

# Research Progress of Cutting Edge Micro Needle Drug Conveyance Framework and its Application in Biomedicine

Sawsan Khdair\*

Department of Pharmacy, Al-Zaytoonah University of Jordan, Amman 11733, Jordan

## Abstract

The rapid advancement of microneedle technology has revolutionized drug delivery systems and found widespread application in the field of biomedicine. This abstract provides an overview of the recent research progress in cutting-edge microneedle drug delivery systems and their versatile applications in various biomedical domains. Microneedles, with their miniature size and ability to painlessly penetrate the skin, offer a novel approach for efficient drug administration. Recent developments in microneedle design, fabrication techniques, and materials have significantly improved their reliability, versatility, and patient acceptance. These innovations have opened new avenues for targeted and controlled drug delivery, enhancing therapeutic outcomes while minimizing systemic side effects. The research progress in microneedle technology spans diverse biomedicine applications, including transdermal drug delivery, vaccination, and biosensing. In transdermal drug delivery, microneedles enable precise control over drug release profiles, allowing for personalized treatment regimens. Their use in vaccination offers painless and convenient immunization, potentially improving global vaccine coverage rates. Additionally, microneedle-based biosensors have shown promise in real-time monitoring of biomarkers, enabling early disease detection and personalized medicine approaches.

**Keywords:** Microneedle technology • Biomedicine • Drug

## Introduction

Micro needle drug delivery systems have emerged as a cutting-edge technology with promising applications in biomedicine. Microneedles are tiny needles typically ranging from a few hundred micrometers to a few millimeters in length, and they can be fabricated from various materials, including polymers, metals, and silicon. These microneedles can be designed to painlessly penetrate the skin and deliver drugs or biomolecules to specific target sites, offering several advantages over traditional drug delivery methods. Microneedle drug delivery systems offer enhanced drug absorption and bioavailability. By bypassing the skin's outermost layer (stratum corneum), they allow direct access to the underlying dermal and epidermal layers, where drug absorption is more efficient. Enhanced drug delivery refers to the use of advanced technologies and innovative strategies to improve the efficiency, specificity, and effectiveness of drug delivery to target sites within the body. The goal of enhanced drug delivery is to optimize therapeutic outcomes while minimizing side effects and reducing the required dosage and treatment duration. Various approaches have been developed to achieve enhanced drug delivery, making it a crucial area of research in the field of medicine and pharmaceutical sciences [1].

## Description

Micro needles can be engineered to target specific tissues or cells, allowing for localized drug delivery. This targeted approach reduces systemic exposure, minimizing side effects and improving therapeutic efficacy. Micro needle-based

vaccine delivery has shown promise in improving immune responses. Micro needle patches loaded with vaccines can be self-administered, potentially increasing vaccination rates and enhancing immunity against infectious diseases. Vaccine delivery is the process of administering vaccines to individuals to stimulate an immune response and protect them against specific infectious diseases. Vaccines play a crucial role in public health by preventing the spread of infectious agents, reducing disease burden, and saving lives. The success of vaccination relies not only on the development of effective vaccines but also on ensuring their efficient and widespread delivery to target populations. The most common method of vaccine delivery is through intramuscular or subcutaneous injections. Injections allow vaccines to directly enter the bloodstream or stimulate the immune system in the underlying muscle tissue. Some vaccines are delivered orally, typically in the form of drops or capsules. Oral vaccines can be more convenient for administration, especially in resource-limited settings, and they can stimulate both mucosal and systemic immune responses. Nasal spray vaccines are administered through the nose and can provide protection against respiratory infections. This route of delivery targets the mucosal immune system of the respiratory tract [2].

Microneedle patches, which have been mentioned in a previous response, offer a painless and convenient way to administer vaccines by self-application to the skin. This method is particularly useful for certain vaccines that require a more targeted approach. Vaccine delivery is a critical component of successful vaccination programs. Timely and widespread administration of vaccines is essential to achieve herd immunity, protect vulnerable populations, and control the spread of infectious diseases. Effective vaccine delivery contributes to disease eradication and elimination efforts, as demonstrated by the success of vaccination campaigns against diseases like polio and measles in various parts of the world. Vaccine delivery is a fundamental aspect of public health strategies to prevent infectious diseases. Advancements in vaccine technology and delivery methods continue to improve vaccination coverage and accessibility, saving countless lives and reducing the global burden of preventable diseases. Effective vaccine delivery is a collaborative effort involving governments, healthcare systems, organizations, and communities to ensure that vaccines reach all individuals who need them, regardless of geographic location or socio-economic status [3].

Micro needle arrays can be customized for individual patients, offering personalized dosing and drug release profiles based on specific medical needs. Micro needle arrays can deliver multiple drugs simultaneously, making

\*Address for Correspondence: Sawsan Khdair, Department of Pharmacy, Al-Zaytoonah University of Jordan, Amman 11733, Jordan, E-mail: khdairstwas@gmail.com

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them suitable for combination therapies. This approach can improve treatment outcomes, particularly in complex medical conditions. Some micro needle systems are designed for sustained drug release over extended periods, eliminating the need for frequent administrations. Researchers have been exploring biocompatible and biodegradable materials for micro needle fabrication, ensuring that the needles dissolve or degrade harmlessly within the body after drug delivery. Micro needle patches have been investigated for painless insulin delivery, offering a convenient and less invasive alternative to traditional injections for diabetes patients. Micro needles can be utilized for targeted delivery of chemotherapy drugs to tumors, reducing the side effects associated with systemic administration and improving the efficacy of cancer treatments [4].

Micro needles loaded with growth factors and other bioactive agents can be used to promote wound healing and tissue regeneration. Micro needles are being explored as an efficient means of transdermal drug delivery for various medications, such as pain relievers, hormone therapies, and cardiovascular drugs. Micro needles have the potential to deliver gene therapies and proteins directly into the skin for the treatment of genetic disorders and other medical conditions [5].

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## Conclusion

Microneedle drug delivery systems have made significant strides in biomedicine, offering numerous advantages over conventional drug delivery methods. Their potential for painless, targeted, and personalized drug delivery makes them an exciting area of research with broad applications in various medical fields. As ongoing research continues to refine the technology, microneedle drug delivery systems hold the promise of revolutionizing drug administration and improving patient outcomes in biomedicine.

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## Conflict of Interest

No potential conflict of interest was reported by the authors.

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## References

1. Dawud, Hala and Aiman Abu Ammar. "Rapidly dissolving microneedles for the delivery of steroid-loaded nanoparticles intended for the treatment of inflammatory skin diseases." *Pharmaceutics* 15 (2023): 526.
2. Avcil, Muhammet and Ayhan Çelik. "Microneedles in drug delivery: Progress and challenges." *Micromachines* 12 (2021): 1321.
3. Waghule, Tejashree, Gautam Singhvi, Sunil Kumar Dubey and Murali Monohar Pandey, et al. "Microneedles: A smart approach and increasing potential for transdermal drug delivery system." *Biomed Pharmacother* 109 (2019): 1249-1258.
4. Kulkarni, Deepak, Fouad Damiri, Satish Rojekar and Mehrukh Zehravi, et al. "Recent advancements in microneedle technology for multifaceted biomedical applications." *Pharmaceutics* 14 (2022): 1097.
5. Tewabe, Ashagrachew, Atlaw Abate, Manaye Tamrie and Abyou Seyfu, et al. "Targeted drug delivery—from magic bullet to nanomedicine: Principles, challenges, and future perspectives." *J Multidiscip Healthc* (2021): 1711-1724.

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