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Advancing Diabetic Foot Ulcer Care: AI and Generative AI Approaches for Classification, Prediction, Segmentation and Detection

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ADMINISTRATIVE INFORMATION

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Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 12 February 2025 and was last updated on 12 February 2025.

INTRODUCTION

Review question / Objective This systematic review aimed to answer the following research question: RQ1: What are the roles of AI in managing DFU? RQ2: What factors have been identified as important in DFU research? RQ3: What are the benchmark datasets used in DFU research? RQ3: What role do generative AI techniques play in overcoming challenges? RQ5: What are the major challenges and future directions in using AI for DFU management?

Rationale The specific contributions of this paper are as follows: (i) A review of the integration of AI in the classification, prediction, and segmen-tation of DFUs. (ii) An exploration of the role of generative AI in enhancing data augmen-tation and addressing limitations in dataset availability. (iii) An examination of innova-tions in mobile application technologies for the monitoring and management of DFUs.

Condition being studied Diabetic foot ulcers (DFUs) represent a significant challenge in managing diabetes, lead-ing to higher patient complications and increased healthcare costs. Traditional ap-proaches, such as manual wound assessment and diagnostic tool usage, often require significant resources, including skilled clinicians, specialized equipment, and extensive time. Artificial intelligence (AI) and generative AI offer promising solutions for improving DFU management. This study systematically reviews the role of AI in DFU classification, prediction, segmentation, and detection. Furthermore, it highlights the role of generative AI in overcoming data scarcity and the potential of AI-based smartphone applications for remote monitoring and diagnosis.

METHODS

Search strategy The search strategy was conducted across multiple databases, including PubMed, IEEE Xplore, Google Scholar, Scopus, and Web of Science, to comprehensively retrieve rel-evant studies. A combination of keywords was used, including “diabetic foot ulcers”, “ar-tificial intelligence”, “machine learning”, “generative AI”, “mobile applications”, “classi-fication”, “prediction”, “segmentation”, and “detection.” Boolean operators (AND/OR) were applied to refine the search results and ensure thorough coverage of the literature.

Participant or population Diabetic foot ulcers Patients.

Intervention 1. The use of Artificial Intelligence (AI) and Deep Learning (DL) models for Diabetic Foot Ulcer (DFU) Classification, Prediction, Detection and Segmentation. 2. Generative AI for Data Augmentation. 3. AI-based mobile applications for Diabetic Foot Ulcer (DFU) management.

Comparator Not applicable.

Study designs to be included The study emphasizes the progress achieved by integrating AI into DFU management. The review explored developments in AI-driven classification, prediction, segmentation, and detection in several areas, such as enabling early intervention and supporting personalized patient care. The study also highlighted the role of generative AI in addressing the issue of data scarcity and how smartphone applications contribute to enabling remote monitoring.

Eligibility criteria
The inclusion criteria:
• Articles focused on the application of AI or generative AI in DFU.
• Article published during the period from 2020 to 2025.
• The language was English.
The exclusion criteria:
• Articles focused on non-DFU-related medical imaging or conditions.
• Articles unrelated to AI applications in DFUs.

Information sources EndNote.

Main outcome(s)
1- AI model performance will be analyzed based on studies published between 2020-2025.
2- The evaluation of AI models for DFU management metrics assesses various aspects of model performance. Accuracy, F1 score. For segmentation tasks, Dice Score and IoU. For prediction tasks, MAE, RMSE, MAE, RMSE.

Quality assessment / Risk of bias analysis If a study lacks a clear methodological framework, e.g., poor in dataset or model validation, it will be excluded.

Strategy of data synthesis 1. Studies will be categorized by AI model purpose: Classification, Prediction, Segmentation and Detection, or genetative AI, or AI-based mobile applications. 2. The analysis will highlight the challenges of AI in DFU management. 3. Identify the key factors for DFU management. 4. Identify the public dataset for DFU management.

Subgroup analysis To explore potential variations in AI-based DFU classification, healing prediction, segmentation, and detection, a subgroup analysis will be conducted based on the following key factors:
1. AI Model Type
2. Study aim: classification, prediction, segmentation, or detection.
3. Dataset Type: image, numerical or both
4. Evaluation Metrics used.

Sensitivity analysis 1. Excluding non-DFU-related medical imaging or conditions Studies. 2. Excluding Studies with Missing or Incomplete Data.

Country(ies) involved Saudi Arabia.

Keywords diabetic foot ulcers, artificial intelligence, machine learning, generative AI, mobile applications.

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