



Department of
Biotechnology



AICTE ATAL Sponsored Faculty Development Programme

on

Cutting Edge Biotechnology for Precision Medicine

Organized by the Department of Biotechnology, KL University

Date: 9th December 2024 to 14th December 2024

The Department of Biotechnology, KL University, successfully conducted a one-week AICTE ATAL-sponsored Faculty Development Programme (FDP) on "Cutting Edge Biotechnology for Precision Medicine" from 9th to 14th December 2024. This program aimed to provide faculty members with a comprehensive understanding of advancements in biotechnology and their applications in precision medicine. The FDP brought together experts, researchers, and academicians to discuss innovations and challenges in this domain.

Objectives of the Programme

The FDP was designed with the following objectives:

- To provide in-depth knowledge of precision medicine and its applications.
- To familiarize participants with cutting-edge biotechnological tools and techniques.
- To bridge the gap between research and practical implementation in healthcare.
- To encourage interdisciplinary collaboration and innovative research.

Programme Structure

The FDP was structured into six days, each focusing on a specific theme related to biotechnology and precision medicine. The sessions included expert lectures, hands-on workshops, and interactive discussions. The highlights of the program are summarized below:

Day 1: 9th December 2024

Inaugural Session

- The program commenced with a welcome address by Prof. V Praveen Kumar, Head of the Department of Biotechnology, KL University.
- The inaugural speech was delivered by the Chief Guest, Prof. K.S. Jagannatha Rao an eminent scientist specializing in Neuroscience and precision medicine.
- The keynote address was delivered by Prof. Buchi Naidu Nalluri, highlighting the transformative impact of biotechnology on personalized healthcare.



Lighting of lamp by Chief Guest, Dr.Jagannatha Rao and department members



Participants from other universities during the program

Technical Session 1: EMERGING TRENDS IN PRECISION VACCINOLOGY

- Speaker: Dr. BVLS Prasad
- Topics covered: Fundamentals of precision medicine, its history, and EMERGING TRENDS IN PRECISION VACCINOLOGY – MEBPVs

This talk provides a comprehensive overview of precision medicine, its historical evolution, and the emerging trends in precision vaccinology, with a focus on Mechanistic Epitope-Based Precision Vaccines (MEBPVs). Precision medicine tailors healthcare approaches to individual genetic, environmental, and lifestyle factors, marking a shift from one-size-fits-all treatments to personalized interventions. The discussion delves into milestones that have shaped this field, including advancements in genomics, bioinformatics, and molecular diagnostics.

The latter part of the talk highlights precision vaccinology, a transformative paradigm aimed at developing vaccines tailored to individual or population-specific immune profiles. Mechanistic Epitope-Based Precision Vaccines (MEBPVs) represent the forefront of this innovation, leveraging epitope mapping, structural immunology, and computational modeling to design vaccines with enhanced efficacy and safety. Emerging technologies such as artificial intelligence, systems biology, and next-generation sequencing are driving this field, offering the potential to combat diseases with unprecedented specificity and adaptability. The talk emphasizes the interdisciplinary nature of these advancements and their implications for global health, highlighting opportunities for personalized prevention strategies in infectious diseases, cancer immunotherapy, and beyond.

Technical Session 2: Genomics in Precision Medicine

- Speaker: Dr. Sreedhar Bodiga
- Topics covered: Advances in Epigenetic Therapies Revolutionizing Precision Medicine

This talk explores the cutting-edge developments in epigenetic therapies and their transformative impact on precision medicine. Epigenetics, the study of heritable changes in gene expression that do not involve alterations in DNA sequence, has emerged as a key area in understanding complex diseases. The discussion begins with an overview of epigenetic mechanisms such as DNA methylation, histone modification, and non-coding RNAs, emphasizing their role in gene regulation and disease progression.

Advances in epigenetic therapies, including inhibitors of DNA methyltransferases, histone deacetylases, and emerging CRISPR-based epigenome editing tools, are revolutionizing the treatment landscape. These therapies enable precise modulation of gene expression, offering targeted interventions for cancer, neurological disorders, and autoimmune diseases. The talk highlights the integration of epigenomic data with precision medicine, facilitated by advancements in next-generation sequencing, bioinformatics, and machine learning. Personalized approaches using epigenetic biomarkers for diagnosis, prognosis, and treatment response prediction are becoming increasingly viable. The discussion also addresses challenges such as therapy specificity, off-target effects, and ethical considerations in epigenome editing. By showcasing the promise of epigenetic therapies, this talk underscores their potential to redefine precision medicine, offering tailored solutions for complex, multifactorial diseases.

Day 2: 10th December 2024

Technical Session 3: CRISPR BASED THERAPEUTICS in Precision Medicine

- Speaker: Dr. Srinivas Bandaru
- Topics covered: CRISPR BASED THERAPEUTIC DEVELOPMENT for precision medicine

Hands-on Workshop

- Theme: Tools for Genomic Data Analysis
- Activities: Participants were introduced to bioinformatics software for genomic and proteomic data analysis.

This talk delves into the revolutionary role of CRISPR-based therapeutics in advancing precision medicine. CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) technology, initially discovered as a bacterial defence mechanism, has transformed biomedical science by enabling precise genome editing. The presentation begins with an overview of CRISPR's mechanisms, focusing on the CRISPR-Cas9 system and its ability to target specific DNA sequences for modification.

CRISPR-based therapeutics are heralding a new era in precision medicine by providing tailored solutions for genetic disorders, cancer, and infectious diseases. Applications include correcting disease-causing mutations, activating or silencing specific genes, and engineering immune cells for targeted therapies like CAR-T cell therapy. Emerging tools such as base editing and prime editing are further expanding CRISPR's precision and versatility. The talk emphasizes the integration of CRISPR with precision medicine principles, leveraging genomic data to customize treatments to an individual's genetic profile. Key challenges, including delivery mechanisms, off-target effects, ethical concerns, and regulatory considerations, are discussed alongside ongoing clinical trials and real-world applications. By addressing both the potential and limitations of CRISPR-based therapeutics, this presentation highlights their transformative impact on personalized healthcare, paving the way for cures to previously intractable diseases.

Technical Session 4: Biopolymers in Healthcare applications

- Speaker: Dr. Pritam Kumar Dikshit
- Topics covered: Biopolymers: Eco-friendly Innovations for Food and Healthcare Applications

This talk explores sustainable and eco-friendly innovations at the intersection of food and healthcare, emphasizing the importance of reducing environmental impact while enhancing human well-being. The presentation begins with an overview of the global challenges posed by conventional practices in food production and healthcare, including resource depletion, pollution, and waste generation.

In the food sector, the talk highlights advancements such as biodegradable packaging, plant-based and lab-grown protein alternatives, and the use of microbial and enzymatic processes for sustainable food production. Techniques like upcycling food waste into value-added products and implementing circular economy principles are discussed as game-changing strategies. In healthcare, the focus shifts to green chemistry approaches for drug development, biocompatible materials for medical devices, and the use of natural and renewable resources for pharmaceutical formulations. Innovations in probiotics, bioplastics, and nanotechnology also illustrate the growing synergy between environmental sustainability and human health. The discussion underscores the role of interdisciplinary collaboration and regulatory frameworks in driving these innovations. By fostering eco-friendly practices, the talk advocates for a sustainable future where food

security and healthcare advancements go hand in hand with environmental conservation.

Day 3: 11th December 2024

Technical Session 5: Biomaterials in Precision medicine

- Speaker: Dr. Sarada Prasanna Mallick
- Topics covered: Applications of Biomaterials in Precision Medicine: Innovations and Advancements (Design & Strategies for development of Tissue Engineered scaffold for Damaged/Diseased tissue Reconstruction
- **Panel Discussion:** Ethical and Regulatory Challenges in Precision Medicine
- Focus: Ethical considerations, regulatory frameworks, and societal implications.

This talk explores the transformative role of biomaterials in precision medicine, focusing on innovative strategies for developing tissue-engineered scaffolds for damaged or diseased tissue reconstruction. Biomaterials, engineered to interact with biological systems, are pivotal in advancing personalized approaches to healthcare by facilitating targeted therapies and regenerative medicine. The presentation begins by introducing the principles of biomaterials design, including biocompatibility, biodegradability, and functional customization. Emphasis is placed on cutting-edge strategies for fabricating tissue-engineered scaffolds, such as 3D bioprinting, electrospinning, and bioactive material incorporation. These scaffolds serve as structural and functional platforms for guiding cell growth, promoting tissue regeneration, and restoring damaged or diseased tissues.

Advancements in integrating biomaterials with precision medicine technologies, including patient-specific designs informed by genomic, proteomic, and imaging data, are highlighted. Examples include scaffolds tailored to match the unique microenvironment of a patient's tissue and the use of bioactive coatings to enhance cellular responses. The talk also discusses challenges like ensuring mechanical stability, scalability, and the potential for immune rejection, as well as solutions involving smart biomaterials and drug delivery systems. By showcasing innovative applications in areas like orthopedics, cardiovascular medicine, and neural regeneration, this presentation underscores the potential of biomaterials to redefine tissue reconstruction and advance precision medicine.

Technical Session 6: Computational Algorithms in Precision Medicine

- Speaker: Dr. ERVA RAJESWARA REDDY
- Topics covered: Computational Algorithms in Precision Medicine

This talk highlights the critical role of computational algorithms in advancing precision medicine, focusing on how these tools enable the customization of healthcare through data-driven insights. Precision medicine leverages vast datasets, including genomics, proteomics, clinical records, and environmental factors, to deliver targeted and effective treatments. Computational algorithms are at the heart of this process, facilitating data integration, analysis, and interpretation. The presentation begins with an overview of algorithmic approaches such as machine learning, deep learning, and statistical modelling. These methods are employed to identify disease biomarkers, predict treatment outcomes, and stratify patients based on genetic and phenotypic profiles. Key applications include drug discovery, personalized treatment recommendations, and early disease detection through predictive analytics.

Emerging trends such as explainable AI (XAI) for transparent decision-making, federated learning for collaborative healthcare data analysis, and multi-omics data integration are discussed. Challenges, including data privacy, algorithmic biases, and the need for robust validation, are addressed alongside strategies for overcoming them. This talk underscores the transformative impact of computational algorithms on precision medicine, emphasizing their potential to improve healthcare outcomes by tailoring interventions to individual needs.

Day 4: 12th December 2024

Technical Session 7: Neuroscience in Precision Medicine

- Speaker: Dr. Bhavanam hanuma Srinivas
- Topics covered: Neuro navigation for precision medicine

This talk explores the role of neuro-navigation in advancing precision medicine, focusing on its applications in neurological diagnostics, surgery, and treatment. Neuro-navigation, a sophisticated technology integrating imaging and computational tools, allows precise localization and targeting of neural structures, enabling highly individualized medical interventions. The presentation begins with an overview of neuro-navigation systems, which combine data from MRI, CT, and real-time imaging to create detailed 3D brain and spinal cord maps. These maps guide clinicians in performing minimally invasive procedures, such as tumor resections, epilepsy surgery, and deep brain stimulation (DBS), with unparalleled accuracy.

Emphasis is placed on the synergy between neuro-navigation and precision medicine, particularly in tailoring treatments to the unique neural anatomy and pathology of each patient. Advances in AI-driven neuro-navigation, augmented reality, and robotics are discussed as emerging tools that enhance precision and reduce risks during interventions. The talk also highlights non-surgical applications, including personalized

brain stimulation protocols for neuropsychiatric conditions and real-time monitoring of treatment responses. Challenges such as high costs, technical complexity, and accessibility are addressed alongside potential solutions. By showcasing innovations in neuro-navigation, this presentation underscores its transformative impact on precision medicine, offering new avenues for personalized care in neurology and neurosurgery.

Technical Session 8: Industrial Visit

- Speaker: Dr. B Srinivasa Reddy
- Topics covered: Neuro navigation for precision medicine

This visit focuses on the application of neuro-navigation technology in precision medicine, particularly in the field of neurology and neurosurgery. Neuro-navigation systems use advanced imaging techniques, such as MRI, CT, and functional brain mapping, to create highly detailed, 3D representations of the brain and spinal cord. These maps guide surgeons during procedures, ensuring precise targeting and minimizing risks to surrounding healthy tissue. The presentation discusses how neuro-navigation enhances the accuracy and safety of interventions for conditions such as brain tumors, epilepsy, and movement disorders. It highlights how this technology helps tailor surgical approaches to individual patients, ensuring personalized treatment strategies based on their unique brain anatomy and pathology. In addition, the talk covers emerging technologies, including the integration of AI, augmented reality, and robotics, which are revolutionizing the field. These innovations allow for real-time adjustments during surgeries and facilitate minimally invasive procedures. Non-surgical applications, such as personalized brain stimulation therapies for neurological and psychiatric conditions, are also explored. The discussion also addresses challenges, including cost, technical expertise, and accessibility, while emphasizing the potential of neuro-navigation to transform personalized care in neurosurgery, enabling more effective treatments and improving patient outcomes.

Day 5: 13th December 2024

Technical Session 9: Nanotechnology in Precision Medicine

- Speaker: Dr. Anil K Suresh
- Topics covered: Nanomedicine in Cancer Theragnostic: Bioengineering to Sustainable Innovations

Case Studies and Group Discussions

- Participants worked in groups to analyze case studies on precision medicine applications.

This talk explores the transformative role of nanomedicine in cancer theragnostics, a field that combines therapy and diagnostics to enhance personalized cancer treatment. It highlights the innovative use of nanotechnology in the development of advanced diagnostic tools and therapeutic strategies, focusing on the bioengineering of nanomaterials to improve cancer detection, treatment delivery, and monitoring. The presentation begins by discussing the unique properties of nanoparticles, such as their small size, surface area, and ability to be engineered for specific interactions with cancer cells. These properties make nanoparticles ideal for targeted drug delivery, enhancing the precision and effectiveness of treatments while minimizing side effects. Advances in designing nanocarriers for chemotherapy, immunotherapy, and gene therapy are covered, emphasizing their ability to overcome biological barriers like drug resistance and poor bioavailability.

The theragnostic aspect is explored, where nanoparticles are engineered to not only deliver treatment but also provide real-time diagnostic feedback through imaging and biosensors. This dual functionality allows for personalized monitoring of treatment responses, enabling dynamic adjustments to therapy based on patient-specific needs. The talk also discusses sustainable innovations in nanomedicine, including the development of biodegradable and biocompatible nanoparticles to reduce toxicity and environmental impact. Challenges such as regulatory approval, scalability, and safety concerns are addressed, alongside strategies to overcome them. Overall, the presentation underscores the potential of nanomedicine in revolutionizing cancer care, offering more effective, personalized, and sustainable treatment options for patients.

Technical Session 10: Proteomics in Precision Medicine

- Speaker: Dr. Sivakumar Vallabhapurapu
- Topics covered: Crosstalk Between Signalling Pathways Contributes to Cancer Progression

This talk explores the complex interactions between various signaling pathways and their role in cancer progression. Cancer is characterized by uncontrolled cell growth and metastasis, driven by disruptions in cellular signaling. The presentation focuses on how crosstalk between different signaling pathways contributes to the tumorigenic process, influencing processes such as cell proliferation, survival, migration, and invasion. The talk begins by reviewing key signaling pathways involved in cancer, including the PI3K/Akt, MAPK, Wnt/ β -catenin, and Notch pathways. These pathways regulate critical cellular functions, and their dysregulation is often a hallmark of cancer. The presentation highlights how the cross-interaction or "crosstalk" between these pathways can amplify oncogenic signals, making them more robust and less susceptible to normal regulatory controls.

The discussion also covers the role of the tumor microenvironment in modulating signaling crosstalk, emphasizing how factors like hypoxia, inflammation, and stromal interactions further drive cancer progression. Specific examples of pathway crosstalk, such as between the EGFR and MAPK pathways or between the Notch and Wnt pathways, are presented to illustrate how these interactions promote tumorigenesis and resistance to therapies. The talk concludes by addressing potential therapeutic strategies aimed at targeting these pathway interactions to block cancer progression. By understanding the molecular mechanisms of crosstalk, new drugs and treatment approaches can be developed to inhibit specific signaling combinations, offering more effective and targeted therapies for cancer patients.

Day 6: 14th December 2024

Technical Session 11: Artificial Intelligence in Precision Medicine

- Speaker: Dr. Asim Bikas
- Topics covered: AI and Precision Medicine

Hands-on Workshop

- Theme: AI-Based Drug Discovery Tools
- Activities: Participants explored machine learning algorithms and their applications in drug development.

This talk focuses on the transformative role of artificial intelligence (AI) in the field of precision medicine, where treatments are tailored to the individual characteristics of each patient. The presentation outlines how AI technologies, such as machine learning, deep learning, and natural language processing, are revolutionizing healthcare by enabling data-driven, personalized approaches to diagnosis, treatment, and patient care.

The talk begins with an overview of how AI integrates vast amounts of data, including genomic, clinical, and environmental information, to make precise predictions about disease risks, treatment responses, and outcomes. Machine learning algorithms are used to analyze complex datasets, identify patterns, and predict individual responses to specific therapies, making healthcare more targeted and effective. The presentation highlights several key applications of AI in precision medicine, including early disease detection, personalized drug development, and the optimization of treatment plans based on real-time patient data. AI is also playing a crucial role in genomics, helping to decode genetic variations and identify biomarkers for more accurate diagnoses and customized therapies. Challenges such as data privacy, algorithmic bias, and the need for transparency in AI-driven decisions are discussed. The talk concludes by emphasizing the potential of AI to redefine healthcare by making it more personalized, efficient, and

accessible, ultimately improving patient outcomes and fostering a more proactive approach to disease prevention and treatment.

Valedictory Session

- Highlights of the week were summarized by the program co-coordinator, Dr.C.Chandrasekhar
- Feedback from participants was collected, emphasizing the practical relevance and knowledge enhancement provided by the FDP.

Feedback from Participants

Participants highly appreciated the comprehensive coverage of topics, expert speakers, and interactive sessions. The hands-on workshops and case study discussions were particularly valued for their practical relevance.

Acknowledgments

The Department of Biotechnology, KL University, extends its gratitude to AICTE ATAL for sponsoring the FDP. Special thanks are due to the esteemed speakers, organizing committee members, and participants for their contributions to the success of the program.