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From the Chief Editor's Desk



Prof. Dr. Bobby Johns G

Dear readers,

Welcome to the January 2024 issue of Pharmline, the esteemed Publication of the Kerala Pharmacy Graduates' Association . As Chief Editor, I am delighted to present this edition, which continues our tradition of excellence in disseminating knowledge and insights within the Pharmacy Community.

KPGA actively engages in numerous Professional endeavours within the state, playing a significant role in advancing the growth and development of our field.

At KPGA, our dedication lies in propelling the Pharmacy profession forward across a spectrum of domains, encompassing regulation, industry, clinical practice, academia, and research. Our Association plays a pivotal role in fostering collaboration and innovation within these spheres, driving forward the standards of education and research in Pharmacy.

In this issue, you will find a diverse range of articles, covering cutting-edge research, and insights into academic practices. We strive to provide our readers with valuable information and perspectives that contribute to their professional growth and development.

Moreover, as advocates for the enhancement of education standards and research, we remain dedicated to supporting the next generation of Pharmacy professionals. Through initiatives aimed at uplifting student education standards and promoting research excellence, we aim to nurture a dynamic and knowledgeable workforce that can effectively address the evolving challenges in the field of Pharmacy.

As we commence a fresh year brimming with possibilities and obstacles, I urge all members of the pharmacy community to actively involve in Pharmline and utilize its resources. Together, let us persist in pushing the frontiers of Pharmacy, fostering positive transformations, and delivering significant contributions to healthcare and society as a whole.

Thank you for your continued support, and I hope you find this issue both informative and inspiring.

Warm regards,

Prof. Dr. Bobby Johns G
Chief Editor, Pharmline

The President Speaks



Dr. PK Sreekumar

Dear esteemed members of the Kerala Pharmacy Graduates' Association,

In the year 2023 our association has contributed much to the profession and society like plenty of seminars webinars discussions students funding, steps for dream project Pharmacy, and KPC. Your dedication and active participation have truly made a difference. The contributions by Womens Wing and Students wing are commendable. As we reflect on the accomplishments of 2023, I am delighted to share the success of various programs featured in this issue of Pharmline, our official publication.

As we step into the new year, let's embrace the opportunities it brings. May 2024 be a year of growth, collaboration, and continued excellence for our association. Let's focus on the future with enthusiasm, setting our sights on new programs that will further elevate our community.

I appreciate your unwavering support and commitment to the mission of the Kerala Pharmacy Graduates Association. Together, let's make 2024 a year of even greater achievements.

I am sure that 'PHARMLINE', the official publication would bring added effect on the outlook of the professionals by sharing their knowledge and experience for the betterment of our profession.

Let us work together for our profession.

Wishing you all a prosperous and fulfilling New Year.

Sincerely,

Dr. PK Sreekumar

President, Kerala Pharmacy Graduates' Association

The Looming Crisis: Antimicrobial Resistance and the Urgent Need for Global Action

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Abstract

Antimicrobial resistance (AMR) poses a formidable global health challenge as microbial organisms evolve mechanisms to withstand the effects of commonly used antimicrobial agents. The increasing prevalence of AMR jeopardizes the efficacy of antibiotics and other antimicrobials, rendering once-treatable infections more difficult to manage. In response to this urgent threat, antimicrobial stewardship (AMS) has emerged as a comprehensive strategy to optimize the use of antimicrobial agents. AMS initiatives focus on promoting responsible prescribing practices, enhancing diagnostic accuracy, and implementing infection prevention and control measures. This abstract highlights the critical need for a coordinated global effort to address AMR, emphasizing the role of AMS in preserving the effectiveness of existing antimicrobials and ensuring sustainable access to these life-saving treatments. The abstract underscores the importance of ongoing research, international collaboration, and the implementation of evidence-based guidelines to combat AMR and secure the future of effective antimicrobial therapy.

Keywords: Antimicrobial resistance (AMR), Antimicrobial stewardship (AMS), Economic implications, Global Health Impact, World Health Organization.

Introduction

Antimicrobial resistance (AMR) is a growing global health threat that jeopardizes the effectiveness of our most potent tools against infectious diseases. Over the years, the misuse and overuse of antimicrobial agents, including antibiotics, antivirals, and antifungals, have led to the emergence of resistant strains of microorganisms. This phenomenon poses a significant challenge to modern medicine, potentially reversing the progress made in treating infections and undermining our ability to manage routine medical procedures.(1)

Antimicrobial Resistance (AMR) occurs when bacteria, viruses, fungi and parasites no longer respond to antimicrobial agents. As a result of drug resistance, antibiotics and other antimicrobial agents become ineffective and infections become difficult or impossible to treat, increasing the risk of disease spread, severe illness and death. The World AMR Awareness Week (WAAW) is a global campaign to raise awareness and understanding of AMR and promote best practices among health stakeholders to reduce the emergence and spread of drug-resistant infections. WAAW is celebrated from 18-24 November every year.

The theme for WAAW 2023 was "Preventing antimicrobial resistance together". To effectively reduce AMR, all sectors must use antimicrobials

prudently and appropriately, take preventive measures to decrease the incidence of infections and follow good practices in disposal of antimicrobial contaminated waste.

The Escalating Problem: The rise of AMR is alarming, driven by factors such as inappropriate prescription practices, agricultural misuse, and inadequate sanitation and hygiene. The over reliance on antibiotics for viral infections, where they are ineffective, contributes to the development of resistant strains. In agriculture, the routine use of antibiotics in livestock for growth promotion and disease prevention has further accelerated the problem. The consequences are dire, as common infections become harder to treat, leading to prolonged illness, higher healthcare costs, and an increased risk of mortality.

Global Health Impact: AMR knows no borders, affecting people, animals, and the environment worldwide. Routine medical procedures, such as surgeries, organ transplants, and cancer treatments, become high-risk endeavors as the risk of infection rises. The loss of effective antibiotics could plunge us into a post-antibiotic era, where even minor infections could become life-threatening. The World Health Organization (WHO) estimates that if left unaddressed, AMR could cause 10 million deaths annually by 2050, surpassing the toll of cancer.

Contributing Factors

1. Overuse in Healthcare: Inappropriate prescription practices and patient demands for antibiotics contribute to overuse in healthcare settings.

2. Agricultural Practices : The use of antimicrobials in agriculture, both for growth promotion and disease prevention, contributes to the development of resistant strains.

3. Global Travel and Trade: The ease of global travel and trade facilitates the spread of resistant microorganisms across borders.

4. Lack of New Antibiotics: The development of new antibiotics has stagnated, partly due to financial challenges and the lengthy and costly process of bringing new drugs to market.(2,3)

The primary mechanisms of AMR include:

1. Mutation

Microorganisms can undergo spontaneous genetic mutations, leading to changes in their DNA. Some mutations can confer resistance to antimicrobial agents.

Horizontal Gene Transfer: Bacteria can exchange genetic material through processes like conjugation, transformation, and transduction. This allows for the rapid spread of resistance genes among bacterial populations.

2. Selective Pressure

Use and Misuse of Antimicrobials: The selective pressure exerted by the overuse and misuse of antimicrobial agents accelerates the survival and proliferation of resistant strains. The more an antimicrobial is used, the greater the likelihood that resistant strains will emerge and dominate.

3. Mechanisms of Resistance

Enzymatic Degradation: Some microorganisms produce enzymes that can inactivate antimicrobial agents. For example, beta-lactamase enzymes can break down beta-lactam antibiotics like penicillins.

Alteration of Drug Targets: Resistant microorganisms may alter the structure of their drug targets, such as receptors or enzymes, making them less susceptible to the effects of antimicrobial agents.

Efflux Pumps: Microorganisms can develop efflux pumps, specialized proteins that actively pump antimicrobial agents out of the bacterial cell, reducing their concentration within the microorganism.

4. Biofilm Formation

Biofilms: Bacteria can form biofilms, which are communities of microorganisms encased in a protective matrix. Biofilms provide a physical

barrier that makes it more challenging for antimicrobial agents to penetrate and act on bacterial cells.

5. Adaptive Responses

Quorum Sensing: Some bacteria use quorum sensing, a system of communication between bacterial cells, to coordinate gene expression. This can lead to the activation of resistance mechanisms in response to environmental signals.(4)

6. Inherent Resistance

Innate Characteristics: Some microorganisms possess intrinsic resistance to certain antimicrobial agents due to their inherent characteristics, such as impermeable cell walls or efflux pumps.

7. Lack of New Drug Development

Limited New Drug Discovery: The slow pace of discovering and developing new antimicrobial agents contributes to the problem. Fewer new drugs mean that existing ones are more likely to be overused, leading to resistance.

Antimicrobial Resistance (AMR) is not only a significant global health concern but also poses substantial economic challenges that reverberate across various sectors. The economic implications of AMR are multifaceted and extend beyond the direct costs associated with treating resistant infections. Understanding and addressing these economic consequences is essential for developing comprehensive strategies to combat AMR.

1. Escalating Healthcare Costs

The rise of antimicrobial-resistant infections contributes to increased healthcare expenditures. Treating resistant strains often requires more expensive and prolonged interventions, including extended hospital stays, intensive care, and the use of costly alternative therapies.

2. Lost Productivity and Workforce Impact

AMR-related illnesses lead to significant productivity losses due to absenteeism and reduced workforce efficiency. The economic burden extends to employers who face increased costs associated with sick leave, disability, and the need for temporary replacements.

3. Agricultural and Livestock Sector Challenges

The agricultural industry experiences economic setbacks due to the use of antimicrobials in livestock. Resistant strains in animals can impact production efficiency, leading to losses in livestock and reduced agricultural output. This, in turn, affects food security and prices.

4. Global Trade Restrictions

AMR concerns influence international trade dynamics. Countries with high levels of AMR may face restrictions on exporting certain products, impacting their economic competitiveness in the global market. Stricter regulations may disrupt established trade relationships.

5. Research and Development Costs

Developing new antimicrobials is an expensive and time-consuming process. Pharmaceutical companies face economic challenges in recouping investments, as the short-term use of antibiotics doesn't align with traditional profit models. This financial disincentive hampers the development of new drugs.

6. Investment in Antimicrobial Stewardship Programs

While the implementation of antimicrobial stewardship programs incurs costs, the potential savings in healthcare and productivity make these programs economically viable. Investing in stewardship initiatives becomes a crucial aspect of mitigating economic losses associated with AMR. (5)

7. Insurance and Healthcare System Strain

The economic implications extend to insurance systems and healthcare providers. Insurance premiums may rise as a response to increased healthcare costs, and healthcare systems face strains in managing the growing burden of AMR-related cases.

8. Global Economic Consequences

The cumulative impact of AMR on individual economies contributes to global economic instability. The potential for widespread resistance-related health crises could trigger economic downturns, affecting industries, financial markets, and overall economic growth.



Combatting AMR

Addressing AMR requires a multi-faceted and collaborative approach.

Improved Antibiotic Stewardship

Healthcare professionals must adopt judicious prescribing practices, ensuring antibiotics are used only when necessary.

1. Global Surveillance: Enhanced surveillance efforts are crucial to monitor the spread of resistant strains and identify emerging threats promptly.

2. Research and Development: Increased investment in research and development is necessary to discover and develop new antimicrobial agents.

3. Public Awareness: Educating the public on the responsible use of antibiotics and the consequences of AMR is vital to fostering behavioral change.

4. Regulatory Measures: Implementing and enforcing regulations on the use of antimicrobials in healthcare and agriculture can help mitigate the problem. (6)

Antimicrobial stewardship (AMS)

AMS is a systematic approach to optimizing the use of antimicrobial agents to ensure the most effective treatment outcomes while minimizing the risk of antimicrobial resistance (AMR) and other adverse events. The goal of antimicrobial stewardship is to enhance patient outcomes, improve individual and public health, and reduce the unnecessary use of antibiotics and other antimicrobials.

Key Components of Antimicrobial Stewardship are,

Leadership Commitment

Establishment of a Stewardship Team: Designate a multidisciplinary team comprising healthcare professionals such as physicians, pharmacists, microbiologists, and infection control practitioners.

Leadership Support: Obtain commitment and support from hospital or healthcare institution leadership for the implementation of AMS programs.

Education and Training

Healthcare Provider Education: Provide ongoing education and training to healthcare professionals on antimicrobial resistance, appropriate prescribing practices, and the principles of antimicrobial stewardship.

Patient Education

Educate patients about the responsible use of

antimicrobials, the importance of completing prescribed courses, and the consequences of unnecessary antibiotic use.

Guidelines and Protocols

Development and Implementation: Establish evidence-based guidelines and protocols for antimicrobial use within the healthcare institution.

Regular Review and Updates: Periodically review and update guidelines based on local resistance patterns, emerging infectious diseases, and the latest scientific evidence.

Surveillance and Monitoring

Antimicrobial Use Surveillance: Monitor antimicrobial prescribing patterns and usage in the healthcare setting.

Microbial Resistance Surveillance

Regularly assess microbial resistance patterns to identify trends and inform antimicrobial prescribing decisions.

Diagnostics and Laboratory Support

Rapid Diagnostics: Implement and utilize rapid diagnostic tools to identify pathogens and determine their susceptibility to antimicrobial agents more quickly.

Collaboration with Laboratories: Foster collaboration between clinicians and laboratory professionals to optimize the selection and interpretation of diagnostic tests.

Feedback and Intervention

Regular Feedback to Prescribers: Provide prescribers with regular feedback on their antimicrobial prescribing practices, including comparisons with peer benchmarks.

Intervention Strategies: Implement interventions, such as prospective audit and feedback, to address inappropriate antimicrobial prescriptions and guide clinicians towards optimal choices.

Collaboration and Communication

Interdisciplinary Collaboration: Promote collaboration among healthcare professionals, including physicians, pharmacists, nurses, and infection control practitioners.

Effective Communication: Ensure effective communication about antimicrobial prescribing decisions between prescribers, pharmacists, and other members of the healthcare team.

Evaluation of Outcomes

Clinical and Microbiological Outcomes: Regularly evaluate patient outcomes, including clinical response and microbiological cure, associated with antimicrobial therapy.

AMR Trends: Assess the impact of AMS program on antimicrobial resistance trends in the healthcare institution.

Antimicrobial Stewardship in the Community

Outpatient Settings: Extend AMS efforts to outpatient settings, including primary care clinics, to address inappropriate antimicrobial prescribing in the community.

Public Awareness: Engage in public awareness campaigns to educate the community about responsible antimicrobial use.(7,8)

Continuous Improvement

Quality Improvement Initiatives: Implement continuous quality improvement initiatives to refine and enhance antimicrobial stewardship efforts over time.

Adaptation to Emerging Threats: Stay abreast of emerging infectious diseases and adapt AMS programs to address new challenges. Here are key aspects and initiatives related to global guidelines on AMR:

World Health Organization (WHO)

The WHO has developed a Global Action Plan on Antimicrobial Resistance, emphasizing a One Health approach that considers human, animal, and environmental factors. The Global Antimicrobial Resistance Surveillance System (GLASS) was established to improve the monitoring of AMR worldwide.

WHO provides guidelines on the use of antimicrobials in various healthcare settings and promotes strategies for infection prevention and control.

Food and Agriculture Organization (FAO)

The FAO contributes to global efforts to combat AMR, particularly in the context of food production and agriculture.

FAO provides guidelines on responsible use of antimicrobials in animal husbandry, aquaculture, and agriculture to minimize the risk of resistance development.

World Organization for Animal Health (OIE)

OIE works to ensure the responsible and prudent use of antimicrobials in animals. The Terrestrial Animal Health Code includes guidelines on the responsible and judicious use of antimicrobial agents in animals.

Global Antimicrobial Resistance Surveillance System (GLASS)

GLASS, initiated by the WHO, aims to standardize and improve the collection, analysis, and sharing of AMR data globally.

The system encourages countries to strengthen their surveillance capacity and contribute data to a global database.

Tripartite Collaboration (WHO, FAO, OIE)

The collaboration among WHO, FAO, and OIE emphasizes a coordinated One Health approach to address AMR.

This collaboration supports joint efforts to reduce the emergence and spread of AMR across human, animal, and environmental sectors.

Global AMR Action Fund

Launched in 2020, the Global AMR Action Fund is a collaborative initiative involving governments, philanthropies, and the private sector. The fund aims to support the development of new antibiotics and other antimicrobial treatments.

Conclusion

Antimicrobial resistance is a global crisis that demands urgent attention and concerted efforts. Failure to address this issue comprehensively jeopardizes the progress made in modern medicine and puts the health of millions at risk. By adopting responsible practices, investing in research, and fostering international collaboration, we can work together to preserve the effectiveness of our antimicrobial arsenal and ensure a healthier and safer future for generations to come.

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The Looming Crisis: Antimicrobial Resistance and the Urgent Need for Global Action

Pharmacy Informatics: Revolutionizing Medication Management and Healthcare

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Abstract

Pharmacy informatics is a dynamic field at the intersection of pharmacy practice and information technology, leveraging digital tools and data to optimize medication management and improve patient outcomes. This article provides a comprehensive overview of pharmacy informatics, its key components, applications, and impact on healthcare. Drawing upon authoritative sources from organizations like HIMSS (Healthcare Information and Management Systems Society) and others, this article explores the current state of pharmacy informatics and its potential to transform the way medications are prescribed, dispensed, monitored, and managed.

Keywords: Pharmacy informatics, Medication Therapy Management, Drug utilization survey, Patient care

Introduction

Pharmacy informatics is an emerging discipline that combines pharmacy practice with information technology (IT) to enhance the quality, safety, and efficiency of medication-related processes. This article delves into the multifaceted aspects of pharmacy informatics, emphasizing its role in shaping the future of healthcare.

The Foundation of Pharmacy Informatics

Definition and Scope: Pharmacy informatics encompasses the use of technology, data, and information systems to support and advance pharmacy practice. It covers a wide range of applications, including electronic prescribing, medication reconciliation, drug utilization reviews, and clinical decision support.

Key Components:

- Electronic Health Records (EHRs)
- Computerized Physician Order Entry (CPOE)
- Pharmacy Information Systems (PIS)
- Automated Dispensing Systems (ADS)
- Clinical Decision Support (CDS)
- Medication Management Software

The Role of Pharmacy Informatics in Medication Management

Medication Safety: Pharmacy informatics plays a crucial role in reducing medication errors by providing real-time access to patient information, drug interactions, and allergy alerts. This enhances medication safety and reduces adverse drug events (ADEs).

Medication Reconciliation: Pharmacy informatics simplifies the process of medications reconciliation, ensuring that patients receive the

correct medications during transitions of care, such as hospital admission or discharge.

Electronic Prescribing: E-prescribing systems facilitate the electronic transmission of prescription from healthcare providers to pharmacies, reducing prescription errors, improving adherence, and streamlining medication dispensing.

Applications of Pharmacy Informatics

Clinical Decision Support: Clinical decision support systems within pharmacy informatics assist healthcare professionals in making informed decisions about medication therapy, dosage adjustments, and treatment plans.

Medication Therapy Management: Pharmacy informatics enables pharmacists to provide comprehensive medication therapy management services, including medication reviews, therapy optimization, and patient counseling.

Drug Utilization Review (DUR): DUR systems analyze patient medication profiles to identify potential issues such as drug interactions, duplications, or contraindications, ensuring safe and effective therapy.

Reporting and Analytics: Pharmacy informatics tools generate data and reports that support quality improvement initiatives, research, and regulatory compliance.

Integration with Healthcare Systems

Electronic Health Records (EHRs): Pharmacy informatics is integrated into EHR systems, allowing seamless sharing of patient information among healthcare providers and continuity of care.

Health Information Exchange (HIE): Interoperability between pharmacy informatics systems and HIE networks facilitates secure data exchange across the healthcare continuum.

Pharmacy Informatics Standards and Initiatives

HL7 (Health Level Seven): HL7 standards are widely adopted in pharmacy informatics for the exchange of clinical and administrative data between healthcare systems.

FHIR (Fast Healthcare Interoperability Resources): FHIR is emerging as a key standard for data exchange in pharmacy informatics, enabling real-time access to structured clinical data.

HIMSS EMRAM (Electronic Medical Record Adoption Model): HIMSS EMRAM provides a framework for assessing healthcare organizations' maturity in adopting electronic medical records and pharmacy informatics systems.

Impact on Patient Care and Outcomes

Pharmacy informatics has a profound impact on patient care by promoting medication adherence, preventing adverse events, and improving chronic disease management. The integration of pharmacy informatics with clinical workflows enhances patient outcomes through evidence-based decision-making.

Challenges and Future Directions

Data Security and Privacy: Ensuring the confidentiality and security of patient data is a persistent challenge in pharmacy informatics.

Interoperability: Achieving seamless interoperability between various pharmacy informatics systems and healthcare platforms remains an ongoing effort.

Workforce Training: Pharmacists and pharmacy technicians require specialized training to effectively utilize pharmacy informatics tools.

Regulatory Compliance: Staying compliant with evolving healthcare regulations and standards is crucial for pharmacy informatics systems.

Conclusion

Pharmacy informatics is reshaping the landscape of medication management and healthcare delivery. Through the integration of advanced IT solutions, data analytics, and interoperable systems, pharmacy informatics empowers health care professionals to provide safer, more efficient, and patient-centered care. As the field continues to evolve, it is essential for healthcare

organizations, policymakers, and educational institutions to invest in its development and harness its full potential for the benefit of patients worldwide.

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Pharmacy Informatics: Revolutionizing Medication Management and Healthcare

A Review on 3D Printed Microfluidic Enabled Hollow Microneedle Architecture for Transdermal Drug Delivery

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Abstract

A fabrication method that uses stereolithography 3D-printing to create hollow microneedles interfaced with microfluidic structures in a single step. The architectures presented here can be implemented in future biomedical devices to enable new modes of operation for transdermal drug delivery applications such as combinational therapy for preclinical testing of biologic treatments. The architectures presented in this review can be implemented in future biomedical devices to enable new modes of operation for transdermal drug delivery applications such as combinational therapy for preclinical testing of biologic treatments.

Key Words: Microneedle, Microfluids, 3D printing, Stereolithography, Transdermal drug delivery

Introduction

Advanced bioengineering and material science have emerged toward personalized medication by creating technologies that facilitate disease diagnosis and the delivery of care. One of the most important personalized medicines is transdermal drug delivery system because it has safe, convenient, and painless drug delivery through the skin. The advanced version of the transdermal drug delivery is via the microneedles.

The minimally invasive nature of the microneedles promises solutions for transdermal drug delivery. Nowadays microneedles are constructed with variety of materials like metals, ceramics, and polymers. Biocompatible polymeric microneedles have the uses widespread over metal or ceramic microneedles due to their easy to manufacture at low cost, effective and safe disposal after use, and make it for customised drug release needles. They offer continuous administration of drugs and can be fabricated with complex architectures. The following are some of the advantages of microfluidic microneedle technology.

- **Painless and non-invasive:** Microneedles are less painful than traditional hypodermic needles and can penetrate the skin with minimal discomfort.
- **Precise and targeted drug delivery:** Microneedles can deliver drugs to specific areas of the body with high precision and accuracy, such as the eye, ear, and skin. Microneedles can improve drug bioavailability by bypassing the skin's natural barrier and delivering the drug directly into the bloodstream.

- **Reduced side effects:** By delivering drugs in smaller doses and targeting specific areas of the body, microneedles can reduce side effects.
- **Cost-effective:** Microneedles are low-cost to produce and can be mass-produced using microfabrication techniques.

However, the manufacturing process and cost of hollow microneedles are often complex and high. One potential solution to these challenges is the use of 3D printing techniques. 3D printing has emerged as a powerful manufacturing technology for the fabrication of microneedles. It enables the production of microneedles from digital models in a single step, saving time and cost compared to traditional manufacturing methods. This review aims to identify the key progress points made in the past 3 years using 3D printing to manufacture microneedles. The study reveals that printing resolution and material properties are critical parameters influencing the outcome of microneedle printing. Additionally, the authors attempted to estimate the impact of 3D printing on the transdermal drug delivery market. They predict that widespread adoption of 3D printing for the fabrication of microfluidic enabled hollow microneedle architectures will lead to increased accessibility and affordability of transdermal drug delivery, ultimately improving patient outcomes and quality of life. Furthermore, the review highlights the potential applications of microfluidic enabled hollow microneedles beyond drug delivery, such as in biosensing and diagnostic devices.

3D printers to print microneedles required

additional processes, and expensive two-photon polymerization (2PP). While 2PP offers high print resolutions, microneedle tips with 30 μ m radius of curvature are enough for epidermal penetration. Here the study presented a rapid, low cost and single step stereolithography (SLA) based 3D printing. The architecture allows the deviation of the input fluid solutions flow rates to facilitate advanced drug delivery in the future combination therapy-based administration. The method makes use of stereolithography 3D printing and pushes its boundaries to create complex architectures at a lower cost and with a faster print speed and throughput than previously reported methods.

Microneedle fabrication with SLA 3D printing

The microfluidic enabled microneedle device developed using an Stereolithography (SLA) printer. The device was designed using CAD software (Fusion 360, Autodesk) and processed in 3D printing preparation software (Preform, Formlabs). The model was oriented in 45° to the build plate to optimize microneedle yield and quality.

Stereolithography is a type of 3D printing technology that uses photochemical processes to create layer-by-layer models, prototypes, patterns, and production parts. A liquid photopolymerizing resin is poured into a vat, and a laser or DLP selectively illuminates the tank's transparent bottom. A lifting platform gradually drags the solidified resin up, and the polymers form the body of a three-dimensional solid. Stereolithography is used to create prototypes for new products, medical models, and computer hardware, among other things.

Figure 1 was visualising that SLA 3D printing to fabricate a single piece, multi-inlet, 3D microfluidic device with a hollow microneedle array. The printer utilizes direct UV light through a laser scanner system to build platform and designed the model by a photopolymer resin layer by layer in the liquid resin tank. To achieve ease of penetration the radius of the curvature at the needle tip will be minimized, well below the SLA printer full width half maximum laser spot size 140 μ m. By leveraging our approach's one-step fabrication capability, printed microneedle arrays can be seamlessly integrated with microfluidic modules.

To test the efficacy of the device, they injected model-drug molecules rhodamine B, fluorescein isothiocyanate, and methylene blue through the device and into porcine skin. Because of their peaks, these fluorochromes were chosen. The research presents a customized microfluidic module design that can be used to perform

hydrodynamic mixing. This design incorporates three distinct inlet microfluidic channels that converge into a single 3D spiral chamber where the injected fluids are hydrodynamically mixed in the desired ratios and emerge homogenized at the outlet.

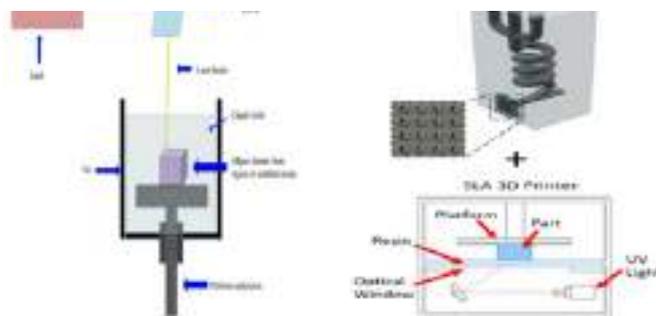


Figure 3. Stereolithography 3D Printer

similar molecular weights, comparable diffusion profiles, and distinct excitation and emission. In transdermal drug delivery, microfluidic structures are used to control the dose, delivery rate, and efficacy of drugs. Using stereolithography 3D-printing, they can be used to create hollow microneedles that are interfaced with microfluidic structures in a single step. Microfluidics has emerged as a viable alternative to traditional drug delivery systems, providing much-needed breakthroughs in nanotechnology to aid in the formulation of nanoparticles for localized drug delivery. Because of their structural uniformity, reproducibility, and highly controllable nature, microfluidic devices have significant clinical relevant properties that have enabled novel drug delivery systems with greater stability, efficiency, and sustained-release patterns.

Investigation and optimization of microneedle design

Scanning electron microscopy demonstrated the 3D-printing scheme's accuracy, consistency, and repeatability across multiple hollow microneedle array designs. Penetration and fracture tests confirmed the mechanical robustness of the microneedles for practical application. A microfluidic-enabled microneedle device was printed using this scheme, which allows for homogeneous mixing of multiple fluids at different flow rates, followed by transdermal delivery of the mixed solution. Flow rate ratio comparisons with coloured dye solutions revealed tuneable control over the relative concentrations of solutes delivered. The platform's ability for transdermal drug modulation and delivery was further validated by ex vivo confocal laser scanning microscopy of three fluorochrome model-drug solutions on porcine skin. This 3D-printed device is especially useful in preclinical studies involving

combinational drug therapy, in which the *in-situ* combination of multiple drugs and the tuning of their physicochemical properties results in more effective outcomes than single or premixed agents alone. Controlled multifluidic synthesis of nanoparticles, for example, we can tune the release mechanisms of various drugs for wound healing applications. The developed fabrication scheme presents new device design possibilities and degrees of freedom for transdermal drug delivery by leveraging SLA's low-cost and multiscale/high speed printing while pushing its resolution limits to render fine hollow microneedle features. Fluid management capabilities enabled by microfluidic architectures with microneedles provide a new level of freedom for transdermal drug delivery.

Conclusion

The article presented a 3D-printing scheme based on SLA to create integrated microfluidic-enabled hollow microneedle devices for transdermal drug delivery. A microfluidic enabled microneedle architecture was printed to render hydrodynamic mixing and transdermal drug delivery within a single device to demonstrate a potential application. Researchers are investigating the use of 3D printing to create complex geometries and structures for microneedles that can improve drug delivery and other biomedical applications. The development of 3D printed microneedles is still in its earliest stages, and many challenges remain, such as the need for more efficient and reliable manufacturing techniques, as well as the development of more sophisticated microfluidic systems. The possible advantages of 3D printed microneedles, on the other hand, are enormous, with the potential to revolutionize the delivery of drugs and other biomedical applications in the future.

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A Review on 3D Printed Microfluidic Enabled Hollow Microneedle Architecture for
Transdermal Drug Delivery

Activities & News



Mr. Abdul Nazeer PU
Gen. Secretary, KPGA

Greetings to all KPGA members! It gives me immense pleasure to present the activity report of KPGA for the year 2023 August to December.

• Independence Day Celebration, August 15, 2023

KPGA Student's Wing conducted an online program on August 15 at 11.30 AM in connection with Independence Day Celebration. Welcome speech was delivered by Ms. Ancy KF and the function was presided by Dr. PK Sreekumar, President of KPGA. The Independence Day message was delivered by Prof. AK Chandrashekhara. Mr. Abdul Nazeer and Prof. Janeera Beevi felicitated the program. There were numerous speeches and musical performances by students from various pharmacy colleges. There were also poster presentations. Vote of thanks was proposed by Aby Augustine Union Chairman Nirmala College of Health Sciences, Chalakkudy.

• National pharmacovigilance week, September 17, 2023

KPGA celebrated National Pharmacovigilance week by organising a webinar in association with IPGA with the theme "Boosting public confidence in Pharmacovigilance". The programme started with the welcome address by Dr. Jeny Samuel. The guest speaker Dr. Shirley John, Professor and Head of Pharmacology, Pushpagiri college of pharmacy, Thiruvalla, enlightened the gathering by giving valuable information about all aspects of pharmacovigilance and importance of Pharmacists in reporting and management of ADRs. The webinar concluded with doubt clearing sessions and vote of thanks.

• World Pharmacists Day Celebrations September 25, 2023 jointly with KPGA

KPGA celebrated World Pharmacist Day jointly with pioneer Pharmacy colleges in Kerala with the theme 'Pharmacy strengthening health systems' on September 25. The details are as follows:

Sree Gokulam SNGM College of Pharmacy, Thuravoor organised awareness classes on World Pharmacist Day. Dr. PK sreekumar, Former deputy Drugs Controller and President of KPGA and Dr. Jeny Samuel, Associate Professor, St Joseph's College of pharmacy, Cherthala were the speakers. Dr. PK Sreekumar delivered a highly informative and interactive talk on the topic 'Know Your medicine'. Dr. Jeny Samuel gave an innovative speech on the topic 'Role of Pharmacists beyond the counter'.

Dr. Joseph Marthoma College of Pharmaceutical Sciences & Research, Kattanam celebrated World Pharmacists Day with many vibrant and educational programmes including WPD walk, skit, poster presentation and quiz competition at the College campus.

Ezhuthachan College of Pharmacy, Thiruvananthapuram organised a special function on WPD-2023. The event witnessed a special honour and recognition award ceremony to Pharma experts from different fields including Academics, Analytical and regulatory, Industry, Clinical Pharmacy and Hospital & Community Pharmacy, who had extended their invaluable service with sincerity and passion. Dr. CR Sudhakaran (Retd. Professor and Head, CPS, TVM), Prof. Janeera Beevi S (Retd. Professor and Head, CPS, TVM, Former HOD- Pharmaceutical Chemistry, ECPS, TVM), Mr. MK Unnikrishna Panicker (Former PCI member and Former Principal, ECPS, TVM), Ms. Sutha T (Chief Government Analyst, Drug Testing Laboratory, Govt. of Kerala, TVM), Ms. Mymoon Khan (Drug Inspector, Drugs Control Department, Govt of Kerala), Mr. Abdul Nazeer PU (Production Manager, Krti Life Sciences, Chalakkudy), Dr. Noble Skaria (PvPi/ MvPi Coordinator, Head of Clinical Pharmacology, Apollo Adlux Hospital, Angamaly), Ms. Sreeja Kumar (Pharmacy Coordinator, PRS hospital, TVM), Sri. G Arjunan (Pharmacist, Vijaya Medicals, Marayamuttom) were honoured on the occasion.

Dale View College of Pharmacy, Thiruvananthapuram conducted a mega organ donation campaign in association with KPGA which was inaugurated by Dr. Noble Gracious, Nodal Officer- KNOS, Assistant

Professor, Dept of Nephrology, Govt Medical College, Thiruvananthapuram.

Caritas College of Pharmacy, Ettumanur organized an intercollegiate quiz challenge in association with KPGA as a part of World Pharmacists Day Celebrations.

• **Webinar on Evidence Based Guidelines Development, October 14, 2023**

KPGA organized a webinar on the topic “Evidence Based Guidelines Development- Need of the hour” on 14th October, 2023. The Guest Speaker for this webinar was Dr. Jisha Sara John, Clinical Pharmacist, Dept of infectious diseases, CMC, Vellore. The programme started with a prayer song by Ms. Namitha, Asst. Professor, Ezhuthchan College of Pharmacy. The moderator of the program was Mr. Rajesh Thalaparambath, Pharmacy Head, Meitra hospital, Kozhikode and executive member of KPGA. The welcome address was delivered by Dr. Sujith Varma K, Principal, National College of Pharmacy, Kozhikode and executive member of KPGA. The program was presided by the President of Kerala Pharmacy Graduates’ Association and former Deputy Drugs Controller Dr. PK Sreekumar, followed by felicitations by Prof. Dr. K KrishnaKumar, Principal, St James College of Pharmacy and Prof. Dr. Shiji Kumar PS, Principal, Dale view college of pharmacy. Dr. Noble Scaria, Head of Clinical Pharmacy, Appolo Adlux Hospital, presented an overview of the topic. In the Session, Dr. Jisha Sara John gave an insight on evidence based guidelines development and the importance of patient safety. The webinar was concluded with the question and answer session. The vote of thanks was proposed by Dr. Preeja G Pillai, Principal, Mar Dioscorus College of Pharmacy, Thiruvananthapuram.

• **Medichoice- Panel discussion on ‘Generic drugs & Branded drugs’ and Mental health session, November 2, 2023**

A one day symposium MEDICHOICE was jointly organised by the Kerala Pharmacy Graduates Association (KPGA) and Association of Pharmaceutical Teachers of India (APTI), Kerala State Branch at St Joseph’s College of Pharmacy, Cherthala on November 2, 2023 with a morning session of expert panel discussion on the topic ‘Generic drugs and Branded drugs’ and an afternoon scientific session on mental health.

Morning session of Expert panel discussion on the topic ‘Generic drugs and Branded drugs’ started at 10 Am including medical professionals, Pharmacists, regulatory officials, socialworkers, journalists and public. The session was inaugurated by honourable MLA Smt. Daleema. Topic was presented by Dr. PK Sreekumar, President, Kerala Pharmacy Graduates’ Association and the moderator of the program was Smt. Saranya Snehajan, Bureau Chief, News 18 Keralam. Panelists of the discussion were Dr. Sabu Sugathan (Senior Civil Surgeon Alappuzha), Dr. Sarath Chandran C (Asst professor, College of Pharmaceutical Sciences, Pariyaram), Shri. Jayan. Philip (Regional Drugs Inspector, Ernakulam), Dr. Sabitha. M, Principal, Amrita School of Pharmacy, Kochi), Shri. Sanal. C (Public Health worker), Alappuzha. The session was very informative and helped to an extent to bring out the perspective of current status of Generic and Branded drugs in India.

The after noon session, ‘Travel with mind’ was led by Shri. Sankar.S, Consultant Psychologist emphasising on the topic ‘Mental Health- Need of the hour’.

• **Pharma Meet- Honouring Mrs. Veena Rajesh and Prize distribution of PHARMAFLIX Video Making Competition, November 15, 2023**

Sree Gokulam SNGM college of Pharmacy, Thuravoor, Alappuzha jointly with KPGA conducted a program PHARMA MEET embracing National Pharmacy Week 2023 on November 15, 2023. In this program eminent Pharmacist, Mrs. Veena Rajesh was honoured for her dedicated work, social commitment and contributions during the pandemic in Dubai and Sharjah. Dr. PK Sreekumar, Dr. Kala D, Mr. Abdul Nazeer, Dr. Jeny Samuel and Ms. Shanthi Nair were instrumental in organizing the programme. Dr. Bobby Johns G enlightened the audience with his motivative and valuable session,

“Big journeys begin with Small Steps”. Cash price and certificates were distributed to the winners of the video competition PHARMAFLIX, conducted by the Women's Wing of KPGA.

• National Pharmacy Week Celebrations, November 23, 2023

Kerala Pharmacy Graduates' Association Jointly with KTN College of Pharmacy, Chalavara, Ottappalam celebrated National Pharmacy Week with the theme 'Join Pharmacists to ensure Patient safety' on November 23, 2023 at KTN College of Pharmacy. Inaugural session started at 10 am. The program was inaugurated by Mr. P. U. Abdul Nazeer General secretary, KPGA followed by inaugural speech highlighting the role of future Pharmacists. Welcome address was delivered by Dr KSG Arul Kumaran, Principal, KTN College of Pharmacy. The program was presided by PP Premkrishnan, Chairman and Management trustee, KTN College of Pharmacy. Dr. PK Sreekumar, Former Deputy Drugs Controller and President of KPGA gave an informative session on the topic "Give the gift of life- Save the blood". Dr. Subash Philip, Principal, Dr. Joseph Marthoma Institute of Pharmaceutical Sciences and Research enlightened the audience with his talk on the topic 'Role of Management in Pharmacy'.

In the afternoon, a community programme 'Marunnarivu' was organised by the NSS unit of KTN College of Pharmacy at Chalavara Panchayat. The guest speaker of the programme was Dr. PK Sreekumar.

• Pharma Scientia

A one day national symposium was conducted by Ezhuthachan College of Pharmaceutical Sciences, Marayamuttom, Neyyattinkara on 20/12/2023 jointly with Kerala Pharmacy Graduates' Association at College auditorium on the topic "Antimicrobial Resistance" with a morning session of Expert panel discussion and an afternoon scientific session.

The program was inaugurated by Former KUHS Vice-Chancellor and Spectrum Director of NIMS, Dr. MKC Nair, along with neyyattinkara MLA, KA Ansalan. Thereafter Panel discussion started with an introduction speech on AMR by Dr. Merlin NJ, Professor and Head, Department of Pharmacology, ECPS. Panel discussions were chaired by Dr. SM Sandhya, Professor and Head, Department of Pharmaceutical Chemistry, ECPS and moderated by DR. PK Sreekumar, Former Deputy Drugs Controller and President of KPGA.

Members of the panel were Dr. Sunitha Kumari R, Medical Officer, Community Health Centre Perumkadavila, Dr. MS Sajeev Kumar, Assistant Drugs Controller, Drugs Control Department, Govt. of Kerala, Dr. Santhanu Chattopathyay, Scientist, Rajiv Gandhi Centre for Biotechnology, Mr. Naveen Chand OC, President, Kerala State Pharmacy Council and Dr. Preeja G Pillai, Principal, Mar Dioscorus College of Pharmacy.

The afternoon session started with Oral and E poster presentation by various delegates on the topic AMR. The session started with an introductory address of Dr. MK Unnikrishna Panicker, Former Member of Pharmacy Council of India and chaired by Mr. SS Venkatakrishnan, Rtd. Drugs Controller of Kerala. The scientific session was handled by Dr. Chitra LR, Clinical Microbiologist, Control Room Nodal Officer, District Medical Office, Thiruvananthapuram.

Report by: **Mr. Abdul Nazeer PU**, Gen. Secretary, KPGA

Compiled by: **Ms. Aathira RS**

Pharmline invites Cover Photos of Students and Pharmacists for the upcoming issues. Those who are interested can send their photos wearing white coat, preferably in Pharmacy related background. Selected photo will be featured as cover model of Pharmline.
Please send your Photos in jpeg format to: kpgapharmline@gmail.com

This issue's Cover Model : **Ms. Aparna Grigorious**,
Pharm.D Intern, St. Joseph's College of Pharmacy,
Cherthala-688 524, Kerala, India



GALLERY

Pharma Scientia

One day Symposium On 20/12/2023

Ezhuthachan College of Pharmaceutical Sciences, Marayamuttom, Tvm





GALLERY

AGM- 2023

Thiruvananthapuram On 30/07/2023



National Pharmacy Week - 2023 19 - 25 November, 2023



NPW celebratons at KTN College of Pharmacy,
Chalavara, Ottapalam



NPW celebratons at Caritas College of
Pharmacy, Kottayam



NPW celebratons at Dale View College of
Pharm.Sc & Reserach, Tvm



NPW celebratons at Ezhuthachan College of
Pharmacy, Tvm



GALLERY

Pharma Meet- 2023

Honouring Mrs. Veena Rajesh and Prize distribution of PHARMAFLIX Competition
On November 15, 2023

SNGM College of Pharmacy, Thuravoor



Mrs. Veena Rajesh being honoured for her dedicated work , social commitment and contributions during Covid-19 pandemic in Dubai and Sharjah.





GALLERY

Medichoice

Panel discussion on 'Generic drugs and Branded drugs' On November 2, 2023
St. Joseph's College of Pharmacy, Cherthala



PHARMLINE

The Official Publication of Kerala Pharmacy Graduates' Association

PHARMLINE is the official publication of KPGA and is published since 1981. It is a tri annual publication. The main aim of the publication is to keep Pharmacists informed on current issues and best practices, as well as serving as a platform for the exchange of ideas, knowledge and opinion among Pharmacists and related disciplines. The Publishers welcome contributions of Pharmaceutical relevance. Original articles are considered for publication on the condition that they have not been published, accepted or submitted for publication elsewhere. The Editors reserves the right to edit manuscripts to fit articles with in space available and to ensure conciseness, clarity and stylistic consistency. All scientific articles submitted for publication are subject to a double-blind review procedure.

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