

Tech & Innovation, Shaping Foot Care of the Future: The DRIFT Project

KEY WORDS

Diabetic foot, foot ulceration, health-tech, innovation, foot screening

BACKGROUND

Diabetes Mellitus (DM) affects 8.5% of the global population, while in Malta, approximately 37,800 individuals (11.2% of the Maltese population) are affected by the condition.¹ Individuals living with diabetes are at risk of developing foot complications, such as foot ulceration, which can lead to amputations followed by permanent disability and reduction in quality of life and independence.² This is set to increase in the coming years, because of an aging population, sedentary lifestyle, and an altered dietary pattern. In Malta alone, diabetes leads to more than 400 lower limb amputations every year, with more than half of these amputees losing their lives within 5 years of the intervention.³ However, through research we know that 85% of these amputations can be prevented with proper screening, prevention programmes and timely management of the disease.⁴ Current foot screening programs require the individual to attend the hospital on routine basis, with such services being harshly impacted during the months due to the COVID-19 pandemic.⁵ This was not only witnessed locally, but also at a global level. This unprecedented situation has been well documented in a retrospective study published by Rastogi et al. in 2021.⁶ Furthermore, the WHO (2020a) reported that out of 155 countries, half of them had partially or completely disrupted health services related to diabetes care and management during May 2020.⁷ Apart from the disruption of non-emergency foot care services, high-risk patients themselves were reluctant and fearful to seek medical assistance during this period.⁸ This may account for the increase in lower limb complications witnessed during the COVID-19 period. In fact, more severe presentations of peripheral arterial disease (PAD) were observed during this time with individuals living with DM being 10.8 times more likely to undergo any level of amputation, while risk for a major amputation (transfemoral or transtibial) stood at 12.5 times higher.^{9,10}

RETHINKING THE PROVISION OF HEALTHCARE

These circumstances have shed light on the many challenges faced in the delivery of care, and the importance for a healthcare system to adapt and remodel itself to address and meet the current demands. The COVID-19 pandemic has necessitated a switch from the traditional way of providing foot care services to other innovative methods care. A good example of this is teleconsultations and remote patient monitoring, which have been widely and increasingly utilized in the past months with success.¹¹

A digital transformation of diabetes foot care has the potential to empower individuals living with diabetes to manage their care by improving the quality and continuity of care provided in the hospital setting and extended in the home and work environment. Enabling people living with diabetes or those at high risk of developing diabetes-related foot complications to manage their condition with integrated digital solutions should be highly considered.

INNOVATION IN THE PREVENTION OF DIABETIC FOOT COMPLICATIONS

Recent advances in the diabetes care paradigm have brought us into a new era of care. Among these are digital medicine products, including continuous glucose monitors, connected insulin pens, and advanced hybrid closed-loop insulin pumps – all targeted at keeping stable glucose levels.

An area that has in recent years attracted significant interest for the prevention of foot ulcerations, is the monitoring of foot temperatures. Elevated skin temperature has been associated with pressure ulcer development in several studies, with any condition that increases skin temperature being suggested to increase the susceptibility to tissue breakdown.¹²⁻¹⁵ It is known that prior to skin breakdown and ulceration, the temperature of the designated area in the foot increases due to localised inflammation – this is known as a ‘warm spot’. This is often brought about by footwear with increased friction between the skin and the shoe interface.



Consequently, the monitoring of skin foot temperature has been used, and proved to be an effective approach in determining the health status of the foot and in preventing foot complications. For example, one study found that 97% of non-traumatic diabetic foot ulcers (DFU) were properly detected through foot temperature assessment around 5 weeks before any visual signs of such DFUs appeared on the foot.¹⁶ Hence, foot temperature monitoring at home could greatly help individuals living with diabetes to identify the 'pre-ulcerative' foot and to predict complications at a much earlier stage.

Over the years, this has led to the development of various foot temperature measurement systems. While some are used solely as research tools in controlled lab environments, others have been made available as clinical tools for use by medical professionals, and a few are also commercialised as consumer products for home use by the patients.¹⁷

THE DRIFT (DENSE RECORDING OF IN-SHOE FOOT TEMPERATURES) PROJECT

Reducing the risk of developing foot complications in diabetes is the logical first priority. Researchers at the University of Malta (UM) in collaboration with Mater Dei Hospital are currently developing smart insoles with embedded thermal sensors that interact with the sole of the foot. This wearable sensor-rich in-shoe monitoring system consists of a dense array of sensors for foot condition and patient activity monitoring, developed to detect arising problematic foot conditions at an early stage. The system will provide users with real-time alerts and suggestions for remedial actions, and can also be used to provide clinicians and consultants with access to regular objective data relating to the patient's condition. This innovative technology aims to transform care for people with diabetes, will aid the clinician to better devise preventive care management, and will significantly reduce the financial burden on the healthcare system by not only reducing the number of ulcerations and amputations, but also improving patients' quality of life.

CONCLUSION

The COVID-19 pandemic has highlighted possibilities and the need for technological advancement products and solutions to support diabetes care. Embracing the change in the delivery of care, will not only be of benefit for the user (patient) but will also provide the clinician with easily available objective data to better devise management care programmes to prevent injury and

reduce the number of ulcerations and amputations in this specific population. This novel approach will bring a paradigm shift in diabetic foot care, bridging self-care and health care.

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