



Keywords : Bioengineering; Insulin delivery systems; Diabetes mellitus; Nanotechnology; Controlled-release formulations; Implantable devices; Microneedle arrays; Smart insulin pens

Introduction

Diabetes mellitus is a chronic metabolic disorder characterized by impaired insulin production or utilization, necessitating exogenous

yet the quest for optimal insulin delivery systems continues. Bioengineering approaches offer innovative solutions to enhance insulin delivery, aiming to improve efficacy, safety and patient adherence. This discussion delves into the latest advancements in bioengineering technologies for developing next-generation insulin delivery systems and their potential impact on diabetes management. Bioengineering approaches offer innovative solutions to enhance insulin delivery, aiming to improve efficacy and patient adherence. Advanced encapsulation techniques protect insulin from degradation and facilitate controlled release, prolonging its pharmacokinetic profile. Novel delivery modalities like microneedle arrays enable painless and minimally invasive administration, enhancing patient comfort and compliance. Implantable devices provide sustained release of insulin, reducing the need for frequent injections and improving convenience. Biocompatible materials ensure device compatibility and controlled drug release, minimizing inflammatory responses and improving patient outcomes. Controlled-release formulations and nanotechnology

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