

# Innovative Approaches in Diabetic Foot Ulcer Management

Advancements in technology have resulted in improved outcomes.

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*Editor's Note: This paper was the winner of the 38th Annual APMWA Student Writing Competition.*

**A**ccording to the International Diabetes Federation, those with diabetes have a 25% increased risk of developing foot ulcers, and one individual undergoes a lower limb amputation every 30 seconds on average (Raghav, et al., 2018). In the United States alone, diabetes care creates an estimated \$273 billion in direct costs and \$90 billion in indirect costs (McDermott, et al., 2023). The major source is foot complications, which lead to increased rates of hospitalizations, emergency department visits, outpatient visits, and home healthcare utilization; this translates to an astounding 200% increase above baseline-costs of diabetes-related care (McDermott, et al., 2023). For instance, within a year those with diabetic ulcers face costs of 5.4 times more than those with their initial diabetic foot ulcers, and 2.8 times higher than those who have ones in subsequent years. Additionally, those with advanced-stage ulcers have a \$50,000 cost per wound (Driver, et al., 2010). Therefore, addressing the prevention and management of diabetic foot ulcers is imperative not only to alleviate human suffering and promote overall well-being but also to mitigate healthcare costs.

## Current Standards

Current standards of care for diabetic foot ulcers include debridement, glycemic and infection control, patient education, negative pressure wound therapy, platelet-rich plasma, growth factors, cellular dermal regeneration templates, acellular dermal matrices, re-purposed medications, stem cell therapies, allografts, skin substitutes, hyperbaric oxygen ther-

implants, and bioengineered tissues. 3D printing in medicine is a feasible method that assures patient-specific design, high complexity, on-demand and cost-effective fabrication, and high productivity (Liaw & Guvendiren, 2017). With further investment in novel treatment approaches alongside 3D-bioprinting, pathophysiological challenges associated with diabetic foot ulcers can be addressed

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apy, and surgical modalities (Dasari, et al., 2021); however, given the escalating prevalence of diabetes mellitus, there's a pressing need for advanced care and management strategies. Therefore, serious consideration should be weighed to embrace innovative approaches for diabetic foot ulcers.

## 3D Printing

One option to pursue is three-dimensional (3D) printing. In the past decade, this technology has made significant contributions across multiple sectors. In healthcare, it has led to advancements in prosthetics,

better and healthcare costs can be decreased (Liaw & Guvendiren, 2017).

As an illustration, scientists at Queen's University in Ireland have developed 3D-printed bandages, referred to as scaffolds, aimed at healing diabetic foot ulcers (Lamprou, 2023). Constructed from lipid nanoparticles and hydrogels, these bandages release antibiotic-loaded molecules rapidly within the initial 24 hours, followed by a gradual release the following ten days (Lamprou, 2023). Additionally, they streamline the workload and expenses of medical personnel by eliminat-

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## Foot Ulcer (from page 101)

ing the need for frequent dressing changes, and they can be produced off-site, enhancing sustainability and cost-efficiency.

### Self-Regulating Footwear

Another example emphasizes self-regulating footwear for diabetics, as most therapeutic footwear accessible in the market does not address

autologous minimally manipulated homologous adipose tissue (3D-AMHAT) in reconstructive surgery for a patient with multiple co-morbidities, rendering traditional flap reconstruction unfeasible (Armstrong, et al., 2022). Consequently, the patient experienced no complications such as autolysis, graft failure, or infection, and observed a reduction in wound size, thereby averting the need for amputation (Armstrong, et al., 2022).

greatly diminished and the well-being of diabetic patients is safeguarded with utmost assurance, thus becoming more of an achievable reality. **PM**

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## With further investment in novel treatment approaches alongside 3D-bioprinting, pathophysiological challenges associated with diabetic foot ulcers can be addressed better and healthcare costs can be decreased.

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abnormal gait cycles of diabetics. Researchers at the Indian Institute of Science and Karnatka Institute of Endocrinology and Research produced a 3D-pair of sandals that includes a snapping mechanism of an inverted shape for pressures to be applied beyond certain thresholds for balance, prevention of injuries, and faster healing of injured areas (Maharana et al., 2022). The sandals are tailored specifically based on weight, foot size, walking speed, and pressure distribution, and are much cheaper than traditional solutions that involve electromechanical approaches such as sensors and actuators (Maharana, et al., 2022).

In the field of surgery, researchers Yoon and Song employed 3D-printed

This underscores the significance of collaborative care involving both surgeons and patients in embracing innovative approaches to reconstructive surgery.

### Conclusion

In conclusion, diabetes mellitus stands as a global health crisis, affecting many worldwide and imposing significant burdens on individuals, healthcare systems, and economies. The prevalence of diabetic foot ulcers, a common and debilitating complication of diabetes, further exacerbates these challenges. However, advancements in technology and innovative approaches like 3D-printing offer hope for prevention and management of diabetic foot ulcers.

From 3D-printed bandages to self-regulating footwear tailored for diabetics, these groundbreaking solutions offer promise in reducing incidence of complications and associated healthcare costs. Moreover, as demonstrated by successful application of 3D-bioprinting in reconstructive surgery, collaborative efforts among researchers, healthcare providers, and patients are vital in embracing these innovative approaches and improving outcomes for individuals living with diabetes. By investing in novel treatment strategies and harnessing the potential of technology, the burden of diabetic foot ulcers is



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