Development of an Android-Based Wise (Wound Internet Assessment) Application for Assessing the Condition Status of Diabetic Ulcer Patients

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Abstract. Background: Documentation is one of the important components that can provide legal testimony, become a communication tool and educational resource as well as research resources.

Aim: To improve planning and successful implementation of technology, creative and targeted design can open opportunities for health technology to be more advanced in the future.

Methods: The literature search process was carried out on research for the last 5 years (2018–2022) in English selected from several databases indexed electronics like Web of Science, PubMed, Scopus, Sage and Pro Quest as well as writing article search results following appropriate protocols and rules by using Preferred Reporting Items then using JBI as critical assesment tool for Systematic Review and Meta-analysis (PRISMA) checklists and flow diagrams.

Results: In the last decade, the hardware for implementing Electronic Data Capture has become much cheaper and more accessible, so there is a need for a medium that can collect data related to the condition of diabetic ulcer patients not only visually from the wound but also data such as disease history, habitual patterns that can interfere with wound healing. This study used the Research and Development method and clinical trial which consisted of 2 stages.

Conclusion: Using electronic media as smartphone applications has advantages over documentation using paper and can provide more convenience for independent wound care practitioners.

Keywords: diabetic · wound · foot ulcer · documentation · application

1 Introduction

Diabetic foot ulcers are one of the most common chronic complications of Type 2 DM [1]. Chronic wounds are defined as those that failed to progress in the ordered and overlapping phases of healing, which are hemostasis and inflammation, proliferation and maturation and remodeling. They remain stationary in the inflammatory phase, despite proper wound management [2]. Chronic wounds are a significant and common cause of morbidity and mortality. These wounds are often multifactorial and pose a challenge to manage [3].

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Reportedly, there are more than 400 million adult diabetics worldwide and the number continues to increase. It is estimated that 25% of diabetics with poor glucose control will develop a foot ulcer in their lifetime and diabetic ulcers have become a major indication for lower limb amputation.[4]. The prevalence of diabetic ulcer patients in Indonesia is around 15%, the amputation rate is 30%, besides that the mortality rate 1 year after amputation is 14.8%. This is supported by Riskesdas data (2018) that the increase in the number of diabetic ulcer sufferers in Indonesia can be seen from the 11% increase in prevalence [5].

Most complications of diabetic ulcers including infection, gangrene and lower extremity amputation are preventable with effective chronic wound management. Documentation is an important component in chronic wound management which can provide legal testimony, become a communication tool and educational resource as well as a research resource [6]. Effective documentation will provide evidence of the services and care provided, show how decisions related to patient care are made, and thereby ensure continuity and consistency in the provision of care [7]. In recent decades, wound management tools have been advancing rapidly, and now there are a wide variety of dressings for wound care [8].

Documentation of the status of wound conditions carried out in the field generally still uses the paper-based method, where wound assessments are still mostly carried out with paper media. There are several weaknesses in using written forms to carry out documentation, such as data security which is not guaranteed due to damage due to storage errors and the inability to provide a basis long-term data [9].

To improve planning and successful implementation of technology, creative and targeted design can open opportunities for health technology to be more advanced in the future [10].

2 Methods

2.1 Literature Search

The literature search process was carried out on research for the last 5 years (2018–2022) in English selected from several databases indexed electronics like Web of Science, PubMed, Scopus, Sage and Pro Quest as well as writing article search results following appropriate protocols and rules by using Preferred Reporting Items then using JBI as critical assesment tool for Systematic Review and Meta-analysis (PRISMA) checklists and flow diagrams.

2.2 Search Strategy

A literature search was carried out on 5 databases namely Scopus, PubMed, Web Of Science, Sage and Pro Quest. The search was carried out in November 2022. The keywords used "("wound documentation" OR "wound assessment") AND ("diabetic ulcer" OR "diabetic foot") OR (" android" OR "mobile application") with restrictions in the year 2018–2022 in English and full text articles, so you get relevant articles.

Table 1 .

PICOT Framework	**Inclusion Criteria**	**Exclusion Criteria**
Problem	Article related to Android-based diabetic ulcer documentation	Documentation in non-diabetic ulcers
Intervention	Documentation in the form of an application	Documentation application that is not focused on ulcers
Outcomes	Applications can do documentation	Applications that are flawed/failed to document
Time	2017–2022	Outside the study time limit that has been determined
Study Design	*experimental quasy, case report,*cross sectional	*Literature review, Systematic review*
Language	*English* and Indonesian	Apart from Indonesian and English

2.3 Inclusion and Exclusion

Article inclusion criteria are. The articles taken were from the last 5 years with a quasy experimental design, case report, cross sectional. The purpose of this study is to develop a WISE application that can be used in documenting the wound condition status of diabetic ulcer patients, so articles without full text and not explaining the documentation of wound condition status are excluded.

10 selected articles were obtained from the 547 articles found. The PICOT in determining inclusion and exclusion criteria in article search is as follows in the table (Table 1).

2.4 Study Selection

The number of articles identified were Scopus 2 articles, PubMed 87 articles, Web Of Science 241 articles, Sage 103 articles and Pro Quest 114 articles for a total of 547 articles. Then a screening was carried out based on the identification of the titles of 411 articles for feasibility review. Articles were screened based on the identification of the title obtained 31 articles. Full text article feasibility test, leaving 10 research articles for review. The following is a flowchart of the study selection process (Fig. 1).

2.5 Data Extraction

The following information was extracted from the 10 articles: information on the demographics, study design, outcome measures, sample size, used evaluation instrument, duration of intervention, country, and year of publication.

2.6 Data Collection Tools/Instrument Evaluation

In assessing the bias and methodological quality of this systematic review the Joanna Briggs Institute (JBI) critical assessment checklist tool was used. The risk of bias in

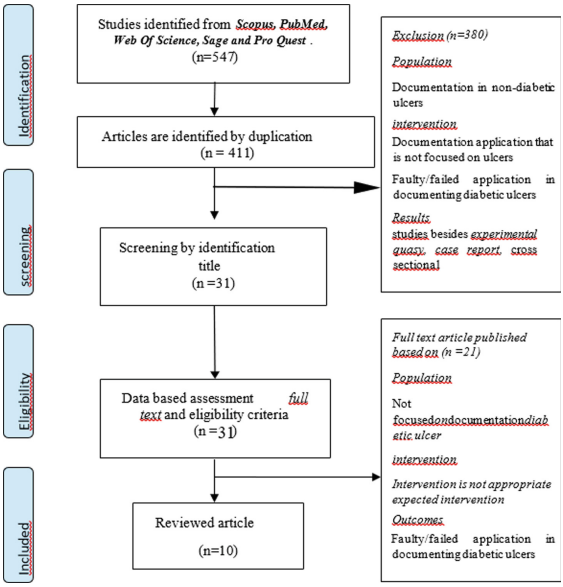

Fig. 1. Flowchart of the Articles Selected for the Systematic Review and the Selection Process Using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyzes).

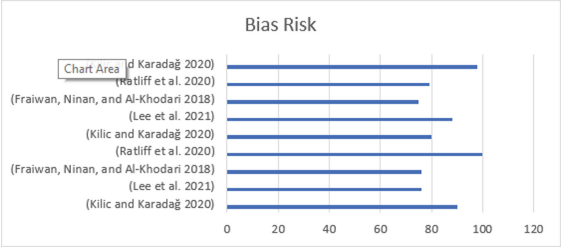

Fig. 2. Bias risk

each study after carrying out a critical appraisal average value of >80%, this shows that the study deserves to be used as a systematic review in making this systematic review article (Fig. 2).

3 Results

3.1 General Features and Types of Study

Of the 547 articles searched through the electronic database, 10 articles met the inclusion and exclusion criteria, with a publication year limit of 2018–2021. Articles in 2022 amounted to 1 (10%), year of publication in 2021 amounted to 4 (40%), year of publication in 2020 amounted to 4 (40%) and year of publication in 2018 amounted to 1 (10%). Research design randomized controlled trial 3 (30%), pilot study 2 (20%), case

Table 2 .

Year of publication	n	%
2018	1	10
2020	4	40
2021	4	40
2022	1	10
Type of study Randomized controlled trial	3	30
pilot studies	2	20
case report	1	10
prospective studies	1	10
non-experimental quantitative study	1	10
methodological study	1	10
cross-sectional	1	10

report 1 (10%), prospective study 1 (10%), cross-sectional 1 (10%), nonexperimental quantitative study 1 (10)% and methodological study 1 (10%) (Table 2).

After All studies analized and explained in detail that documentation interventions using electronic media/android in diabetic ulcer patients, with an average sample of 75 diabetic ulcer patients. Documentation of diabetic ulcers is carried out in several ways using handheld gadgets, including by using the temperature detection feature embedded in a smartphone so that it can detect changes in temperature in areas at risk of ulcers and their surroundings [11]. In addition, the camera on the smartphone is used to capture the holographic sticker that has been affixed to wound area a so that information related to injuries can appear automatically on the user's smartphone [12].

4 Discussion

The current wound assessment process is manual [13], Repetitive wound documentation is tedious but essential to chronic wound care [14]. Treatment plans and scheduling of follow-up assessments are based on the information found in the wound documentation. Wound information such as wound location, depth, size, edges, and surrounding skin conditions is often documented, but can vary in detail among different clinical practices [15]. Therefore, the introduction of digitalization of chronic wound management to reduce the burden for patients, clinicians, and the health care system is desirable.

digitalization with the aim of documenting diabetic wounds on smartphones carried out by presenting several features, shows that smartphone application-based documentation is superior to paper-based documentation [16].

The M-DFEET application has proven to be effective and reliable. This application is specially designed to make it easy for the user, especially her type 2 diabetic, to self-examine feet anytime, anywhere. The M-DFEET app also assesses the patient's

confidence in performing regular and independent foot examinations. The M-DFEET application employs a theoretical approach to increase the reliability of early detection of diabetic foot in patients with type 2 diabetes, which is expected to prevent diabetic foot complications and reduce causes of death [17].

According to Kuang et al. (2021) in his study entitled Evaluation of smartphone-based applications for measuring diabetic foot ulcers. The NDKare 3D meter provides excellent depth representation and rivals his WoundVue camera when it comes to volume. Two different users used each phone s (Samsung Galaxy S8+ and Apple iPhone 5). Despite these numerous variables, the results show that different users with different smartphones can achieve similar results using this software.

A study conducted by Friawan (2018) by developing a mobile application utilizing the capabilities of the FLIR ONE camera shows the overall image of the patient's feet with the help of BGR images. The blue figure shows areas with cold temperature in the image, and the red parts show warm areas, which indicates the process of developing diabetic foot ulcers. The results of the study show that by detecting a difference in temperature at -16 °C on the foot images provided, the system can predict areas at risk for ulcers [11].

Overall, the range of technologies that is researched in relation to supporting nursing care is quite extensive, but hardly any technology has been researched intensively enough to produce conclusive result [19]. The results of the review study above explain that the documentation that has been developed into a mobile phone application can be used to predict the likelihood of diabetic ulcers occurring in the foot area and assessment with digital media has a positive effect on documenting the status of the wound condition.

Authors' Contributions. All authors conceived the study. ABI, AB and RDT shared work in all stages of the screening process. ABI and AB performed the data extraction for the single studies, RDT performed the data extraction for the reviews, interpreted the results and wrote the first draft of the manuscript. All authors contributed to data analysis, drafting or revising the article, have agreed on the journal to which the article will be submitted, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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