

A VISUAL DATASET OF DIABETIC FOOT ULCERS FOR AUTOMATED DETECTION USING COMPUTER VISION

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ABSTRACT

Background: Diabetic foot ulcers (DFUs) are a common complication of diabetes mellitus that require continuous monitoring, particularly in homecare settings. Computer vision offers promising tools for automating wound assessments. This study aimed to develop a visual dataset of diabetic foot ulcers to support future computer vision applications for automatic wound detection. **Methods:** A total of 30 patients with diabetes (13 men and 17 women) receiving homecare services at Kartika Husada Clinic, Malang Regency, and its affiliated group were included. Wound images were collected over four months using standardized photography. Each image documented the location, size, tissue condition, and signs of infection. **Results:** Most wounds were located on the plantar or heel areas. The visual characteristics included necrotic tissue, granulation, purulent discharge, and signs of inflammation. The dataset reflects variations in wound appearance and severity, which are essential for developing robust machine learning models. **Conclusion:** The resulting dataset provides a foundation for developing automated wound-detection tools using computer vision. This also supports the implementation of intelligent monitoring systems.

Keywords: computer vision, diabetic foot ulcer, homecare, image documentation, wound dataset.

DATASET VISUAL ULKUS KAKI DIABETIK UNTUK DETEKSI OTOMATIS MENGUNAKAN COMPUTER VISION

ABSTRAK

Latar Belakang: Ulkus kaki diabetik (*diabetic foot ulcers/DFU*) merupakan komplikasi umum pada diabetes melitus yang memerlukan pemantauan berkelanjutan, terutama dalam layanan homecare. Teknologi computer vision menawarkan pendekatan yang menjanjikan untuk mengotomatisasi proses pengkajian luka. Penelitian ini bertujuan untuk mengembangkan dataset visual ulkus kaki diabetik sebagai dasar pendukung pengembangan aplikasi computer vision untuk deteksi luka secara otomatis di masa mendatang. **Metode:** Sebanyak 30 pasien diabetes (13 laki-laki dan 17 perempuan) yang menerima layanan homecare di Klinik Kartika Husada Kabupaten Malang dan kelompok afiliasinya dilibatkan dalam penelitian ini. Pengambilan gambar luka dilakukan selama empat bulan menggunakan metode fotografi terstandar. Setiap gambar mendokumentasikan lokasi luka, ukuran luka, kondisi jaringan, serta tanda-tanda infeksi. **Hasil:** Sebagian besar luka ditemukan pada area plantar (telapak kaki) atau tumit. Karakteristik visual luka meliputi jaringan nekrotik, jaringan granulasi, eksudat purulen, dan tanda-tanda inflamasi. Dataset visual yang dihasilkan menunjukkan variasi tampilan dan tingkat keparahan luka yang penting untuk pengembangan model machine learning yang lebih andal. **Kesimpulan:** Dataset yang dihasilkan dapat menjadi dasar dalam pengembangan alat deteksi luka otomatis berbasis computer vision. Selain itu, hasil penelitian ini mendukung penerapan sistem pemantauan cerdas dalam pengelolaan luka kaki diabetik.

Kata kunci: computer vision, dataset luka, dokumentasi gambar, homecare, ulkus kaki diabetik.

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INTRODUCTION

Diabetes mellitus (DM) is one of the most widespread chronic illnesses globally, with complications that can significantly diminish the quality of life (Hossain et al., 2024, Antar et al., 2023). One of the most serious outcomes is the formation of diabetic foot ulcers (DFUs), which leads to considerable morbidity, extended hospital stays, and a heightened risk of lower limb amputation (AJM and RW., 2023, Jean-Baptiste et al., 2025). According to the World Health Organization (WHO), more than 830 million individuals worldwide live with diabetes as of 2022, and this figure is expected to continue to rise (WHO, 2024a, WHO, 2024b). In Indonesia, the situation is equally concerning, as the country is among the top five in the world with the highest number of diabetes cases (Tricruise, 2025).

Effective management of DFUs necessitates ongoing observation to identify signs of worsening, infection, or healing (Akkus and Sert, 2022, AJM et al., 2018). However, in numerous low- and middle-income regions, such as rural areas in Indonesia, access to specialized wound care is often restricted (Swaminathan et al.,

2024b, Swaminathan et al., 2024a). Homecare services present a viable alternative to hospital-based care; however, they frequently face challenges owing to a lack of trained personnel and dependence on subjective visual evaluations (Jafary et al., 2020, Landers et al., 2016).

Recent advancements in computer vision and artificial intelligence (AI) have opened new frontiers in medical image analysis (Kabir et al., 2025). Automated wound assessment systems using digital images have shown promise in detecting wound size, color changes, and infection. However, the development of such systems is hindered by the lack of high-quality, context-specific datasets, especially from Southeast Asian populations.

This study addresses this gap by developing a curated visual dataset of foot ulcers collected from patients receiving home-based care in Malang Regency, Indonesia. The dataset serves as a foundational resource for training and validating AI-based wound detection models tailored to meet local clinical needs.

METHODS

Study Design and Setting

This descriptive observational study was conducted to develop a curated image dataset of diabetic foot ulcers in patients undergoing home-based wound care. Data were collected at the Kartika Husada Primary Inpatient Clinic, Malang Regency, Indonesia, between June and August 2025.

Participants

A total of 30 patients diagnosed with diabetes mellitus and presenting with foot ulcers were enrolled using purposive sampling method. The inclusion criteria were as follows: diagnosis of diabetes mellitus (type 1 or 2), presence of active foot ulcers during the study period, receipt of homecare services from the clinic, and provision of informed consent for wound image documentation. Exclusion criteria included patients with extensive gangrene requiring hospitalization, those with active malignancies, and individuals who declined to provide written consent for wound image documentation.

The participants consisted of 13 males and 17 females, aged between 45 and 76 years.

Image Acquisition Procedure

Wound images were captured using a high-resolution smartphone camera in consistent lighting conditions. Each photograph included a reference scale (ruler) placed adjacent to the ulcer for size

estimation purposes. The ulcers were photographed from multiple angles (top-down and oblique) to ensure full visualization of the shape, depth, and surrounding tissue.

Image Parameters and Metadata

Each image was manually annotated with the following clinical metadata: wound location (plantar, dorsal, heel, toe, lateral), estimated wound size (in cm), tissue characteristics (granulation, necrotic, slough), signs of infection (erythema, pus, swelling, exudate), and patient demographic data (sex, age, comorbidities).

Data Processing and Storage

The images were anonymized and stored in a secure, encrypted folder for future processing. No personally identifiable information was included in the dataset. The dataset serves as a foundational training corpus for developing and validating machine learning models for diabetic wound detection. All images were captured using a smartphone camera a resolution of 12 MP.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of the Institut Teknologi Sains dan Kesehatan RS dr. Soepraoen Malang (approval number: KEPK-EC/275/VI/2025). All participants provided written informed consent prior to the data collection.

RESULTS

A total of 30 images of diabetic foot ulcers were collected from patients undergoing homecare treatment at the Klinik Kartika Husada Group, Malang Regency. The sample consisted of 13 male and 17 female patients. Image collection will be conducted over a three-month period from April to June 2025.

Each image captured variations in ulcer characteristics, including anatomical location, wound size, tissue color, exudate presence, signs of infection, and severity. The images range from superficial lesions to advanced ulcers with necrotic tissue and cellulitis. All images were captured using a standard digital camera under natural lighting conditions at a fixed distance of approximately 30 cm from the wound site.

To ensure representative coverage, nine images were selected for inclusion in the main manuscript based on their diversity in wound appearance and clinical relevance. These images are presented in Figure 1, showcasing the visual diversity critical for training and validating computer vision models for wound detection in homecare settings.



Figure 1. Representative images of diabetic foot ulcers in three homecare patients.

The remaining 27 images are provided as supplementary visual material in Appendix A1 and A2 (Images A1–A27). These appendices offer a comprehensive visual reference for researchers and practitioners working on automated wound detection systems.

DISCUSSION

This study contributes a novel visual dataset of diabetic foot ulcers (DFUs) obtained from patients receiving home care in Malang Regency, Indonesia. The dataset captured clinically relevant variations in ulcer appearance, including tissue necrosis, granulation, exudate, and infection. Such diversity is crucial for training robust computer vision models to support wound detection and monitoring in real-world homecare environments.

Our findings are consistent with those of previous studies that highlight the importance of dataset variability. For instance, the Ulcer Foot Optical Segmentation Network (UFOS-Net) study emphasized that existing DFU datasets often lack sufficient diversity in ulcer manifestations, which limits the segmentation model performance (Jiao et al., 2025). Similarly, the Zivot protocol demonstrated how standardized metadata and image collection enhance dataset usability for AI applications (Basiri et al., 2024). These insights strengthen the

relevance of our dataset, which represents images from a community-based homecare setting that is rarely covered in the existing literature.

This dataset has several implications for research. In clinical practice, it can support task-shifting in homecare by enabling nurses and caregivers to use AI-powered mobile tools for preliminary wound assessments. For AI research, it provides a localized foundation for developing deep learning models capable of handling diverse wound presentations, thereby addressing the generalization gap in previous datasets (Debnath et al., 2025). For policy and innovation, it demonstrates the feasibility of developing context-specific AI applications in nursing and community health, which aligns with the digital health transformation goals of low- and middle-income countries.

This study had several limitations. First, the dataset was relatively small ($n = 30$), which may constrain the diversity of wound presentations captured, as larger multicenter studies are typically required to represent the full clinical spectrum of diabetic foot ulcers (Liu et al., 2025). Additionally, all images were obtained from a single homecare clinic network in East Java, which may limit the generalizability of the dataset to populations with different demographic and healthcare characteristics of the patients.

Clinical metadata, such as Wagner grade, vascular status, and comorbid conditions, were not consistently annotated, thereby reducing the immediate applicability of the dataset for supervised machine learning tasks. Another limitation relates to potential lighting bias during image acquisition; home environments vary considerably in brightness, color temperature, and spatial constraints. Despite adherence to standardized photography procedures, differences in natural versus artificial light sources and variations in image angles may affect color integrity and overall consistency, potentially influencing the performance and interpretability of future AI model developments.

Future studies should expand the dataset to include larger and more diverse patient populations across multiple regions and detailed clinical annotations. The integration of segmentation masks, wound grading, and progression labels would enable the development of more sophisticated deep learning algorithms. Field-testing AI-enabled mobile applications in homecare scenarios is also critical for assessing usability, accuracy, and clinical impact. Finally, incorporating XAI approaches, as demonstrated in DFU_XAI (Basiri et al., 2024), is essential to ensure transparency and clinical trust in AI-based wound assessment systems.

CONCLUSION

This study introduces a novel dataset of 30 diabetic foot ulcer images collected from homecare patients in a real-world community setting in Indonesia. The dataset captures the visual diversity of wound conditions and is intended to support the development of automated detection tools using computer vision techniques. The inclusion of this dataset addresses the lack of localized, field-based data required to develop AI-powered health applications tailored for homecare scenarios. By making this dataset available, we aim to facilitate future innovations in wound care monitoring, particularly in regions with limited access to specialized services. Further work is recommended to annotate the dataset with clinical metadata, integrate segmentation or classification labels, and evaluate the performance of AI models trained on these data.

Patient Consent for Publication

Statement

Written informed consent for the publication of anonymized clinical images and related data was obtained from all participating patients prior to data collection.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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Data Availability

The image dataset generated and analyzed during the current study is available from the corresponding author on reasonable request, subject to ethical approval and patient privacy regulations.

Authors' Contributions

YA: Conceptualization, data collection, manuscript drafting. EW: Data analysis, methodology, critical revision. MA: Technical support, manuscript review, and editing. All authors read and approved the final manuscript.

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