



## Review

## Health economics of diabetic foot ulcer and recent trends to accelerate treatment

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## ABSTRACT

Diabetic foot ulcer is a preventable complication of diabetes that imposes a significant burden on the community. It leads to amputation and increased disability if left untreated and thus bears profound implications on the individual, the community and the health system at large. Diabetic foot (DF) is an area of research interest where interdisciplinary researchers are trying to elucidate the best strategy to halt the progression of chronic diabetic wounds. It is an area where tissue engineering research is making a strong impact through the use of scaffolds and skin substitutes for diabetic wound healing. This review aims at discussing the geographical health economics, its impact on healing and factors influencing financial costs of DFU. The upcoming economic and clinical impacts due to disease outbreak such as the 2020 COVID-19 has also been discussed. Finally, it will discuss novel therapy available with emphasis on skin tissue engineering scaffolds with a cost-benefit analysis. The review aims at promoting better management of people with diabetes with emphasis on emerging treatments and technologies.

## 1. Introduction

Diabetes mellitus affects more than 400 million people worldwide. The International Diabetes Federation (IDF) estimates that there were 463 million people living with diabetes in 2019 globally and in 2045 there will be more than 700 million people living with diabetes. IDF further projects that the prevalence of Diabetes Mellitus will multiply rapidly with a more pronounced increase in West Pacific, South East Asia, Mediterranean and North Africa, that is the rapidly developing region [1] (Fig. 1A). However, this is not in proportion to the estimated healthcare budget increase for diabetes (Fig. 1B). Another interesting fact is that diabetes expenditure seems to be in line with the GDP per region (Fig. 1C).

Diabetes foot problems, including diabetic foot ulcer (DFU), contribute to significant morbidity and mortality globally due to repeated hospital admissions and the risk of amputations, incurring substantial healthcare costs. The costs escalate if the prevalence and complexity of diabetic foot problems increase. It is reported that people living with diabetes have up to 40% risk of undergoing a lower extremity amputation, while the lifetime risk of developing a DFU is around 25%. It is estimated yearly that 67% amputations in the United States and

90% of amputations in the United Kingdom are related to diabetes [2]. A meta-analysis [3] demonstrated a geographical variance in the prevalence of DFU where Belgium had the highest prevalence with a rate of 16% and Australia the lowest with a rate of 1.2%. This study evaluated 67 studies with different methodologies across the globe. Most of the studies originated in Asia and Europe and covered a total population of 801 985 participants. While the prevalence differed by region, the overall prevalence worldwide was 6.3%. Several risk factors have been identified including type 2 diabetes mellitus, age, longer duration of diabetes, male gender, body mass index, smoking and the presence of complications such as diabetic nephropathy and peripheral vascular disease.

For people living with diabetes, lower extremity amputations (LEA) are positively associated with peripheral vascular disease, ulcers or infections [4] (Fig. 2). It is believed that with effective intervention and management of DFU, amputations can be averted, reducing the long term burden on the economy and health system.

Various preventive and curative strategies have been devised to prevent DFU and avoid amputations. Interventions consist of improved topical agents and dressings, innovative approaches such as hyperbaric oxygen therapy and negative pressure wound therapy as well as newer

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