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TITLE Revolutionising Diabetic Foot Ulcer Assessment with AI-Powered Tissue Segmentation

AUTHORS Professor Ashad Kabir (1,2), Dr Sayed Ahmed (3), and Jill Featherston (4)

EMAIL akabir@csu.edu.au; sayed@footbalancetech.com.au; Jillf **INSTITUTION** (1) School of Computing, Mathematics and En

ABSTRACT (maximum 450 words. Please use the following or similar headings: Background/Methods/Results/Conclusions)

Background:
Chronic wounds, including diabetic foot ulcers, are a major global health issue, leading to significant costs and negative impacts on patient quality of life. Accurate assessment of wound tissue types is essential for effective treatment planning and monitoring. However, traditional visual assessment is time-consuming and can vary significantly between clinicians, leading to inconsistent care. Recently, artificial intelligence (AI) has emerged as a promising tool to help clinicians identify and segment different types of wound tissue more consistently and accurately. Yet, progress in this area has been slowed by the lack of high-quality, publicly available wound image datasets and standardised evaluations of AI systems.

Methods:
We created a novel dataset of 147 wound images that includes six key tissue types that clinicians typically assess: slough, granulation, maceration, necrosis, bone, and tendon. These images were labelled in three formats to test different ways of training AI systems: full-image labelling, smaller patches, and superpixel-based labelling (which breaks images into meaningful regions). We then conducted a comprehensive study to assess the performance of various AI models on these images. This included evaluating over 82 different approaches, ranging from widely used AI systems that segment images into different tissue types to methods that classify images based on learned patterns.

Results:
Our study found that the way images were labelled had a significant impact on AI performance. AI models trained on full images generally performed better than those trained on smaller patches or superpixel regions, suggesting that more holistic labelling improves accuracy. Among the many models tested, one approach known as FPN+VGG16 achieved the best results, correctly segmenting tissue types with an average Dice score of 82.25%, a metric indicating strong agreement between the AI and expert annotations. In addition, classification approaches using AI to extract features from images also showed promise as simpler, effective alternatives. These findings highlight the potential for AI to support clinicians by providing more consistent, objective wound tissue assessments.

Conclusions:
This study offers the first comprehensive comparison of AI methods for wound tissue assessment using a newly developed, publicly available dataset designed to meet clinical needs. By systematically evaluating different labelling strategies and AI models, we provide practical guidance for developing reliable tools to assist clinicians in diagnosing and monitoring chronic wounds, including diabetic foot ulcers. Importantly, this research lays the foundation for integrating AI models into user-friendly mobile applications for ulcer assessment, enabling clinicians to capture wound images at the point of care and receive instant, consistent tissue analysis. Such tools have the potential to standardise wound assessments across settings, improve clinical decision-making, and ultimately enhance patient outcomes. We hope this work will encourage further research and adoption of AI-based solutions in wound care practice.