REVOLUTIONIZING DIABETES CARE: MOBILE APP-BASED TELEDERMATOLOGY WITH INTERPROFESSIONAL COLLABORATION AND COMMUNITY EMPOWERMENT FOR MANAGING SKIN COMPLICATIONS OF DIABETES MELLITUS

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Abstract **Background**: Skin complications are common in diabetes mellitus (DM), often manifesting as infections, ulcers, and other dermatological conditions that impair quality of life and increase healthcare costs. Despite advances in medical technology, limited access to dermatological expertise, delays in diagnosis, and fragmented care systems remain significant barriers, particularly in resource-limited settings.
Objectives: This study aims to critically review innovative approaches that integrate teledermatology with interprofessional collaboration and community empowerment, offering novel insights into managing skin complications in diabetes mellitus.
Method: The peer-reviewed literature and empirical findings from PubMed and Scopus on teledermatology, interprofessional collaboration, and community empowerment in managing skin complications of diabetes mellitus are discussed. Given the limited clinical evidence on integrating teledermatology and collaborative care, this review explores existing practices and commonly employed therapies for diabetes-related dermatoses.
Results: Teledermatology improved access to care, reducing time to diagnosis by up to 40% and enhancing patient satisfaction scores by 80%. Interprofessional collaboration involving endocrinologists, dermatologists, nurses, and community health workers reduced complication rates by 25% and streamlined care coordination. These interventions showed significant promise in addressing gaps in current diabetes care models.
Conclusion: This study concluded that the combined approach of teledermatology with interprofessional collaboration and community empowerment represents a transformative and promising strategy in diabetes care, with the potential to improve outcomes, enhance healthcare efficiency, and serve as a scalable model for addressing chronic disease complications.

Keywords: collaboration, diabetes mellitus, diabetes-related dermatoses, skin, teledermatology.

BACKGROUND

Diabetes mellitus (DM) is one of the most prevalent chronic non-communicable diseases in Indonesia. Based on current data, the prevalence of diabetes in Indonesia is projected to increase to 16.09% in 2045 (40.7 million cases) from 9.19% in 2020 (18.69 million cases). Meanwhile, the number of deaths in diabetes mellitus patients is projected to rise to 955,468 cases in 2045 from 433,752 cases in 2020. In terms of healthcare costs, managing diabetes mellitus cases in Indonesia has incurred significant expenses, especially in cases with complications, ranging from approximately US $930/person/year to ± US $1480/person/year. [1,2]

One of the most common chronic skin complications in type 2 diabetes mellitus is diabetic foot ulcers (DFU). DFU is often associated with high mortality rates, morbidity, and substantial economic burden in its management in Indonesia, with an estimated prevalence of 7.3%. DFU may begin as an open wound on the foot that is difficult to heal, accompanied by tissue infections and foot problems due to nerve and/or arterial blood vessel disorders. If not properly treated, complications such as amputation can occur. (3,4) Other skin complications found in DM patients besides DFU include dry skin (xerosis cutis), necrobiosis lipoidica, diabetic dermopathy, bullosis diabeticorum, digital sclerosis, and acanthosis nigricans. [5]

Despite advancements in healthcare services, the management of skin complications in DM remains challenging due to delayed diagnosis, fragmented healthcare systems, and limited resources. [6–8] Delayed diagnosis is often an issue for patients in remote or underserved areas who lack access to dermatology specialists, hindering proper skin care. (6) Moreover, DM management often involves separate consultations among specialists, leading to uncoordinated care. [7] Limited resources such as inadequate infrastructure, insufficiently trained healthcare personnel, and low awareness of skin care often impede effective management. [8]

A comprehensive and accessible solution to improve the management of skin complications in DM is needed. Teledermatology, a recent technology that includes mobile phone applications, can be a viable solution to address the issues in managing skin complications in DM. [9–19]

METHODS

The peer-reviewed literature and empirical findings from PubMed and Scopus on teledermatology and interprofessional collaboration in managing skin complications of diabetes mellitus are discussed. Given the limited clinical evidence on integrating teledermatology and collaborative care, this review explores existing practices and commonly employed therapies for diabetes-related dermatoses.

RESULT AND DISCUSSION

The Role of Teledermatology in Managing Skin Complications in DM

Teledermatology was first introduced in 1993 in Norway. Its use has expanded rapidly in Europe and North America, driven by advancements in high-quality camera technology. Based on available data, only 41.9% of respondents are familiar with the term "teledermatology." [16] However, the COVID-19 pandemic accelerated the global adoption

of teledermatology and increased its utilization for remote consultations. Teledermatology offers numerous advantages over in-person consultations.
Teledermatology is more cost-effective than in-person consultations, with high satisfaction rates among both patients and physicians. (20) Younger individuals, women, and non-Caucasian populations are more likely to use teledermatology compared to in-person consultations. Attendance rates for teledermatology consultations are higher than for face-to-face visits. [19]

In terms of diagnostic reliability, the concordance rate between teledermatology and in-person consultations is 68.9%. The diagnostic accuracy is higher (71%) when performed by specialists compared to non-specialists (44%). [18] Teledermatology patients have greater trust in the professional skills of their doctors compared to in-person consultations. However, in-person patients feel more involved in decisions regarding their care. [21]

Health-related quality of life (HRQoL) reported by teledermatology patients is higher compared to those attending in-person consultations. [22] Additionally, teledermatology reduces per-patient costs from $245.66 to $196.04. Approximately 40% of cases are resolved at the primary care level without the need for specialist referrals. [23] Patient satisfaction with teledermatology increases with effective communication, including receiving care plans within 24 hours. [24] Enhanced communication reduces satisfaction score variations, emphasizing the importance of effective communication in improving patient experiences with teledermatology. [24] Most patients also find teledermatology convenient. [25] Accessibility and service quality are key factors supporting patient satisfaction in teledermatology utilization. [26] Most respondents (81.9%) expressed willingness to use teledermatology after learning about its services. [27]

Countries such as Australia, Norway, the United States, Singapore, China, Tanzania, Botswana, Canada, and India have implemented teledermatology according to their respective national guidelines. [28–36] In Indonesia, studies on teledermatology utilization have been conducted with previously trained healthcare workers. Diagnostic accuracy between healthcare workers and dermatologists increased from 46.9% to 77.2% over time. [37] Furthermore, research conducted in 2024 by Jones L et al. demonstrated the environmental benefits of teledermatology in mitigating climate change, with an average carbon emission reduction of 11.17 kg per virtual consultation compared to face-to-face visits. [17]

Teledermatology has several advantages and challenges in its application. Advantages include reducing consultation wait times and hospital visits, cost efficiency for monitoring skin conditions, effectiveness in diagnosis and follow-up, and improved access to healthcare without compromising patients' quality of life. [38] Challenges include image quality and technological infrastructure limitations, missed diagnosis risks, and the need for international legal and medical guidelines to protect patient privacy. Nonetheless, teledermatology holds promise for enhancing access, efficiency, and satisfaction in skin care, with potential for widespread acceptance if public awareness and technological infrastructure are improved.

Teledermatology improved access to care, reducing time to diagnosis by up to 40% and enhancing patient satisfaction scores by 80%. Interprofessional collaboration involving endocrinologists, dermatologists, nurses, and community health workers reduced complication rates by 25% and streamlined care coordination. These interventions showed significant promise in addressing gaps in current diabetes care models. [9–19]

Beyond teledermatology alone, a hybrid method combining teledermatology and in-person consultations is a preferred alternative, offering a balance of efficiency and accuracy. Studies suggest that most patients and doctors are satisfied with teledermatology, although they favor combining it with in-person consultations. Additionally, many patients still prefer direct visits for physical examinations. Therefore, teledermatology can complement rather than replace in-person care, ensuring broader acceptance in daily clinical practice. [9][27][39] Training, technological support, international guidelines, and integration of national and local policies are crucial to ensuring safe and effective implementation in the future. [11]

The Role of Interprofessional Collaboration in Managing Skin Complications in DM

Interprofessional team collaboration is a crucial component in managing diabetes and skin complications such as diabetic foot ulcers. This team may consist of various specialists, including general practitioners, nurses, internal medicine specialists, dermatologists, neurologists, and others. The core of the interprofessional approach is patient-centered care, where the patient becomes the focal point for all healthcare providers. Research shows that interdisciplinary collaborative approaches improve wound management outcomes compared to fragmented conventional approaches. Additionally, patient satisfaction and quality of life improve.[4,40,41]

One outcome of interdisciplinary collaboration is the development of a guideline as a decision-making tool in managing diabetic foot ulcers in DM patients. This guideline outlines the roles of each profession involved in the primary care team. Research in Canada shows that interprofessional care teams correlate with more accurate diagnoses and better wound healing outcomes than conventional community care services.[4,40,41]

The Role of Community Empowerment in Managing Skin Complications in DM

Community empowerment involves patients and their families in DM management through education and skill-building to address DM-related skin complications. Efforts may include educational training to teach the signs of skin complications and skin care procedures. Additionally, health cadres act as intermediaries, facilitating teledermatology consultations and providing follow-up care after consultations.[42,43]

Benefits of community empowerment include increased patient confidence in handling skin problems and reduced need for healthcare visits. Furthermore, education on early detection and management of skin complications can lower the risk of worsening complications, such as infections or amputations. Community involvement in managing DM skin complications fosters cooperation and mutual support within the community.[42,43]

CONCLUSION

A synergistic approach combining teledermatology and collaboration can be achieved through remote consultations via mobile applications guided by dermatologists, while local collaborative teams such as health cadres or nurses implement management plans developed by the doctors. Additionally, real-time communication facilitates sustained control and timely interventions. Community empowerment also plays a role in bridging patients and their families with healthcare professionals.

The integration of mobile app-based teledermatology with interprofessional collaboration and community empowerment is a transformative strategy in managing skin complications in DM. This model has the potential to improve patient prognosis, enhance healthcare service efficiency, and serve as a scalable solution, especially in remote areas.

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