid and on-site measurements. **Conclusion**: Combining nanotechnology with Green Analytical Chemistry offers practical and sustainable solutions for modern analytical challenges, promoting safer laboratories and environmentally responsible analytical methods.

Keywords: Green Analytical Chemistry, Nanotechnology, Sustainable Analysis, Green Synthesis

PAP017

A Comparative Regulatory Assessment Of E-Pharmacies in India, The United Kingdom, And Singapore

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Introduction: E-pharmacy is defined as the web-based sale and distribution of drugs and other pharmacy products. This sector has experienced a significant rise over the years. Its development has revolutionized the way healthcare is accessed globally, providing great benefits like improved convenience, greater ease of access, and better patient care. However, there have been disadvantages like possibility of drug abuse, the spread of counterfeit drugs, lack of medical oversight, the issue of patient privacy, and difficulties in verifying the identities of patients as well as the authenticity of the medical prescriptions. This underlines the importance of a common regulatory framework. **Methods:** As different nations have adopted different models for regulation, it is required to undertake a comparative analysis to understand best practices. The study investigates and compares e-pharmacy regulations that exist between India, the United Kingdom, and Singapore. **Results:** Results of analysis present the rigid HSA-driven regulatory system of Singapore, structured regulation in the UK under GPhC & MHRA, India's changing regulatory environment under CDSCO and MoHFW. This study covers areas such as legal provisions, licensing, verification of prescriptions, data protection requirements, & advertising norms. **Conclusion:**The goal of this comparison is to point out gaps in regulation, examine national advantages and disadvantages, and draw conclusions that are universally relevant. These conclusions may be used to promote standardized and future-proof

approaches to regulation that guarantee ethical, and efficient use of e-pharmacy services. The conclusions are universally relevant since this comparison has relevance in different healthcare systems and models of regulation around the world.

Keyword: CDSCO, Comparative Regulatory Frameworks, E-Pharmacy Regulation, HSA, MHRA.

PAP018

A Comprehensive Review of the European Regulatory Framework for Peptide Therapeutics

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Introduction: Peptide therapeutics represent a growing class of medicinal products characterized by high selectivity, favourable safety profiles, and wide therapeutic utilization. Their structural diversity, synthetic complexity, and specific impurity patterns create an important regulatory challenge. In Europe, development and approval follow a multilayered regulatory system, which involves the European Medicines Agency, the European Commission, and national competent authorities. This review intends to provide a detailed overview of the main European regulatory framework applicable to peptide therapeutics within quality, nonclinical, clinical, and post-authorisation domains**. Methods:** A structured review of regulatory and scientific documents was performed using the EMA databases, the EudraLex Volumes 1-10, ICH guidelines, CHMP and PRAC publications and the peer-reviewed literature published between 2005 and 2024. Documents were screened for relevance to peptide classification, CMC expectations, nonclinical evaluation, clinical development pathways, pharmacovigilance obligations, biosimilar considerations and lifecycle management. Extracted data were synthesised into thematic regulatory domains. **Results:** Expectations were clearly outlined with regard to peptide classification, quality characterisation, impurity profiles, analytical validation, process control, and CTD/IMPD reporting. Nonclinical results included relevance considerations, toxicological needs, immunogenicity testing, and waivers. Clinical routes, ranging from CTA procedures, dose response methods, accelerated routes, conditional approval, orphan drug designation, and post-approval plans, were also included. Other outcomes included pharmacovigilance responsibilities, biosimilarity approval procedures and generic approval for peptide molecules, and upcoming challenges involving peptide conjugates, long-acting formulations, and modern delivery technologies. **Conclusion:** The European regulatory framework for therapeutic peptides is well-established but also fast-evolving. Harmonisation on an ongoing basis, further clarification of classification criteria, more instrumental analysis guidelines, and a widening of the regulatory science initiatives are essential to support effective development, approval, and life cycle management of medicinal products based on peptides.

Keywords: Peptide Therapeutics, Drug Regulation Europe, European Medicines Agency, Clinical Development, Pharmacovigilance

PAP019

Review On Analytical Methodologies for Quantitative Estimation Of Sitagliptin Phosphate and Lobeglitazone Sulfate

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Introduction: Type II diabetes mellitus (T2DM) continues to be a rapidly growing global health burden that requires efficient pharmacotherapy backed by trustworthy analytical quality control. Two commonly used antidiabetic medications with complementary mechanisms of action are sitagliptin phosphate, an inhibitor of dipeptidyl peptidase-4 (DPP-4), and lobeglitazone sulfate, an agonist of peroxisome proliferator-activated receptor-γ (PPAR-γ). To guarantee pharmaceutical quality, regulatory compliance, and therapeutic consistency,

precise quantitative estimation of these medications is crucial. **Methods:** UV-visible spectrophotometry, high-performance liquid chromatography (HPLC), high-performance thin-layer chromatography (HPTLC), ultra-performance liquid chromatography (UPLC), and liquid chromatography–tandem mass spectrometry (LC–MS/MS) were among the analytical techniques that were thoroughly and critically reviewed. According to ICH Q2(R1) validation guidelines and pharmacopeial standards (USP, IP, BP), the methods were assessed based on sensitivity, selectivity, accuracy, precision, robustness, and applicability to pharmaceutical and biological matrices. **Results:** For stability-indicating studies, pharmacokinetic analysis, bioanalytical applications, and fixed-dose combination formulations, chromatographic and hyphenated techniques demonstrated superior sensitivity and specificity. Spectrophotometric techniques, on the other hand, demonstrated limited applicability for complex or multicomponent systems despite offering simplicity and cost-effectiveness. **Conclusion:** This review emphasizes future trends toward green analytical chemistry and sophisticated, sustainable hyphenated techniques while highlighting the advantages and disadvantages of current analytical methods. These methods support innovation-driven pharmaceutical analysis by promising enhanced analytical performance with less environmental impact.

Keywords: Lobeglitazone sulfate, sitagliptin phosphate, type II diabetes mellitus, green analytical chemistry, and hyphenated methods

PAP020

Drug Price Control in India and the United Kingdom: A Comparative Policy Analysis

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Introduction: The price of medicines directly influences how easily patients can access essential treatments, making drug price control a key public health priority. Different countries regulate medicine prices in their own way, shaped by their healthcare systems and population needs. This review examines how India and the United Kingdom approach drug price regulation and highlights the rationale behind their distinct methods. **Methods:** The review draws on official policies, government acts and regulatory documents from India and the United Kingdom. Indian frameworks such as the Drugs (Prices Control) Order and the National Pharmaceuticals Pricing Policy were examined alongside United Kingdom mechanisms including the Voluntary Scheme for Branded Medicines Pricing, Access and Growth, the Statutory Scheme and National Institute for Health and Care Excellence assessments. These materials were compared to understand differences in regulatory philosophy, implementation and effect on patients and healthcare costs. **Results:** India relies on direct price control through ceiling prices and essential medicine lists to maintain affordability, especially for widely used treatments. In contrast, the United Kingdom focuses on value-based assessments, negotiated rebates and expenditure caps to manage National Health Service spending while supporting innovation. Both systems contribute to affordability, but they operate through fundamentally different models. **Conclusion:** India's approach is strong in protecting access to essential medicines, whereas the United Kingdom offers a more flexible structure that balances cost control with value assessment. Future improvements could include adopting selective value-based tools in India and enhancing transparency within the United Kingdom's pricing processes. Combining strengths from both systems may support more equitable and sustainable pricing policies.

Keywords: affordability, drug pricing regulation, india, price control, united kingdom

PAP021

Combination Vaccines in the United Sates: A Retrospective Analysis Of 25 Years Of Post-Marketing Surveillance Through Vaccine Adverse Event Reporting System (VAERS)

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Introduction: Combination vaccines represent a significant advancement in public health by allowing immunization against multiple diseases in a single formulation. By reducing the total number of injections, these vaccines improve patient compliance, minimize procedural discomfort, and enhance overall uptake, particularly in paediatric populations where frequent visits can lead to missed doses. However, these vaccines also introduce challenges, including formulation complexity, potential immunologic interference, and difficulties in attributing specific adverse events to individual components. **Methods:** This study evaluates the safety profile of twelve combination vaccines licensed in the United States between 1999 and 2024. Data were analysed from the Vaccine Adverse Event Reporting System (VAERS), a national passive post-marketing surveillance system. Reports were categorized and assessed based on age, symptom onset, severity, and clinical outcomes such as hospitalization, life-threatening events, disability, emergency room visits, and death. **Results:** The majority of reported adverse events were classified as mild. Diphtheria, tetanus, and acellular pertussis (DTaP) containing vaccines generated the highest volume of reports, primarily among infants. In contrast, measles, mumps, and rubella (MMR) containing vaccines demonstrated excellent safety profiles, characterized by high recovery rates and zero reported deaths. Serious outcomes, including hospitalization and death, were found to be rare across all analysed vaccine types. **Conclusion:** Despite the inherent limitations of passive surveillance such as underreporting and lack of confirmed causality the findings support the continued use of combination vaccines. They remain a safe, effective, and scalable strategy for achieving broad immunization coverage. Their role is vital in simplifying logistics, reducing cold chain requirements, and fostering public confidence in global vaccination programs.

Keywords: Combination vaccines, Vaccine safety, Vaccine Safety Reporting System (VAERS), post- marketing surveillance, Adverse events

PAP022

Analytical Technique Selection for Regulatory Submission of Dapagliflozin & Pioglitazone Formulation: Key Considerations

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Introduction: Two common antidiabetic medications used to treat type 2 diabetes are pioglitazone and dapagliflozin. While pioglitazone is a thiazolidinedione that increases insulin sensitivity, dapagliflozin is a member of the sodium-glucose co-transporter-2 (SGLT-2) inhibitor class. The development and validation of trustworthy analytical techniques are crucial for quality control and regulatory compliance because of their growing clinical application in single and mixed dose forms. **Methods:** This review provides an overview of many proven analytical methods for estimating pioglitazone and dapagliflozin in pharmaceutical dosage forms that have been documented in the literature. Techniques include stability-indicating techniques, high-performance thin-layer chromatography (HPTLC), reverse phase high-performance liquid chromatography (RP-HPLC), and UV-visible spectrophotometry were assessed. In accordance with ICH recommendations, validation criteria such as accuracy, precision, linearity, specificity, robustness, limit of detection (LOD), and limit of quantification (LOQ) were thoroughly examined. **Results:** Because of their excellent sensitivity, accuracy, and reproducibility, RP-HPLC procedures were determined to be the most popular of the reported approaches. For routine analysis, UV spectrophotometric techniques provided affordability and ease of use. Method specificity was confirmed when the

medicines were successfully isolated from their degradation products using stability-indicating techniques. Within regulatory bounds, the majority of procedures showed acceptable validation**. Conclusion:** In order to guarantee the effectiveness, safety, and quality of pharmaceutical dosage forms, validated analytical methods for the quantification of pioglitazone and dapagliflozin are essential. While UV techniques are appropriate for preliminary and economical analysis, RP-HPLC is still the recommended approach for routine and stability analysis. Researchers and analysts working in pharmaceutical quality control will find this review to be a helpful resource.

Keywords: Dapagliflozin, Pioglitazone, UV- Spectrophotometry, HPLC (High Performance Liquid Chromatography), RP-HPLC(Reverse Phase- High Liquid

PAP023

Sustainable Evolution In Analytical Chemistry: Employing Rgb Model and Green Metric Tools for Greenness and Whiteness Assessment

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Introduction: The increasing demand on sustainability in analytical chemistry has led to the development of frameworks such as Green Analytical Chemistry (GAC) and White Analytical Chemistry (WAC). Conventional analytical techniques like HPLC and HPTLC are based on toxic solvents, require high energy, generate hazardous waste & raising environmental and safety concerns. These limitations highlight the need for more sustainable and practically applicable analytical approaches. **Methods**: A literature-based conceptual review was carried out to examine the principles, evaluation tools, and applications of GAC and WAC. Key green metric tools, including AGREE, GAPI, BAGI, and the RGB 12 scoring model were critically reviewed to assess their effectiveness in evaluating environmental sustainability, analytical performance, and practical applicability. **Results**: The analysis shows that GAC helps reduce environmental impact by using clear visual and numerical tools to assess how green an analytical method is. However, it usually gives less importance to method performance and practical use in real laboratory conditions. WAC improves on GAC by combining three key aspects: environmental safety (Green), analytical performance (Red), and practical usability (Blue). The RGB-12 model allows a balanced evaluation of these factors, where higher whiteness scores indicate methods that are reliable, practical, and environmentally sustainable. **Conclusion**: GAC and WAC serve complementary roles in advancing sustainable analytical chemistry. While GAC emphasizes environmental responsibility, WAC provides a more comprehensive framework by combining greenness with analytical reliability and practical applicability, supporting the development of sustainable analytical methods.

Keywords: Green Analytical Chemistry, White Analytical Chemistry, AGREE, GAPI, BAGI, RGB 12

PAP024

Global Regulatory Perspectives of 3D Printing Technology in the Development Of Medical Devices

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Introduction: 3D printing or additive manufacturing is being used extensively for medical devices including orthopaedic implants, cranial implants, dental restorations, prostheses, and surgical instruments. Additionally, many different types of printing technology are available including powder bed fusion, FDM, SLA/SLS and DMLS allowing for point-of-care manufacturing. However, powder bed fusion is the most common. The rapid emergence of these technologies presents new challenges to conventional regulatory assumptions. **Methods:** A systematic review and evaluation of published scientific literature, international regulation standards (ISO /

ASTM), USFDA, EU, CDSCO India, PMDA Japan, TGA Australia, etc., were used in conjunction with a regulatory analysis. Areas of comparative evaluation between the countries were the device classification, pre-market approval pathways, quality management systems, process validation, software control, and post-market surveillance associated with additively manufactured products. **Results:** The results show that the greatest level of regulatory readiness for 3D printed products can be seen with the USFDA and TGA as they both have developed specific guidance to promote innovations in additive manufacturing. Conversely, the EU MDR places the most emphasis on traceability and the responsibilities associated with post-market obligations, but has limited harmonised standards for additive manufacturing. Emerging regulators like CDSCO and PMDA have continued to use the generalised regulations for devices. **Conclusion:** The regulatory framework must evolve to establish digital design control, allow for materials variability, and enable localized manufacturing (point-of-care) of products to protect the quality, safety, and efficacy of products.

Keywords: 3D Printing, Powder Bed Fusion, Additive Manufacturing, Medical Devices, Point-of-care.

PAP025

Comparative Evaluation Of Bioequivalence Outcomes Under ICH M13A And Preceding Regional Guidelines

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Introduction: Bioequivalence studies are the primary requirements for the approval of generic drugs and they are also an assurance of the therapeutic equivalence with the original products. Through the years, the different regulatory requirements of different bodies, such as the US FDA, EMA, Health Canada, CDSCO, and ANVISA, have resulted in the performing of studies more than once, the increase of the cost of developing a drug, and the facing of operational difficulties by the companies and contract research organizations. **Methods:** A comparative and qualitative regulation review was performed comparing the outcomes of bioequivalence as per ICH M13A and the former regional guidelines. In order to evaluate the discrepancies in the study design, pharmacokinetic parameters and the regulatory decision-making, some hypothetical CRO-based case scenarios were invented. **Results:** The implementation of ICH M13A showed that regulatory convergence could be enhanced through the use of a harmonized study design, a standardized pharmacokinetic assessment, and a set of common statistical acceptance criteria. The guideline retained scientific rigor and patient safety but at the same time cut down on fasting and fed studies that were not necessary. **Conclusion:** ICH M13A is a major step forward for the worldwide convergence of bioequivalence standards for immediate-release oral dosage forms. The common structure lays the groundwork for quick and cost-effective generic drug development, elimination of superfluous studies, and uniformity of regulatory decisions in different parts of the world.

Keywords: Bioequivalence, Contract Research Organizations, ICH M13A, Immediate-Release Dosage Forms, Regulatory Harmonization

PAP026

Stability-Indicating RP-HPLC Method Development and Validation for Determination Of Related Substances in CNP Analogue

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Introduction: Peptide-based therapeutics are increasingly important in clinical practice, yet comprehensive control of process-related and degradation impurities remains challenging. Regulatory expectations for impurity profiling and stability data, coupled with the absence of official monographs for many C-type natriuretic peptide (CNP) analogues, necessitate robust stability-indicating methods**. Methods:** A reverse-phase high-performance liquid chromatography (RP-HPLC) method was developed for the quantitative determination of related substances in a CNP analogue active pharmaceutical ingredient. Critical chromatographic parameters, including stationary phase, gradient program, mobile phase pH, and organic modifier content, were systematically optimized to achieve baseline separation between the main component and its impurities. The method was validated in accordance with ICH Q2(R2) guidelines for specificity, linearity, accuracy, precision, robustness, and sensitivity. **Results:** The optimized method provided adequate resolution between the CNP analogue and all observed related substances, including stress-induced degradation products. Linearity was demonstrated over the working range with correlation coefficients exceeding accepted thresholds, and recoveries were within commonly applied limits for peptide assays. Intra- and inter-day precision experiments yielded %RSD values within typical criteria, and deliberate variation of method parameters confirmed robustness. **Conclusion:** The validated RP-HPLC procedure is stability-indicating and suitable for routine determination of related substances in a CNP analogue, supporting quality control and regulatory submission for peptide drug substances.

Keywords: CNP analogue, Method validation, Related substances, RP-HPLC, Stability-indicating

PAP027

A Comprehensive Review on Applications of Hyphenated LC-NMR In Pharmaceutical Analysis

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Introduction: Hyphenated techniques in pharmaceutical analysis represent a significant advancement in analytical chemistry, combining separation methods with detection technique to enhance the resolution, sensitivity, and efficiency of analytical processes. **Methods:** This review highlights the compilation of research carried out by different scientists by using hyphenated LC-NMR in pharmaceutical analysis. Hyphenated LC-NMR was performed by three different modes (1)online flow mode (2) stop flow mode (3) Loop/Cartridge Storage Mode and LC–SPE–NMRs. **Results:** Nowadays LC-NMR has very a wide range of applications and this technique has become increasingly important in pharmaceutical analysis in impurity profiling, degradation product characterization, metabolite profiling and quality control and authentication, LC–NMR facilitates chemical fingerprinting and structure elucidation of minor bioactive metabolites, chemometric based drug discovery approaches and herbal drug standardization out of this most widely used in natural product analysis Additionally, LC–NMR has demonstrated utility in food analysis, environmental monitoring, and metabolomics by enabling detailed structural analysis of complex matrices. **Conclusion:** LC-NMR is a sensitive and powerful analytical technique that combines the separation capabilities of HPLC with structural elucidation capability of NMR spectroscopy. Continuous advancements in LC-NMR has become increasingly valuable in pharmaceutical research and development, particularly in drug discovery, formulation, and quality control.

Keywords: Analytical technique, LC-NMR; Natural product analysis

PAP028

Zazibona's Evolving Centralised Assessment Pathway: Regulatory Implications for Southern African Development Community (SADC) Harmonisation

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Introduction: ZaZiBoNa collaborative medicines registration is the major regional response to an inefficient regulatory environment within the SADC region, including regulatory workload sharing and avoidance of duplicative national reviews, or needless time delays, in accessing new products for patient benefit. Among Africa's harmonization efforts and other related initiatives for collaborative and reliance-based regulatory systems, the poster will aim to assess the establishment of ZaZiBoNa's centralized assessment pathway as well as its implications for harmonization of regulatory systems among SADC member states. **Methods:** This poster summarizes peer-reviewed literature, regional regulatory assessments, and official communications and publications related to the regulatory harmonization exercise from 2020 until early 2025. This includes the African Medicines Regulatory Harmonization updates, published assessments of ZaZiBoNa's performance, and other recent documents related to the centralized assessment approach that has only been piloted to date. It also provides an overview of developments in participant authority roles, assessment workflow, and governance structure. **Results:** As a result, the report states, centralized, predictable, timed, and more harmonized processes replace decentralized work sharing. Key outcomes include decreased regulatory duplication, enhanced regulatory trust, more efficient dossier evaluation, and national decision making and implementation variability. **Conclusion:** ZaZiBoNa's centralized approach is a major step towards regulatory convergence within the Southern African Development Community (SADC) region and offers valuable lessons for international regulatory cooperation. These advancements provide useful insights into cooperative regulatory systems and their function in enhancing access to quality-assured medications in resource-diverse contexts for pharmacy students and regulatory professionals.

Keywords: centralised assessment pathway, regulatory collaboration, regulatory harmonisation, SADC medicines regulations, ZaZiBoNa's

PAP029

A Systematic Comparative Review of Pre-Market Regulatory Requirements for Generic Modified-Release Solid Oral Dosage Forms in the United States and European Union

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Introduction: Solid oral dosage forms with modified release characteristics (MR-OSD) are vital to the field of pharmacotherapy in the 21st century because they can be used for the controlled delivery of drugs, improving pharmacokinetics, reducing dosing frequency, and enhancing patient compliance. However, complex formulation of MR-OSD creates difficulties in the development of generics because of significant differences in expectations among different regulators and regions. This review will examine the pre-market regulatory requirements needed by MR generics in the U.S. and E.U. and compare their respective approval processes, key stages, documentation formats, and reviews. **Methods:** A systematic comparative assessment was conducted using regulatory frameworks, guidance documents, and scientific standards issued by the US Food and Drug Administration and the European Medicines Agency. Key areas evaluated included approval pathways, dossier content requirements, validation procedures, review sequencing, and technical expectations for dissolution testing, bioequivalence study design, in vitro–in vivo correlation, and modelling-based approaches. **Results:** The analysis identifies both alignment and divergence between US and EU regulatory approaches. While both jurisdictions require robust dissolution characterisation and demonstration of bioequivalence for MR products, differences exist in dissolution specification setting, flexibility in bioequivalence design, acceptance of modelling tools, and review timelines. The US follows a structured, iterative review process, whereas the EU applies a phased and decentralised assessment model. **Conclusion:** The findings highlight regulatory complexities arising from procedural and technical variability between the US and EU and emphasise the need for strategic alignment to support efficient MR generic development and predictable market authorisation.

Keywords: Bioequivalence Specifications, Generic Drug Development, Modified-Release Dosage Forms**,** Pre-Market Review Timelines, Regulatory Frameworks.

PAP030

Forced Degradation Studies and Characterization of Impurities in Tyrosine Kinase Inhibitor Used in Treatment of Chronic Myeloid Leukaemia (CML): An Analytical Approach

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Introduction: Chronic myeloid leukaemia (CML) is one of the most common leukaemia's occurring in the adult population. Targeted therapy which has been introduced in recent years is directed against cancer-specific molecules and signaling pathways. Tyrosine kinases are an especially important target inhibitors, as they play an important role in the modulation of growth factor signaling. Forced degradation studies play a critical role in understanding the stability profile and impurity behaviour of Tyrosine Kinase Inhibitors (TKIs). These studies are conducted to subject TKIs to various accelerated conditions such as acidic and alkaline hydrolysis, oxidation, thermal stress, photolysis, and humidity. The generated degradation products provide valuable perception into the intrinsic stability of the drug substance and drug product. **Methods:** This review looks at the latest developments in some analytical techniques employed for impurity profiling in drugs like Imatinib, Bosutinib and Dasatinib including high-performance liquid chromatography (HPLC), ultra-high-performance liquid chromatography (UHPLC), liquid chromatography–mass spectrometry (LC–MS/MS), and nuclear magnetic resonance (NMR) spectroscopy, are widely employed for the detection, identification, and structural elucidation of degradation products. **Result:** The degradants produced were analysed using various analytical techniques and the impurity profiling was evaluated. **Conclusion:** Such studies ensure robust quality control strategies, and ultimately contribute to the safe and effective use as well as proper Storage condition and shelf life of Tyrosine Kinase Inhibitors used in therapies.

Keywords: Accelerated Conditions, Degradants, Impurity profiling, Storage conditions, Tyrosine Kinase Inhibitors.

PAP031

Pharmacovigilance In The Digital Era: Advancing Risk Management and Patient Safety

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Introduction: Pharmacovigilance (PV) plays a critical role in ensuring patient safety through the detection, assessment, and prevention of adverse drug reactions (ADRs). Risk management is a core component of PV, aimed at maintaining a favorable benefit–risk balance of medicines. With the advent of digital technologies, PV has shifted from a reactive to a proactive system supported by mobile applications, artificial intelligence (AI), and global safety databases. In India, the Pharmacovigilance Programme of India (PvPI), under the Ministry of Health & Family Welfare, has significantly strengthened drug safety surveillance. **Methods:** This review evaluates India's PV framework coordinated by the Indian Pharmacopoeia Commission (IPC), comprising over 600 ADR Monitoring Centres (AMCs) nationwide. Digital tools such as the PvPI mobile application, online ADR reporting portal, and toll-free helpline (1800-180-3024) were assessed. Global integration with WHO–UMC Vigibase and the use of advanced safety platforms including Oracle Argus Safety, WHO VigiLyze, and FDA Sentinel were examined to highlight automation and AI-driven risk management. **Results:** India contributes more than 250,000 Individual Case Safety Reports (ICSRs) annually to Vigibase, improving early signal detection and regulatory decision-making. Digital reporting has reduced reporting timelines by approximately 30–40%, enabling timely actions such as safety label updates, risk minimization measures, and product recalls. Automation through safety databases has enhanced data quality, and regulatory compliance. **Conclusion:** Digital pharmacovigilance has become an essential risk management tool, enhancing ADR reporting efficiency, regulatory responsiveness, and

patient involvement. Continued technological integration, along with improved reporting awareness and data governance, will further strengthen global drug safety systems.

Keywords: Pharmacovigilance, Risk Management, Patient Safety, Digital Health, Adverse Drug Reactions

PAP032

A Green RP-HPLC Method Development and Validation for the Quantitative Estimation Of Vildagliptin and Pioglitazone Hydrochloride in Bulk and Tablet Dosage Form

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Introduction: A greener method was developed to quantify combination of Vildagliptin and Pioglitazone hydrochloride in bulk and tablet by the reverse phase -HPLC method **Methods:** The G-score of the solvents were checked by GSST before deciding the mobile phase. The research work used Box-Behnken Design (BBD) having % organic modifier, flow rate, and wavelength as critical method attributes for noting the effects on responses like retention times of both drugs, NTP of both drugs and resolution between the peaks. A developed method was validated as per ICH guidelines. **Results and Discussion:** The final optimized methods used an Epic C18 column (4.6*25 cm; 5 µm) as stationary phase, 10µl injection volume, flow rate of 1 ml/min with 10mM phosphate buffer: ACN (40:60 v/v) as mobile phase and 22°C column temperature. Run time was 10 minutes. The detection wavelength was set to 218 nm. The linearity of the method was in the range of 25-75 µg/ml for Vildagliptin and 7.5-22.5 µg/ml for Pioglitazone hydrochloride. The outcome of the parameters like precision, accuracy, specificity, system suitability, and robustness were satisfactory and within the acceptance criteria. The greenness score was checked by different tools like AGREE, GAPI, and BAGI, which confirmed the greenness of the present work. **Conclusion:** Overall, the research offers a rapid, reliable, cost-effective, and eco-friendly analytical approach suitable for routine quality control, aligning modern pharmaceutical practices with sustainable and responsible analytical methodologies

Keywords: Quantitative analysis, Pioglitazone Hydrochloride, RP-HPLC, Vildagliptin, Green Method

PAP033

Digital PAT-Enabled Qbd in Continuous Manufacturing: Accelerating Generic Drug Compliance

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Introduction: Digitalization of manufacture industry is a key step in any progress of the production process. It includes increased use of robotics, automation and computerization, reduce costs, to improve efficiency, productivity. Regulatory agencies - the U.S. FDA and EMA encourage the adoption of Continuous Manufacturing (CM) and Quality by Design (QbD) for consistent product performance and rapid approval of generic drugs. The predicted profitability of the generic product will require strategic planning for the subsequent launch timing. There's a lack of real-time control and predictive quality assurance in existing manufacturing frameworks. The work aims to develop an integrated process analytical technology (PAT) approach for a dynamic co-precipitation process characterization and design space development. Principles in Continuous Manufacturing can accelerate generic drug compliance and enable real-time release testing (RTRT). **Methods:** Fundamental to QbD is understanding the material attributes and process parameters, their effect on the critical to quality attributes (CQA)

and controlling variability. PAT, outlined by the FDA in 2004, designs and control process parameters affecting quality attributes of in-process materials. PAT tools such as sensors, probes and spectroscopy- measure critical parameters and collect large data sets. **Results:** CM concepts, describes scientific approaches specific to drug products. Integrating of digital PAT tools can enhance process understanding and ensure regulatory traceability through automated data recording. **Conclusion:** Digital PAT-enabled QbD within CM represents an Integrative approach to achieving regulatory excellence in generic drug production, advancing Pharma 4.0 though predictive, data-driven quality management via the technology-organization-environment (TOE) framework.

Keywords: Continuous Manufacturing (CM), Process analytical technologies (PAT), Quality by design (QbD), Real-time release testing (RTRT), Technology-organization-environment (TOE).

PAP034

Artificial Intelligence- Assisted Thermal Validation of Sterilization Processes for Parenteral Products

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Introduction: Thermal validation is a critical requirement in parenteral pharmaceutical manufacturing to ensure that sterilization processes consistently achieve the desired Sterility Assurance Level (SAL). Conventional moist heat sterilization relies on fixed time–temperature cycles and limited sensor data, which may lead to overprocessing or undetected cold spots. With increasing regulatory emphasis on risk-based approaches and digital transformation, artificial intelligence (AI) offers new opportunities to enhance process understanding, real-time monitoring, and predictive control of sterilization processes. **Methods:** This work presents an integrated framework combining conventional thermal validation practices with AI-enabled process analytics. Standard qualification activities including cycle development, heat distribution and heat penetration studies, and performance qualification were complemented by AI-based approaches such as predictive heat penetration modelling, adaptive F_0 estimation, sensor data fusion, and trend analysis of historical sterilization cycles. AI-supported tools were used as decision-support systems to identify worst-case locations, optimize cycle parameters, and improve consistency across load configurations. **Results:** The AI-assisted framework demonstrated improved prediction of cold spots, reduced variability in delivered lethality, and enhanced confidence in sterilization cycle performance. Integration of real-time sensor data with predictive models enabled early detection of deviations and minimized reliance on conservative overkill conditions while maintaining regulatory compliance. **Conclusion:** AI-enhanced thermal validation strengthens sterility assurance by shifting sterilization control from reactive verification to predictive and risk-based decision-making. While AI does not replace established sterilization principles, its integration with validated thermal processes supports improved product quality, operational efficiency, and alignment with modern regulatory expectations.

Keywords: Thermal validation, Parenteral products, Artificial intelligence, Heat penetration, Sterility assurance level

PAP035

Validation And Industrial Evaluation Of Automated Visual Inspection Systems for Particulate And Cosmetic Defect Control in Sterile Parenteral Products

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Introduction: Visual inspection is a mandatory critical quality control step for sterile parenteral products to ensure the absence of particulate matter, cosmetic defects, and container integrity failures. While manual visual

inspection (MVI) is the traditional compendial method, it is inherently subjective, operator-dependent, and susceptible to fatigue-related variability. With increasing production volumes and stringent regulatory expectations, the pharmaceutical industry is progressively adopting Automated Visual Inspection (AVI) systems to improve inspection reliability, consistency, and compliance. The objective of this study was to evaluate and validate an Automated Visual Inspection (AVI) system for injectable products and to compare its inspection performance with manual visual inspection using statistically accepted methodologies under industrial manufacturing conditions. **Methods:** An industry-based validation study was conducted focusing on particulate matter generation sources across manufacturing operations, including raw material handling, compounding, filtration, filling, sealing, and container washing. The AVI system was assessed for its capability to detect particulate matter, cosmetic defects, fill volume deviations, and container closure integrity using camera-based imaging, light obscuration principles, container rotation, and crosswise image subtraction. Validation was performed using Knapp methodology, wherein Quality Factors obtained from manual inspection (FQA) were statistically compared with those generated by the AVI system (FQB). High Voltage Leak Detection (HVLD) was integrated to evaluate container integrity. **Results:** The AVI system demonstrated inspection efficiency equal to or greater than manual visual inspection, satisfying the acceptance criterion of ≥100% efficiency relative to manual inspection. The automated system showed superior consistency, higher inspection throughput, reduced false rejections, and elimination of human bias. Integration of HVLD further enhanced defect detection related to container leakage, strengthening overall product quality assurance. **Conclusion**: The study confirms that Automated Visual Inspection systems provide a scientifically robust, reproducible, and regulatory-compliant alternative to manual inspection for sterile parenteral products. Adoption of AVI significantly improves inspection reliability, operational efficiency, and patient safety, supporting its implementation as a standard industry practice in modern pharmaceutical manufacturing.

Keywords: Automated Visual Inspection; Sterile Parenterals; Particulate Matter Control; Knapp Methodology; Pharmaceutical Quality Assurance

PAP036

A Review on Pharmaceutical Water System Design, Validation, And Quality Control

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Introduction: High-purity water is a critical utility in pharmaceutical manufacturing, and its quality directly influences product safety, regulatory compliance, and the performance of sterile processing systems. This review provides an overview of the design, operation, and control of pharmaceutical water systems, with emphasis on Purified Water (PW) and Water for Injection (WFI). **Methods**: The review is based on an evaluation of industrial water-system processes, including pretreatment steps, membrane-based purification, distillation, validation documentation, and routine monitoring practices observed during internship experience. Process flow diagrams, qualification stages (URS, DQ, IQ, OQ, PQ), and quality attributes such as TOC, conductivity, endotoxin levels, and microbial load were examined to understand system capability. **Results**: The assessment showed that a multi-stage treatment approach comprising sand filtration, carbon adsorption, softening, ultrafiltration, reverse osmosis, double RO, and multicolumn distillation consistently supports compliance with pharmacopeial standards, achieving low conductivity values, controlled microbial counts, and endotoxin levels below regulatory limits. Effective loop design, thermal sanitization, ozone treatment, and preventive maintenance were identified as essential strategies to prevent biofilm formation and system failures. **Conclusion**: Overall, the literature and practical findings demonstrate that a robustly designed and validated water system, supported by continuous monitoring and disciplined maintenance, is fundamental to ensuring sustained production of high-quality pharmaceutical water.

Keywords: Water for Injection, Reverse Osmosis, Qualification, Conductivity, Regulatory compliance

PAP037

Multiplexed Lab-On-A-Chip Platforms Integrating Nano-Biosensors for the Detection of Uric Acid, Vitamin B12 And Vitamin D3: Recent Advances and Applications

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Introduction: Simultaneous detection of multiple biomarkers is increasingly important in pharmaceutical analysis. Uric acid, vitamin B12, and vitamin D3 represent diverse chemical and physiological properties, posing distinct analytical challenges. Lab-on-a-Chip (LOC) platforms offers integrated solutions for multiplexed biomarker analysis, providing advantages such as minimal sample volume, rapid detection, and high sensitivity. **Methods:** This review highlights recent advances in LOC platforms for simultaneous detection of uric acid, vitamin B12, and vitamin D3. Nano-biosensor-based electrochemical, optical, and fluorescence detection strategies are discussed. Selective recognition elements, including molecularly imprinted polymers and aptamer-functionalized surfaces, and their integration into microfluidic channels are described. **Results:** Multiplexed LOC devices effectively capture and detect these three biomarkers with high specificity and precision. Uric acid is primarily detected via electrochemical Nano sensors, vitamin B12 through aptamer-based detection, and vitamin D3 using hydrophobic molecularly imprinted polymers or aptamer-functionalized systems. Integration of multiple recognition elements allows parallel quantitative measurement, reducing reagent and sample consumption. **Conclusion:** LOC platforms incorporating Nano-biosensors provide a sensitive, efficient, and versatile approach for simultaneous detection of uric acid, vitamin B12, and vitamin D3, demonstrating significant potential for pharmaceutical analysis, quality control, and point-of-care applications.

Keywords: Multiplexed LOC, Nano-biosensors, Uric Acid, Vitamin B12, Vitamin D3

PAP038

The Regulatory Perspective of Real-World Data In USA, Europe, And UK

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Introduction: Real-world evidence (RWE) and real-world data (RWD) are vital for drug development, regulatory compliance, and decision-making, and as such, they are gaining importance in the pharmaceutical sector and Drug Regulatory Agencies (DRAs) worldwide. Although limited documentation is known about the combination of RWE, it is utilized by DRAs to evaluate various treatment modes and monitor post-market safety. **Methods:** The aim of the study was to examine that how DRAs' opinion is incorporated into the regulatory decision-making process regarding RWE. Review and comparison of several development methodologies used by DRAs in the US, Europe, and the UK to create and implement RWE were conducted, along with a discussion of what challenges they faced. **Results:** It was discovered that the USFDA, EMA, and MHRA employed various approaches in the development of RWE. The UK's adoption of RWE was comparatively restricted as compared to the US and EU, and this was largely influenced by the country's unique pharmaceutical environment and developmental phases. The development of RWE involves several inputs, activities, outputs, and consequences that must be understood to guide actions that will optimize RWD and use RWE to improve health care decisions. **Conclusion:** Real-World Data (RWD) has become more widely available, which has altered the global landscape for medication development and decision-making of regulation. Regulatory bodies in the US, UK, and EU now recognize the value of RWD in supplementing traditional clinical trial data to create a more complete picture of a product's safety and effectiveness.

Keywords: Real world data, Real world evidence, Drug regulatory authority

PAP039

Banning Of Microplastic In EU, US And South Korea

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Introduction: The intentional use of microplastics in cosmetics and personal care products has raised major regulatory concerns because these particles do not break down easily. Issues in the current scenario include varying definitions of microplastics, insufficient examination of leave-on products, and the evaluation of safe and sustainable alternatives. These plastic particles are used for exfoliating, thickening, and forming protective layers in products; however, they are not eliminated effectively by normal wastewater treatment processes and therefore spread widely in the environment. As the harm caused by these particles, regulators are introducing bans and restrictions, particularly for cosmetic products. **Methods:** This examines how microplastics in EU, US, and South Korea, with attention to laws involved, how microplastic are defined, rules are enforced, and how these have developed with time. **Results:** The Microbead-Free Waters Act of 2015, US was introduced as one of the first laws to ban plastic microbeads in rinse off personal care products. In comparison, the EU has applied a thorough and precautionary regulatory strategy via Regulation (EU) 2023/2055 within the REACH framework. With the help of this regulation, a gradual limitation on the use of intentionally included microplastics in cosmetic products has been imposed. In 2017, South Korea applied a nationwide prohibition on microplastics in rinse-off cosmetic products. A comparison reveals notable differences in the levels of this region in their regulatory goals, timelines for implementation and enforcement approaches. **Conclusion:** This analysis highlights the importance of aligning regulations, expanding their coverage, and utilizing evidence-based policymaking to effectively manage microplastics in cosmetic products worldwide.

Keywords: Cosmetic; EU Regulations; Microplastic; US Regulations; South Korea regulations.

PAP040

AI-Enabled Medical Devices In India: Regulatory Challenges and Future Directions

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Introduction Artificial intelligence is quickly changing the healthcare landscape, offering opportunities to improve efficiency, accessibility, and clinical outcomes. Use of AI enabled healthcare technologies like AI enabled medical device and AI-SaMD is increasing rapidly in India. In next ten years the India healthcare market is about to grow rapidly. However, along with these opportunities many challenges like critical governance, ethical, regulatory, and implementation arises. **Methods** This review combines evidence from recent studies to understand current state of how AI is used in Indian healthcare focusing on regulatory frameworks, data governance, clinical validation, and equity of access. **Results** By introducing Medical Device Rules in 2017 India has made a notable progress while current regulations mainly follow traditional rules and other AI specific issues like algorithm transparency, adaptive learning, data privacy, accountability and malpractice risk are not fully addressed. Furthermore, major challenges suchas limited availability of healthcare innovations, unequal access of

digital technologies between rural and urban populations and limited domestic manufacturing capacity remains continuous. A systematic review of AI-SaMD studies shows that most applications are limited in specialized clinical areas, indicating need for wider use across healthcare setting, better collaboration among different disciplines, training clinicians, and strong post-market surveillance. **Conclusion** Study highlights need to create high quality datasets, improve regulatory clarity, and regularly review policies to understand overall impact of AI and emerging healthcare technologies. In conclusion, a step-by-step governance approach over short, medium, and long term is necessary to manage the risks, address ethical issues and totally use AI to improve healthcare in India.

Keywords: Artificial intelligence, AI-enabled medical devices, AI-SaMD (AI based software as medical device), healthcare governance, Indian medical device regulations

PAP041

Regulatory Pathways For Digital Therapeutics: A Comparative Review Of The US FDA, EMA, And CDSCO Frameworks

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Introduction: Digital therapeutics (DTx) are innovative therapeutic interventions, in which the therapeutic activity is carried out by algorithms and software. Digital Therapeutics (DTx) are evidence-based therapeutic interventions driven by software to prevent, manage, or treat a medical disorder or disease. DTx development can have a positive impact on providing well customised health services as their design is tailored to fit patient's needs. **Methods:** The advantages of digital therapeutics fall in line with market demand; thus, the digital therapeutics market is expanding globally, focusing on advanced medical markets. There are many digital therapeutics products such as Sleepio for insomnia, Daylight for anxiety, Livongo and Omada products for diabetes, pre-diabetes, hypertension, etc. **Results:** In 2015, Sepah et al. first mentioned the term "digital therapeutics" and expressed that DTx are "evidence-based behavioral treatments delivered online" that can increase healthcare accessibility and effectiveness. In the United States, digital therapeutics are regulated as Software as a Medical Device (SaMD), with approval pathways such as the 510(k) and De Novo routes commonly used. In Europe, digital therapeutics fall under the Medical Device Regulation, requiring CE marking through notified bodies, with risk-based classification determining regulatory requirements. India currently lacks a dedicated regulatory framework for digital therapeutics, and such products are regulated under the Medical Devices Rules, 2017, resulting in ambiguity regarding approval and compliance. **Conclusion:** The adoption of digital therapeutics is intricate and often involves various interests in numerous fields, decision-making processes, and individual or organizational value judgments. For digital therapeutics to be thoroughly introduced into real life, technical aspects must be supported, and an approach that considers users must be further investigated.

Keywords: Digital Therapeutics, Regulatory pathways, SaMD, US FDA

PAP042

Emerging Risks of PFSA Impurities in Pharmaceuticals: The Need for a Regulatory Framework and Global Harmonization

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Introduction: Perfluoroalkyl sulfonic acids (PFSA) are continuous fluorinated compounds that are extensively found as minute contaminants in the pharmaceutical ingredients, excipients, and manufacturing environments. Some of the common examples are perfluoro octane sulfonic acid (PFOS) and perfluoro hexane sulfonic acid

(PFHxS), which are prominently linked to the widespread industrial use of fluoropolymers, processing aids, and environmental legacy contamination. Such contaminants can penetrate global supply chains. **Methods:** We reviewed recent studies on PFSA toxicity, testing methods, and regulations and compared PFSA findings with current rules for extractables, leachables, and impurities. We focused on the type of regulatory changes expected to overcome the concern and ensure the safety and efficacy of the product. **Results:** PFSA presents unique analytical and control challenges owing to its chemical stability, necessitating validated methods capable of detecting concentrations from parts-per-billion to parts-per-trillion across various matrices. Toxicological data from related PFAS classes suggest developmental, immunological, and endocrine effects, raising concerns about chronic low-level exposure through the use of medicinal products. Their environmental persistence further increases ecological risks. Regulatory guidance remains internationally fragmented, leading to inconsistent testing, reporting, and limit-setting that complicate risk management and may impact patient safety and supply chain stability. **Conclusion:** Establishing a proactive, risk-based regulatory framework is critical. This framework should (1) clearly define the PFSA of concern in pharmaceuticals, (2) require validated, sensitive analytical methods, (3) set science-based threshold values informed by toxicology and exposure assessments, and (4) incorporate PFSA considerations into GMP and supplier qualification processes. International harmonization through organizations such as the ICH, WHO, EMA, FDA, and CDSCO is crucial for safeguarding public health and ensuring a robust pharmaceutical supply chain management.

Keywords: Analytical Methods, Impurities, PFSA, Pharmaceuticals, Regulatory Harmonization

PAP043

API Supply Chain Vulnerability and Drug Security: An Interdisciplinary Pharmacy Perspective

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Introduction: The global pharmaceutical industry depends on continuous access to active pharmaceutical ingredients (APIs), which are critical for medicine safety, efficacy and availability. Despite strong formulation capacity, countries such as India remain highly dependent on a limited number of foreign API suppliers. This concentration has exposed vulnerabilities in drug supply chains, particularly during pandemics, geopolitical tension and regulatory disruptions. **Methods:** This study employs a structured narrative review combined with policy and industry analysis. Peer-reviewed pharmaceutical literature, regulatory agency publications, international health organization reports and industrial case studies were systematically evaluated. Comparative synthesis was used to examine economic, regulatory, quality assurance, environmental and policy dimension of API manufacturing and sourcing with emphasis on relevance to pharmacy practice and public health. **Results:** The analysis revealed significant dependent on concentrated API sources, leading to increase risk of supply disruptions, price volatility and drug shortages. Import driven sourcing models adversely affected medicine availability and regulatory compliance during global crises. Countries implementing diversified sourcing strategies, domestic API manufacturing and strong regulatory oversight demonstrated improved drug security and supply resilience. **Conclusion:** API supply chain vulnerabilities is a critical determinant drug security public health resilience. Addressing this challenge requires an interdisciplinary pharmacy approach integrating industrial pharmacy, pharmacoeconomics, and regulatory affairs, pharmaceutical policy and environmental sustainability. Strengthening resilient API ecosystem is essential for ensuring medicine affordability, quality and long- term pharmaceutical security.

Keywords: Active pharmaceutical ingredients, pharmacoeconomics, quality assurance, regulatory affairs, sustainability API manufacturing.

PAP044

Review On Analytical Methods For Estimation Of Chemical Constituents Of *Psidium Guajava, Abrus Precatorius L. And Glycyrrhiza Glabra*

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Introduction: Medicinal plants like *Glycyrrhiza* species, *Abrus precatorius*, and *Psidium guajava* have been extensively studied for their phytochemical composition, medicinal qualities, and safety. Numerous researchers have used modern analytical techniques to investigate species identification, chemical profiling, extraction optimisation, and detoxification mechanisms in these plants. However, this knowledge is spread throughout numerous studies. The goal of this review is to consolidate, analyse, and discuss existing research findings on the phytochemical analysis, quality control, and safety assessment of these medicinal plants. **Methods:** This review is based on the estimation of chemical constituents of *Glycyrrhiza, Abrus precatorius, and Psidium guajava*. Analytical techniques used in the reviewed studies include HPTLC, HPLC, LC-MS, GC-MS, NMR spectroscopy, and UV-Visible spectrophotometry. The data on phytochemical content, species separation, extraction methods, detoxification (Shodhana), and quality control were gathered, compared, and summarized. **Results:** According to the reviewed literature, chromatographic and chemometric approaches are useful for distinguishing *Glycyrrhiza* species and identifying species-specific markers such as flavonoids, saponins, and coumarins. Studies on *Abrus precatorius* have shown that the Ayurvedic Shodhana procedure effectively reduces the poisonous alkaloid abrine. *Psidium guajava* has been reported to contain a wide range of volatile and non-volatile phytochemicals, including flavonoids, phenolics, tannins, and terpenoids, which support its traditional therapeutic usage. **Conclusion**: This review emphasises that prior research significantly supports the application of contemporary analytical techniques for phytochemical profiling, botanical authenticity, quality control, and safety assessment of medicinal plants. This review, by collecting and integrating the work of other researchers, provides a consolidated reference that can aid future investigations, encourage herbal standardisation, and promote the safe and effective use of medicinal plants in healthcare.

Keywords: *Abrus precatorius*; Chemometrics; Chromatographic analysis; Glycyrrhiza *glabra;* Herbal standardisation; Medicinal plants; Phytochemical profiling; *Psidium guajava.*

PAP045

Safety-Focused Analysis of Extractables and Leachable Arising From Pharmaceutical Packaging and Contact Materials

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Introduction: Extractables are chemical substances that can be released under extreme testing conditions. Leachable are the materials that transfer into the product during storage or actual use scenarios. Given that these substances may be administered or consumed by patients, it is crucial to assess their safety. These substances may present safety risks to patients if they are found at harmful levels. Consequently, a safety-centred assessment of E&L is crucial to guarantee that drug products stay safe, effective, and adhere to regulatory standards throughout their lifecycle. **Methods:** The procedure for evaluating safety begins with extractables studies that entail exposing materials to severe conditions, such as elevated temperatures, prolonged contact, and aggressive solvents to identify any potential chemical leachable. High Performance Liquid Chromatography (HPLC) is regarded as a universal method for separating organic compounds. Gas Chromatography (GC) is applied to semi-volatile and volatile analytes and also supports various detection methods like MS, Flame Ionization Detectors (FID), and

more. GC-MS delivers spectral data that aids in the identification of substances. GC with Headspace Sampling examines vaporized volatile compounds. This method can be beneficial when residual solvents are expected to be in the processing material. Every identified compound undergoes toxicity evaluation based on accessible safety data, toxicological concern thresholds (TTC), and permitted daily exposure (PDE) assessments within a risk-based framework. **Results:** The evaluation produces a detailed extractables profile and determines which substances appear as leachable in the final product. Risk evaluation utilizes a multi-faceted strategy that examines both the likelihood of extractable/leachable, presence and the possible effects on product quality and patient safety. **Conclusion:** The combination of comprehensive analytical testing and detailed toxicological risk assessment in E&L studies guarantees safe packaging choices, adherence to regulations, and the enduring safety of pharmaceutical products during their lifespan.

Keywords: Extractables, Leachable, Safety-Focused Analysis, Toxicological Risk Assessment, Permitted Daily Exposure (PDE)

PAP046

Pathways For Regulatory Qualification Of AI-Enabled Biomarkers Within the U.S. FDA DDT Framework

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Introduction: Artificial intelligence-powered biomarkers are progressively acknowledged as Drug Development Tools (DDTs), fulfilling the stringent requirements of drug development through the establishment of new clinical trial endpoints. In the context of patients with non-alcoholic steatohepatitis (NASH), the semi-quantitative evaluations performed by pathologists to analyse histological specimens introduce a considerable degree of subjectivity, thereby complicating the assessment of immediate drug response sensitivity. The formalized process for the qualification of a biomarker within a specific Context of Use (COU) is delineated within the United States Food and Drug Administration (FDA) DDT Program. **Methods**: AI biomarker was built using machine learning trained on extensive whole-slide liver biopsy datasets curated by expert pathologists to assess disease activity and fibrosis features. Validation included analytical testing and clinical comparison against traditional pathologist scoring systems. The FDA DDT qualification involved three submissions namely; a Letter of Intent, Qualification Plan, and Comprehensive Qualification Package. **Results:** Accordingly, these studies have revealed that the AI biomarker had reduced inter- and intra-observer variation, more sensitivity to histological change, and strength when using more than two independent datasets. Continuous quantitative outputs could be used to provide a better patient stratification and assessments of therapeutic response with the help of the AI system than the conventional ordinal score systems. Inclusion of AI derived biomarkers into the FDA DDT Program supports their use as objective endpoints that enable regulatory acceptance, more efficient clinical trials, and accelerated drug development in complex diseases like NASH. **Conclusion**: AI enabled histological biomarkers are a potentially objective and effective complement to conventional endpoints when qualified under the FDA DDT Program. Having them as regulatory sponsors can lead to more effective conduct of clinical trials, accelerated and better-quality decision-making and expedite the creation of treatment of complex diseases such as NASH.

Keywords: Artificial intelligence biomarkers, Biomarker qualification, Drug Development tool, Non-alcoholic steatohepatitis.

PAP047

A comprehensive review on the characterization of sustainable eco-friendly nanomaterials

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Introduction: The materials that have at least one dimension that is about 1-100 nm are called nanomaterials. An eco-friendly approach to synthesize nanomaterials without the use of toxic harmful chemicals, high energy or any hazardous solvents is known as green chemistry. Green nanomaterials are nanostructures that are produced using biological agents, such as plant extracts, bacteria, fungi, algae, or natural polymers, in accordance with green chemistry principles, guaranteeing low toxicity, high biocompatibility, energy efficiency, and minimal environmental impact. These green nanomaterials can either be metals or metal oxides. These green nanomaterials are majorly used for targeted drug delivery, for wound healing and tissue regeneration, to increase the biocompatibility of drugs and to potentially decrease the toxicity and side effects. **Methods:** The common techniques employed for characterization of metal and metal oxide nanoparticles include Fourier transform infrared spectroscopy, energy dispersive spectroscopy, atomic force microscopy, UV-visible absorption spectroscopy, X-ray diffraction, scanning electron microscope, transmission electron microscope etc. **Results**: The main characteristics that determine the properties and functionality of green nanomaterials are specific surface area, surface morphology, elemental composition, particle size, size distribution and crystallinity. Characterization of green nanoparticles is significant to study about the nature, behavior and functional properties of synthesized green nanoparticles **Conclusion:** In order to find potential applications of green nanomaterials, characterization of these nanoparticles is significant. These nanoparticles are characterized for its compositional structure and surface morphology.

Keywords: Green nano materials, Nanoparticles, Characterization

PAP048

Vaccine Recalls & Regulatory Actions: A Global Case Study Review

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Introduction: Vaccines are highly prized assets in the healthcare systems, although there have been some exceptions where a situation involving quality has happened, causing recalls, which in turn led to the necessary actions being taken by the regulatory bodies. **Methods:** This review adopted a case study approach by analyzing documented instances of vaccine recalls reported by major regulatory authorities. Literature documentation by main vaccine regulating bodies identifies instances that could lead to recalls, actions taken by the bodies, and their results. Moreover, main literature sources are also used. **Results:** From case study analysis undertaken globally, main reasons leading to the issuance of majority recalls regarding vaccines pertain to issues relating to the production of the vaccine products, threats of contamination, misreading in labeling, or the products safety data. There is variability in the type of notification communication plan, and the level of enforcement of the notification among the regulatory bodies. The final goal of all notification and communication is patient/public safety. **Conclusion:** The studies involving vaccine product recall have shown that it is essential to have appropriate regulatory control during different stages of its lifecycle. There are many lessons that have been drawn for improved quality control measures and post-market surveillance to be adopted to build greater confidence and to allow compliance with the requirements. The current review stress the need for a global regulatory framework to allow the immunization programs to continue in the global world.

Keywords: Global regulatory framework, Product contamination, Labeling errors, Vaccine recalls.

PAP049

SEC-HPLC-based Method Development and Validation for aggregate analysis in cyclic peptide formulation

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Introduction: Peptide-based therapeutics are preferably used in the management of chronic metabolic conditions and complex disease conditions like acromegaly due to their selectivity and specificity. However, peptides are susceptible to physical instability, particularly aggregation, which may impact product quality, safety, and efficacy. Monitoring aggregate formation is therefore a critical quality attribute. **Methods:** A size exclusion high-performance liquid chromatography (SEC-HPLC) method was developed to detect and quantify aggregates in a cyclic peptide-based formulation. Chromatographic conditions and sample preparations were optimized to achieve efficient separation of monomer and HMWs. Forced degradation studies were performed to evaluate method specificity, and validation was carried out in accordance with ICH Q2 (R2) guidelines. **Results**: The optimized SEC-HPLC method demonstrated clear and reproducible separation between monomeric and aggregated species. Stress studies showed a measurable increase in aggregate levels, confirming the stability-indicating nature of the method. Validation data met acceptance criteria for specificity, linearity, precision, accuracy, and robustness. The platform method proved suitable for monitoring aggregation behavior in cyclic peptide formulations. **Conclusion**: SEC-HPLC method was successfully developed and validated for aggregate analysis in a cyclic peptide formulation. The method is appropriate for routine quality control and stability assessment of chronic and complex therapeutics such as GLP-1-like analogs, Oncology, etc.

Keywords Aggregation, Force Degradation, HMWs, Peptides, Size-Exclusion High-Performance Liquid Chromatography (SEC-HPLC)

PAP050

Derivatization in chromatography: techniques, applications and challenges

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Introduction: In pharmaceutical analysis, chemical derivatization is a crucial technique for resolving analyte intrinsic limitations like low volatility, thermal instability, high polarity, and insufficient detector response. These limitations frequently limit direct analysis using spectroscopic detection when used with HPLC (High Performance Liquid Chromatography) and other separation methods. Functional groups are chemically altered by well-designed derivatization reactions to improve analyte compatibility with analytical systems and method performance. **Methods:** This review critically evaluates chemical derivatization approaches reported in pharmaceutical literature with particular emphasis on HPLC (High performance liquid chromatography) based methods. Reaction-based classifications including silylation, acylation and alkylation are examined. The influence of derivatization reagents, reaction conditions, and functional group specificity on chromatographic behaviour and response is systematically examined. **Results:** The reviewed studies consistently show that derivatization significantly improves analyte detectability, as seen by higher signal intensity, better peak symmetry, lower detection limits, and enhanced chromatographic efficiency. Reliable qualitative and quantitative analysis is made possible by acylation and alkylation processes, which improve selectivity and detector sensitivity. In several cases, derivatization also improved method robustness and reproducibility, supporting its relevance in validated analytical procedures. **Conclusion:** In conclusion, chemical derivatization remains an indispensable component of pharmaceutical analytical methodology. A better understanding of derivatization reactions and their analytical consequences is essential for rational method development, validation, and regulatory-compliant analysis. Future

efforts should prioritize selective, simplified, and environmentally sustainable derivatization strategies to meet evolving analytical demands.

Keywords: Alkylation, Chemical derivatization, Detector sensitivity, HPLC (High performance liquid chromatography)

PAP051

Establishing Pharmaceutical Regulatory Intelligence Alert System and Monitoring Framework for ASEAN and CIS Countries Using Free Tools

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Introduction: Pharmaceutical Regulatory Intelligence focuses on the collection and interpretation of pharmaceutical regulatory updates to support proactive compliance and timely market access. In the ASEAN (Association of Southeast Asian Nations and CIS (Commonwealth of Independent States) regions, regulatory frameworks are frequently revised and update information across multiple official sources, making monitoring a time-consuming job for regulatory affairs professionals. These gaps are mainly addressed through manual oversight or expensive software, which are not be feasible for most. **Methods:** This study aims to propose a centralized regulatory intelligence alert system using freely available tools to monitor pharmaceutical regulatory framework across ASEAN and CIS region. Official websites of Regulatory authorities of ASEAN and CIS countries were used as primary source for data mapping. Tools such as Google Alerts, Visualping, Google Forms, and Google Sheets are used for automated monitoring, keyword-based filtration, and structured data collection. The system is subjected to preliminary validation and applied in routine regulatory monitoring over an eight-month period from July 2025 to February 2026. **Results:** Regulatory updates are organized by country/region, key words and alert type to improve accessibility and traceability. During Initial use the system showed automation and improved data collection, however challenges such as language barrier and irrelevant alert were observed. **Conclusion:** Overall, this study proposes a low-cost and centralized regulatory tracking system which enables systematic monitoring of regulatory updates and improves regulatory awareness across complex pharmaceutical markets.

Keywords: ASEAN, CIS, Free tools, Monitoring System, Pharmaceutical Regulatory Intelligence

PAP052

Algorithm Drift In AI/ML-Based Medical Devices: Regulatory Oversight of Detection, Local Adaptation and Explainability

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Introduction: The increasing adoption of Artificial Intelligence and Machine Learning (AI/ML)-based medical devices puts the established regulatory principles that presuppose unchanged product behaviour after its market authorization under serious obstacle. Unlike traditional devices, AI/ML-based systems are prone to algorithm drift, i.e. its performance may vary over time as a result of changes in the data distributions, clinical workflows, or software upgrades. An AI-radiology device, trained on historical chest imaging data, may display reduced accuracy after being implemented in a hospital with new-patient demographics, new-imaging devices, or new-acquisition criteria. Similarly, the clinical decision support systems may also be variable regarding their performance following the change in the treatment plan or the structure of electronic health records. This drift can lead to compromised patient safety, bias, and diminshed clinical efficacy, but current regulatory frameworks are not well defined, have no monitoring expectations, and no governance mechanisms. **Methods:** This review focuses on regulatory issues surrounding algorithmic drift in AI/ML-based medical devices. **Results:** We address the risks of retraining at hospital-level and on-site customisation, which drifts us towards more and more

uncoordinated model variants that cannot be centrally controlled. Moreover, we highlight drawbacks of the existing explainability techniques that hamper the ability of clinicians to identify abnormal model behaviour and diminish confidence in AI-assisted decision-making. **Conclusion:** Lastly, we suggest a regulatory framework, based on a lifecycle that includes pre-market stress testing and post-market performance review which allows long-term dynamic regulation of AI/ML-based medical devices used in clinical practice.

Keywords: AI/ML, Algorithm Drift, Explainability, Medical Devices, Safety.

PAP053

Regulatory Framework and Challenges in Control of Process-Induced Impurities in Herbal based Nutraceuticals: An Indian Perspective with Global Comparison

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Introduction: Herbal based nutraceuticals are widely utilized for health promotions as well as preventing different diseases. The production of herbal/nutraceuticals generally follows different processes such as drying/roasting of herbal substances, extraction/concentration of herbal/nutraceuticals. Due to this kind of production processes, different unnecessary compounds such as polycyclic aromatic hydrocarbons can be generated. The study is necessary to highlight regulatory limitations, compare international practices using official guidelines, and support the need for risk-based, harmonized impurity control frameworks for herbal based nutraceuticals in India. **Methods:** This review study was conducted to gain insights on the approach taken by different regulatory authority for the handle of the impurities created through the processing of herbal based nutraceuticals. The objective of this study was to compare the existing regulatory requirements for the handling of these impurities in different regions to the India. The study made its assessments using the publicly available regulatory requirements, the regulatory publications by the Food and Drug Administration in the USA, the regulatory notifications by the European regions, as well as the Indian regulatory documents for herbal products as well as nutraceuticals. **Results:** In India, the regulation of process-related impurities in herbal products and nutraceuticals takes place by general guidelines related to contaminants, where there are no specific guidelines related to this kind of impurities are not available. The European Union has set specific guidelines related to process-induced impurities like PAHs, whereas the United States has emphasized on the control of impurities by current good manufactured practices and quality specifications. **Conclusion:** This study pointed out the regulatory limitation related to the control of process-induced impurities in herbal based nutraceuticals in the Indian regulatory scenario. Strengthening risk management guidelines and bringing impurity control measures into alignment across other countries could significantly improve overall product safety and quality.

Keywords: Herbal products, Nutraceuticals, Polycyclic aromatic hydrocarbons, Process-induced impurities, Regulatory framework

PAP054

Analytical Determination of Nitrosamine Impurities in Pharmaceuticals

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Introduction: Nitrosamines are potentially mutagenic and carcinogenic impurities that have become a major regulatory concern following their detection in several pharmaceutical products. Their presence in angiotensin II receptor blockers, histamine-2 receptor antagonists, antidiabetic agents, and antimicrobial drugs highlights the important role of pharmaceutical analysis in their detection, quantification, and control to ensure product safety and regulatory compliance. **Methods:** This review is based on an evaluation of published analytical research articles and regulatory guidelines related to nitrosamine impurities in active pharmaceutical ingredients and finished dosage forms. The literature was assessed to identify sample preparation strategies, analytical techniques,

detection limits, and challenges associated with trace-level determination of nitrosamines in different pharmaceutical matrices. **Results:** Analytical determination of nitrosamines is challenging due to very low acceptable intake limits and the complexity of pharmaceutical formulations. Gas chromatography-mass spectrometry and liquid chromatography–tandem mass spectrometry are the most commonly reported techniques because of their high sensitivity and selectivity. Approaches such as suitable extraction procedures, and calibration strategies including matrix-matched calibration or standard addition are widely used to reduce matrix effects. These methods have been applied successfully to both drug substances and finished products, enabling detection of multiple nitrosamines at trace levels in compliance with regulatory requirements. **Conclusion:** Robust and sensitive analytical methods are essential for reliable detection and control of nitrosamine impurities. Strengthening analytical monitoring and appropriate method selection plays a key role in risk assessment, regulatory compliance, and patient safety.

Keywords: Nitrosamines; Analytical determination; GC–MS; LC–MS/MS

PAP055

Comparative Analysis of Crystals Grown Under Normal Condition and Space Analogue Condition

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Introduction: Crystallization is a key physicochemical process that governs the structural, morphological, and polymorphic properties of pharmaceutical compounds and amino acids. Environmental factors such as gravity-driven convection significantly influence nucleation and crystal growth behavior. Simulated space-analogue conditions offer a controlled platform to study crystallization dynamics under reduced convection compared to standard laboratory environments. The present study aimed to compare crystal growth behavior under simulated habitat conditions with conventional laboratory conditions. **Methodology:** Crystallization was carried out using the antisolvent–solvent method, where the amino acid was dissolved in water and ethanol gradually employed as an antisolvent. Antisolvent addition was initiated on Day 1, and samples were collected immediately after addition and at regular two-day intervals. Crystal growth and morphological evolution were monitored over time using light microscopy. **Results:** It showed that crystallization in both environments progressed from early needle- or rod-like structures to more stable crystal forms with increasing time. While no significant differences were observed in fundamental structural parameters such as crystal length, width, or angular features, a slightly faster morphological transition was noted under simulated habitat conditions. Notably, crystals grown under simulated conditions exhibited enhanced optical clarity, improved uniformity, and higher apparent purity compared to those formed under standard laboratory conditions. **Conclusion:** simulated space-analogue conditions were found to influence crystallization kinetics and crystal quality without altering basic geometric characteristics. These findings highlight the potential of space-analogue environments in improving crystal clarity and uniformity, which may have important implications for pharmaceutical crystallization and solid-state research.

Keywords: Crystallization, Simulated Condition, Light Microscopy, Morphological features.

PAP056

Recent Advancements and Development in Applications of Raman Spectroscopy in Pharmaceutical Analysis

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Introduction Raman spectroscopy has emerged as a significant spectroscopic technique in the recent times due to its ever-growing significance and advancements. It is a widely adaptable technique for pharmaceutical analysis due to its insensitivity toward water molecules, which makes it superior compared to other techniques for the detection of various drugs in drug delivery systems. It has expanded its role as a non-destructive nature and

excellent molecular specificity. **Methods** Recent developments in Raman spectroscopy include low-frequency Raman spectroscopy, Raman imaging, and the combination of chemometric and machine-learning techniques. High-performance lasers with increased power and stability provide enhanced excitation for Raman measurements. Coupled with advanced optics, these lasers offer better spatial resolution, allowing for analysis of micro- and nanoscale samples. **Results** Raman spectroscopy is used to analyze defects and characterize crystal structure and chemical composition. It is widely used in the investigation of semiconductors, polymers, and catalysts. It is essential for medication development, quality assurance, and counterfeit identification of it. It makes it possible to quickly identify pharmaceutical constituents, monitor drug formulations, and identify interactions between drugs and polymers. **Conclusion** The advancements in Raman spectroscopy have significantly enhanced its capabilities and expanded its applications in the current period. Improved instrumentation, enhanced sensitivity, and expanded techniques like SERS (Surface Enhanced Raman Spectroscopy) have revolutionized the field, enabling new possibilities for chemical analysis.

Keywords: Raman spectroscopy, Chemometrics, Non-destructive analytical techniques

PAP057

Hidden risks beneath the skin: Carcinogenic potential of Tattoo & PMU Inks

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Introduction: Tattooing and permanent makeup (PMU) have become widely popular across the world. These procedures involve injecting pigments into the dermal layer of the skin using fine needles. Along with color pigments, tattoo and PMU inks may contain harmful substances such as polycyclic aromatic hydrocarbons (PAHs), heavy metals, and primary aromatic amines (PAAs). Unlike topical cosmetic products, these pigments remain in the skin for long periods, which may lead to prolonged internal exposure. However, the long-term health effects of these retained pigments are not yet fully understood. **Methods:** A structured review of scientific literature published between 1994 and 2022 was carried out using PubMed and related databases. Studies related to toxicological analysis, experimental findings, and epidemiological evidence on tattoo and PMU inks were included. Different analytical techniques reported in the studies included Inductively Coupled Plasma–Mass Spectrometry (ICP-MS), X-Ray Fluorescence (XRF), Atomic Absorption Spectrophotometry (AAS), and Scanning Electron Microscopy with Energy-Dispersive Spectroscopy (SEM/EDS). **Results:** The reviewed literature showed that tattoo inks are complex mixtures of organic compounds, metal-based pigments, and additives. Black inks often contain PAHs, some of which are known or suspected carcinogens. Colored inks, especially red, yellow, and orange, commonly contain azo dyes that can break down into carcinogenic aromatic amines when exposed to ultraviolet radiation. **Conclusion:** The findings suggest potential long-term toxicological and carcinogenic risks associated with tattoo and PMU pigments, highlighting the need for further research and stricter regulatory control.

Keywords: Azo dyes, carcinogenic risk, heavy metals, permanent makeup, Tattoo ink

PAP058

Analytical Characterization of Biotherapeutic Monoclonal Antibody Drug Products: Regulatory and Quality Perspective - A Review

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Introduction: Monoclonal antibodies (mAbs) are large glycoprotein biopharmaceuticals derived from living systems using recombinant DNA (rDNA) and hybridoma technologies. They exhibit inherent batch-to-batch variability, necessitating stringent quality controls to ensure product consistency, safety, and efficacy.

Comprehensive quality assessment involves full characterization of structural integrity, purity, and biological activity using state-of-the-art analytical techniques. This poster presents a complete quality analysis of mAbs alongside the relevant regulatory framework. **Methods:** Key analytical techniques for mAb characterization include liquid chromatography-mass spectrometry (LC-MS), circular dichroism (CD), Fourier-transform infrared spectroscopy (FTIR), size-exclusion chromatography (SEC), ion-exchange chromatography (IEX), high-performance liquid chromatography (HPLC), sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE), bioassays, and enzyme-linked immunosorbent assay (ELISA). **Results:** The analysis provides a comprehensive review of quality control strategies for mAb biologics, with insights into regulatory requirements and critical quality attributes (CQAs)/key quality attributes (KQAs) for biotherapeutic approval. The regulatory framework aligning with CDSCO biosimilar guidelines, ICH Q6B, and WHO standard guidelines. **Conclusion:** This work offers complete insights into the regulation of monoclonal antibodies from a quality assurance perspective.

Keywords Biologics, Biotherapeutics, Characterization, Monoclonal antibodies

PAP059

Pandemic-Ready India: A Review of Emergency Drug Approval Regulations

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Introduction: The COVID-19 pandemic highlighted how essential it is for countries to have a regulatory system that can respond quickly during health emergencies. Although India managed the situation with strong scientific and industrial support, the approval of new or repurposed drugs often took longer because the existing system is mainly designed for normal circumstances. Emergency drug approval helps bridge this gap by enabling quicker access to promising medicines while still considering safety and quality. However, India currently lacks a structured, long-term emergency approval framework that can be activated immediately when a new pandemic arises. This review focuses on understanding the present Indian regulatory landscape and discusses why a dedicated emergency drug approval system is important for a pandemic-ready and future-focused India. **Methods:** The review is based on an analysis of official guidelines, regulatory notifications, published studies, and reports from national and international agencies. Key sources included CDSCO and DCGI communications during COVID-19, along with global reference models from WHO, USFDA, and EMA. Information is compared to identify gaps, delays, and practical challenges experienced in India during the pandemic. The collected data is then interpreted to suggest areas where India can strengthen its emergency regulatory framework. **Results:** The analysis showed that India depended largely on temporary, situation-specific measures during COVID-19, such as accelerated reviews. Issues such as slow trial approvals, absence of a permanent emergency use authorization (EUA) structure, delayed manufacturing permissions, and limited real-time pharmacovigilance affected the speed of drug availability. Coordination between multiple agencies also emerged as a major challenge. Compared to countries with predefined emergency pathways, India's response was effective but lacked a consistent regulatory foundation that could be reused in future crises. These findings indicate a strong need for standardized, transparent, and faster emergency approval processes. **Conclusion:** The review suggests that establishing a permanent emergency drug approval framework will significantly improve India's preparedness for future pandemics. Such a system should include rapid clinical trial approval mechanisms, clear EUA guidelines, faster manufacturing authorizations, and an active emergency pharmacovigilance network. Strengthening these areas will not only help ensure timely access to critical medicines during crises but will also support India's vision of transforming healthcare and building a resilient, self-reliant, and pandemic-ready nation under Viksit Bharat.

Keywords: Emergency Drug Approval, Pandemic, Regulatory Framework, Public Health Emergency, Viksit Bharat

PAP060

Switching to Biosimilar Adalimumab: Global Switching Evidence, FDA-EMA-Indian Regulatory Landscape, and Policy Challenges, A Focused Review

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Introduction - After the patent of adalimumab expired, it has been noted that biosimilars are entering the markets quickly because of cost advantages. Still, it might be difficult to switch from innovator to approved biosimilars because of issues relating to implementation in clinical practices while adhering to regulations. **Methods -** Literature search was accomplished with Google Scholar, SpringerLink, PubMed, and legal documents addressing randomised controlled trials, clinical studies, and regulatory issues in switching from innovator adalimumab to approved biosimilars. **Results -** Clinical and real-world studies have clearly shown that there is no significant difference in safety, efficacy, and immunogenicity between switching from innovator adalimumab and biosimilar agents. However, there is a wide gap in regulations regarding biosimilar drugs. The US FDA has a clear regulation regarding the interchangeability of biosimilar drugs, allowing substitution without the physician's consent. The EMA has a complementary approach to switching, encouraging the process but not supporting the concept of interchangeability. The regulations regarding biosimilar drugs in India are still nascent, and lack of detailed information creates a significant problem in adhering to guidelines**. Conclusion -** The review focuses on clinical switching between innovator adalimumab and biosimilar agents and is divided into the US FDA and EMA regulations and the regulations regarding biosimilar drugs in India. Based on the gaps in policies in India, there is an emphasis on the healthcare system and policies in India.

Keywords: Biologics, Biosimilars, Immunogenicity, Interchangeability, Switching studies.

PAP061

From QSR To QMSR And MDD To MDR: Key Developments Shaping Global Medical Device Regulation

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Introduction: Wheelchair, dialyzer, Ventilator and life-saving devices like pacemakers, implant, and heart valves are examples of medical devices that we use on a daily basis. Stethoscopes, and glucometers are standard hospital equipment. They are all vital. Therefore, each nation must implement and maintain medical device regulations to ensure the efficacy, effectiveness, and safety of the devices that nurses, physicians, and patients will use. **Method:** Comparative analysis of QMSR draft guideline (October 2025), to be implemented in February 2026, is done with old regulation QSR (21 CFR 820), which is part of the US medical device regulation. Similarly, the EU MDD is compared with the new MDR. In addition to that, the amendment of the MDR regulation from 2021 to 2025 is also included, with future amendments that are officially published but not implemented yet. **Result:** In QSR, ISO 13485 is now incorporated as a reference in 820.7 (subsection of 21 CFR 820). After ISO incorporation, now it known as QMSR that helps in global acceptance, and reduces regulatory burden. The EU MDR regulation introduces comparatively strict requirements for clinical safety and post- market surveillance. It also incorporates EUDAMED for tracing of medical devices. Under this guideline, manufacturer have to recertify their devices. To prevent shortage, the timeline is extended for re-certification to 2027 or 2028, according to medical device risk. **Conclusion**: Both the U.S. and EU regulatory transitions strengthen patient safety and align quality expectations globally. The shift to QMSR and MDR enhances oversight, transparency, and long-term regulatory harmonisation.

Keywords: EUDAMED, ISO 13485, MDR, QMSR, Re-certification.

PAP062

A Comparative Review on Analytical Methods for Promethazine Across Different Matrix

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Introduction: Promethazine hydrochloride is a first-generation antihistamine widely used for decades to treat allergic reactions, nausea, vomiting, motion sickness, and common cold symptoms. Its extensive clinical use necessitates accurate and reliable analytical methods for precise quantification in pharmaceutical formulations. **Method:** This review summarizes analytical methods reported in the literature, United States Pharmacopeia, Indian Pharmacopoeia for pharmaceutical analysis and quality assurance of promethazine hydrochloride. UV–visible spectrophotometric methods based on oxidative coupling and ion-pair complex formation have been reported. Stability-indicating reversed-phase high-performance liquid chromatography (RP-HPLC) and reversed-phase ultra-performance liquid chromatography (RP-UPLC) methods have been applied to study degradation products including 10H-phenothiazine (PRM Imp-A), iso-promethazine (PRM Imp-B), and desmethyl promethazine (PRM Imp-C) under stress conditions. Advanced analytical approaches, such as sensor-based detection and ZnO-based potentiometric membrane electrodes along with structural characterization using Fourier transform infrared spectroscopy (FTIR), nuclear magnetic resonance (^{1}H and ^{13}C NMR), solid-state ^{35}Cl NMR spectroscopy have been employed for crystal form determination and characterization. **Results:** RP-HPLC and RP-UPLC methods enable quantitative determination and detection of degradation products and impurities, confirming stability studies, while Advanced detection analytical techniques confirm structural integrity and physicochemical properties. **Conclusion:** Combined chromatographic and advanced detection techniques, sensor-based and spectroscopic approaches offer a robust framework for quantitative analysis, impurity profiling, and stability evaluation of promethazine hydrochloride.

Keywords: Analytical method; Degradation products; Impurities; Promethazine hydrochloride; Stability study

PAP063

Hidden Mutagens in Medicines: Genotoxic Impurities and Their Analytical Detection

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Introduction: Genotoxic impurities (GTIs) are trace-level chemical entities present in pharmaceutical drug substances or products that possess the potential to interact with genetic material, resulting in DNA damage, mutations, chromosomal aberrations, and carcinogenic effects. GTIs represent a major toxicological and regulatory concern. According to regulatory guidelines, particularly ICH M7, genotoxic impurities are controlled using the threshold of toxicological concern (TTC) of 1.5 µg/day, creating significant analytical challenges. These impurities may arise from various sources such as starting materials, intermediates, reagents, catalysts, solvents, process- related by-products, degradation products, excipient interactions, and environmental contaminants. Several therapeutic drug classes, including antihypertensives, antidiabetics, anticancer agents, antivirals, antibiotics, and central nervous system drugs, have been reported to contain GTIs. **Methods:** Conventional techniques such as UV, IR, NMR, and TLC are used for preliminary screening and structural characterization, while advanced chromatographic methods including HPLC, UPLC, GC, and capillary electrophoresis enable routine analysis.Highly sensitive hyphenated techniques such as LC–MS, LC–MS/MS, GC–MS, GC–MS/MS, and high-resolution mass spectrometry are extensively utilized to achieve detection at parts-per-billion levels. Complementary approaches including derivatization techniques, headspace GC, spectrofluorimetric, and in-silico toxicological assessment further enhance detection capabilities. **Results:** Thus, the above text demonstrates that genotoxic impurities occur across multiple therapeutic drug classes and can be effectively detected at trace (ppm–ppb) levels using advanced hyphenated analytical techniques-based approaches provide superior sensitivity, selectivity, and regulatory compliance for routine genotoxic impurity analysis. **Conclusion:** Effective

identification and control of genotoxic impurities using appropriate analytical strategies are critical to ensure pharmaceutical product safety, quality, and regulatory compliance throughout drug development and manufacturing.

Keywords: Genotoxic impurities; ICH M7; threshold of toxicological concern; hyphenated techniques; LC–MS; GC–MS

PAP064

Review on Analytical Techiniques for Calcium Quantification in Calcium Rich Plants

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Introduction: Calcium is one of the most essential minerals required by the human body, supporting vital processes such as bone development, muscle activity, nerve communication & several metabolic reactions. There are different plant species in India that act as rich sources of calcium. For example, Moringa (*Moringa oleifera*), Sesame (*Sesamum indicum*) which contains high levels of calcium in its leaves & is helpful after injury for supporting the strength of bones; Fenugreek (*Trigonella foenum-graecum*) & Amaranth (*Amaranthus spp*.), which is useful for reducing osteoporosis & inflammation. To understand their nutritional significance more precisely, accurate measurement of calcium levels in these plant materials becomes important. The present work reviews and compares a range of analytical techniques used for estimating calcium in plant samples. **Methods:** The methods examined include UV–Visible spectrophotometry, flame photometry, EDTA complexometric titration and atomic absorption spectroscopy (AAS). Each technique was evaluated for practicality, sensitivity, accuracy & overall suitability for routine or detailed analysis. Findings indicate that UV–Visible methods & colorimetric approaches are convenient and economical but demand careful control of reaction conditions. Flame photometry allows quick estimation for samples containing higher levels of calcium, though its selectivity is limited. EDTA titration remains a dependable classical technique, provided pH is strictly regulated to avoid interference. **Result**: Among all, AAS demonstrated the highest precision and sensitivity, making it the most reliable choice when accurate trace-level measurement is required. **Conclusion:** Overall, the selection of an appropriate method should depend on available instrumentation, required precision and the nature of the sample. While AAS is ideal for detailed studies, EDTA titration and flame photometry are adequate for everyday laboratory analysis of calcium-rich plants.

Keywords: Calcium quantification, spectrophotometric methods, flame photometry, atomic absorption, EDTA titration

ABSTRACTS -POSTER PRESENTATION (HERBAL MEDICINES AND NATURAL PRODUCTS)

HNP001

Natural Scar Modulator: Formulating and Evaluating the Therapeutic Potential of *Trachyspermum ammi* (Ajwain) in Post-Acne Scars

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Introduction: Acne scarring is a persistent dermatological concern associated with inflammation, microbial colonization, and impaired wound healing. Herbal formulations provide a safer alternative to synthetic therapies due to their multitargeted activity and superior skin compatibility. *Trachyspermum ammi* (Ajwain) exhibits potent antimicrobial and anti-inflammatory properties, while *Moringa oleifera* is rich in antioxidants and bioactive compounds that promote wound healing and skin regeneration. The objective of the present study was to formulate, optimize, and evaluate a polyherbal topical ointment containing Ajwain seed extract and *Moringa oleifera* leaf extract for acne scar management. **Methods:** Ajwain essential oil was obtained by hydro-distillation, and *Moringa oleifera* leaf extract was prepared using Soxhlet extraction with ethanol. Formulation optimization was carried out by varying extract concentrations to develop a stable absorption-type ointment using beeswax, coconut oil, vitamin E oil, and lavender oil. The optimized formulation contained 15% w/w Ajwain extract and 10% w/w *Moringa oleifera* extract. Phytochemical screening was conducted to identify major bioactive constituents. The formulation was evaluated for physicochemical parameters including appearance, pH, spreadability, consistency, extrudability, washability, diffusion, and stability at 37 °C for 2 months. Antimicrobial and antifungal activities and microbial limit tests were performed using standard pharmacopeial methods. **Results:** The optimized ointment showed smooth, semi-solid consistency, skin-compatible pH (5–6.5), and good spreadability (20–25 s), indicating favourable patient compliance. Stability studies revealed no phase separation or degradation. Microbial limit tests confirmed the absence of pathogenic bacteria and fungi, demonstrating formulation safety. **Conclusion:** The optimized polyherbal ointment demonstrated satisfactory stability, safety, and physicochemical characteristics, supporting its potential as a natural topical formulation for acne scar management. Further clinical studies are recommended to confirm its therapeutic efficacy.

Keywords: Acne scar management, Ajwain, Antimicrobial, Moringa Oleifera, Topical ointment.

HNP002

Building ADR Reporting Culture of Herbal Medicines for Patient's Safety

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Introduction: Herbal medicines are widely used across the globe and are often perceived as safe due to their natural origin. According to the World Health Organization (WHO), nearly 80% of the world's population relies on traditional and herbal medicines for primary healthcare. In India, the use of Ayurveda, Siddha, Unani, and other herbal products has increased significantly in recent years. However, adverse drug reactions (ADRs) associated with herbal medicines remain grossly underreported, posing a potential risk to patient safety. Factors such as lack of awareness, absence of standardized reporting mechanisms, polyherbal formulations, and misconceptions regarding safety contribute to poor ADR reporting. Building a robust ADR reporting culture for herbal medicines is therefore essential to ensure patient safety and rational use. **Methodology**: A narrative review approach was adopted using published literature from national and international databases, including WHO reports, pharmacovigilance program documents, and peer-reviewed journals. Data related to ADRs of herbal medicines, reporting trends, and patient safety outcomes were analyzed. Secondary data from pharmacovigilance programs and published surveys among healthcare professionals were included to support statistical observations. **Results:** The review revealed that herbal medicines account for 5–10% of reported ADRs globally, but actual incidence is believed to be much higher due to underreporting. Studies indicate that less than 1% of herbal medicine–related ADRs are formally reported to national pharmacovigilance systems. Surveys among healthcare professionals show that nearly 60–70% are unaware of existing ADR reporting systems for herbal products, while about 75% of patients do not report adverse effects assuming herbal medicines are inherently safe. Commonly reported ADRs include hepatotoxicity, allergic reactions, gastrointestinal disturbances, and herb–drug interactions. **Conclusion**: In

rural India, about 70% of the population depends on traditional systems like Ayurveda for healthcare and these patients have lack of knowledge on ADR reporting. The underreporting of ADRs associated with herbal medicines represents a significant challenge to patient safety. Establishing a strong ADR reporting culture requires increasing awareness among healthcare professionals and the public, integrating herbal pharmacovigilance into existing reporting systems, and promoting regulatory support. Strengthening education, simplifying reporting mechanisms, and encouraging active participation can significantly enhance patient safety and contribute to the rational and safe use of herbal medicines.

Keywords: Herbal medicines, ADRs, Pharmacovigilance, WHO.

HNP003

From Docking to Dietary Intervention: Preclinical Evaluation of Thymus vulgaris for Dual Management of Rheumatoid Arthritis and Osteoporosis

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Introduction: Rheumatoid arthritis (RA) and osteoporosis (OP) are chronic, debilitating inflammatory disorders that severely impair mobility and quality of life. Although TAK1 and JAK inhibitors offer meaningful therapeutic benefits, their use is limited by adverse effects including pulmonary toxicity, psoriasis, gastrointestinal complications, and immunosuppression. This highlights the need for safer, more effective alternatives. *Thymus vulgaris*, a Lamiaceae herb with established antibacterial, antiviral, and anti-inflammatory properties, emerged as a promising natural source. Preliminary docking revealed strong interactions of thymol with JAK and TAK1, suggesting therapeutic potential. **Methods:** Key phytoconstituents of *T. vulgaris* were identified through literature mining, metabolomics profiling, and cheminformatics screening. ADMET prediction guided compound prioritization, followed by molecular docking and molecular dynamics simulations to evaluate interaction stability with JAK and TAK1. In vitro assays on MG63, and VERO cells assessed cytotoxicity, osteogenic activity, and anti-inflammatory responses. In vivo efficacy was validated in ovariectomized (OVX) and collagen-induced arthritis (CIA) models using biochemical markers and histopathology. A functional herbal cookie containing standardized extracts was formulated, optimized nutritionally, and examined for retained bioactivity. **Results:** The study yielded a stable, polyherbal cookie exhibiting significant anti-inflammatory and osteoprotective activity. Both in vitro and in vivo evaluations confirmed robust cytocompatibility, enhanced osteogenesis, reduced inflammatory biomarkers, and improved histological outcomes. **Conclusion:** The optimized formulation demonstrates strong potential as a safe, evidence-based nutritional intervention for RA and OP. Its validated therapeutic performance and consumer-friendly design position it well for technology transfer, commercialization, and integration into functional food and health-oriented industries.

Keywords: *Thymus vulgaris*, Rheumatoid arthritis, Osteoporosis, Functional nutraceutical

HNP004

Deep Computational Deconstruction of *Canna indica* L. Phytochemical Interactomes Illuminates Mechanistic Axes of Lipid Homeostasis

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Introduction: Hyperlipidaemia is a major risk factor for cardiovascular disease, and current treatments are limited

to single-target action. *Canna indica* L. has traditionally been used to treat metabolic disorders and contains various phytochemicals with potential lipid-modulating effects. This study provides a systems-level computational investigation of the multi-target antihyperlipidaemic mechanisms of *C. indica*. **Methods:** A total of 226 phytochemicals were compiled from various databases and screened for drug-like properties. The predicted targets overlapped with hyperlipidaemia-associated genes. Overlapping genes were evaluated using STRING-based protein–protein interaction mapping and pathway enrichment analysis. Eleven qualified phytochemicals were docked against nine key lipid-regulatory proteins (HMGCR, NPC1L1, PCSK9, CETP, SOAT1, LPL, NR1H3, CYP7A1, ABCA1, and ABCG1) using PyRx. **Results:** Network analysis showed that major regulatory hubs included NR3C1, ESR1, NR1H3, NPC1L1, and SOAT1. Enriched pathways implicated nuclear receptor signalling, ABC-transporter-mediated cholesterol efflux, bile acid biosynthesis, and cholesterol absorption and esterification. Docking results showed that campesterol had the highest affinity towards NR1H3 (−10.8 kcal/mol), SOAT1 (−10.7 kcal/mol), and LPL (−10.3 kcal/mol). Danazol exhibited strong binding to CETP (−10.1 kcal/mol) and PCSK9 (−9.8 kcal/mol), whereas rutin exhibited a high affinity for HMGCR (−9.0 kcal/mol) and CYP7A1 (−9.6 kcal/mol). These interactions collectively modulate cholesterol absorption, synthesis, esterification, bile acid formation, triglyceride hydrolysis, and cholesterol efflux. **Conclusion:** This integrative computational analysis demonstrates that *C. indica* exerts pleiotropic and multi-target lipid-regulatory effects. Campesterol, danazol, and norgestrel emerged as promising antihyperlipidaemic candidates, providing a mechanistic basis for future research.

Keywords: *Canna indica*, Hyperlipidemia, Lipid homeostasis, Molecular docking, Network pharmacology

HNP005

Molecular Insights into Herbal Medicines and Natural Products: Emerging Strategies for Next-Generation Drug Development

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Introduction: Herbal medicines and natural products have gained renewed scientific attention due to their rich phytochemical diversity and ability to modulate multiple molecular pathways. Unlike conventional single-target drugs, plant-derived bioactive compounds exhibit multi-target actions influencing inflammation, oxidative stress, metabolic regulation, and cellular signaling, making them promising candidates for next-generation therapeutic development. **Methods:** A structured literature review was performed using major scientific databases, including PubMed, Scopus, Web of Science, Science Direct, and Google Scholar. Peer-reviewed articles published between 2010 and 2024 were selected to capture recent advances in natural product research. The review scope covered phytochemical characterization, molecular mechanisms, computational approaches (network pharmacology and molecular docking), bioassay-guided fractionation, and advanced formulation strategies aimed at improving pharmacokinetic and therapeutic performance. **Results:** Recent studies demonstrate that combining high-resolution analytical techniques with computational predictions enhances the identification of novel bioactive phytochemicals and their molecular targets. These strategies reveal synergistic interactions within complex herbal formulations and support targeted delivery using nanotechnology-based systems. Furthermore, standardization tools such as genomic barcoding and chromatographic fingerprinting improve quality control, authenticity and reproducibility. Nonetheless, challenges remain in clinical validation and regulatory harmonization. **Conclusion:** The integration of molecular profiling, computational modelling, and advanced drug-delivery technologies provides a strong scientific rationale for the rational development of herbal medicines. This framework addresses limitations related to efficacy, bioavailability, and standardization, supporting the translation of phytochemicals into clinically credible, evidence-based therapeutic agents for modern drug development.

Keywords: Herbal medicines, Natural products, Phytochemicals, Drug development, Nanotechnology

HNP006

Isolation, phytochemical analysis, and antioxidant activity of Oxalis corniculata Linn fractions by column chromatography.

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Background: *Oxalis corniculata* Linn. is a traditionally used medicinal herb for the treatment of gastrointestinal disorders, inflammation, and liver-related ailments. Its therapeutic importance is mainly attributed to bioactive phytoconstituents such as phenolics and flavonoids, which are known for their antioxidant properties. The present study aimed to isolate phytochemical fractions from the hydroalcoholic extract of *O. corniculata* and evaluate their in vitro antioxidant activity to scientifically validate its traditional use. **Methods:** The whole plant was shade-dried and extracted with 50% ethanol using a reflux method. The crude hydroalcoholic extract was successively fractionated with n-hexane, chloroform, n-butanol, and water. The n-butanol fraction was further subjected to silica gel column chromatography using petroleum ether, chloroform, and methanol in gradient elution, resulting in fourteen sub-fractions. Total phenolic content was estimated using the Folin–Ciocalteu method, while total flavonoid content was determined by the aluminium chloride colorimetric method. Antioxidant activity was evaluated using the DPPH radical scavenging assay, and IC_{50} values were calculated. **Results:** The hydroalcoholic extract showed an overall yield of 18% w/w, while the aqueous fraction exhibited the highest yield (61% w/w). Quantitative analysis revealed that the n-butanol fraction contained the highest phenolic (8.0 ± 0.02 g%) and flavonoid (28.1 ± 0.06 g%) contents. In the DPPH assay, the n-butanol fraction demonstrated the strongest antioxidant activity among all fractions (IC_{50} = 81.5 ± 0.3 µg/mL), though it was less potent than vitamin C (IC_{50} = 31.2 ± 0.4 µg/mL). **Conclusion:** The study confirms that the antioxidant activity of *Oxalis corniculata* is closely associated with its phenolic and flavonoid content, particularly in the n-butanol fraction, supporting its traditional medicinal use and potential as a natural antioxidant source.

Keywords: Oxalis corniculata, Antioxidant activity, Phenolic compounds, Flavonoids, DPPH assay

HNP007

Formulation and Evaluation of Novel Dermal Scar Patches for Enhanced Wound Healing

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Introduction: Scars conventional treatments like laser therapy are often invasive and costly. This study focuses on the formulation of a novel non-invasive dermal patch designed to enhance scar healing. The patch incorporates bioactive ingredients including Shea butter, Vitamin E, Coffee seed oil, Almond oil, and Hyaluronic acid to promote hydration and reduce fibrosis. **Methods:** The dermal patches were fabricated using the solvent casting technique. A backing membrane was prepared using 5% w/v Polyvinyl Alcohol (PVA). The drug matrix was formulated by dissolving HPMC and Ethyl Cellulose in an ethanol-chloroform solvent system, utilizing Propylene Glycol as a plasticizer and Glycerol as a lubricant. The formulations were dried for 24 hours and evaluated for physicochemical properties including folding endurance, tensile strength, and moisture analysis. **Results:** The optimized patches exhibited excellent mechanical characteristics, demonstrating a folding endurance of 120 folds and a tensile strength of 75 MPa. The formulation showed a percentage elongation of 15% and a uniform thickness of 0.35 mm. Moisture content was recorded at 7% with a moisture uptake of 10%, ensuring a balanced environment for hydration without maceration. **Conclusion:** The developed polyherbal scar patch meets all necessary performance criteria. This formulation represents a promising, user-friendly, and non-invasive cosmeceutical solution for effective scar management.

Keywords: Dermal Patch, Scar Management, Solvent Casting, HPMC, Wound Healing.

HNP008

Formulation and Evaluation of Polyherbal Foot Crack Bigel

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Introduction: Cracked heels are a prevalent dermatological condition caused by the absence of oil glands in the feet, leading to dryness, pain, and susceptibility to microbial infections. While synthetic treatments exist, they often lack sustained efficacy or cause irritation. This study aims to formulate a "Bigel"—a biphasic system combining hydrogel and organogel—incorporating *Aloe vera*, Hibiscus, Papaya, and Calendula extracts to provide synergistic healing, moisturizing, and antimicrobial benefits. **Methods:** The Bigel was prepared by mixing a Carbopol-based hydrogel with a beeswax and olive oil-based organogel. Herbal extracts were obtained via Soxhlet extraction, boiling, and maceration, then incorporated into the base using a mechanical homogenizer at 500 rpm. Five formulations (F1-F5) were developed and evaluated for physicochemical properties including pH, viscosity, spreadability, and antimicrobial activity against *E. coli*. **Results:** All formulations were homogeneous and semi-solid. The optimized batch (F3) exhibited a pH of 5.3, Spreadability of 5.2 g.cm/sec, and a 1.4 cm zone of inhibition against *E. coli*, confirming its stability and suitability for topical application. **Conclusion:** The developed polyherbal bigel successfully combined the hydration properties of hydrogels with the emollient action of organogels. Formulation F3 met all evaluation criteria, offering a stable, safe, and effective natural alternative for the management of cracked heels.

Keywords: Polyherbal Bigel, Cracked Heels, Organogel, Aloe vera, Antimicrobial.

HNP009

A Review on The Pharmacological Activities and Therapeutic Prospects of Traditional Herbs for Developing New Antipsychotic Drugs.

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Introduction: Schizophrenia and related psychotic disorders remain major global health burdens, yet current antipsychotic medications often exhibit significant side effects and limited efficacy, particularly against negative and cognitive symptoms. Traditional herbal medicine, with its history of use in managing neurological and psychological conditions, offers a valuable, untapped reservoir of novel compounds. This review aims to systematically analyse the pharmacological activities of traditional herbs and their constituent phytocompounds to assess their therapeutic prospects for developing next-generation antipsychotic drugs. **Methods:** A comprehensive search was conducted across major scientific databases (e.g., PubMed, Scopus, Web of Science) using terms such as "traditional herbs," "antipsychotic activity," "schizophrenia," "phytochemistry," and "pharmacological mechanisms." The review focused on studies detailing in vitro and in vivo data, specifically examining herb effects on key pathological pathways (e.g., dopaminergic, serotonergic, glutamatergic neurotransmission, neuroinflammation, and oxidative stress). Studies detailing compound isolation and mechanistic insights were prioritized. **Results:** Numerous traditional herbs demonstrated significant pharmacological activities relevant to psychosis treatment. Key findings include the modulation of dopamine D2 and serotonin 5-HT2A receptors by compounds like alkaloids and terpenoids, mimicking the action of atypical antipsychotics. Furthermore, many herbal extracts exhibited powerful neuroprotective and anti-inflammatory properties (e.g., reducing microglial activation) that address non-dopaminergic aspects of the disease, which are often neglected by current drugs. . These multi-target activities suggest that traditional herbs offer a promising polypharmacological approach superior to single-target agents. **Conclusion:** The existing scientific literature strongly supports the therapeutic prospects of traditional herbs and their isolated phytocompounds for new antipsychotic drug discovery. Their diverse mechanisms of action targeting neurotransmission, inflammation, and neuroprotection provide a foundation for developing safer and more effective treatments with the potential to address the full spectrum of

schizophrenic symptoms. Further clinical validation and compound optimization are warranted to translate this botanical knowledge into clinically viable medications.

Key Words: Antipsychotic Drugs, Traditional Herbs, Schizophrenia, Pharmacological Activity, Phytocompounds

HNP010

Formulation and Evaluation of Polyherbal Dark Compound containing Ginger, Fennel, Shatavari, Amla Extract for the Management of Dysmenorrhea

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Introduction: Dysmenorrhea causes significant menstrual pain in many women. This study developed functional dark chocolate containing Soxhlet-extracted ginger, shatavari, fennel, and amla for anti-inflammatory, hormonal, uterine-tonic, and antioxidant benefits. Evaluations showed good stability, acceptable sensory qualities, and no significant degradation, offering a novel, consumer-friendly Ayurvedic-based delivery system for dysmenorrhea management. **Methods:** Herbal dark compound chocolate was prepared using ginger, shatavari root, fennel, and amla fruit extracts with Morde dark/white chocolate base, vanilla essence, and butter. Cleaned herbs were shade-dried 4–5 days, powdered, and extracted. The chocolate base was melted in a water bath, mixed with extracts and excipients, moulded, and frozen for 8–10 hours. **Results:** The prepared chocolate formulation showed desirable sensory characteristics with an appealing color, pleasant chocolaty aroma, sweet taste, and smooth, glossy texture. Stability studies revealed no significant changes in its color, odor, taste, or overall appearance after one month of storage under different temperature conditions. The formulation demonstrated low moisture content, suitable viscosity, and consistent weight uniformity across samples, indicating excellent stability, good processing properties, and reliable product quality throughout the evaluation period. **Conclusion:** The herbal dark chocolate enriched with Ginger, Shatavari, Fennel, and Amla extracts exhibited good physical, sensory, and stability properties. These herbs reduce inflammation, balance hormones, and support uterine health, offering a promising natural remedy for dysmenorrhea. The palatable chocolate base improves acceptability as a novel herbal delivery system. Further clinical trials are recommended.

Keywords: Dysmenorrhea, Ginger, Shatavari, Fennel, Amla,

HNP011

Developing and Assessing A Herbal Oral Dosage Form for the Treatment of Obesity and Diabetes Mellitus

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Introduction: Diabetes mellitus, either Type 1 or Type 2, is characterized by peripheral insulin resistance or pancreatic β-cell dysfunction that impairs the metabolism of proteins, fats, and carbohydrates. This is made worse by obesity, which increases inflammation, cytokines, and NEFAs. *Baccharoides anthelmintica*, which contains terpenes, steroids, and flavonoids, has long been prized for its anti-inflammatory and antidiabetic properties. **Methods:** Using verified Baccharoides anthelmintica seeds, herbal pills were made in accordance with the Ayurvedic Pharmacopoeia of India. TLC fingerprinting and physicochemical analysis were used to standardize the shade-dried seed powder. Direct compression was used to prepare the tablets. Pre-compression and post-

compression characteristics were assessed for the granules and compressed tablets. A streptozotocin (STZ)-induced diabetic rat model was used to assess the tablets' antidiabetic efficacy. **Results:** The formulation's phytochemical consistency was verified by thin-layer chromatography. Good flow characteristics appropriate for direct compression were suggested by pre-compression parameters such angle of repose, bulk and tapped density, compressibility, and Hausner's ratio. Standards were met by the post-compression settings. The formulation demonstrated antidiabetic potential by drastically lowering blood glucose levels and improving pancreatic function in STZ-induced diabetic mice. **Conclusion:** The global rise in chronic diseases, including diabetes and obesity, is linked to insulin resistance, BMI, and elevated NEFAs, hormones, and pro-inflammatory cytokines. This study demonstrates that *Baccharoides anthelmintica* seeds exhibit significant and sustained hypoglycaemic effects over 24 hours.

Keywords: Anti diabetic activity, Direct compression, Traditional medicine, Chewable tablets

HNP012

Evaluation of Extracts and Fractions from Synedrella Nodiflora (L) Leaves for Anticancer Activity

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Introduction: Plant-derived bioactive compounds are increasingly explored as safer anticancer agents. *Synedrella nodiflora* (L.) is traditionally known for its medicinal properties and contains phytochemicals with potential antioxidant and anticancer effects. **Methods:** Leaves were extracted and fractionated using solvents of increasing polarity. Phytochemical screening, antioxidant assays (DPPH, superoxide, nitric oxide, hydrogen peroxide), and in-vitro anticancer activity using the MTT assay were performed. **Results:** Phytochemical analysis confirmed the presence of alkaloids, flavonoids, tannins, saponins, glycosides, steroids, and phenolic compounds. Methanolic and ethyl acetate extracts showed strong antioxidant activity with >60% radical scavenging and lower IC_{50} values compared to chloroform and petroleum ether extracts. MTT assay revealed dose-dependent cytotoxicity. The ethyl acetate fraction exhibited the highest anticancer activity with >70% cell growth inhibition and the lowest IC_{50} value, followed by the methanolic extract showing moderate potency. Other extracts showed higher IC_{50} values and weaker cytotoxic effects. **Conclusion:** The study confirms that *Synedrella nodiflora* leaves possess significant antioxidant and anticancer potential, highlighting their promise as a natural source of anticancer agents.

Keywords: *Synedrella nodiflora*; anticancer activity; plant extracts; fractions; antioxidant activity; MTT assay; IC_{50}; phytochemicals

HNP013

Antidepressive Effect of Gallic Acid on Depression Linked with Hyperglycemia Via PPAR

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Introduction: Diabetes Mellitus is a cluster of metabolic disorders which is characterized by hyperglycemia resulting from insulin resistance. Managing hyperglycemia causes symptoms of stress in diabetic individuals. **Methods:** The etiology of depression in hyperglycemic conditions like diabetes is quite complex and is still not known properly. However, environmental factors, inflammation, hypothalamic-pituitary-adrenal axis dysregulation, and insulin resistance are discussed in the literature as some of the factors responsible for the pathogenesis of depression and cognitive dysfunction in individuals with type 2 diabetes. Peroxisome proliferator-activated receptor (PPAR)-α and γ play as a vital target for neuropsychiatric disorders and behavioural dysfunction. **Results:** The role of (PPAR)-α and γ ligands centrally are well known for the treatment of diabetes and cardiovascular disease. Now it plays a major role as a target for depression. Gallic acid acts as an

antidepressive effect on depression linked with hyperglycemia by acting through PPAR-α and PPAR-γ receptors. **Conclusion:** This states the insights into the significant potential of gallic acid as an anti-depressive, anti-oxidative, and blood sugar-lowering compound.

Keywords: Gallic acid; Antioxidant; Hyperglycemia; Antidepressive effect; Diabetes Mellitus

HNP014

Role Of Artificial Intelligence In Standardisation Of Herbal Drugs And Detection Of Adulterants

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Introduction: The growing global use of herbal drugs raises concerns about quality and adulteration due to complex phytochemistry and identification limits, while artificial intelligence enables accurate, objective, and scalable standardization solutions. **Methods:** A comprehensive literature search was conducted using peer-reviewed databases including Google Scholar, ScienceDirect, and ResearchGate, along with ethnobotanical and pharmacognostic sources. Artificial Intelligence (AI) tools for herbal drug standardization integrate spectroscopy, chromatography, imaging, and multi-omics data to generate phytoconstituent fingerprint profiles. Machine learning algorithms such as Random Forests, Support Vector Machines, artificial neural networks, and Convolutional Neural Networks support quality grading, batch consistency, and reproducibility. For adulteration detection, AI-assisted DNA barcoding with machine and deep learning enables precise species identification. Spectral, chromatographic, Natural Language Processing, and knowledge-graph approaches. **Results:** The reviewed studies demonstrate that AI-assisted DNA barcoding offers superior accuracy, sensitivity, and reliability for species authentication and adulteration detection compared to conventional sequence alignment and phylogenetic methods, particularly for processed and powdered herbal materials. Machine learning and deep learning models applied to spectral, chromatographic, and image-based datasets reliably discriminate authentic samples from adulterants, enabling accurate quality grading and improved batch-to-batch consistency. AI-driven phytoconstituent fingerprint profiling enhances detection of substitution, contamination, and toxic adulterants by capturing complex, nonlinear data patterns. These approaches significantly reduce dependence on expert-based sensory evaluation and single-marker analysis, supporting automated, reproducible, and high-throughput quality control across diverse herbal drug systems. **Conclusion:** AI enhances herbal drug standardization by improving accuracy, reproducibility, and scalability through integrated molecular, chemical, and phenotypic data, strengthening regulatory compliance, consumer safety, and global confidence.

Keywords: Adulteration detection; Artificial intelligence; DNA barcoding; Herbal drug standardization; Machine learning.

HNP015

A Review on Traditional Medicinal Plants of Madhya Pradesh: Ethnic Usage and Pharmacological Validation Against Diseases.

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Introduction: Madhya Pradesh (MP), India, is a biodiversity hotspot and home to numerous indigenous communities whose rich ethnic knowledge represents an invaluable resource for traditional medicine. For centuries, these communities have utilized local flora for primary healthcare. This review aims to systematically consolidate and evaluate the traditional knowledge and ethnic usage of medicinal plants native to MP, specifically focusing on those with documented pharmacological activities against common ailments, thereby bridging the gap between traditional wisdom and modern scientific validation. **Methods:** A comprehensive literature search was executed across peer-reviewed databases (PubMed, Scopus, Google Scholar) and ethno-botanical texts. The search

included keywords such as "Madhya Pradesh," "traditional medicine," "tribal herbs," "ethnobotany," and "pharmacology." Studies were selected if they reported on the indigenous use of MP flora (e.g., by the Gond, Bhil, or Baiga tribes) and included experimental data (*in vitro* or *in vivo*) validating their therapeutic claims against diseases like diabetes, inflammation, or infectious diseases. **Results:** The review identified several endemic and widely used medicinal plants from MP, such as *Chlorophytum borivilianum (Safed Musli*), *Boswellia serrata* (*Salai*), and species of *Andrographis.* The ethnic uses, which often include treating fever, snake bites, respiratory issues, and chronic diseases like arthritis, showed significant correlation with modern scientific findings. Pharmacological validation studies consistently revealed the presence of diverse bioactive compounds (e.g., saponins, triterpenoids, alkaloids) responsible for proven anti-inflammatory, antimicrobial, and hypoglycemic activities. The findings affirm the potential of these traditionally used herbs as candidates for modern drug development. **Conclusion:** The traditional medicinal plants of Madhya Pradesh offer a rich repertoire of natural compounds with validated pharmacological actions that support their long-standing ethnic usage. This review confirms the imperative need to preserve indigenous knowledge while promoting scientific research to isolate, characterize, and clinically develop novel therapeutic agents from this unique floristic region. Further phytochemical and clinical trials are warranted to integrate these traditional remedies into mainstream healthcare.

Key Words: Ethnobotany, Indigenous Knowledge, Madhya Pradesh, Pharmacological Validation, Traditional Medicines

HNP016

Herbal-Derived Modulators Of Tlr4 Signaling In Raw264.7 Macrophages: A Molecular Approach Toward Cancer-Associated Cytokine Regulation

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Introduction: Cancer-associated inflammation is primarily mediated by Toll-like receptor-4 (TLR4) activation in macrophages, resulting in excessive production of pro-tumorigenic cytokines that contribute to proliferation, angiogenesis, and metastasis. Natural plant-derived regulators of this pathway offer safer therapeutic alternatives. *Kigelia pinnata*, a widely used medicinal plant, possesses notable anti-inflammatory and immunomodulatory phytoconstituents. This study evaluates the potential of *K. pinnata* fruit extract to modulate TLR4-driven cytokine release in LPS-stimulated RAW264.7 macrophages. **Methods:** RAW264.7 macrophages were cultured in DMEM containing 10% FBS and maintained at 37°C and 5% CO_2. Cells were pre-treated for 2 hours with standardized concentrations of K. pinnata fruit extract, followed by stimulation with LPS (1 µg/mL) to activate TLR4 signaling. After 24 hours, supernatants were collected for the quantification of TNF-α, IL-6, and IL-1β using a sandwich ELISA. Absorbance was recorded at 450 nm, and cytokine concentrations were determined from standard curves. Cell viability was assessed using the MTT assay to verify non-toxic treatment levels. All experiments were performed in triplicate. **Results:** *K. pinnata* extract significantly reduced LPS-induced secretion of TNF-α, IL-6, and IL-1β in a dose-dependent manner. Cell viability remained above 85%, indicating that cytokine suppression was not associated with cytotoxicity. These observations confirm effective modulation of TLR4-mediated inflammatory signaling. **Conclusion:** *K. pinnata* fruit extract exhibits strong anti-inflammatory activity by suppressing key cancer-associated cytokines in RAW264.7 cells. Its ability to modulate TLR4 signaling highlights its potential as a natural adjunct for managing inflammation-driven cancer progression.

Keywords: *Kigelia pinnata*; RAW264.7 macrophages; TLR4 signaling; Pro-inflammatory cytokines; Cancer-associated inflammation

HNP017

Herbal Medicine & Natural Product: A Review of Natural Products in PCOS Therapy

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Introduction: polycystic ovary syndrome (pcos) is a complex endocrine disorder affecting millions of women worldwide, characterized by hormonal imbalances, ovular dysfunction, and metabolic complications. While conventional treatments like hormonal contraceptives and insulin sensitizers are common, they often carry side effects. Consequently, there is a growing shift toward validating indian traditional knowledge (itk), specifically ayurveda and siddha medicine, to identify safer, plant-based therapeutic alternatives. **Methods:** This review synthesized data from classical Ayurvedic texts and contemporary scientific databases (PubMed, Google Scholar, and ScienceDirect). We examined the pharmacological profiles of specific Indian medicinal plants—such as *Asparagus racemosus* (Shatavari), *Saraca asoca* (Ashoka), and *Cinnamomum cassia* (Cinnamon)—focusing on their phytochemical constituents and their impact on the hypothalamic-pituitary-ovarian (HPO) axis. **Results:** Scientific evidence suggests that these natural products exert multi-target effects. Key findings indicate that active compounds like *shatavarin* and cinnamaldehyde help regulate menstrual cycles, reduce androgen levels, and improve insulin sensitivity. Furthermore, many traditional herbs act as potent antioxidants, mitigating the oxidative stress typically associated with PCOS-related follicular damage. **Conclusion:** The transition from traditional usage to evidence-based science confirms that Indian natural products offer a viable, holistic approach to PCOS management. Integrating these traditional remedies with modern clinical protocols could enhance therapeutic outcomes; however, standardized clinical trials remain essential to establish precise dosages and long-term safety profiles.

Keywords: PCOS, Ayurveda, Natural Products, Phytoestrogens, Indian Traditional Knowledge

HNP018

Simultaneous Chemo- and Genotaxonomic Approaches for Establishing Authenticity of Bala Drugs Used in Ayurveda

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Introduction: Bala is an important group of herbal drugs widely used in Ayurveda and comprises four varieties collectively known as Bala Chatushtya. Owing to similarities in vernacular names, macroscopic characters, and traditional usage, several botanically distinct plant species are frequently used interchangeably as Bala in the raw drug market. Such substitution and adulteration result in misidentification, leading to variations in chemical composition that adversely affect the quality, safety, and therapeutic efficacy of Ayurvedic formulations and challenge their standardization. **Methods:** Seven plant species commonly encountered as Bala, namely *Abutilon indicum, Sida acuta, Sida alba, Sida alnifolia, Sida cordifolia, Sida rhombifolia,* and *Sida veronicaefolia*, were selected for investigation. A validated high performance liquid chromatography method was developed for the simultaneous quantification of key bioactive markers vasicine, vasicinone, and ephedrine. Based on chemical similarity, selected species were further subjected to DNA fingerprinting to establish genetic distinctness. **Results:** Vasicine was detected in *Sida cordifolia, Sida acuta,* and *Sida veronicaefolia*, whereas vasicinone was observed in *Sida cordifolia* and *Sida acuta*. Ephedrine was found exclusively in *Sida cordifolia*. DNA fingerprinting effectively differentiated the chemically similar species, clearly demonstrating their distinct genetic profiles. **Conclusion:** The combined application of chemotaxonomic and genotaxonomic approaches offers a reliable and robust strategy for accurate identification and authentication of Bala drugs, thereby supporting quality control, preventing adulteration, and ensuring therapeutic consistency in Ayurvedic medicines. This integrated approach can significantly strengthen regulatory acceptance and scientific validation of traditional herbal drugs used worldwide today.

Keywords: Ayurveda, Bala, Chemotaxonomy, DNA fingerprinting, HPLC

HNP019

Phytosome Technology: Unlocking the Full Skin-Protective Potential of Silymarin

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Introduction: Medicinal herbs and their bioactive phytochemicals are increasingly explored for dermatological applications due to their antioxidant, anti-inflammatory, and skin-protective effects. Silymarin, a flavonolignan complex from *Silybum marianum* (milk thistle), shows considerable potential for skin protection, anti-aging, and oxidative stress reduction. However, its topical efficacy is limited by poor aqueous solubility, low membrane permeability, and reduced bioavailability, restricting effective delivery to the target site. **Methods**: A phytosome-based nanotechnology approach was employed to enhance the topical bioavailability of silymarin. Phytosomes are phyto–phospholipid complexes that improve lipophilicity, biocompatibility, and stability of phytochemicals. Phytosome-encapsulated silymarin was evaluated for physicochemical properties, skin absorption, retention, and antioxidant activity, and compared with free silymarin to assess improvements in bioavailability and therapeutic potential. **Results**: Phytosome-encapsulation of silymarin greatly improved the aqueous solubility, bioavailability, and penetration properties compared to the conventional formulations. Phytosome encapsulation increased silymarin aqueous solubility by 3–5-fold, enhanced in vitro skin permeation by 2.5–3.0-fold, and improved skin retention by ~2.0–2.3-fold compared to free silymarin. Phytosomal silymarin showed significantly higher antioxidant activity (~75–80% inhibition) than free silymarin (~45–50%) at equivalent doses, achieving comparable efficacy at ~50% lower concentration. **Conclusion**: The phytosome-based delivery system for silymarin is thus a crucial intervention to improve the permeability and bioavailability limitations, thus increasing the topical use of the therapeutic agent. This approach integrates the effective use of traditional herbs and modern technology, thus offering the protective and antioxidant effects to the skin.

Keywords: Silymarin, Phytosome, Topical delivery, Antioxidant, Skin protection

HNP020

Formulation and Evaluation of Polyherbal Gummies for the Management of Dysmenorrhea

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Introduction: Primary dysmenorrhea affects a significant population of menstruating women, often necessitating the use of Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), which are associated with adverse effects. There is a growing demand for patient-friendly, natural alternatives. This study aims to formulate medicated gummies containing a synergistic blend of Matricaria chamomilla, Zingiber officinale, and Foeniculum vulgare to manage pain and inflammation effectively. **Methods:** The formulation is under development using pectin as a plant-based gelling agent, with xylitol and mannitol employed as sugar substitutes to obtain a sugar-free and vegan dosage form. Initially, three base (blank) gummy batches (B1, B2, and B3) were prepared by varying pectin concentrations (2.5%, 3.0%, and 3.5% w/w) to optimize moldability, texture, and structural integrity of the gummy base. Based on the optimized base formulation, five medicated gummy batches (F1–F5) were developed by varying the pectin concentration (2.5–4.0% w/w) and xylitol: mannitol ratios using a trial-and-error approach. Standardized herbal extracts were incorporated uniformly into the gummy base. Preliminary evaluation parameters included appearance, weight variation, pH, texture, and in vitro dissolution behaviour. Dissolution studies were carried out. **Results:** Among the base batches, B2 (3.0% w/w pectin) exhibited optimal clarity, chewiness, and mechanical stability and was selected for herbal incorporation. All five medicated batches showed uniform appearance and acceptable physical characteristics. The average weight of the gummies ranged from 3.0 g to 3.6 g across batches, with pH values between 5.3 and 5.8, indicating suitability for oral administration. Batch F3,

formulated using a xylitol: mannitol ratio of 1:1 and 3.0% w/w pectin, demonstrated superior texture, effective masking of herbal bitterness, and good structural integrity. Dissolution studies revealed a gradual and consistent release of herbal constituents, with batch F3 showing approximately 83% release within 30 minutes. Batches containing higher pectin concentrations exhibited comparatively slower dissolution profiles. **Conclusion:** The ongoing research aims to develop a novel, sugar-free, and plant-based dosage form for dysmenorrhea management. By utilizing Pectin and natural sweeteners, this formulation offers a promising, patient-compliant alternative to conventional analgesics. Preliminary batch-wise quantitative data support the ongoing formulation optimization through a trial-and-error approach, with further refinement in progress.

Keywords: Dysmenorrhea, Fennel, Ginger, Gummies, Herbal

HNP021

Natural Polymeric Excipients as Functional Carrier in Floating Drug Delivery System: A Review

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Background: Floating drug delivery systems are designed to prolong gastric residence time and enhance the oral bioavailability of drugs with narrow absorption windows. Several antidiabetic drugs benefit from gastroretentive delivery, making FDDS a suitable formulation approach. Natural gums have gained attention as polymeric carriers due to their safety, biodegradability, and gel-forming properties. **Objective:** The objective of this review is to comparatively evaluate various natural gums used as polymeric carriers in floating drug delivery systems formulated for antidiabetic drugs. **Methods:** A comprehensive review of published research articles was conducted focusing on FDDS formulations containing natural gums such as guar gum, xanthan gum, gum karaya, gum acacia, quince seeds gum, linseed gum and pectin. And also compare these all gums with different grade of HPMC The collected studies were analyzed and compared based on formulation characteristics and performance parameters including floating lag time, total floating duration, swelling behavior, matrix integrity, and in vitro drug release profiles. **Results:** The reviewed literature indicates that the type and physicochemical properties of natural gums significantly influence the floating behavior and release characteristics of FDDS. High-viscosity and strong gel-forming gums were found to enhance buoyancy, maintain matrix integrity, and provide sustained drug release, whereas low-viscosity gums facilitated rapid swelling and shorter release durations. Polymer concentration and combinations further modulated floating efficiency and drug release kinetics. **Conclusion:** Natural gums demonstrate considerable potential as polymeric carriers in floating drug delivery systems for antidiabetic drugs. Their ability to control buoyancy and drug release, coupled with biocompatibility and sustainability, supports their use as effective alternatives to synthetic polymers. Continued research focused on optimization and standardization may further improve their applicability in gastroretentive antidiabetic drug delivery.

Keywords: Floating drug delivery system, Natural excipients, Gastroretentive drug delivery system, Natural gum

HNP022

Synergistic Anti-Obesity Potential of Acacia Nilotica and Acacia Catechu Combined Extracts

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Introduction: - Obesity is a metabolic pandemic associated with chronic inflammation and excess adiposity. Although synthetic lipase inhibitors, such as Orlistat, do exist they suffer from gastrointestinal side effects. Such anti-obese potential of a polyherbal cryptic extract developed using Acacia nilotica and Acacia catechu (stated to possessing antihyperlipidaemic effect traditionally) was evaluated in the present study with an aim to increase therapeutic efficacy and reduce dose-dependent toxic effects **Methods: -** Hydro-ethanolic extracts (70:30) were

standardized based on total phenolic and flavonoid content. Catechin and epicatechin were profiled as marker using HPTLC. Synergy in vitro was evaluated by PL inhibition assay to determine the Combination Index. In vivo experimentation was performed with High-Fat Diet (HFD)-induced male Wistar rats treated for 6 weeks with optimized combination (200 mg/kg) at a ratio of 1:1 based, either with intention to loose their body weight and BMI or else serum lipid profile **Results: -** 1:1 combination exerted a potent synergistic inhibition on PL with IC {50} value of 42.5 micro g/ml, which was much lower than that of A. nilotica (68.2 micro g/ml) or A. catechu (55.8 micro g/ml) ($P < 0.05$). In vivo, compound group exhibited a decrease of 28.4% in gain body weight and statistically reversal on the Atherogenic Index. Biochemical analysis showed a 35% decrease in serum TG and 42% decrease in LDL-C. **Conclusions: -** The results corroborate the strong synergistic antimetabolic obesity effects against surpressed fat absorption and systemic expense in adipogensis, suggesting that this blend could be of interest as cost-effective metabolic health modulators.

Keywords: Acacia nilotica, Acacia catechu, Synergism, Anti-obesity, Pancreatic Lipase

HNP023

A Comprehensive Review on The Toxicological Profile, Pharmacokinetic Interactions, and Pharmaceutical Incompatibilities of *Moringa Oleifera* Lam

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Introduction: While *Moringa oleifera* (MO) is globally lauded for its diverse pharmacological benefits, the increasing trend of co-administering herbal supplements with conventional pharmacotherapy necessitates a thorough safety evaluation. This review explores the often-overlooked aspects of MO, specifically focusing on its toxicological thresholds, metabolic pathways, and potential chemical incompatibilities within pharmaceutical formulations. **Methods:** A comprehensive analytical review was performed by synthesizing data from high-impact peer-reviewed journals published between 2015 and 2025. The study focused on clinical and preclinical data regarding dose-dependent toxicity, herb-drug interaction mechanisms via the Cytochrome P450 system, and the physical-chemical interactions of MO extracts with common pharmaceutical excipients. **Results:** Analysis reveals that MO possesses a favorable safety profile at standard therapeutic doses; however, chronic administration of highly concentrated extracts may induce sub-acute toxicity in hepatic and renal architectures. From a pharmacokinetic perspective, MO demonstrates a significant capacity to modulate CYP3A4 and CYP2D6 isoenzymes, which may inadvertently alter the plasma concentration of narrow-therapeutic-index drugs. Furthermore, pharmacodynamic synergy was identified when used alongside hypoglycemic agents, posing a risk of uncontrolled hypoglycemia. The study also highlights specific incompatibilities between MO-derived biopolymers and certain ionic surfactants, which can compromise the stability of modern drug delivery systems. **Conclusion:** Although *Moringa oleifera* remains a potent therapeutic agent, its integration into clinical practice requires a nuanced understanding of its metabolic interactions and formulation chemistry. This review underscores the necessity for rigorous standardization and clinician awareness regarding herb-drug combinations to prevent adverse clinical outcomes.

Keywords: Herb-Drug Interactions, Incompatibility, *Moringa oleifera*, Pharmacokinetics, Toxicology

HNP024

Multi-Target Botanical Synergy Against Cancer: Integrated Anticancer Actions of Curcuma longa, Moringa oleifera, Psidium guajava, and Coriandrum sativum

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Introduction: - Systemic toxicity and drug resistance limit the effectiveness of conventional chemotherapy, and cancer continues to be a leading cause of death worldwide. Promising substitutes are provided by natural products with multi-target actions. The combined anticancer potential of Curcuma longa, Moringa oleifera, Psidium guajava, and Coriandrum sativum is investigated in this study. **Methods: -** The MTT assay was used to assess the cytotoxic activity of plant materials extracted with appropriate solvents on specific cancer cell lines. Combination treatment analysis based on decreased cell viability was used to evaluate synergistic interactions. **Results: -** When compared to individual extracts, polyherbal combinations showed increased anticancer activity, suggesting synergistic modulation of pathways related to angiogenesis, oxidative stress, apoptosis, and inflammatory signaling. **Conclusions: -** The results validate the potential of multi-target botanical synergy as a successful anticancer approach. These polyherbal formulations deserve more in-vivo and clinical research because they may increase therapeutic efficacy while lowering toxicity.

Keywords: - *Curcuma longa*, *Moringa oleifera*, *Psidium guajava*, *Coriandrum sativum*, cancer cell lines.

HNP025

Formulation and Evaluation of Antimicrobial Gel from Methanolic Leaf Extract of *Clitoria Ternatea L*

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Introduction: Herbal medicines have been used since ancient times for preventing and treating various diseases and continue to gain scientific importance due to their safety and therapeutic potential. Many medicinal plants possess antimicrobial, antioxidant, and anti-inflammatory properties, making them effective alternatives to synthetic drugs, particularly for skin infections. The increasing prevalence of antibiotic resistance emphasizes the need for natural antimicrobial agents. *Clitoria ternatea* Linn., commonly known as Aparajita or Butterfly pea, is traditionally used for wounds, inflammation, fever, and skin disorders. It is rich in bioactive phytoconstituents such as flavonoids (quercetin, kaempferol, rutin), anthocyanins (ternatins), phenolic compounds (tannic acid), alkaloids, saponins, and glycosides, which contribute to its antimicrobial and antioxidant activity. This study aimed to formulate and evaluate an antimicrobial herbal gel using *Clitoria ternatea* leaf extract. **Methods:** Leaves were collected, authenticated, and extracted using continuous Soxhlet extraction with ethanol. Pharmacognostical, physicochemical, and phytochemical evaluations were performed. An herbal gel was prepared using Carbopol as the gelling agent and evaluated for physical properties, antimicrobial activity, and topical bioavailability. **Results:** The gel was light green, homogeneous, and free from grittiness, with suitable pH, viscosity, and spreadability. Phytochemical screening confirmed quercetin, kaempferol, rutin, ternatins, tannic acid, alkaloids, saponins, and glycosides. The formulation exhibited significant antibacterial activity against *Bacillus subtilis* (76 mm) and *Staphylococcus aureus* (65 mm), comparable to streptomycin. The Carbopol gel enhanced topical bioavailability by providing prolonged skin contact, sustained release, and improved local penetration of active compounds, contributing to its antimicrobial efficacy while minimizing systemic absorption. **Conclusion:** *Clitoria ternatea* leaf extract can be successfully formulated into an effective antimicrobial gel with improved topical bioavailability. The gel shows promise as a safe and natural alternative to synthetic topical agents, warranting further studies for clinical validation

Keyword: Antimicrobial activity, Clitoria ternatea L, Fabaceae, spreadability, homogeneity, gel.

HNP026

Exploring The Mechanism of Anti-Osteoporotic Action of *Terminalia arjuna* Using Network Pharmacology and Molecular Docking

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Introduction: Osteoporosis is a chronic skeletal disease characterized by reduced bone mass and deterioration of bone microarchitecture, leading to increased fragility and fracture risk. Conventional therapies generally target a single molecular pathway and are often associated with limited efficacy and adverse effects. In contrast, medicinal plants offer a polypharmacological approach. *Terminalia arjuna*, a widely used Ayurvedic medicinal plant, has demonstrated promising bone-protective potential. The present study was aimed at elucidating the mechanism of anti-osteoporotic action of *T. arjuna* using an integrated network pharmacology and molecular docking approach. **Methods:** Major phytoconstituents of *T. arjuna* were retrieved from Dr. Duke's Database and the IMPPAT platform. Potential protein targets were predicted using Swisstargetprediction and intersected with osteoporosis-associated genes from Genecards using Venny 2.1. Protein–protein interaction networks were constructed through STRING, followed by pathway enrichment analysis. Docking studies were performed using Pyrx and visualized with Discovery Studio. **Results:** The PI3K–Akt signaling pathway, estrogen signaling pathway, and osteoclast differentiation pathway were identified as key pathways involved in osteoporosis modulation. Three hub targets—AKT1, ESR2, and PIK3CA—were selected for validation through molecular docking. Selected phytochemicals, including luteolin, kaempferol, arjungenin, and arjunolic acid, exhibited strong binding affinities towards these targets, suggesting potential inhibition of bone resorption and promotion of bone formation. **Conclusion:** Overall, this integrative strategy highlights the multi-target and multi-pathway therapeutic potential of *T. arjuna* in osteoporosis management and provides computational support for its traditional use.

Keywords: Osteoporosis, network pharmacology, *T. arjuna*, molecular docking, PI3K–Akt signaling pathway.

HNP027

Metabolic Engineering Strategies for Enhanced Bacoside Production in *Bacopa monnieri*

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Introduction: *Bacopa monnieri* (L.) Pennell, commonly known as Brahmi, is an important medicinal herb in Ayurvedic medicine. The neuroprotective and cognitive-enhancing properties of the herb are mainly attributed to triterpenoid saponins known as bacosides. However, The plant faces sever challenges like low natural yield and slow growth rate. Additionally, environmental variability restrict large-scale and consistent production of bacosides. Metabolic engineering has emerged as a promising strategy to enhance the biosynthesis of these valuable secondary metabolites in *B. monnieri*. **Methodology:** Metabolic engineering approaches focus on manipulating the triterpenoid biosynthetic pathway, primarily the mevalonate (MVA) pathway. Key enzymes such as 3-hydroxy-3-methylglutaryl-CoA reductase (HMGR), squalene synthase, and β-amyrin synthase are targeted through genetic transformation and overexpression strategies. *Agrobacterium*-mediated transformation and *Agrobacterium rhizogenes*-induced hairy root cultures are employed to achieve stable gene expression. Additionally, elicitor treatments including methyl jasmonate and salicylic acid are used to stimulate secondary metabolite production. Omics-based tools such as transcriptomics and metabolomics support pathway elucidation and gene identification. **Results:** Enhanced expression of key biosynthetic genes leads to increased accumulation of bacosides in *in vitro* cultures, particularly in hairy root systems. Elicitor-treated cultures show further improvement in metabolite yield, indicating synergistic effects of genetic and biochemical interventions. **Conclusion:** Metabolic engineering offers an effective and sustainable approach for improving bacoside

production in *Bacopa monnieri*. Integration of genetic manipulation, elicitation, and *in vitro* culture systems holds significant potential for pharmaceutical and nutraceutical applications.

Keywords: *Bacopa monnieri*, bacosides, hairy root culture, metabolic engineering, triterpenoid biosynthesis

HNP028

Biowaste to Beauty: A Formulation Study on Pistachio Shell–Based Facial and Body Exfoliants

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Introduction: Pistachio nuts (*Pistacia vera* L.) are widely consumed for their nutritional and sensory attributes; however, their processing generates a significant quantity of shell waste, accounting for nearly half of the nut's total weight. These shells are commonly discarded despite being rich in lignocellulosic materials such as cellulose, hemicellulose, lignin, phenolic compounds, vitamins, minerals, and trace antioxidants. Owing to these constituents, pistachio shells possess structural strength and potential skincare benefits. Exfoliating cosmetic products such as facial scrubs and shower gels require careful selection of particle size, gelling agents, surfactants, moisturizers, and pH to ensure efficacy and skin compatibility. Compared to conventional natural exfoliants like walnut shell powder, which often possess irregular and coarse particles that may cause micro-abrasions, pistachio shell powder can be processed to obtain controlled and smoother particle sizes. This study explores the conversion of pistachio shell waste into a functional natural exfoliant for cosmeceutical applications. **Methods:** Pistachio shells were collected, cleaned, dried, powdered, and sieved to obtain a targeted particle size range of 250–500 µm, suitable for mild yet effective exfoliation. For facial scrub formulation, a Carbopol gel base was prepared in water, and a mixture of sodium lauryl sulfate, glycerin, turmeric, and additives was incorporated, followed by gradual addition of pistachio shell powder and pH adjustment using triethanolamine. For the exfoliating shower gel, Carbopol was swollen in water, and a surfactant phase containing sodium lauryl sulfate and glycerin was added slowly. Preservatives, essential oil, and pistachio shell powder were mixed, and pH was adjusted. **Results:** Both formulations showed smooth texture, uniform appearance, acceptable pH, stable viscosity, good spreadability, effective exfoliation, and easy washability. The targeted particle size provided gentle, uniform exfoliation with reduced abrasiveness compared to conventional walnut shell exfoliators, enhancing skin safety and user comfort. **Conclusion:** The findings confirm that pistachio shell waste can be effectively utilized as a sustainable, eco-friendly natural exfoliant in facial scrub and shower gel formulations for cosmeceutical use.

Keywords: Cosmeceuticals, Exfoliating shower gel, Facial scrub, Natural exfoliant, Pistachio shell waste.

HNP029

Preparation of Ointment From *Averrhoa carambola* Fruit Extract and It's Evaluation

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Introduction: *Averrhoa carambola* (star fruit) is a tropical fruit widely used in traditional medicine and valued for its rich phytochemical composition. The fruit contains bioactive constituents such as flavonoids, phenolic compounds, tannins, vitamins, antioxidants, and oil-soluble phytoconstituents like β-sitosterol and carotenoids, which are known to exhibit antimicrobial, anti-inflammatory, antioxidant, and wound-healing properties. Herbal ointments are preferred for topical drug delivery because they provide prolonged contact with the skin, improved patient compliance, and minimal systemic side effects. **Methods**: Fresh *Averrhoa carambola* fruits were collected, washed, sliced, shade-dried, and pulverized into coarse powder. The powdered material was subjected to ethanolic

extraction by maceration. The extract was filtered and concentrated to obtain a semisolid mass. An ointment base was prepared using white soft paraffin and liquid paraffin, and the extract was incorporated into the base by levigation to ensure uniform distribution. The formulated ointment was evaluated for physicochemical parameters such as appearance, homogeneity, pH, spreadability, consistency, and stability**. Results:** The formulated ointment showed smooth texture, uniform appearance, and good homogeneity without any grittiness. The pH was within the acceptable range for topical application, indicating skin compatibility. Spreadability and consistency were satisfactory, suggesting ease of application. Stability studies revealed no significant changes in physical characteristics during storage. The ointment base enhanced penetration of active constituents by forming an occlusive layer on the skin, increasing hydration of the stratum corneum, and facilitating diffusion of oil-soluble phytoconstituents into deeper skin layers. **Conclusion:** The study concludes that *Averrhoa carambola* fruit extract can be effectively formulated into a stable and skin-compatible herbal ointment with potential for topical therapeutic applications.

Keywords: *Averrhoa carambola*, Fruit extract, Herbal ointment, Physicochemical evaluation, Topical formulation.

HNP030

From Glycolysis to Pro-Longevity Pathways: Anti-Ageing Potential of D-Mannoheptulose in Avocado Oil

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Introduction: Ageing is driven by interconnected processes including oxidative stress, chronic low-grade inflammation (inflammageing), mitochondrial dysfunction, impaired proteostasis and dysregulated nutrient-sensing pathways. Avocado oil is widely recognized for its barrier-supportive lipids and antioxidant unsaponifiable fraction (e.g., tocopherols, phytosterols and carotenoids), which may protect skin and tissues from oxidative and inflammatory damage. D-Mannoheptulose (DMH), a characteristic "rare" C7 sugar from avocado, is a well-known inhibitor of hexokinase/glucokinase and can act as a glycolysis "brake," thereby influencing glucose sensing and insulin signalling. This review evaluates how combining DMH (as an avocado-derived polar bioactive) with avocado oil (as a delivery and synergistic lipid matrix) could plausibly produce antiaging effects through metabolic reprogramming and redox-inflammatory control. **Methods:** A structured literature search was conducted using PubMed, Scopus and Google Scholar, focusing on studies related to DMH biology (hexokinase/glucokinase inhibition, glucose sensing, insulin secretion), nutrient-sensing pathways (AMPK, mTOR, sirtuins/NAD^+), oxidative stress markers, inflammatory mediators, mitochondrial function, autophagy, and evidence on avocado oil's dermatologic/metabolic protective actions. **Results:** Evidence supports that avocado oil's lipid profile and unsaponifiables can strengthen barrier integrity and reduce oxidative-inflammatory stress, thereby limiting collagen degradation and tissue damage associated with ageing. DMH-mediated reduction of glycolytic flux may mimic aspects of mild calorie restriction by dampening glucose-triggered insulin/IGF-1 signalling while favouring a "maintenance mode" characterized by AMPK activation, relative mTOR suppression and sirtuin/NAD^+-linked stress resistance. These pathway shifts are mechanistically aligned with enhanced autophagy, improved mitochondrial quality control and reduced inflammageing. **Conclusion:** DMH-enriched avocado preparations, supported by avocado oil's antioxidant and barrier-protective constituents, represent a plausible multi-target antiaging strategy that converges on nutrient-sensing reprogramming, redox balance and inflammation control.

Keywords: Avocado oil, Calorie Restriction, D-Mannoheptulose, Inflammageing, Maintenance mode

HNP031

Development And Evaluation of Wound Healing Polyherbal Formulations.

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Introduction: Wound healing is a natural process in organisms where replacement of destroyed or damaged tissues is achieved by newly produced tissue. For better drug delivery and better patient compliance, nanoemulgel is an emerging topical drug delivery system that provides a greaseless, easily spreadable, non-staining, safer, bio-friendly, transparent or milky appearance, and an effective drug delivery system as compared to other topical drug delivery systems. **Methods:** Different extracts were prepared by maceration method. For the preparation of nanoemulgel, primarily, a nanoemulsion was formed in which the aqueous phase and liquid phase were mixed vigorously until a homogeneous mixture was formed. Secondarily, the preparation of the hydrogel was done by adding polymers to the water and mixing them well. Nanoemulgel was prepared by mixing the nanoemulsion with hydrogel in 1:1 ratio, under continuous stirring until a homogeneous product was formed, and was evaluated. **Results:** Among the prepared extracts, *Punica granatum* showed the highest extractive yield (16. 57 % w/w) , whereas *Phyllanthus emblica* showed the lowest (8.48 % w/w) **.** Formulation A exhibited acceptable physicochemical properties with a creamy yellowish appearance and pleasant odour. The pH of the formulation was found to be 6.67 ± 0.58 indicating suitability for topical application. Stability studies revealed no phase separation or significant physical changes during the study period 3 days . In vivo wound healing studies demonstrated that Formulation A produced significantly higher wound contraction (90 %) compared to the blank (60%) and untreated control groups (50 %) with faster wound closure observed on day 9. **Conclusion:** Nanoemulgel formulation prepared by using *Moringa oleifera*, *Glycyrrhiza glabra*, and *Sesamum indicum* oil. (Formulation A) showed better wound healing properties.

Keywords: Nanoemulgel, Wound healing, Polymers.

HNP032

Therapeutic Significance of Ophiorrhiza - Derived Camptothecin in Colon Cancer

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Introduction: Globally, colorectal cancer is one of the main causes of cancer-related death. Despite their effectiveness, conventional chemotherapeutic drugs are frequently linked to serious toxicity and harm to healthy cells. The structural variety and improved safety profile of natural compounds generated from medicinal plants have drawn attention. Among them, Ophiorrhiza species are recognized for being abundant in camptothecin, a strong anticancer alkaloid that has been shown to be effective against colon cancer. **Methods:** With a focus on Ophiorrhiza species, a systematic analysis of the literature was conducted utilizing electronic databases to find research on herbal medications used in colon cancer. Pre-established inclusion and exclusion criteria were used to filter pertinent articles. Information about the components of phytochemicals, their mode of action, their traditional use, and their potential to prevent cancer were examined and compiled. **Result:** According to the reviewed investigations, camptothecin and associated secondary metabolites are present in large concentrations in Ophiorrhiza species, especially Ophiorrhiza mungos and Ophiorrhiza recurvipetala. By blocking DNA topoisomerase I, these substances have potent anticancer properties that restrict the growth of cancer cells and trigger apoptosis. Different species were found to have varying amounts of camptothecin, which were impacted by factors such as location, climate, and time of collection. Despite being understudied, a number of species have demonstrated encouraging anticancer potential. **Conclusion:** An important natural source of anticancer medicines for the treatment of colon cancer is herbal medications made from Ophiorrhiza species. Their historic usage and medicinal significance are supported by their rich phytochemical profile, especially camptothecin. To confirm

their effectiveness, improve extraction techniques, and create safer, more affordable anticancer formulations, more extensive experimental and clinical research is needed.

Keywords: Colon cancer, Herbal drugs, Ophiorrhiza, Camptothecin, Anticancer activity.

HNP033

A Comprehensive Review of Naringin: From Phytochemistry to Therapeutic Applications

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Introduction: A naturally occurring flavanone glycoside, naringin is primarily present in citrus fruits, particularly grapefruit. Naringin has attracted significant interest in pharmaceutical and biomedical research due to its unique phytochemical structure and wide range of biological activity. In order to emphasize naringin's potential use in medicinal and nutraceutical applications, the current review attempts to gather and critically examine its phytochemical characteristics, extraction methods, and pharmacological advantages. **Methods:** Naringin was extracted from citrus peels using conventional solvent extraction with hydro-alcoholic solvents and compared with advanced techniques such as ultrasound-assisted and microwave-assisted extraction. Process parameters including solvent composition, temperature, and extraction time were optimized to enhance yield. The obtained extracts were purified using chromatographic techniques and characterized by spectroscopic methods, including UV–Visible spectroscopy and HPLC, to confirm the presence and purity of naringin. **Results:** Naringin has a variety of pharmacological actions, including antioxidant, anti-inflammatory, cardioprotective, antidiabetic, neuroprotective, anticancer, and antibacterial properties, according to the review. When compared to traditional approaches, advanced extraction techniques were found to increase extraction efficiency, yield, and purity. Naringin's glycosidic structure limits its oral bioavailability despite its promising therapeutic profile; its pharmacological efficacy is largely dependent on its biotransformation to naringenin. **Conclusion:** Naringin emerges as a promising bioactive flavonoid with significant therapeutic potential. Advances in extraction technologies and formulation strategies may help overcome bioavailability challenges, enabling its effective pharmaceutical application. Further clinical studies and standardized processing methods are essential to translate its pharmacological benefits into clinically viable products.

Keywords: Naringin, Flavone, Extraction.

HNP034

Formulation & Evaluation of Herbal Syrup for Respiratory Disorder

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Introduction: The present study focuses on the formulation and evaluation of an herbal syrup intended for the effective management of cough and asthma. The formulation incorporates traditionally used medicinal plants known for their antitussive, bronchodilator, and expectorant properties, including vasaka, ginger, turmeric, liquorice, kalangoe and tulsi. These herbal ingredients were selected based on their documented phytochemical constituents and therapeutic efficacy in respiratory ailments. The formulation underwent a series of evaluations, including physical parameters and stability studies. Results indicated that the herbal syrup possessed significant antitussive and bronchodilatory effects. The study concludes that the developed herbal formulation can serve as a safe and effective alternative treatment for cough and asthma, supporting the use of traditional herbal remedies in modern pharmaceutical formulations**. Conclusion**: the formulation and evaluation of herbal syrups for respiratory disorders involve careful selection of herbs, optimization of formulation, and focus on safety and efficacy. **Method**: Filter all powder herbs into clean stainless steel vessels Add 400ml disteled water (4times required final volume Heat genteelly & allow to boil slowly Steir occationally , keep veasels half cover to prevent contamination Volume is reduce to ¼ pH (100 ml) Stop heating and allow to cool Filter the decoction to a

whatsman filter paper to remove coarse particals Collect clear aqueous extract **Result:** The formulation and evaluation was done in a proper manner and the test was performed.

Keywords: Herbal Syrup, Cough, Asthma.

HNP035

Immunostimulatory potential of saffron (*Crocus sativus L.*) thread extract: An *in-vitro* neutrophil phagocytosis study

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Introduction: Natural compounds are increasingly explored for their immunomodulatory potential because of their favourable safety profiles. *Crocus sativus* L. (saffron), a valuable Indian spice, possesses a variety of pharmacological activities. This study assesses the immunostimulatory effect of saffron thread extract using an *in vitro* neutrophil phagocytosis model. **Method:** Human polymorphonuclear neutrophils (PMNs) were isolated and incubated with *Candida albicans* in the presence of saffron thread extract at concentrations of 250, 500, and 1000 µg/mL. Phagocytic activity was assessed microscopically after Giemsa staining and expressed as the phagocytic index (PI), calculated as the mean number of *Candida* cells engulfed by 100 neutrophils. Immuno-stimulation was determined by comparison with the control. **Result:** The control group showed a PI of 13. Saffron thread extract significantly enhanced phagocytic activity, with PI values of 23, 28, and 30 at 250, 500, and 1000 µg/mL, respectively. The highest immunostimulation was observed at 250 µg/mL (176.92%), followed by 1000 µg/mL (130.76%) and 500 µg/mL (115.38%). **Conclusion:** The results indicate that saffron thread extract enhances neutrophil-mediated phagocytosis, supporting its potential as a natural immunomodulatory agent.

Keywords: Saffron, Immunostimulation, Phagocytosis, Neutrophils, Natural immunomodulators

HNP036

Vitiligo and the Therapeutic Role of Piperine in Skin Repigmentation

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Introduction: Vitiligo is a skin disorder characterized by loss of pigmentation due to melanocyte damage. Piperine promotes regimentation by stimulating melanocyte activity and melanin synthesis. **Methods:** Vitiligo is a chronic skin disorder characterized by white patches caused by loss of melanin due to destruction or dysfunction of melanocytes. It is mainly an autoimmune condition, with genetic factors, oxidative stress, nerve-related influences, and triggers such as stress, injury, or illness contributing to its development. Piperine is a naturally occurring amide alkaloid responsible for the pungent taste of *Piper nigrum* and *Piper longum*. It is obtained from dried pepper fruits by solvent (ethanol) extract, followed by concentration and crystallization to produce purified yellow needle-shaped crystals used in pharmaceutical applications. Piperine promotes repigmentation in vitiligo through multifaceted molecular and cellular mechanisms. It activates melanocytes, enhancing their proliferation and directed migration into depigmented skin regions. Piperine enhances melanin production by upregulating tyrosinase, the key enzyme in melanogenesis, and by regulating intracellular signaling pathways essential for melanocyte survival, differentiation, and function. Also provides antioxidant protection against oxidative stress–induced melanocyte damage and shows immunomodulatory effects that reduce autoimmune-mediated cytotoxicity. When applied topically, especially alongside ultraviolet phototherapy, piperine acts synergistically to boost melanogenic activity and accelerate skin repigmentation, supporting its role as an effective adjunct in vitiligo treatment. **Result:** Piperine's antioxidant and immunomodulatory properties help protect melanocytes from oxidative stress and autoimmune damage, suggesting piperine's potential as a supportive treatment in vitiligo. **Conclusion:** Review of available studies indicates that piperine effectively stimulates melanocyte proliferation and migration, increases tyrosinase activity, and enhances melanin production in depigmented skin.

Keywords: Depigmentation, Piperine, Vitiligo.

HNP037

Beyond Topical Therapy: Oral Ceramides (Ceramosides) in Skin Barrier Restoration

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Introduction: Ceramides (Sphingolipids) play a vital role in maintaining skin hydration, barrier function, and antimicrobial defense. The impaired epidermal barrier and skin dryness in chronic skin conditions such as atopic dermatitis (eczema), psoriasis, and aged skin (wrinkles) are associated with the depletion of ceramides (CERs) in the stratum corneum. This leads to decreased collagen, elastin, and keratin proteins while it increases trans epidermal water loss and skin irritation. Various topical formulations only provide symptomatic relief and are inefficient. Instead of relying on topical solutions, oral administration of ceramides extracted from natural sources like wheat and rice proves otherwise to be more effective. **Methods:** Polar lipid fraction extracted from wheat albumen consists of synergistic combination of glucosylceramides, digalactosyl diglyceride (DGDG). Ceramosides represent fast-acting wheat extract enriched with phytoceramides. Beyond skin benefits, this formulation addresses hair-related concerns. Systemic activity primarily enhances endogenous synthesis of collagen, elastin, keratin. Mechanism of action involves inhibition of collagenase, elastase enzymes, preserving extracellular matrix architecture, along with antioxidant activity reducing oxidative stress. Emerging concept of administering purified bioactive ceramide components rather than crude extracts may further enhance therapeutic efficacy. DGDG functions as coexisting galactolipids, demonstrating high biological potency in experimental studies. **Results:** Ceramosides, WPLC supplementation decreases telogen hair density while increasing the anagen hair density, leading to reduced hair shedding. It aids in replenishing and restoring ceramides; accelerating keratin and elastin production is proven. **Conclusion:** Oral supplementation with plant-derived ceramides such as Ceramosides supports systemic restoration of skin barrier integrity, hydration, hair health through enhanced collagen, elastin, keratin synthesis.

Keywords: Ceramides, DGDG, Collagen, Elastin.

HNP038

Formulation and Evaluation of Topical Herbal Gel for Wound Management

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Introduction: Bioactive secondary metabolites found in medicinal plants, especially polyphenols, are important for wound healing and antioxidant activity. Before being added to topical herbal formulations, plant extracts must be properly evaluated and standardized from a pharmacognostical perspective. The current study's objectives were to evaluate a selected medicinal plant physicochemically and phytochemically, assess its antioxidant activity, and formulate a standardized herbal gel for wound care. **Methods:** The plant material was collected, authenticated, shade-dried, powdered and physicochemical evaluation carried out using standard procedure. Different extracts were prepared using a suitable solvent by macerating for 48 Hrs. Total phenolic content was determined by the Folin–Ciocalteu method and expressed as gallic acid equivalents (GAE), while Standard in vitro DPPH radical scavenging assays were used to measure the antioxidant activity. Based on the phytochemical profile, the standardized extract was added to a topical gel base. The prepared gel's organoleptic characteristics, pH, homogeneity, spreadability, and stability were evaluated. **Results:** Physicochemical parameters like moisture content, Extractive value and ash value are within standard limits that confirm its identity, quality, and purity. The extract demonstrated considerable phenolic content and significant antioxidant activity at a higher concentration of 50µg/ml. The prepared herbal gel had acceptable physicochemical properties, such as a skin-compatible pH, good spreadability, and satisfactory stability, which indicate its suitability for topically promoting wound healing.

Conclusion: The findings indicate that the plant extract is a promising source of antioxidant phytoconstituents, and incorporating it to a herbal gel provides an effective topical delivery for wound management.

Keywords: Total phenolic content, Antioxidant activity, Herbal gel, Wound Healing, Plant Extr

ABSTRACTS -POSTER PRESENTATION (AI IN DRUG DISCOVERY AND PHARMACEUTICAL CHEMISTRY)

AIP001

Integrating AI-Driven Drug Discovery with Traditional Ayurvedic Knowledge for Accelerated Phytomedicine Innovation

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Introduction: The global demand for effective, safe, and natural therapeutics necessitates the rapid innovation of phytomedicines. Traditional Ayurvedic knowledge, representing an expansive repository of empirical wisdom concerning polyherbal formulations, remains largely untapped by modern drug discovery pipelines. This review explores a paradigm shift where Artificial Intelligence (AI) is integrated with Ayurvedic principles to drastically accelerate the identification and optimization of novel therapeutic agents from natural sources. The objective is to demonstrate how this synergy can overcome the challenges of complexity and time inherent in traditional methods. **Methods:** This systematic review analyses the convergence of machine learning (ML) models including deep learning and network pharmacology with Ayurvedic data resources. Specifically, we examined studies that utilize AI for key drug discovery phases: target identification based on *Dravyaguna* (materia medica) properties, compound screening within Ayurvedic herbs (e.g., using Quantitative Structure-Activity Relationships, QSAR), and polyherbal formulation optimization guided by principles of *Vipaka* (post-digestive effect) and Dosha balancing. **Results:** Integration of AI significantly enhances the efficiency of phytomedicine development. AI-driven network pharmacology successfully predicted synergistic interactions in polyherbal mixtures, validating traditional formulations and identifying novel targets (e.g.,). Furthermore, ML models accurately predicted the efficacy and toxicity profiles of Ayurvedic compounds, reducing the need for extensive in vitro and in vivo testing. This synergistic approach demonstrated the potential to shorten the lead compound identification phase from several years to a few months. **Conclusion:** The strategic integration of AI-driven drug discovery methodologies with the profound knowledge base of Ayurveda constitutes a powerful and validated approach for accelerated phytomedicine innovation. This synergy not only validates ancient wisdom but also establishes a new, efficient, and scientifically rigorous pipeline for developing next-generation herbal therapeutics, promising a future of personalized and precise natural medicine.

Key Words: Artificial Intelligence (AI), Ayurveda, Phytomedicine, Network Pharmacology, Drug Discovery

AIP002

Genetic Algorithms for Drug Discovery

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Introduction: Genetic Algorithms (GAs) are evolutionary optimization techniques inspired by the principles of natural selection and biological evolution. They are widely used to identify optimal or near-optimal solutions to complex problems characterized by large search spaces. In GAs, candidate solutions are evaluated using a fitness function, and the most suitable individuals are selected to generate offspring through crossover and mutation. This iterative process continues over multiple generations until a desirable solution is achieved. Due to their robustness and flexibility, genetic algorithms are increasingly applied in multidisciplinary fields, including computational chemistry and drug discovery. **Methods:** In genetic algorithms, an initial population of candidate solutions is generated and evaluated based on a predefined fitness score. High-performing solutions are selected and combined through crossover operations to generate new offspring, while mutation introduces diversity and prevents premature convergence. To further enhance efficiency, genetic algorithms can be integrated with complementary statistical and machine learning techniques to reduce the search space and computational cost. For example, matrix genetic algorithms utilize algebraic matrix operations to organize optimal solutions along diagonal positions, thereby simplifying the identification of promising candidates. Additionally, k-nearest neighbors (kNN) classification can be combined with genetic algorithms to group structurally or property-wise similar data points, enabling faster convergence toward optimal solutions. **Results:** The integration of genetic algorithms with matrix operations and kNN classification significantly improves optimization efficiency by reducing redundant searches and computational overhead. When applied to drug discovery, genetic algorithms efficiently navigate the vast chemical space to identify lead molecules that simultaneously satisfy multiple criteria, such as efficacy, potency,

and favorable pharmacokinetic properties. This approach enables the systematic generation and evaluation of numerous molecular permutations and combinations, yielding high-quality lead candidates within fewer computational cycles. **Conclusion:** Genetic algorithms provide a powerful and efficient framework for solving complex optimization problems with extensive search spaces, such as those encountered in drug discovery. Their ability to evolve optimal solutions over successive generations, especially when combined with statistical and machine learning techniques like matrix genetic algorithms and kNN, significantly reduces computational burden. By accelerating lead identification and optimization, genetic algorithms offer substantial advantages in reducing both the time and cost associated with pharmaceutical drug development.

Keywords: Genetic Algorithms, optimal solutions, computational load, Drug discovery

AIP003

Ai-Driven Prediction of Nanoparticle Pharmacokinetics and Biodistribution: A Data-Centric, Explainable Modeling Framework for Smarter Nanomedicine Design

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Introduction: Nanoparticles are increasingly used in drug delivery, molecular imaging, gene therapy, and mRNA/siRNA therapeutics. However, reliable prediction of nanoparticle pharmacokinetics (PK) and biodistribution (BD) remains challenging due to complex and nonlinear interactions with biological systems. Conventional approaches are costly, time -consuming, and often lack generality, across nanoparticle compositions and physiological conditions. **Methods:** In this project, I have compiled various physicochemical and biological data of diverse nanoparticles, including gold, silica, polymeric, lipid -based, and metallic systems, from publicly available repositories such as caNanoLab, the Nanomaterial Registry, and PubVinas. And generate an AI-Driven framework to enable predictive and mechanistically interpretable assessment of nanoparticle pharmacokinetics and biodistribution. Various features which I have extracted and included in the framework are particle size, polydispersity, zeta potential, core material, surface chemistry, dose, administration route, and time -resolved organ concentrations. For the more accurate results I have evaluated various multiple machine learning models — Random Forest, XG Boost, multilayer perceptron, and graph neural networks alongside a hybrid physiologically based pharmacokinetic (PBPK) model. **Results:** Predicted result which I have anticipated is that PBPK -hybrid approach improved temporal prediction accuracy and analysis and identification of various characteristics like zeta potential magnitude, PEGylation percentage, and ligand density explains the biodistribution of the nanoparticles. Analysis of administration route significantly influenced hepatic and splenic uptake, while tumor accumulation correlated with surface charge and targeting ligand density. **Conclusion:** The proposed AI-driven, PBPK-framework enhances the accuracy and interpretability of nanoparticle pharmacokinetics and biodistribution prediction. This approach has the potential to accelerate Nano medicine development by reducing animal experimentation, optimizing formulations at early stages, and supporting rational design decisions. The framework also provides a foundation for future integration of genomic markers, advanced PBPK systems, and real-time bio distribution imaging.

Keywords: Nano medicine, Hybrid PBPK –machine learning models, Explainable AI, Biodistribution prediction, Nanoparticle design.

AIP004

WRN Helicase Inhibition: A Synthetic Lethal Strategy Targeting Microsatellite Instable Cancers

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Introduction: Werner syndrome RecQ helicase (WRN) is a critical DNA-processing enzyme, and germline mutations in the WRN gene cause Werner syndrome, a rare progeroid disorder characterized by premature aging. In recent years, WRN has emerged as a promising therapeutic target in cancer treatment based on the principle of

synthetic lethality, particularly in microsatellite instability–high (MSI-H) cancers. This strategy parallels the clinical success of PARP inhibitors in BRCA-mutant tumors, where tumor-specific defects in DNA repair pathways are selectively exploited. In MSI cancers, defects in DNA mismatch repair lead to the accumulation of repetitive DNA sequences, creating a unique genomic and transcriptional vulnerability that depends on WRN helicase activity for proper DNA replication and genome maintenance. Methods: The therapeutic strategy targeting WRN focuses on the development of "trapper" molecule–based inhibitors that selectively interfere with WRN function in MSI cancer cells. These inhibitors, exemplified by the clinical candidate HRO761, are designed to bind a non-conserved pocket of the WRN helicase domain. Binding locks WRN into an inactive conformation while it remains associated with chromatin. This trapped state triggers a cascade of post-translational modifications, including SUMOylation mediated by PIAS4 and ubiquitination by RNF4, which marks WRN for degradation. The final step involves selective proteolytic removal of WRN through the p97/VCP-dependent proteasome pathway. **Results:** The use of WRN "trapper" inhibitors exploits a transcriptional and replication-associated vulnerability unique to MSI cancers, where extensive TA-dinucleotide repeat expansions accumulate throughout the genome. WRN helicase activity is essential for resolving these repetitive sequences during DNA replication. Inhibition and chromatin trapping of WRN result in impaired replication fork progression, accumulation of DNA damage, and selective cancer cell lethality. Importantly, this effect is largely restricted to MSI-H tumor cells, demonstrating both potency and selectivity, while sparing normal cells with intact mismatch repair mechanisms. **Conclusion:** WRN helicase represents a highly attractive and biologically validated target for precision cancer therapy in MSI-H tumors. The development of trapper-based WRN inhibitors such as HRO761 provides a novel mechanism of action that induces selective degradation of WRN through post-translational modification and proteasomal pathways. This approach extends the concept of synthetic lethality beyond PARP inhibition and highlights the therapeutic potential of targeting replication stress and transcriptional scars unique to genetically unstable cancers.

Keywords: WRN helicase, Synthetic lethality, Microsatellite instability (MSI-H), Mismatch repair deficiency (MMR-D), Allosteric WRN inhibitors

AIP005

AI-Enhanced Biosensors and Bio-Wearables for Real-Time Therapeutic Drug Monitoring

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Introduction: Therapeutic drug monitoring (TDM) is transitioning from conventional laboratory-based measurements toward more personalised and continuous assessment. AI-driven biosensors and bio-wearables enable real-time monitoring of drug concentrations, providing deeper insight into individual pharmacokinetic variability. **Methods**: This review evaluates current advancements in electrochemical, microfluidic, optical and nanosensor-based biosensing platforms. The integration of these technologies into flexible bio-wearables was analysed alongside AI and machine-learning models used for interpreting real-time pharmacological data. **Results**: Biosensors incorporated into wearable systems allow minimally invasive measurement of therapeutic molecules in sweat and interstitial fluid. AI enhances TDM by identifying drug-level trends, predicting future concentrations and detecting early signals of toxicity or subtherapeutic exposure. Combined with automated pharmacovigilance systems, these technologies support faster and more precise clinical decision-making. **Conclusion**: The synergy of biosensors, bio-wearables and AI represents a major advancement in personalised medicine. Despite challenges with calibration, long-term stability and data governance, AI-enabled continuous TDM improves dosing accuracy, enhances patient safety and supports a connected model of real-world monitoring.

Keywords: Artificial intelligence, biosensors, bio-wearables, precision dosing, therapeutic drug monitoring

AIP006

AI-Guided Design and Mechanistic Validation of Triazolo-Oxadiazole Hybrids as Dual B-Raf/PI3K Inhibitors to Suppress MAPK Reactivation

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Introduction: Therapeutic resistance driven by MAPK reactivation and compensatory PI3K/Akt signaling remains a major limitation of current B-Raf–targeted therapies. Dual inhibition of these interconnected pathways is a promising strategy to achieve durable antitumor responses and suppress adaptive resistance mechanisms.This study aims to develop AI-designed triazolo-oxadiazole hybrids capable of balanced dual targeting of B-Raf and PI3K/Akt pathways to overcome MAPK reactivation–mediated resistance. **Methodology:** An integrated AI-driven workflow combining kinase structure curation, consensus pharmacophore modeling, generative molecular design, and multi-objective scoring was employed to design triazolo-oxadiazole hybrids. Top-ranked candidates were synthesized via optimized CuAAC and heterocyclization routes and evaluated using *in silico* docking, MMGBSA/ FEP-lite rescoring, off-target prediction, and preliminary *in vitro* mechanistic assays relevant to B-Raf and PI3K/Akt signaling. **Results:** AI-based screening generated a structurally diverse and developable library of dual target candidates exhibiting strong and balanced predicted binding to B-Raf (WT/V600E) and PI3Kα, with minimal inter-target free-energy penalties ($\Delta\Delta G \leq 3$ kcal/mol). Lead compounds demonstrated favorable physicochemical profiles, low predicted hERG and CYP liabilities, and limited off-target kinase propensity. Synthetic optimization enabled efficient access to prioritized triazolo-oxadiazole hybrids in good yields and high purity. **Conclusion:** The results provide strong proof-of-concept that AI-designed triazolo-oxadiazole hybrids can achieve balanced dual inhibition of B-Raf and PI3K/Akt pathways with favorable develop ability and mechanistic efficacy. These findings establish a robust foundation for expanded biological profiling and in vivo validation to advance resistance-resilient anticancer therapeutics.

Keywords: AI-guided drug design, B-Raf, MAPK reactivation, PI3K/Akt signaling, Triazolo-oxadiazole hybrids.

AIP007

Triazolo-Quinazoline Carbothioamide Derivatives as p38 MAP Kinase Inhibitors

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Introduction: The p38 mitogen-activated protein kinase (MAPK) pathway regulates key cellular processes, including proliferation, apoptosis, differentiation, and stress responses. Its dysregulation is closely associated with cancer progression and therapeutic resistance, making p38 MAPK an attractive target for anticancer drug development. Triazoloquinazoline derivatives have emerged as promising scaffolds due to their diverse biological activities. This study aims to develop novel trisubstituted triazoloquinazoline-3-carbothioamide derivatives as potential p38 MAPK inhibitors. **Methods:** A series of trisubstituted triazoloquinazoline-3-carbothioamide derivatives was synthesized and structurally characterized using ^{1}H NMR, ^{13}C NMR, and mass spectrometry. Molecular docking studies were conducted against p38 MAPK (PDB ID: 1W7H) to predict binding interactions. The anticancer activity of the synthesized compounds was evaluated using in vitro cytotoxicity assays against MCF-7 breast cancer cell lines. The most active compounds were further assessed for their inhibitory activity against p38 MAPK using biochemical assays. **Results:** Docking studies revealed strong binding affinities of the synthesized compounds toward p38 MAPK, with compound 8h exhibiting the highest docking score of −8.0 kcal/mol. In vitro cytotoxicity assays showed that compound 8h displayed the most potent anticancer activity against MCF-7 cells, with an IC_{50} value of 29.72 ± 0.18 µM. Biochemical evaluation confirmed significant p38 MAPK inhibition by compound 8h, yielding an IC_{50} value of 342.34 ± 0.19 nM. **Conclusion:** The results demonstrate that trisubstituted triazoloquinazoline-3-carbothioamide derivatives are promising p38 MAPK

inhibitors. Compound 8h, in particular, represents a strong lead candidate for further optimization and development as a selective anticancer agent targeting p38 MAPK.

Keywords: p38 MAPK, MTT Assay, Anticancer activity, Triazolo-Quinazoline Carbothioamide

AIP008

A Concise Review on AI-Driven Drug Discovery for Viksit Bharat

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Background: Artificial intelligence (AI) is increasingly transforming pharmaceutical research by enabling predictive, data-driven, and cost-efficient approaches to drug discovery. Conventional discovery pipelines are constrained by long development timelines, high attrition rates, and rising research and development (R&D) costs, particularly in developing economies. In alignment with India's national vision of *Viksit Bharat@2047*, AI has emerged as a strategic enabler supporting the transition toward innovation-driven pharmaceutical growth. **Scope:** This review synthesizes recent advances in AI-driven drug discovery, covering applications of machine learning (ML), deep learning (DL), natural language processing (NLP), and generative artificial intelligence (GAI) across the drug discovery continuum. Emphasis is placed on target identification, virtual screening, lead optimization, translational research, and the evolving Indian pharmaceutical and biotechnology ecosystem. **Key Insights:** Evidence from academic literature and industry reports indicates that AI integration can significantly reduce discovery timelines, improve R&D efficiency, and enhance early-stage decision-making. The growing adoption of AI platforms by Indian pharmaceutical companies, biotechnology startups, and contract research organizations highlights India's expanding role in AI-enabled pharmaceutical innovation. **Implications and Future Directions:** AI-driven drug discovery is positioned as a foundational component of India's pharmaceutical innovation strategy. Addressing challenges related to data quality, regulatory frameworks, workforce development, and ethical considerations will be essential to sustain long-term impact and realize the objectives of the *Viksit Bharat@2047* vision.

Keywords: AI-driven drug discovery, Machine learning, Pharmaceutical innovation, Viksit Bharat.

AIP009

Synthesis, Characterization and Pharmacological Screening of Some Benzimidazole Analogues as Antioxidants

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Introduction: Benzimidazole analogues are of wide interest because of their diverse biological activity and clinical applications. They are remarkably effective compounds both with respect to their inhibitory activity and their favourable selectivity ratio. Looking at the importance of benzimidazole nucleus, it was thought that it would be worthwhile to design and synthesize some new benzimidazole derivatives and screen them for potential antioxidant activity. **Method:** The intermediates were prepared by condensing benzocaine with substituted benzaldehydes in acidic medium. These intermediates were further condensed with 2-substituted benzimidazole to obtain final analogues. **Result:**Each synthesized compound was characterized using analytical and spectral data and purity was checked by TLC. Antioxidant screening of newly synthesized compounds was carried out against standard ascorbic acid according to DPPH method. Molecular docking studies of each molecule was also carried out using AutoDock Software against Heme oxygenase I protein. All synthesized compounds (IV a-h) showed more docking affinity as compared to standard ascorbic acid against heme oxygenase I protein. **Conclusion:** Compound IVa, IVc and IVg was found to be significantly more active for scavenging of radical as compared to other synthesized analogues.

Keywords: Benzimidazole, Schiff bases, Antioxidant activity, DPPH , Heme oxygenase I.

AIP010

AI-Driven Molecular Pharmacological Profiling and FDA Drug Repurposing Strategy Using Machine Learning and Deep Learning Neural Networks in Chemotherapy

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Introduction: Therapeutic resistance continues to be a serious barrier for chemotherapy in advanced hematological malignancies, particularly chronic myeloid leukemia. Conventional techniques frequently fail to account for the biological variability that drives treatment resistance. Molecular pharmacological profiling is increasingly being utilized to uncover resistance mechanisms and investigate therapeutic alternatives using artificial intelligence and machine learning methods. **Methods:** This review systematically synthesizes modern computational techniques, such as machine learning algorithms, deep learning neural networks, and molecular docking software. Natural language processing (NLP), Random forest methods, gradient boosting models, support vector machines, Convolutional neural networks (CNN), and Recurrent neural networks (RNN) are used in conjunction with genetic and pharmacological databases for medication repurposing. **Results:** AI-supported frameworks allow for the integration of genetic variant analysis with pharmacological databases, making it easier to identify resistance-associated molecular patterns. Patient stratification based on mutational signatures, drug-target compatibility assessment across diverse genetic backgrounds, and pathway-focused treatment selection all yield better predictive results. Published research consistently indicates molecular markers associated with defective DNA damage response, altered metabolic pathways, and dysregulated intracellular signaling as potential treatment targets for existing medications. **Conclusion:** Artificial intelligence-driven molecular pharmacological profiling offers a structured, evidence-based framework for identifying alternative therapeutic choices in chemotherapy-resistant illnesses. Strategic use of FDA-approved medications reduces development times and regulatory complexity while facilitating the shift to individualized, adaptable cancer treatment options in precision oncology.

Keywords: Artificial Intelligence, Chemotherapy Resistance, Computational Oncology, Drug Repurposing, Molecular Pharmacology

AIP011

In Silico Design, Autodocking and Synthesis of Substituted Pyrazoline Derivatives as Potential Antimalarial agents.

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Introduction: Malaria remains a major global health concern due to the rapid emergence of resistance in *Plasmodium falciparum* against currently available antimalarial drugs. This growing resistance highlights the urgent need for novel and effective therapeutic agents. Pyrazoline derivatives are known to possess diverse pharmacological activities and have recently gained attention as promising scaffolds for antimalarial drug discovery, although they remain relatively underexplored. **Methods:** Quantitative structure–activity relationship (QSAR) models were developed using a dataset of 104 reported pyrazoline derivatives active against chloroquine-sensitive and chloroquine-resistant strains of *P. falciparum*. Based on structure–activity relationship (SAR) analysis, 112 novel 1,3,5-trisubstituted pyrazoline derivatives were designed. Molecular docking studies were performed using AutoDock 4.2.6 against key malarial targets, including dihydrofolate reductase (PfDHFR, PDB ID: 1LDG) and heme detoxification proteins. **Results:** From the designed compound library, 10 molecules with

favorable docking scores were synthesized and characterized. Docking studies revealed that compound 53 exhibited the highest binding affinity (−8.9 kcal/mol), surpassing the reference ligand. SAR analysis indicated that halogen, nitro, and aromatic substitutions significantly enhanced antimalarial activity. QSAR descriptors emphasized the importance of electronic characteristics and molecular flexibility in determining biological activity. **Conclusion:**
The combined in silico and experimental investigations demonstrate that substituted pyrazoline derivatives possess significant potential as antimalarial agents. These findings support further optimization and biological evaluation of this scaffold as a promising lead for the development of new antimalarial drugs.

Keywords: Malaria, Pyrazoline derivatives, Autodocking, QSAR, *Plasmodium falciparum*

AIP012

Design, Synthesis and Biological Evaluation of Some Novel Peptidomimetics as Anticancer Agents

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Introduction: The development of new human epidermal growth factor receptor 2 (HER2) directed small molecules is necessary because breast cancer with HER2 overexpression continues to be a significant clinical challenge due to its aggressive progression and the limits of current targeted therapies. **Methods:** Peptidomimetics were built in this work utilizing literature-guided design, docked into the HER2 receptor (PDB ID: 1N8Z), and evaluated in silico for drug-likeness and binding using docking and absorption, distribution, metabolism, and excretion **(**ADME) assays. The top-scoring candidates were synthesized using multi-step organic reactions, characterized by IR, MS, and 1H-NMR, and evaluated using the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide assay (MTT assay) for antiproliferative activity on Michigan cancer foundation-7 (MCF-7) breast cancer cells. **Results:** Five of the planned peptidomimetics were synthesized, and their in vitro, synthetic, and computational analyses showed good drug-likeness and HER2-targeted activity compared with standard inhibitor. With half maximal inhibitory concentration (IC50) of 3.606 µg/mL, compound (6) had the highest potency in vitro, outperforming the standard HERP7 (IC50 13.2 µg/mL). Compound (8) also demonstrated significant activity in line with its docking profile. **Conclusion:** These results indicate that piperazine-based peptidomimetics, particularly compound (6), are potential lead compounds for further research as treatments for HER2-targeted breast cancer.

Keywords: Anticancer activity, HER2 inhibition, MCF-7 cells, Peptidomimetics, Piperazine derivatives.

AIP013

A Systematic In-Silico Reassessment of Safety and ADME Profile of Vilazodone and Fluoxetine: Implications for Autism Spectrum Disorder

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Introduction: Autism Spectrum Disorder (ASD) poses persistent therapeutic challenges, particularly in identifying pharmacological options that balance effectiveness with safety in neurodevelopmentally sensitive populations. Fluoxetine is commonly prescribed off-label in ASD, yet concerns regarding its metabolic complexity and adverse effect burden remain. **Methods:** To systematically reassess drug suitability prior to experimental validation, Vilazodone and Fluoxetine were comparatively evaluated using an integrated in-silico pharmacological approach. Canonical molecular structures were analyzed with SwissADME to assess physicochemical properties, drug-likeness, and CNS suitability; ProTox-3.0 to predict acute and organ-specific toxicity risks; BioTransformer 3.0 to simulate Phase I metabolic pathways and CYP450 involvement; and curated human data from ChEMBL to confirm validated mechanisms of action and regulatory safety annotations. **Results:** Across all analyses, Vilazodone demonstrated a more controlled and stable pharmacological profile. It exhibited favorable CNS-compatible properties without major chemical liabilities, lower predicted toxicity risks, and a reduced metabolic burden. BioTransformer predicted fewer and less complex metabolites for Vilazodone, whereas Fluoxetine

generated multiple metabolites, including the long-acting norfluoxetine. ChEMBL analysis further confirmed dual validated serotonergic mechanisms for Vilazodone and indicated a lower regulatory safety burden relative to Fluoxetine. **Conclusion:** This integrated in-silico reassessment suggests that Vilazodone offers a more balanced profile with respect to safety, metabolic stability, and neuropharmacological suitability than Fluoxetine, supporting its prioritization for further ASD-focused investigation, with in-vivo studies planned as the next step to confirm these findings.

Keywords: Vilazodone, Fluoxetine, Autism Spectrum Disorder, AI in Drug Discovery, In-silico Drug Repurposing

AIP014

A Comparative *In-Silico* Study (via ADMETlab and ProTox) of Linalool and Standard Osteoporosis Drugs

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Introduction: Osteoporosis a skeletal disorder necessitates long-term management, yet current pharmacotherapies are frequently limited by severe adverse effects, including hepato- and cardiotoxicity. Linalool, a naturally occurring terpene, has emerged as a promising candidate. This study utilizes *in silico* modelling to benchmark the safety profile of Linalool against established anti-osteoporotic agents, evaluating its potential as a safer therapeutic alternative. **Methods:** Comparative toxicity profiling of Linalool against standard osteoporotic agents (SERMs, bisphosphonates, and anabolics) was conducted using ADMETlab 3.0 and ProTox platforms. Critical endpoints, including hERG inhibition, hepatotoxicity (H-HT, DILI), mutagenicity (AMES), and LD50 values, were assessed. Probability scores were rigorously analyzed to benchmark the safety margin of Linalool relative to currently marketed formulations. **Results:** Linalool exhibited a superior safety profile, maintaining probability scores well below the concern threshold (<0.5). Analysis revealed negligible risk for cardiotoxicity (hERG: 0.019) and hepatotoxicity (H-HT: 0.338; DILI: 0.022), alongside confirmed non-mutagenic (AMES: 0.006) status. In sharp contrast, marketed synthetics displayed high toxicity burdens; Raloxifene showed extreme probabilities for hERG blockage (0.953) and DILI (0.944), while Alendronate flagged for significant nephrotoxicity and respiratory toxicity. Furthermore, the peptide group (Teriparatide/Salmon Calcitonin) presented moderate-to-high alerts for neurotoxicity, ototoxicity, and immunotoxicity. Both tools independently validated Linalool's safety, whereas standard agents frequently exceeded toxicity probability limits (>0.90). **Conclusion:** This primary screening establishes that Linalool possesses a distinct safety advantage over currently available synthetic and peptide-based osteoporotic treatments. The absence of organ-specific toxicity positions Linalool as a promising, low-risk lead candidate for drug development, necessitating further in vivo investigation to address the safety gaps in current osteoporosis management.

Keywords: Linalool, Osteoporosis, ADMET analysis, Safety Profiling, Drug Repurposing

AIP015

AI-Guided Repurposing Of FDA-Approved Drugs for Triple Negative Breast Cancer Using Gene Expression Signatures and Network Pharmacology

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Introduction: Triple-negative breast cancer (TNBC) is characterised by the lack of oestrogen, progesterone, and HER2 receptors and continues to be the most aggressive and treatment-refractory subtype of breast cancer. The lack of defined molecular targets results in fewer therapeutic options, and traditional drug development is expensive, slow, and has a high failure rate. As a result, the repurposing of approved drugs has become a fast and efficient alternative. Artificial intelligence and network-based biological models have significantly advanced to the point where they can now reveal previously unknown drug disease relationships, thus unveiling new therapeutic

opportunities for TNBC. **Methods:** This review summarizes AI-guided and network pharmacology approaches used for TNBC drug repurposing. By comparing gene activity in tumours and healthy tissue, key pathways driving tumour growth, immune evasion, and chemoresistance are identified. Disease gene signatures are matched with drug-induced expression profiles using databases such as LINCS, GDSC, and Connectivity Map to highlight compounds capable of reversing oncogenic patterns. Network pharmacology further maps drug–protein interactions across cellular pathways to identify multi-target and synergistic therapies tailored to specific TNBC. **Results:** Machine learning, based methods have pinpointed various non-cancer drugs, such as antiretrovirals and cardiac glycosides, that exhibit anti-TNBC effects in experimental systems. Systems-level analyses point to interaction between multiple pathways as the major mechanism of effectiveness. **Conclusion:** Artificial intelligence enabled network-informed drug repurposing is a fast, economical, and precision, driven approach to solving the drug scarcity problem in TNBC, thus, it is consistent with the next translational and clinical research integration.

Keywords: Triple-negative breast cancer; Artificial intelligence; Drug repurposing; Network pharmacology; Gene expression signatures.

AIP016

IN SILICO Studies To Identify Novel Hits As Parp1 Inhibitors

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Introduction: Poly (ADP-ribose) polymerase-1 (PARP1) is an essential enzyme involved in the repair of DNA damage and maintenance of genomic stability. Inhibition of PARP 1 has emerged as a successful therapeutic strategy for treating cancers with homologous recombination deficiencies, particularly those associated with BRCA1 and BRCA2 mutations. Despite already available FDA approved PARP1 inhibitors such as Olaparib, Rucaparib, Niraparib and Talazoparib, their long-term use is restricted by toxicity, development of resistance and suboptimal selectivity, necessitating the discovery of novel inhibitors. **Methods:** A set of 30 diverse compounds was taken having PARP1 inhibition activity, to build a pharmacophore model using Phase module of Schrodinger. Validation of the best generated hypothesis was done by using 49 actives and 1000 molecules decoy set. The validated pharmacophore was further utilised to screen ZINC database from which the potential novel hits were identified. The hits were further checked for their *in-silico* ADMET predictions and molecular docking against PARP1 and PARP2. **Results:** The pharmacophore model with the survival score of 5.142 was selected and further was validated. The ROC and EF values were found to be 0.77 and 18.78 respectively. Virtual screening led to potential hits having acceptable fitness score. Hits with satisfactory ADMET profile and promising docking interaction profile against PARP1 and PARP2 were considered as novel hits. **Conclusion:** Overall, this integrated computational strategy is anticipated to facilitate the identification of novel and promising PARP1 inhibitor lead molecules with improved efficacy and selectivity thereby supporting the rational design of next-generation anticancer agents. These results may broaden the applicability of PARP1 targeted therapies across various cancer types and guide the subsequent structure-based optimisation strategies for translational and preclinical research advancement.

Keywords: Cancer, PARP1, 3D-QSAR, Pharmacophore, Molecular docking.

AIP017

Machine Learning –Based ADMET Prediction in Early Discovery

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Background: Absorption, Distribution, Metabolism, Excretion, and Toxicity (ADMET) properties play a critical role in drug discovery, as poor ADMET profiles are a major cause of late-stage drug failure. Traditional experimental evaluation of ADMET properties is time-consuming, costly, and resource intensive. Hence, machine learning–based in silico models have emerged as efficient alternatives for early prediction of ADMET characteristics. **Objective:** The objective of this study was to develop and evaluate machine learning models for the prediction of multiple ADMET properties of chemical compounds using automated model selection and Hyperparameter optimization techniques. **Methods:** Chemical and biological data for ADMET properties including Caco-2 permeability, P-gp substrate, blood–brain barrier (BBB), CYP450 inhibition, human and rat liver microsomal stability, and hERG inhibition were collected from ChEMBL and related databases. Molecular descriptors and fingerprints were generated using RDKit. The datasets were split into training and test sets in an 8:2 ratio. Hyperopt-sklearn was employed to construct classification models using multiple machine learning algorithms. **Results:** The developed models achieved strong predictive performance, with most ADMET models showing AUC values greater than 0.85. Random Forest, Support Vector Machine, and Gradient Boosting algorithms demonstrated superior performance across multiple ADMET endpoints. **Conclusion:** This study demonstrates that automated machine learning approaches can efficiently generate robust ADMET prediction models. Such models can support early-stage drug discovery by reducing experimental burden and improving candidate.

Keywords: ADMET Profiling, Auto Machine learning, Hyperparameter, In Silico Drug Discovery, QSAR Modelling

AIP018

Design, Synthesis, and Biological Evaluation of Novel Anticancer Agents

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Introduction: Lung cancer remains one of the leading causes of cancer-related mortality worldwide, highlighting the urgent need for novel and effective therapeutic strategies. The mammalian target of rapamycin (mTOR), a key regulator of the PI3K/AKT/mTOR signaling pathway, is frequently dysregulated in lung cancer and plays a crucial role in tumor cell growth, proliferation, and survival. Targeting mTOR therefore represents a promising approach for lung cancer therapy. **Method**: In this study, tetrahydroquinoline (THQ) and related heterocyclic derivatives were designed and synthesized as potential mTOR inhibitors using a structure-based drug design approach. Computer-aided drug design (CADD) tools were employed to conceptualize and optimize novel THQ-based scaffolds for enhanced binding affinity, selectivity, and favorable physicochemical properties. Molecular docking and ADMET predictions were performed to assess target interactions and pharmacokinetic profiles. Selected compounds were synthesized via multi-step organic reactions, and their structures were confirmed using mass spectrometry, 1H NMR, and 13C NMR analyses. Biological evaluation included in vitro antiproliferative assays against lung cancer cell lines, cytotoxicity assessment in normal cells, apoptosis analysis by flow cytometry, and molecular dynamics simulations. **Result**: Docking studies revealed stable and favorable interactions of the synthesized THQ derivatives with the mTOR active site, supported by acceptable ADMET profiles and reduced predicted toxicity. The synthesized compounds exhibited significant antiproliferative activity against lung cancer cells, with minimal cytotoxic effects on normal cells. Apoptosis studies and molecular dynamics simulations further confirmed the stability, binding consistency, and biological relevance of the lead candidates. **Conclusion**: The results of this study demonstrate that tetrahydroquinoline-based derivatives represent a promising class of mTOR-targeted anticancer agents for lung cancer. The combined computational, synthetic, and biological findings provide a strong foundation for further structural optimization, expanded biological evaluation, and future preclinical development.

Keywords: mTOR, Lung Cancer, Tetrahydroquinoline, Apoptosis

AIP019

Synthetic strategies and structure activity relationships of androgen and estrogen receptor PROTAC degraders for cancer therapy (2019–2025)

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Introduction: Cancer remains a major global health challenge, with prostate and breast cancers among the most common hormone-driven malignancies. Their growth and survival depend largely on nuclear hormone receptors primarily the androgen receptor (AR) in prostate cancer and estrogen receptor-α (ERα) in breast cancer. Although current therapies that inhibit hormone signalling are initially effective, many patients eventually develop resistance. This resistance is frequently caused by receptor mutations, overexpression, splice variants, or hormone-independent signalling. These limitations highlight the need for new therapeutic strategies that eliminate the receptor protein itself rather than merely inhibiting its activity. PROteolysis TArgeting Chimeras (PROTACs) are a new way to address this problem. PROTACs are small molecules that bring a target protein and an E3 ubiquitin ligase together, leading to selective protein degradation by the proteasome. Because this process is catalytic, they can eliminate both normal and resistant forms of AR and ER. **Methods:** This review discusses the key medicinal chemistry strategies used to design and synthesise AR and ER PROTACs, focusing on warhead choice, linker design, and E3 ligase selection. Important synthetic strategies and structure activity relationship trends are summarized to explain how small structural changes affect degradation efficiency. **Results:** In recent years, several potent androgen receptor degraders (ARDs), such as ARD-69, ARD-266, ARD-2585, and ARD-2051, and estrogen receptor degraders (ERDs), including ERD-308 and ERD-1233, have been reported with strong cellular and in vivo activity. **Conclusion:** Overall, this review presents targeted protein degradation as a promising strategy for the treatment of hormone-based cancers.

Keywords: PROTACs; ARD; ERD; E3 ligase; Synthesis; Structure Activity Relationship

AIP020

Artificial Intelligence in Drug Discovery and Development: Using IVIVC Modelling

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Introduction: Drug discovery and formulation development are resource-intensive processes with high failure rates. Artificial intelligence (AI) and machine learning (ML) have revolutionized these stages by enhancing prediction accuracy and efficiency, particularly in in vitro–in vivo correlation (IVIVC) modelling, which predicts in vivo performance from in vitro data. AI-driven approaches also support early decision-making and risk assessment during formulation development. **Methods:** This review analyses recent literature and case studies on AI/ML applications in drug discovery. Computational techniques, including neural networks, deep learning, and predictive modelling, were evaluated for target identification, lead optimization, dissolution–pharmacokinetic correlations, formulation design, and dosage form performance prediction. **Results:** AI/ML models excel in identifying drug candidates and forecasting pharmacokinetic parameters such as CMax, TMax, and AUC through IVIVC. These methods are particularly effective for modified and sustained-release formulations, reducing variability, development time, and the need for extensive animal and human bioequivalence studies. **Conclusion:** AI/ML-based IVIVC modelling streamlines drug development, reduces costs, enhances formulation reliability, and supports regulatory decision-making. With increasing data availability, these technologies are expected to play a pivotal role in future pharmaceutical innovation.

Keywords: Artificial Intelligence, Machine Learning, Drug Discovery, IVIVC, Pharmacokinetics

AIP021

Overcoming EGFR-Mediated Drug Resistance in NSCLC via Halogenated Quinazoline–Thiazole Derivatives

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Introduction: Mutations in the epidermal growth factor receptor (EGFR), particularly L858R, T790M, and exon 19 deletions, play a pivotal role in the development and treatment resistance of non-small cell lung cancer (NSCLC). To address resistance associated with mutant EGFR, a novel series of halogenated quinazoline–thiazole hybrids (SP4a–SPF5) was designed to enhance binding affinity toward EGFR mutants and restore therapeutic responsiveness in resistant NSCLC models. **Method**: The target compounds were synthesized through a multi-step synthetic pathway and fully characterized using thin-layer chromatography (TLC) and detailed spectroscopic analyses, including 1H and 13C nuclear magnetic resonance (NMR) spectroscopy. Antiproliferative efficacy was assessed using MTT assays against EGFR-mutant NSCLC cell lines—H1975 (L858R/T790M), PC9 (EGFR exon 19 deletion), and HCC827— alongside normal BEAS-2B lung epithelial cells to evaluate selectivity and cytotoxic safety. **Results**: Among the synthesized derivatives, SP4b, SP5a, and SP5b exhibited significant growth inhibition against EGFR-mutant NSCLC cell lines. Notably, SP5a emerged as the most potent compound, demonstrating IC_{50} values of 13 µM against both H1975 and PC9 cells. SP4b showed moderate cytotoxicity, with IC_{50} values of 31 µM and 39 µM against H1975 and PC9 cells, respectively. SP5b displayed selective antiproliferative activity (IC_{50} = 18 µM for H1975 and 17 µM for PC9), though less potent than osimertinib (IC_{50} = 5.2 nM). Importantly, all active compounds exhibited minimal toxicity toward normal BEAS-2B cells and wild-type EGFR expressing lines (IC_{50} >100 µM). In contrast, SP4c and SPF5 demonstrated negligible cytotoxic activity. Collectively, these results highlight the importance **Conclusion**: The newly synthesized quinazoline–thiazole hybrids displayed promising anticancer activity with pronounced selectivity against EGFR-mutant NSCLC cells. Compounds SP4b, SP5a, and SP5b were identified as lead candidates, with SP5a showing superior potency and a favorable comparative profile relative to osimertinib, supporting its potential for further preclinical development as a targeted EGFR inhibitor.

Keywords: quinazoline; thiazole; EGFR; synthesis; halogenated hybrids; anticancer; NSCLC; drug discovery; TKIs; NMR analysis.

AIP022

Development of new indole based monocarboxylate transporter 1 inhibitors as potential anticancer agents using molecular docking with deep learning

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Introduction: Monocarboxylate transporter1 (MCT1) is an excellent target that is overexpressed in solid cancers. MCT1 and MCT4 maintain a symbiosis between hypoxic and normoxic cancer cells for the lactate shuttle. Normoxic cells uptake lactate (via MCT1) that is effluxed from hypoxic cells (via MCT4) for fueling oxidative phosphorylation for ATP synthesis. Inhibition of MCT1 forces normoxic cells to consume glucose rapidly, leading to glucose starvation in hypoxic cells, resulting in their death. In this study, we have developed new indole-4-cyanoacrylate based MCT1 inhibitors as potential anticancer agents. **Methods:** The first step of the study-involved design of new molecules based on the known indole-based MCT1 inhibitors. The designed molecules were analyzed by GNINA based molecular docking using Convolutional Neural Networks (CNNs) scoring functions. Top 2 molecules were further analyzed by molecular dynamics using Desmond MD simulation

programme. The best-selected molecules were synthesized using multistep organic synthesis and characterized by IR, NMR, Mass and HPLC. **Results:** In this work, in total 50 molecules were designed based on known MCT1 inhibitors. Molecular docking using GNINA helped in ranking molecules based on the binding affinities and CNN scores. Molecules, IND-15 and IND-23 were found to be the most promising with higher binding affinities comparable to the standard MCT1 inhibitors. MD simulation for IND-15 and IND-23 showed substantial stabilization of protein suggesting good protein binding. The synthesized molecules will be further evaluated for anticancer potential. **Conclusion:** This work reveled several indole-4-cyanoacrylate based molecules as new MCT1 inhibitors aiding in future drug development for cancer.

Keywords: Drug discovery, MCT1, deep learning, anticancer

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Patel Nidhi	NAP022	Formulation, Optimisation and Evaluation of W/O/W Multiple Emulsion of Sumatriptan Succinate for Enhanced Oral Bioavailability
Gupta Akansha	NAP023	Development and Evaluation of Simvastatin Loaded Chitosan Nanoparticles for Diabetic Wound Healing
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Purohit Dev	NAP059	Formulation and Optimization of Tolvaptan-Loaded Multilayer Nanofibers Mucoadhesive Buccal Patch: A Strategic Approach to Mitigate Hepatotoxicity and Improve Solubility
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Adarsh Gupta	PCP083	To Explore the Context-Dependent Role of Apoptosis-Inflammation Axis Genes in the Prognosis of Neurodegeneration

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Vyas Isha	PAP051	Establishing Pharmaceutical Regulatory Intelligence Alert System and Monitoring Framework for

		ASEAN and CIS Countries Using Free Tools
Patel Bushra	PAP052	Algorithm drift in ai/ml-based medical devices: regulatory oversight of detection, local adaptation and explainability
Patel Dhruval	PAP053	Regulatory Framework and Challenges in Control of Process-Induced Impurities in Herbal based Nutraceuticals: An Indian Perspective with Global Comparison
Parikh Rutvik	PAP054	Analytical Determination of Nitrosamine Impurities in Pharmaceuticals
Patel Tisha	PAP055	Comparative analysis of Crystal Growth Under Normal Condition and Space analogue Condition
Khushi Arora	PAP056	Recent Advancements & Development in Applications of Raman Spectroscopy in Pharmaceutical Analysis
Sharma Diya	PAP057	Hidden risks beneath the skin: Carcinogenic potential of Tattoo & PMU Inks
Uteshiya Shital	PAP058	Analytical Characterisation of Biotherapeutic Monoclonal Antibody Drug Products: Regulatory and Quality Perspective - A Review
Thaker Aanal	PAP059	Pandemic-Ready India: A Review of Emergency Drug Approval Regulations
Arora Aakash	PAP060	Switching to Biosimilar Adalimumab: Global Switching Evidence, FDA-EMA-Indian Regulatory Landscape, and Policy Challenges, a focused review.
Mansuri Safina	PAP061	From QSR to QMSR and MDD to MDR: key developments shaping global medical device regulation
Karathiya Rupen	PAP062	Comparative Study of Analytical Methods for Promethazine Across Different Dosage Forms
Anchal Deo	PAP063	Hidden Mutagens in Medicines: Genotoxic Impurities and Their Analytical Detection.
Modi Prachi	PAP064	Review on Analytical Techiniques for Calcium Quantification in Calcium Rich Plants

HNP - Herbal Medicine and Natural Products

Author Name	Abstract Code	Title
Mishra Ankit	HNP001	Natural Scar Modulator: Formulating and Evaluating the Therapeutic Potential of *Trachyspermum ammi* (Ajwain) in Post-Acne Scars
Kumar Ashwani	HNP002	Building ADR Reporting Culture of Herbal Medicines for Patient
Patel Shrusti	HNP003	Preclinical Evaluation of *Thymus vulgaris* for Dual Management of Rheumatoid Arthritis and Osteoporosis
Khan Abdul Samad	HNP004	Deep Computational Deconstruction of *Canna indica* Phytochemical Interactomes Illuminates Mechanistic Axes of Lipid Homeostasis
Gandhi Parv	HNP005	Molecular insights into herbal medicines and natural products: emerging strategies for next-generation drug development
Shubham S Khedekar	HNP006	Isolation, phytochemical analysis, and antioxidant activity of *Oxalis corniculata* Linn fractions by column chromatography.
Baramkule Ashutosh	HNP007	Formulation and Evaluation of Novel Dermal Scar Patches for Enhanced Wound Healing
Mahajan Ekta	HNP008	Formulation and Evaluation of Polyherbal Foot Crack Bigel
Chaurasia Priyanshi	HNP009	A Review on The Pharmacological Activities and Therapeutic Prospects of Traditional Herbs for Developing New Antipsychotic Drugs.
Suruse Tejas	HNP010	Formulation and Evaluation of Polyherbal Dark Compound containing Ginger, Fennel, Shatavari, Amla Extract for the Management of Dysmenorrhea
Kohale Kanchan	HNP011	Developing and Assessing A Herbal Oral Dosage Form for the Treatment of Obesity and Diabetes Mellitus
Ghatole Vaibhav	HNP012	Evaluation of Extracts and Fractions from *Synedrella nodiflora* (L) Leaves for Anticancer Activity
Aakash Kumar S	HNP013	Antidepressive Effect of Gallic Acid on Depression Linked with Hyperglycemia Via PPAR
Dubal Diya	HNP014	Role of artificial intelligence in standardisation of herbal drugs and detection of adulterants
Patle Paridhi	HNP015	A Review on Traditional Medicinal

		Plants of Madhya Pradesh: Ethnic Usage and Pharmacological Validation Against Diseases
Joshi Yashawini	HNP016	Herbal-derived modulators of tlr4 signaling in raw264.7 macrophages: a molecular approach toward cancer-associated cytokine regulation
Dubey Diksha	HNP017	A Review of natural product in pcos therapy
Srivastava Anshu	HNP018	Simultaneous Chemo- and Genotaxonomic Approaches for Establishing Authenticity of Bala Drugs Used in Ayurveda
Gandhi Dipal	HNP019	Phytosome Technology: Unlocking the Full Skin-Protective Potential of Silymarin
Chovatiya Pushti	HNP020	Formulation and Evaluation of Polyherbal Gummies for the Management of Dysmenorrhea
Thummar Hitakshi	HNP021	Natural Polymeric Excipients as Functional Carrier in Floating Drug Delivery System: A Review
Sonawane Abhishek	HNP022	Synergistic anti-obesity potential of *Acacia nilotica* and A*cacia catechu* combined extracts
Mall Priti Mahendrapal	HNP023	A Comprehensive Review on the Toxicological Profile, Pharmacokinetic Interactions, and Pharmaceutical Incompatibilities of *Moringa oleifera* Lam
Dhobale Sejal	HNP024	Multi-Target Botanical Synergy Against Cancer: Integrated Anticancer Actions of Curcuma longa, Moringa oleifera, Psidium guajava, and Coriandrum sativum
Pratiksha Pawar	HNP025	Formulation and evaluation of antimicrobial gel from methanolic leaf extract of *Clitoria ternatea* L
Bhatt Kavya	HNP026	Exploring the mechanism of Anti-Osteoporotic action of *Terminalia arjuna* using Network Pharmacology and Molecular Docking
Vaishnav Monika	HNP027	Metabolic Engineering Strategies for Enhanced Bacoside Production in *Bacopa monnieri*
Khatale Aarti	HNP028	Biowaste to Beauty: A Formulation Study on Pistachio Shell–Based Facial and Body Exfoliants
Divate Prerna	HNP029	Preparation of ointment from *Averrhoa carambola* fruit extract and it's

		evaluation
Panchal Shital	HNP030	From Glycolysis to Pro-Longevity Pathways: Anti-Ageing Potential of D-Mannoheptulose in Avocado Oil
Shah Rudra P	HNP031	Development And Evaluation of Wound Healing Polyherbal Formulations.
Kriz patel	HNP032	Therapeutic significance of aphiorrhiza-derived camptothecin in colon cancer
Patel Adityakumar D	HNP033	A Comprehensive Review of Naringin: From Phytochemistry to Therapeutic Applications
Anushka Jagtap	HNP034	Formulation & Evaluation of Herbal Syrup for Respiratory Disorder
Raut Shreya	HNP035	Immunostimulatory potential of saffron (*Crocus sativus* L.) Thread extract: An in-vitro neutrophil phagocytosis study
Contractor H. Aarya	HNP036	Vitiligo and the Therapeutic Role of Piperine in Skin Repigmentation
Patel Om	HNP037	Beyond Topical Therapy: Oral ceramides (Ceramosides) in skin barrier restoration
Maradia Bina	HNP038	Formulation and Evaluation of Topical Herbal Gel for Wound Management

AIP - AI in Drug Discovery and Pharmaceutical Chemistry

Author Name	Abstract Code	Title
Mahajan Chhavi	AIP001	Integrating AI-Driven Drug Discovery with Traditional Ayurvedic Knowledge for Accelerated Phytomedicine Innovation
Kamdar Labdhi	AIP002	Genetic Algorithms for Drug Discovery
Patel Rishabh Dipakkumar	AIP003	AI-Driven Prediction of Nanoparticle Pharmacokinetics and Bio Distribution: A Data-Centric, Explainable Modeling Framework for Smarter Nanomedicine Design
Geeta Nandaniya	AIP004	WRN helicase inhibition: a synthetic lethal strategy targeting microsatellite instable cancers
Shah Mauj	AIP005	AI-Enhanced Biosensors and Bio-Wearables for Real-Time Therapeutic Drug Monitoring
Pingili Divya	AIP006	AI-Guided Design and Mechanistic Validation of Triazolo-Oxadiazole Hybrids as Dual B-Raf/PI3K Inhibitors to Suppress MAPK Reactivation
Awasthi Archana	AIP007	Triazolo-Quinazoline Carbothioamide Derivatives as p38 MAP Kinase Inhibitors
Kukadia Krish M	AIP008	A Concise Review on AI-Driven Drug Discovery for Viksit Bharat
Bargi Pranjali	AIP009	Synthesis, characterization and pharmacological screening of some benzimidazole analogues as antioxidants
Kurup Suraj	AIP010	AI-Driven Molecular Pharmacological Profiling and FDA Drug Repurposing Strategy Using Machine Learning and Deep Learning Neural Networks in Chemotherapy
Patidar Priti	AIP011	In Silico Design, Autodocking and Synthesis of Substituted Pyrazoline Derivatives as Potential Antimalarial agents.
Soria Jahnavi	AIP012	Design, synthesis and biological evaluation of some novel peptidomimetics as anticancer agents
Kirtan Parmar	AIP013	A Systematic In-Silico Reassessment of Safety and ADME Profile of Vilazodone and Fluoxetine: Implications for Autism Spectrum Disorder
Mahadevia Diya Anangkumar	AIP014	A comparative In-silico Study of Linalool and Standard Osteoporosis Drugs
Shah Aayushi Anesh	AIP015	AI-guided repurposing of fda-approved drugs for triple negative breast cancer using gene expression signatures and network pharmacology.

Patel Vrittika	AIP016	In silico studies to identify novel hits as PARP1 inhibitors
Ansari Sabina	AIP017	Machine Learning based ADMET prediction in early discovery
Chaube Udit	AIP018	Design, Synthesis, and Biological Evaluation of Novel Anticancer Agents
Patel Meera	AIP019	Synthetic strategies and structure activity relationships of androgen and estrogen receptor PROTAC degraders for cancer therapy (2019–2025)
Shah Stuti	AIP020	Artificial Intelligence in Drug Discovery and Development: Using IVIVC Modelling
Md Swapan Hossain	AIP021	Overcoming EGFR-Mediated Drug Resistance in NSCLC via Halogenated Quinazoline–Thiazole Derivatives
Patel Sakshi	AIP022	Development of new indole based monocarboxylate transporter 1 inhibitors as potential anticancer agents using molecular docking with deep learning

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