Rasiel Joy del Rosario and Ruby Ann Serrame

Nurses' Role in the Management of Foot Ulcers in Type 2 Diabetes Mellitus in Clinical Settings

A Descriptive Literature Review

Metropolia University of Applied Sciences

Degree Programme in Nursing

Bachelor of Health Care

Bachelor's Thesis

May 2025

Abstract

Authors	Rasiel Joy del Rosario and Ruby Ann Serrame
Title	Nurses' Role in the Management of Foot Ulcers in Type 2 Diabetes Mellitus in Clinical Settings
Number of Pages	28 pages + 3 appendices
Date	22 May 2025
Degree	Bachelor of Health Care
Degree Programme	Nursing and Healthcare
Instructor	Linda Dinda

The purpose of this study was to describe nurses' role in managing foot ulcers in adults with type 2 diabetes mellitus (T2DM) in clinical settings. The aim was to understand how nurses utilize different interventions to manage diabetic foot ulcers in adults with T2DM, concentrating on prevention, foot ulcer care and patient education.

A qualitative study design was adopted as a methodological approach, using a descriptive literature review method. The data gathering of articles in this study were obtained from trustworthy references, CINAHL and PubMed based on inclusion and exclusion criteria. A total of thirteen (13) relevant articles were assessed and the data were analyzed through inductive content analysis.

Thirteen (13) articles were evaluated to find answers for two (2) study questions. For study question one (1), five (5) articles explored how nurses manage diabetic foot ulcers (DFUs) in adults with T2DM, identifying four (4) categories: physical assessment, neurological assessment, vascular assessment and infection control. For study question two (2), ten (10) articles discussed the role of nurses in DFU care, highlighting four (4) roles: leadership in nursing, patient advocate, health educator and collaborator.

Diabetic foot ulcers (DFUs) remain to be a severe medical consequences of diabetes and nurses contribute an important role in prevention through early detection and assessments. When equipped to lead, advocate, educate and collaborate, nurses can provide patient-centered care that lower the risk of infection, hospitalization and even amputation. Continuous education, training and teamwork can promote more favourable outcomes and greater life satisfaction for adults with DFUs.

Key Words	diabetic foot ulcers, type 2 diabetes mellitus, healthcare professionals, nurses, adults, patients

Contents

1 Introduction

Diabetic foot ulcers (DFUs) exhibit life threatening conditions related with diabetes arising from skin breakdown of the foot (Kim 2023: 328). Diabetic foot disease is characterized by deep tissue wounds, linked to existing or previously identified diabetes. Complications that can arise include peripheral neuropathy, peripheral artery disease (PAD), infections, ulcers, neuro-osteoarthropathy, gangrene and the possibility of amputation. Foot ulcers are one of the major health issues of type 2 diabetes mellitus (T2DM), potentially resulting in decreased standard of living and economic crisis for the individual. Additionally, it imposes significant strain on the individual's family and on the healthcare professionals as well as on the services to society. (Hu, Zhang, Chen and Zhang 2023: 2.)

Managing T2DM requires a comprehensive approach that includes lifestyle changes, taking medications as prescribed, regular monitoring and patient education. Nurses are essential in this process because they are in the position to educate, assist and empower patients. Interventions led by nurses can help improve self-management, enhance glycemic control and encourage patients to become more involved and knowledgeable about their condition. Also, health promotion and wellness programs play a huge part in reducing difficulties related to diabetes. Nurses, due to their regular interactions with patients, are in an ideal position to offer interventions focused on nutrition, physical activity and stress management. (Ibrahim et al. 2024: 2.)

Nurses hold a significant role in the prevention of diabetic foot complications through patient education, early risk identification and collaborative care. A fundamental aspect of their responsibility involves educating patients on appropriate foot care practices. This includes emphasizing the importance of daily foot inspections, maintaining proper hygiene and selecting suitable footwear to minimize risk of injury and ulceration. In addition, nurses also perform regular foot assessments to spot early signs of neuropathy, poor circulation or wounds that enable timely interventions and implementation of preventive strategies. Furthermore, nurses contribute significantly to interdisciplinary collaboration with healthcare professionals, facilitating the development of individualized care that address multifaceted needs of patients enhancing effectiveness of prevention and promoting better clinical outcomes. (Al Moteri et al. 2024: 2502.)

However, patients encounter difficulties due to insufficient education on foot care or lack of clear communication from their healthcare professionals that resulted in non-compliance to treatment plans. Patients also face the high cost of treatments, challenges in following care routines and emotional stress considering the need for nurses with empathy, understanding and support. (Aalaa et al. 2021: 1116-1117.)

2 Background

Diabetic foot ulcers (DFUs) are extremely and increasingly common effects of diabetes, often leading to infection, limb amputation and even death. Their development is complex, involving various factors that contribute to different stages of ulcer progression. A major challenge in DFUs treatment is the high rate of recurrence and amputations even after initial healing highlighting for care management. The prevalence of diabetes mellitus is escalating at a concerning rate worldwide. This metabolic disorder affects various organs, including the heart, kidneys, eyes and nervous system leading to severe complication such as cardiovascular disease, stroke, vision impairment, renal failure and limb amputation. One of the most common and serious complication is DFUs which affects approximately 6.3% of people with diabetes mellitus globally. Due to its high incidence and associated health risks, DFUs remains a prevalent cause of hospital stay among diabetic patients. (Wang, Yuan, Xu and Yu 2021: 1049-1050.)

2.1 Type 2 diabetes mellitus and its complications

Type 2 diabetes mellitus (T2DM) is a long-term metabolism disorder described by increased glucose levels due to insulin deficiency or insulin resistance. T2DM is usually related with various factors such as obesity, physical inactivity, poor diets and genetics. Macrovascular complications include damage to the large blood vessels that causes heart attacks, heart failure, strokes, and a reduction on the blood circulation to the lower extremities and increases the chance of foot ulcers and amputations. (Adare, Tiyare and Marine 2024: 2.) On the other hand, microvascular complications such as diabetic nephropathy, neuropathy and retinopathy has been increasing in newly diagnosed type 2 diabetes patients, causing to irreversible health consequences, reduced quality of life and economic burdens (Yaprak and Leskin 2023:1601).

2.2 The role of nurses in managing diabetic foot ulcers

Effective management of DFUs requires nursing interventions based on clinical assessments, patient conditions and evidence-based care. Key treatment goal includes wound healing, infection control, recurrence prevention and overall health improvement. Essential nursing practices involve patient history reviews, physical exams, foot care education and specialist referrals when needed. Annual foot assessments are crucial for high-risk patients, particularly those with PAD or neuropathy. Nurses should evaluate medical history, conduct physical checks and assess sensation loss. Using standardized tools, such as the 60-second wound assessment helps identify complications, early implementation of a comprehensive diabetic foot examination has also shown positive results in DFUs management. It also emphasizes that nurses in DFUs role are regularly assessing nutrition, cholesterol, blood sugar, blood pressure, checking for neuropathy, preventing ulcers from returning, promoting self-care and adherence to treatment of the patient. Nurses play a key role in educating families and patients about foot care to reduce re-ulceration and the probability of lower extremity amputation (LEA). Nurses also perform photographic wound assessment to track its progress. Due to DFUs, working with multi-professional healthcare teams plays a vital role in delivering thorough interventions. It is clear that the role of nurse specialists assumed to be more important with collaboration with colleagues on same level of opportunity. (Subrata and Phuphaibul 2019: 302-303.)

2.3 Clinical settings

Before receiving care in specialized diabetes centres for DFUs, patients often experience major challenges that affect them on personal, family and social areas. These challenges contribute to a reduced level of functioning which is considered an important measure of overall health. The diminished quality of life is described as limited in physical function, such as reduced work capacity; psychological factors, including low satisfaction, enjoyment, well-being, self-esteem, fear, emotional exhaustion; and social obstacles related to work rehabilitation, leisure and family involvements. To meet these complex needs, healthcare services focus on providing steady, continuous care with building a strong and supportive relationship between patients and healthcare professionals. (Stasini, Margari, Fasoi, Kelesi and Dafogianni 2020: 1073-1074.)

Additionally, foot complications from diabetes mellitus are one of the significant reasons of hospital admissions compared to other complications of diabetes. The development of DFUs can result in disabilities, limb loss and a significant reduction in standard of living.

DFUs also has a major impact on a secondary healthcare service, as their onset and complications can lengthen hospital stays and increase mortality rates. To address these issues, the incorporation of new knowledge and a positive change in the perspective of the patients must be the aim to lessen stereotypes and improve the existing understanding of the disease and its complications. (Roupa et al. 2021: 1029, 1032.)

3 Purpose, aims and research questions

The purpose of this study is to describe nurses' role in managing foot ulcers in adults with type 2 diabetes mellitus in clinical settings. The aim is to understand how nurses utilize different interventions to manage diabetic foot ulcers in adults with T2DM, concentrating on prevention, foot ulcer care and patient education. Based on the purpose and aim, the research questions will be:

1.How do nurses manage DFUs in adults with T2DM in clinical settings?

2.What is the role of nurses in managing DFUs in adults with T2DM in clinical settings?

4 Methodology and methods

Qualitative methodology is suitable for this study as it allows comprehensive exploration of nurses' interventions and experiences in managing type 2 diabetes mellitus foot ulcers in adults.

In healthcare, qualitative research is commonly given to interpret health behaviour patterns, explore lived experiences, establish behavioural theories, identify healthcare needs and plan effective interventions. Due to its broad applications in healthcare, the use of qualitative methodology in health research significantly increased. Qualitative research can lead to the advancement of health interventions, explanatory health models and medical-social theories. The nature of qualitative research is in view of complexity of human behaviour and dept. (Renjith, Yesodharan, Noronha, Ladd, and George 2021: 1.)

4.1 Data collection method

A literature review is to understand research topics and incorporate previous studies that can be conducted in different methods. One of these methods is a descriptive review that aims to

reveal understandable pattern from a current literature. This review method generally has a structured process that consists of searching, filtering and organizing. (Yang and Tate 2012.)

The method used for the data gathering of articles in this study were obtained from a reputable databases, CINAHL and PubMed through Metropolia LibGuides'. To find answers to our study questions, literature searches were performed through relevant keywords and phrases. Each article was reviewed and analyzed for the selection of relevant ones.

4.2 Data search and selection

The PICo framework was applied to recognize the search keywords (refer to Table 1). In this study, the population refers to nurses' role in delivering care for adult patients with T2DM and foot ulcers. The focus of the interest is on the management of T2DM foot ulcers within clinical environments. The components of population, interest and context were based on the study's title, research questions and the aim of this literature review.

Table 1. PICo Framework

Population	Nurses
Interest	Management of T2DM foot ulcers
Context	Clinical settings

Once the key search terms were determined, we outlined specific inclusion and exclusion criteria to narrow the literature search that answers our study questions. Criteria for inclusion in the database search are as follows: the studies must focus on nurses who are involved in caring for patients with T2DM and foot ulcers within clinical settings. Only articles written in English and classified as primary, peer-reviewed articles will be included, provided they discuss the role of nurses in managing T2DM foot ulcers. Moreover, the research should be published within the past five (5) years to ensure it aligns with the latest practices and guidelines in managing T2DM foot ulcers. Finally, the articles should have a nursing perspective and abstract included. The inclusion and exclusion criteria, along with their rationale were summarized in Table 2.

Table 2. Inclusion and exclusion criteria

Inclusion	Exclusion	Rationale
Inclusion criteria 1: Studies focusing on adults with T2DM foot ulcers in clinical settings.	Exclusion criteria 1: Studies that focusing with non T2DM foot ulcers.	Rationale 1: The focus is on adults with T2DM foot ulcers in clinical settings.
Inclusion criteria 2: Primary studies and peer reviewed	Exclusion criteria 2: Dissertations	Rationale 2: Metropolia guidelines
Inclusion criteria 3: Studies prepared and issued in English	Exclusion criteria 3: Studies not prepared and issued in other languages than in English.	Rationale 3: The study does not have outside funding and that interpreting services is not available.
Inclusion criteria 4: Articles with abstract available.	Exclusion criteria 4: Articles with no abstract available.	Rationale 4: Limited time and resources.
Inclusion criteria 5: Articles published during the last 5 years.	Exclusion criteria 5: Articles published over 5 years ago.	Rationale 5: Up to date articles are preferred.
Inclusion criteria 6: Articles that contain nurses role and management.	Exclusion criteria 6: Articles apart from nursing.	Rationale 6: Emphasized is on nurses' role and management.

For this study we conducted our search using two electronic databases found in Metropolia LibGuides', CINAHL and PubMed, to find relevant research articles. These databases were chosen to focus on main articles from a nursing point of view and ensure their significance to the nursing scope. These articles were sourced from reputable academic literatures by reviewing the reference lists of main studies.

To gather applicable articles, five (5) key search terms are used during the search process. The search phrases are the following: (nurs* role OR interventions OR management) AND hospital AND (foot ulcer OR foot ulcers OR diabetic foot ulcer OR diabetic foot ulceration OR diabetic foot OR diabetes foot OR dfu), hosp* AND (diabetic foot ulcer or dfu or diabetic

foot) AND (nurs * intervention OR management OR role), (diabetic foot ulcer* OR diabetic foot sore* OR diabetic wound) AND (nurs* management OR intervention OR role*) AND hospital, nurse AND diabetic foot ulcer, nurse AND diabetic foot ulcer AND (clinical setting OR hospital OR clinical practice), Truncation (*) and Boolean operators such as “AND” and “OR” were used to include variations on search terms. The search terms were developed with the support and supervision from the Metropolia University of Applied Sciences’ library. A consultation was scheduled to receive personalized assistance in searching for relevant articles through Metropolia LibGuides Databases.

Table 3. Data search table findings

Database/ date/ limits	Search phrase	Total number of hits based on limitations	Papers/ records included based on title	Papers/ records included based on abstract	Papers/ records included based on full text
CINAHL / 03 March 2025 limits: 5 years, adults, english, abstract available, peer-reviewed	(nurs* role OR interventions OR management) AND hospital AND (foot ulcer OR foot ulcers OR diabetic foot ulcer OR diabetic foot ulceration OR diabetic foot OR diabetes foot OR dfu)	n=327	n=34	n=24	n=0
PubMed / 06 March 2025 limits: 5 years, adults, english, abstract available, peer-reviewed	(nurs* role OR interventions OR management) AND hospital AND (foot ulcer OR foot ulcers OR diabetic foot ulcer OR diabetic foot ulceration OR diabetic foot OR diabetes foot OR dfu)	n=49	n=12	n=11	n=1

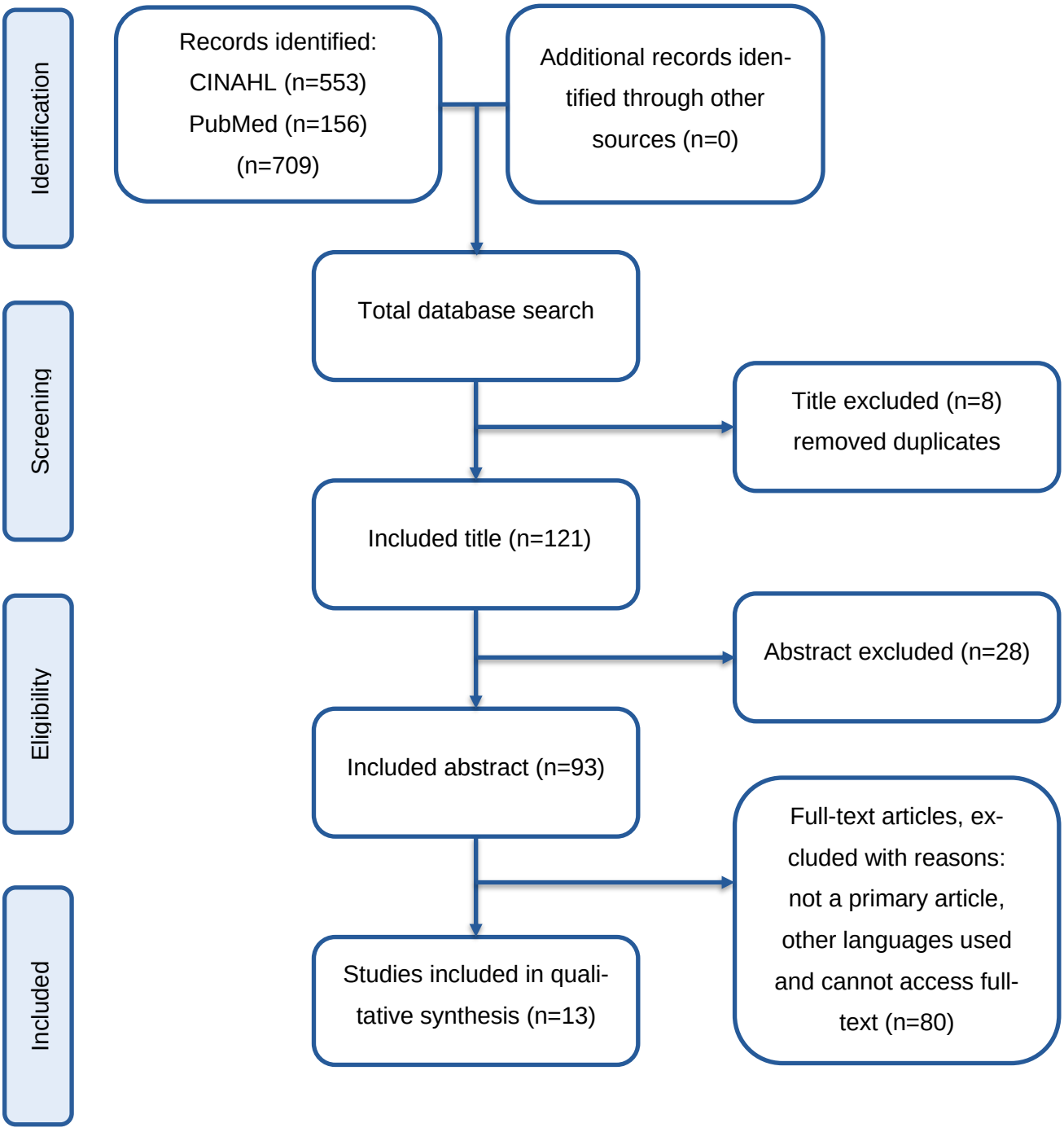
CINAHL / 09 March 2025 limits: 5 years, adults, english, abstract available, peer-reviewed	hosp* AND (diabetic foot ulcer or dfu or diabetic foot) AND (nurs * intervention OR management OR role)	n=64	n=8	n=1	n=0
PubMed / 09 March 2025 limits: 5 years, adults, english, abstract available, peer reviewed	hosp* AND (diabetic foot ulcer or dfu or diabetic foot) AND (nurs * intervention OR management OR role)	n=24	n=0	n=0	n=0
CINAHL / 11 March 2025 limits: 5 years, adults, english, abstract available, peer reviewed	(diabetic foot ulcer* OR diabetic foot sore* OR diabetic wound) AND (nurs* management OR intervention OR role*) AND hospital	n=40	n=14	n=11	n=0
CINAHL / 11 March 2025 limits: 5 years, adults, english, abstract available, peer reviewed	nurse AND diabetic foot ulcer	n=104	n=33	n=27	n=9
PubMed /12 March 2025 limits: 5 years, adults, english, abstract available, peer reviewed	nurse AND diabetic foot ulcer	n=50	n=16	n=11	n=1

CINAHL / 14 March 2025 limits: 5 years, adults, english, abstract available, peer reviewed	nurse AND diabetic foot ulcer AND (clinical setting OR hospital OR clinical practice)	n=18	n=9	n=8	n=1
PubMed / 14 March 2025 limits: 5 years, adults, english, abstract available, peer reviewed	nurse AND diabetic foot ulcer AND (clinical setting OR hospital OR clinical practice)	n=33	n=3	n=2	n=1
Records in total	With duplicates	n=709	n=129	n=93	n=13
Records after duplicates removed	8 duplicates	n=709	n=121	n=93	n=13
Total number of included articles		-	-	-	n=13

Reporting standards like PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) are developed to guarantee that the methods and outcomes are clearly described, supporting full transparency of systematic reviews. Flow diagrams in evidence synthesis supply an immediate way for the readers to comprehend the primary steps involved in a review and analyze the exclusion of insignificant record during the process. The PRISMA flowchart is generally used tool that represents the study selection process in systematic reviews. It supports researchers document the number of records identified, screened, assessed for eligibility and added in the final analysis, providing a transparent methodology. (Haddaway, Page, Pritchard, and McGuinness 2022: 1-2.)

The PRISMA flow chart (Figure 1) represents the process of study selection in a review. It starts with seven hundred nine (709) of records identified through CINAHL and PubMed database searches. Then, no additional records identified through other sources as the articles obtained through CINAHL and PubMed articles were sufficient. After removing irrelevant articles based on title and eight (8) duplicates, the titles of remaining articles were screened leading to one hundred twenty-one (121) titles included for abstract evaluation. Out of those one hundred twenty-one (121), ninety-three (93) abstracts were found to meet the initial criteria, while twenty-eight (28) were excluded. Further evaluation of full-text articles has been done and resulted in eighty (80) being excluded for various reasons. Lastly, thirteen (13) articles were included for qualitative synthesis.

Figure 1. PRISMA flowchart



4.3 Data analysis method

Qualitative content analysis is a research method used to coherent manner that examine and interpret written, spoken or visual data to uncover patterns, themes and categories. Unlike quantitative analysis which emphasizes statistical patterns, qualitative content analysis delves into context and meaning within the data. There are two primary approaches to qualitative analysis, inductive and deductive. The inductive method is data driven, allowing themes to emerge naturally without predefined frameworks, this is ideal when there is limited prior research on topic. In contrast, deductive approach is theory driven, meaning researchers use existing framework to categorize and analyze data systematically. The choice between these approaches depends on research objective and the availability of established theories in the field. In nursing research, qualitative content analysis is particularly valuable for exploring patient experiences, healthcare challenges and professional interactions. It provides critical insights into areas such as treatment adherence, nurses` emotional well-being and ethical dilemmas in healthcare which may not be fully captured through quantitative methods. By applying inductive or deductive approaches researchers can either develop new theories or validate existing ones that can lead to nursing improvement. (Elo and Kyngäs 2008: 109-113.)

An inductive qualitative content analysis was utilized to interpret the data in this study. The process started with identifying meaning units from the articles which were carefully assessed and assigned codes. These codes were grouped into sub-categories and formed into generic categories which were combined into broader main categories. This process helped answer the study questions: (1) How do nurses manage DFUs in adults with T2DM in clinical settings? and (2) What is the role of nurses in managing DFUs in adults with T2DM in clinical settings? by organizing key results from the data.

Table 4.Sample of data analysis of the research article for the study question 1.

Article	Meaning Units	Coding	Sub-category	Generic Category	Main Category
2	Participants indicated that during physical examinations, they assess the skin by observing various features such as color , presence of calluses or deformities, swelling ,dryness, hydration and overall hygiene. They also take notes of the patients` footwear, assess nail care practices and check for signs of fungal infections. In terms of neurological assessment some reported using monofilaments to test foot sensitivity and using touch to evaluate temperature perception. For vascular assessment, several participants mentioned palpating peripheral pulses and measuring the ankle brachial index (ABI) as part of routine evaluation. (Arrais et al. 2022, p. 4)	Participants indicated that during physical examinations, they assess the skin by observing various features such as color , presence of calluses or deformities, swelling ,dryness, hydration and overall hygiene. Check for signs of fungal infections. Using monofilaments to test foot sensitivity and using touch to evaluate temperature perception. Palpating the pulses, adding the measurement of the (ABI)	Skin assessment Skin monitoring Sensory monitoring Circulatory monitoring	Physical assessment Infection control Neurological assessment Vascular assessment	Nurses management in DFUs

Figure 2. Categorisation in inductive analysis for the research question 1.

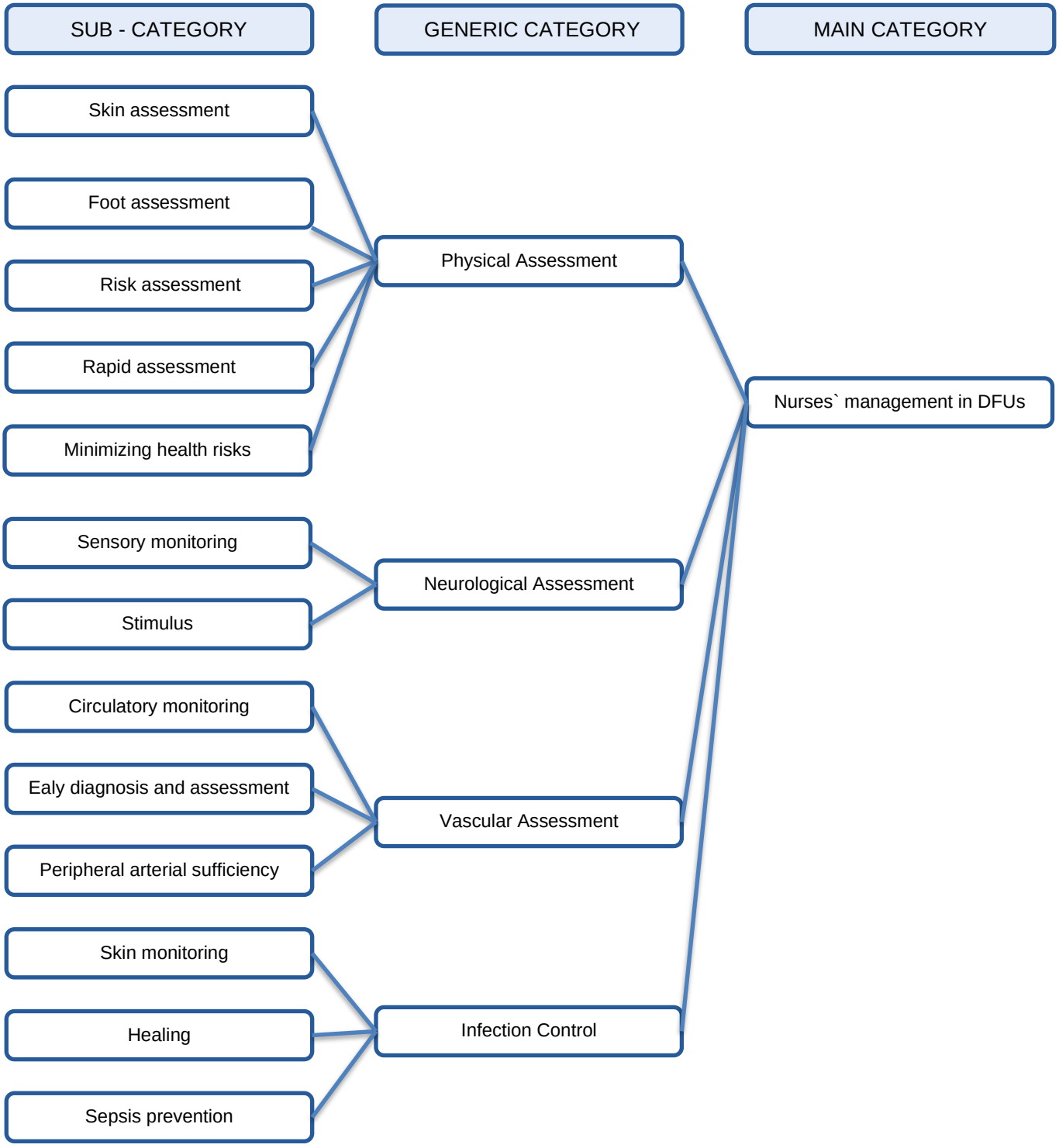
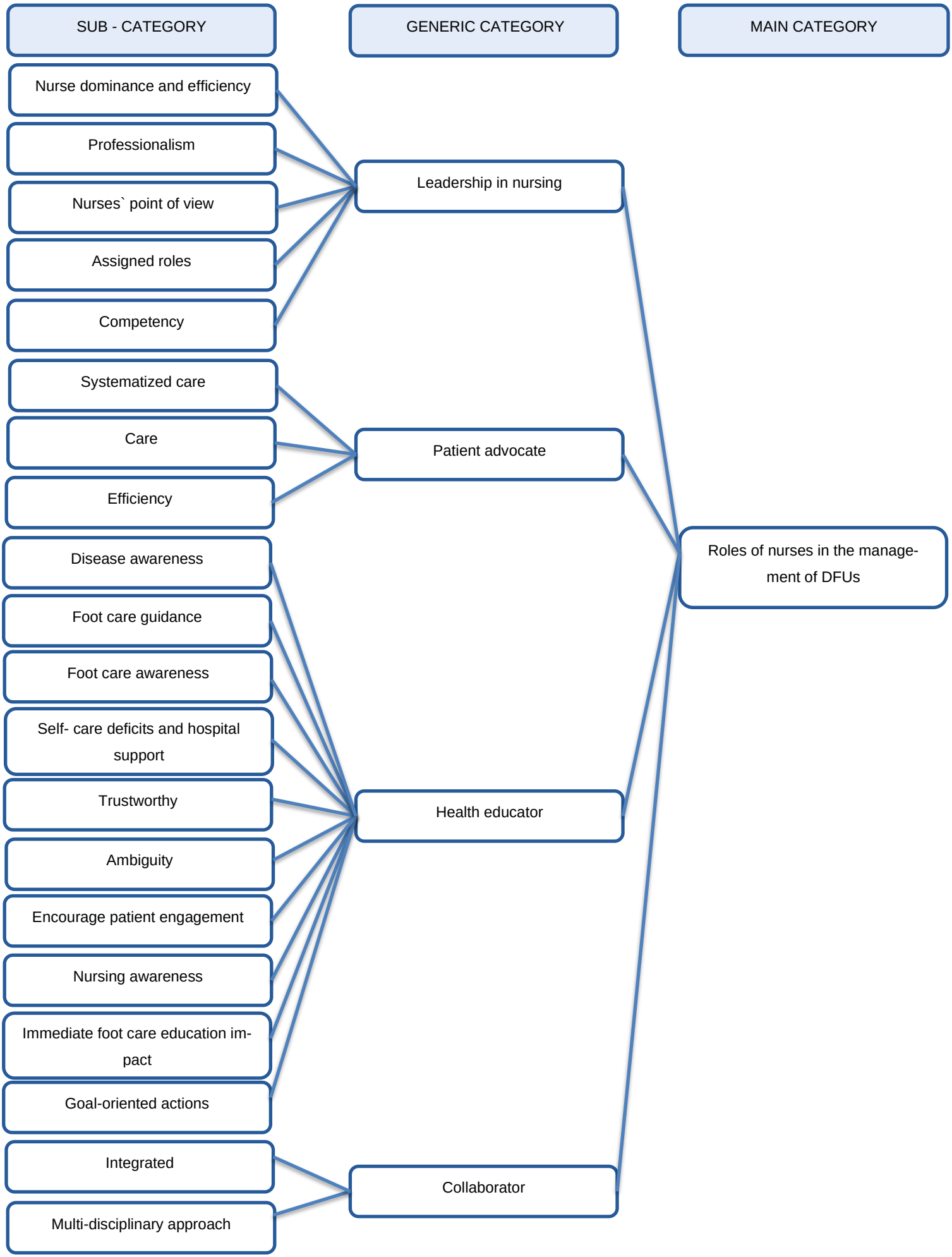


Table 5. Sample of data analysis of the research article for the study question 2.

Article	Meaning units	Coding	Sub-Category	Generic Category	Main Category
1	Another theme influencing nurse-led multidisciplinary care is professional worthiness which includes aspects such as nurse authority and efficiency. Participants described receiving consistent, coordinated and focused care highlighting the central role and competence of nurses. These insights reflect the professional growth of nursing in delivering high- quality care to patients with chronic conditions like diabetic foot ulcers supporting effective wound healing (Nayeri et al. 2020, p. 3139)	Nurse-led multidisciplinary care is professional worthiness Receiving consistent, coordinated and focused care highlighting the central role and competence of nurses. Reflect the professional growth of nursing in delivering high-quality care to patients.	Nurse dominance and efficiency Systematized care Professionalism	Leadership in nursing Patient advocate Leadership in nursing	Role of nurses in the management of DFUs.

Figure 3. Categorisation in inductive analysis for the research question 2.



5 Results

In this descriptive literature review, thirteen (13) articles were analyzed to explore the role of nurses` in managing diabetic foot ulcers (DFUs) in patients with type 2 diabetes mellitus (T2DM). The articles were conducted across various countries between 2020 up to the current year. These articles came from variety of places around the world, it included one (1) study from Iran in the Middle East, one (1) from South Korea in East Asia and three (3) from Brazil in South America. There was also one (1) study from Portugal and three (3) from Spain in Southern Europe. North America was presented by one (1) study from Canada, while one (1) study came from Denmark in Northern Europe. Additionally, there was one (1) study from New Zealand in Oceania and one (1) from South Africa in Africa. This wide range of locations shows there is a global interest in understanding the role of nurses in managing diabetic foot ulcers in different healthcare settings and cultures.

The focus of this study was primarily on the involvement of nurses in the care of patients with DFUs examining both their roles and management. The analysis were derived from two study questions that includes: (1)How do nurses manage DFUs in adults with T2DM in clinical settings? and (2) What is the role of nurses in managing DFUs in adults with T2DM in clinical settings?, which led to eight (8) generic categories and thirty-three (33) subcategories. The findings are visually represented by categories in figures 2 and 3.

5.1 Nurses management in DFUs

To find answers to study question one (1), thirteen (13) articles were thoroughly evaluated. Out of these, five (5) articles explored how nurses manage foot ulcers in adults with T2DM in clinical settings. Four (4) generic categories identified: physical assessment, neurological assessment, vascular assessment and infection control.

5.1.1 Physical assessment

The physical assessment of DFUs includes several important steps that nurses use to care for their patients. From the nurses´ comments, they check the skin by looking for changes in color, calluses, deformities, swelling, dryness and pay special attention to hygiene especially between toes, and hydration through moisturizing skin. They also examine the types of shoes the patient wears and make sure the nails are cut properly, recommending straight cuts rather than rounded ones to avoid injury. Some nurses use structured evaluation forms or checklists to guide the process, ensuring that all areas of risk are assessed systematically. Additionally,

the assessment includes asking patients about pain or discomfort, as well as any history of ulcers or previous amputations. (Arrais et al. 2022: 4.)

It is essential to establish a reliable and cost-effective risk assessment system that prioritizes physical assessments for the prevention of foot ulceration in diabetic patients. Regular and rapid foot examinations should be integrated into routine care to facilitate early detection and potential issues. (Lee, Jeong, Kim, Cho, and Kim 2021: 6.) Furthermore, improved physical assessment can reduce health risks for diabetic foot patients. Nurses are encouraged to assess individuals with PAD and peripheral neuropathy for signs like hair loss, dry skin, abnormal nails, cold skin, pallor, cyanosis, rest pain, tingling and any prior incidence of ulcers or amputations. (Nascimento et al. 2024: 3994, 4002.)

5.1.2 Neurological assessment

In the neurological evaluation, some participants mentioned using monofilaments testing to check foot sensitivity, which helps identify loss of sensation in patients with T2DM. They also reported assessing touch and temperature perception to detect potential nerve damage. (Arrais et al. 2022: 4.)

Several participants reported sensory input that prompted them to evaluate their feet, such as pain in the soles, chafing from shoes or fluid drainage like pus or blood on their socks. For instance, one participant found a blister after noticing the sock was wet when arrived at home from work, while some participants also mentioned that unusual odors from their shoes or socks alerted them to problems. As their wounds progressed, they observed changes in appearance, sensation or foul smell. These findings highlight the importance of conducting neurological assessments to identify sensory issues. (Crocker, Tan, Palmer and Marrero 2022: 2488.)

5.1.3 Vascular assessment

Peripheral arterial disease (PAD) is a key contributor affecting vascular health in patients with DFUs. The accumulation of fatty plaques builds up inside the arteries, reducing blood flow to peripheral areas, particularly lower limbs. Accurate vascular assessment therefore, is crucial in early detection of PAD. Furthermore, PAD combined with peripheral neuropathy often disrupts regulation of foot temperature causing abnormal temperature and impairing vasodilation and vasoconstriction mechanisms. These increase the risk in developing DFUs. Clinical indicators such as intermittent claudication, ankle- brachial index (ABI), absent pulses, delayed color return after 1-minute leg elevation and cold feet are used. Nurses use tools like infrared

thermometers to measure temperature accurately. This helps nurses promptly identify the indicators of impaired peripheral tissue perfusion in patients with DFUs. (Nascimento et al. 2024: 3998- 4002.)

In relation to the assessment of vascular function, nurses commonly palpate the pulses in the feet to check blood flow and identify any circulation problems. They also use the ABI, a simple procedure that compares blood pressure in the ankle with that in the arm to evaluate vascular health more accurately. As reported in the studies, one nurse described this practice by saying, “We feel the pulses to assess blood flow and use the ABI test if we need a clearer picture”. Another nurse explained,” We check the pulses and look for temperature differences in the feet to understand the condition of the blood vessels”. These methods support early detection of poor circulation. (Arrais et al. 2022: 4.)

5.1.4 Infection control

More than half of the patients referred to advanced practice nurse (APN), sixty one (61) out of one hundred three (103) or fifty-nine percent (59%) fully healed their DFUs. During the study period, APN referred twenty-four (24) patients soon after diagnosis with infected neuro- ischemic and neuropathic DFUs. Prompt and appropriate referrals ensured timely hospital care in controlling infections and preventing ulcers from worsening or the need for amputation. (Jiménez-García, Jiménez-Abad, López and García-Fernández 2024:10.)

The importance of proper foot hygiene including thorough washing and drying, especially between the toes is emphasized to minimize the risks of fungal and bacterial infections. Patients are recommended to wear clean, appropriate shoes, cotton socks without seams and to moisturize skin to prevent irritation and skin damage. (Arrais et al. 2022: 4.)

When home treatments failed, patients and their families realized the need for immediate professional medical attention. For example, one patient in the study noticed that one toe was swollen and the color has already changed before seeing a doctor, marking a transition from ignoring symptoms to recognizing the seriousness of the condition. Similarly, other patients initially tried self-care and noticed signs of inflammatory response such as; elevated in pus, swelling or redness, then after consulted for a hospital care. Many patients felt that despite seeking medical care, the result was amputation or long healing process. Delays in accessing medical specialists, medications and proper wound care often lead to infections. (Crocker et al. 2022: 2490-2491.)

5.2 Role of nurses in the management of DFUs

To find answers to study question two (2), thirteen (13) articles were critically analyzed and of these, ten (10) articles discussed the role of nurses in managing foot ulcers in adults with T2DM in clinical settings. Four (4) generic categories identified: leadership in nursing, nurse as patient advocate, health educator and collaborator.

5.2.1 Leadership in nursing

Leadership in nursing emerged as a major factor in the effective management of DFUs, as demonstrated through the various categories identified in this study.

According to Nayeri et al. (2020), one key factor that supports nurse-led multidisciplinary care is the concept of professional worthiness, which encompasses the full spectrum of professional development in nursing and the delivery of quality care for patients with chronic conditions such as DFUs. Given their various involvement of the role, nursing profession demands a high level of responsibility and attentiveness. The studies further reported that inadequate education can impact the quality and effectiveness of care delivered, and can affect the general well-being of individuals and communities. The primary objective of nursing education, as noted , is to prepare competent nurses equipped with fundamental knowledge and abilities to deliver quality care and support public health. Several elements were identified in relation to nursing professionalism which include clinical exposure, proficiency, ongoing career development, ethics, human values and a responsibility for maintaining quality patient care. (Nayeri et al. 2020: 3139.)

In addition, although a majority of nurse respondents from Sol Plaatje Municipality in the Northern Cape demonstrated a moderate to good level of knowledge about diabetic foot care, with eighty-four percent (84.8%) of participants showing adequate understanding, these findings provide a strong starting point for further growth and indicate that through interventions and educations improvement is possible. (Mafusi et al. 2024:6.)

Font-Jimenez et al. (2020), also found that expert nurses emphasized the benefits of personalized and empathic care. Their ability in understanding the typical patient needs enables them to efficiently establish initial care for all patients. (Font-Jimenez, Acebedo-Uridales, Aguaron-Garcia, De Sousa and Rubio-Rico 2020: 113.)

Furthermore, the relationship between patients and healthcare professionals was described by unspoken predefined roles that influence their cooperation. Patients feel they are expected to act in a certain way that reflect as a typical role of being a patient. However, the position of nurses play an integral part. Treating patients with professionalism, compassion and respect without being authoritative can increase patients' sense of safety, sincerity and trust in the care they receive. (Søndergaard, Christensen, Dahl, Drejer, and Høgh 2024:10.)

5.2.2 Patient advocate

Patient advocacy was identified as a major component in the holistic management of DFUs. This involved responding to patient's physical, emotional and cultural needs, while also managing barriers to care. These findings show how nurses empower patients, encourage early interventions and promote changes to improve quality care for individuals and healthcare system.

It was reported by the participants that patients under their care had expectations related to their situations, culture, customs and religion, which whether positively or negatively influenced the recovering of diabetic ulcers. Nurses emphasized that their expertise in managing foot ulcers helped establish patient's confidence, leading to improved mood and reduced stress. Furthermore, nurses stated that when patients gained a sense of autonomy and the relevance of self-care, the size, depth and severity of wound often decreased, exhibiting stronger nurse-patient relationships and greater patient satisfaction with the quality of life provided. (Nayeri et.al. 2020: 3139.)

Similarly, nurses in Minas Gerais, Brazil, noted the challenges in providing preventive care due to the increased demand for services, limited staffing and time constraints. They also identified patient's lack of disease acceptance and low commitment in self-care as significant challenges. This was consistent with findings in the literature. Nurses also highlighted that timely self-care interventions were critical on preventing like ulcers or infection of the lower limbs (UILL) and that sufficient care led to improve clinical outcomes and an improved life satisfaction for patients. (Gonçalves et al. 2024: 5-6.) Moreover, Korea and other countries with comparable healthcare challenges require a simple and a reliable risk classification system that enables nurses to effectively perform foot examinations during patient's waiting time for medical consultations (Lee et al. 2021:6).

5.2.3 Health educator

Based on the reviewed studies, most patients with DFUs were not aware how to take care of their feet which can lead to serious complications. It is also revealed that healthcare professionals that include nurses, need more training to effectively serve as health educators.

The study by Gonçalves et al. (2024) stated that DFUs' patients oversight their feet which lead to the development of UILL. This part of self-management is crucial as it shows how nurses can help educate patients with lack of knowledge in caring for their feet. Additionally, when it comes to ongoing education, professionals highlighted the need for more training for all members of the healthcare team. It was also noticed that only a few of nurses had undergone specific training on diabetes-related problems like UILL. (Gonçalves et al. 2024:6,7.)

According to Daly et al. (2020), while managing risk factors, giving education to patients plays a significant involvement in the prevention and reduction of recurrence of diabetic foot disease. Unfortunately, not all DFUs' patients are aware of the disease and health literacy is a major barrier. Current patient education efforts have not been effective in preventing foot ulcers before they happen. (Daly, Arroll, Nirantharakumar and Scragg 2020: 46.)

Expert nurses in Portugal and Spain also identified the value of encouraging healthy lifestyle and proper foot care to prevent another ulcers or even amputations. One simple way to support this is by providing patients with written instructions during discharge or in a separate leaflet. (Font-Jimenez et al. 2020: 111.) Meanwhile, some patients in Canada shared that their doctors rarely do foot assessments or explain what is diabetic foot care all about. In contrast, one patient expressed trust in the guidance given by nurse educator, even though they did not see each other so often. (Walsh and Kuhnke 2024: 64.) Moreover, many patients had encountered the term "foot ulcers" but they did not always link it to the issues they are experiencing on their own feet. Instead, patients saw them as minor problems like blisters, rough skin, scratch, inflammation or pain. This misunderstanding indicates a major issue in patient education not just for those with DFUs but also among healthcare professionals. (Crocker et al. 2020: 2488, 2491.)

On the other hand, Søndergaard et al. (2024) revealed that using humor in conversations can help create a comfortable and open atmosphere, encouraging more discussions on health promotion between patients and healthcare providers (Søndergaard et al. 2024: 6). In Spain, though checking the feet of the patients during consultation is important, doing this alone does not prevent ulcers or amputations. In this regard, educating patients especially

those at high risk can enhance their foot care knowledge and lead to fewer complications. (Hidalgo-Ruiz et al. 2023: 81.) Finally, offering education programs can greatly optimize the quality of life for people with DFUs by helping them practice better self-care especially when it comes to their feet (Mafusi et al. 2024: 5).

5.2.4 Collaborator

The role of a nurse as a collaborator was demonstrated on how care was coordinated in different healthcare settings. Through active communication, shared decision-making and personalized guidance, nurses supported the continuity of care in managing DFUs.

According to Crocker et al. (2022), all participants in the study at some point sought medical attention either from their general practitioner, a regular podiatrist, urgent care department, in relation on how critical they perceived the condition to be and the type of care they could access as soon as possible (Crocker et al. 2022: 2490). On the other hand, when the interaction between patients with DFUs and healthcare professionals was defined by collaboration, it allowed concrete support and exchange of knowledge. Furthermore, when healthcare professionals purposely addressed the patients' coping needs, it helped establish collaborative relationship built on mutual understanding. By sharing professional insights and guidance such as how to change wound dressing, follow treatment plans, use of medications and observe symptoms at home; patients gained more capabilities and person-centred collaboration. In addition, the collaborative process was improved by maintaining eye contact, nodding and smiling during consultations that made patients feel supported and that patients could express their questions or clarify misunderstandings. (Søndergaard et al. 2024: 7.)

6 Discussion

6.1 Discussion of main results

Diabetic foot ulcers (DFUs) are common, and serious complications often lead to infection, delayed healing and even amputation. This discussion concentrates on four key areas: physical assessments, neurological assessments, vascular assessments and infection control. Effective management of DFUs relies heavily on comprehensive nursing assessments and timely interventions to improved patient outcomes. Physical assessment is fundamental as nurses evaluate skin integrity, detect deformities and monitor for signs such as calluses, swelling and dryness. Neurological assessment plays a key role in identifying sensory loss.

Vascular assessment is equally important as prompt recognition facilitates timely referrals and targeted treatment to improve circulation. Evaluation of infection reduces complication of DFUs. Intervention and adequate referral to specialized care reduces complications, hospitalizations and amputations.

Physical assessment is a crucial step in the risk reduction and management of DFUs, as it helps in the early detection of risk factors such as neuropathy, poor circulation, skin integrity issues and structural deformities. Physical foot examinations is a core component of nursing care of patient with diabetes and should be carried out regularly to prevent complications. These assessments typically include checking for skin breakdown, deformities , foot temperature, peripheral pulses and loss of protective sensation. Nurses are involved in identifying potential issues. (Subrata and Phuphaibul 2019: 303.)

However challenges remain. Arrais et al. (2019) reported that in many clinical settings, nurses limited their visual inspection of the skin and often did not use standardized tools or protocols. Another barrier identified was workload and time constraints, particularly in primary care often struggle to complete comprehensive foot assessments due to patient volume and lack of training. (Arrais et al. 2019: 6.)

From the patients` perspective this gap assessment becomes even more apparent, Crocker et al. (2022) reported that many individuals with diabetes were unaware of what a complete foot examination should entail and not even realizing their feet has been assessed. Nursing care must go beyond physical examination to actively engage and inform patients. (Crocker et al. 2022: 2489.)

Wang et al. (2021) outlined that complications such as diabetic peripheral neuropathy (DPN) reduces pain perception due to damage in small sensory nerve fibers and PAD blockage of peripheral arteries resulting reduced blood supply on lower limbs, making a minor trauma unnoticed and progressively worsen (Wang et al. 2021: 1049-1050). In addition this mirrored accounts described by Crocker et al. (2022) where most participants attributed their ulcer development and sensory loss . One patient for example reported suffering severe burns from hot pavement without realizing it. Another patient reflected it on how his inability to feel early symptoms led to tissue damage that leaded to amputation. These examples underscore serious consequences of delayed detection and treatment on foot injuries . Nevertheless patients indicated earlier awareness of symptoms , retaining some sensations, regular foot assessments , protective footwear and integrating neurological and vascular assessments can reduce burden of DFUs. (Crocker et al. 2022: 2489.)

In DFUs the presence of bacterial toxins can lead to tissue damage, collagen degradation and malnutrition which ultimately impair wound healing process (Crocker et al. 2022: 2490-2491). Proper infection management starts with early recognition which is crucial for preventing progression of infection. As pointed by Arrais et al. (2022), thorough foot hygiene such as washing, drying especially between toes, wearing clean socks and moisturizing can significantly reduce the risk of fungal and bacterial infections thus playing preventive role in wound care (Arrais et al. 2022: 4).

Apparently patients only sought medical care after signs of infections such as pus, discoloration or swelling become evident. These delays are further compounded by limited access to specialized wound care and antibiotics. (Crocker et al. 2022: 2491.) Antibiotic therapy tailored to severity of infection is commonly recommended narrow spectrum antibiotic for mild cases and broader regimens for severe infections. However the overuse or inappropriate use of antibiotics contributed to growing concerns of resistance and further drug interactions emphasizing the need for careful antimicrobial stewardship. (Wang et al. 2021: 1049-1050.)

On the other hand, this study explored the role of nurses in managing DFUs and identified four key categories: leadership in nursing, patient advocate, health educator and collaborator. The findings support what previous studies has shown that nurses play a crucial function for the prevention, early detection and treatment of DFUs. However, nurses face challenges that can affect the quality of care such as lack of training and limited patient awareness.

Leadership in nursing was highlighted in this review as beneficial to promoting professional care for patients with chronic conditions like DFUs. This supports earlier studies that emphasized the importance of assessment and professional conduct during the first stage of DFU care (Subrata and Phuphaibul 2019:303). Similarly, it was pointed out that well-trained nurses bring value to healthcare professional teams (Nayeri et al. 2020: 3139), but as previous study noted, that inadequate training remains a barrier in many clinical settings (Adare, Tiyare and Marine 2024: 11). This only shows that while nurses has the ability to lead DFU management effectively, continuous education is highly needed.

As patient advocates, nurses respond not only to clinical needs but also to emotional, cultural and social aspects of care. This aligns with the previous findings that noted the lack of trust in nursing abilities which might be based in inadequate support and training (Roupa et al. 2021:1032). Still, the studies in this review show that nurses who are experienced can

build a strong relationship with patients, which can help alleviate stress and improve outcomes. When patients feel heard, understood and supported, they are more committed to self-care.

The role of a nurse as a health educator came up strongly in this study. Most of the patients with DFUs still lack basic knowledge about how to attend care for their feet, which increases the exposure of ulcers and complications. There were also two studies highlighted the importance of simple and clear education to prevent ulcers and the recurrence of diabetic foot disease (Wang et al. 2021:1054; Daly et al. 2020:46). However, a previous study found that less than half of patients had received foot education from nurses (Stasini et.al 2020: 1077). This gap emphasized the urgent need to prioritize nurse-led education as part of a routine in DFUs care.

Finally, the collaborator role of nurses was supported both in this study and in previous findings. Nurses collaborate with various teams, coordinating care and building trust through clear communication and shared decision-making. This is supported with the previous study that emphasized that DFU care is more effective when nurses, doctors and families work together (Subrata and Phuphaibul 2019: 303). Moreover, a simple human gestures like eye contact and a smile can make patients feel safer and more involved in their care (Søndergaard et al. 2024: 7).

6.2 Ethics and validity

Ethics in research are essential for various reasons. First, they secure the integrity of research by fostering authenticity and honesty while prohibiting actions such as fabrication and falsification of data. Second, ethical guidelines assist researchers in collaborating by providing moral values like justice, accountability and trust. Lastly, they advocate public accountability implementing policies pertaining to research misconduct and protection of the participants, thereby increasing transparency and confidence in research methodologies. (Pirani 2024: 96-97.)

Validity, at its core is more than just following a methodological process but presenting the usefulness and truthfulness of the research findings in a real-life situations. It shows a crucial role in maintaining the strength and relevance of conclusion made from data. Validity also supports the connection between theories behind a study to the actual observed data. (Lim 2024: 156.)

In conducting this study, scientific databases like CINAHL and PubMed were used to access primary studies and peer-reviewed articles, ensuring the foundation of evidence-based research. We also consulted the librarian at Metropolia University Applied Sciences for assistance in navigating these databases and identifying key search phrases for the selection of relevant articles related to this study. To maintain academic accuracy and avoid plagiarism, each source was appropriately cited, referenced and submitted to Turnitin program according to the guidelines given by Metropolia University Applied Sciences.

6.3 Conclusion

Diabetic foot ulcers (DFUs) remain a major and often underestimated complication of diabetes, but with the right strategies, many of their severe outcomes can be prevented. A thorough and proactive approach grounded in physical, vascular, neurological and infection assessments empower nurses to detect problems early and intervene swiftly. Integrating structured tools and checklists into routine care not only ensures consistency but also enhances the quality of patient care. Most importantly, fostering timely responses to even minor foot issues can be life changing. By combining clinical vigilance with standardized assessment, nurses can significantly reduce the risk of infection, hospitalization and amputation improving the lives of those living with DFUs.

Moreover, this study emphasized the important roles of nurses in the management of DFUs in adults with T2DM. Nurses are leaders, advocates, educators and collaborators. The findings showed that when nurses are well-trained, they can deliver effective, patient-centered care and lead patients through prevention. However, there are still gaps in trainings among nurses and patient education, making it difficult to prevent further complications. Studies also showed that collaboration between healthcare professionals, patients and relatives is the key for better outcomes. This study can benefit healthcare professionals by strengthening the role of nurses and it also encourages systems to support nurses with continuous training, ultimately enhancing the quality of life of adults with DFUs.

This qualitative literature review has a few limitations that should be considered. Firstly, only studies written in English and selected academic databases were included so some relevant research may have been missed. Secondly, because this is a review of existing literature and did not involve original study, the findings depend heavily on how those original authors collected and interpreted their data which limits the depth of the findings. Thirdly, variations set-

tings, sample sizes and methods across the studies make it difficult to compare or generalizability of the results is limited. Lastly, the three (3) months' time frame may have limited the depth and breadth of the literature review.

References

Aalaa, M., Mehrdad, N., Bigdeli, S., Dehnad, A., Sohrabi, Z. and Arabshahi, K.S. 2021. Challenges and Expectations of Diabetic Foot Care from the Patients' Point of Views. Journal of Diabetes Metabolic Disorder. 20 (2). 1111-1118.

Adare, A.F., Tiyare, F.T. and Marine, B.T. 2024. Time to development of macrovascular complications and its predictors among type 2 diabetes mellitus patients at Jimma University Medical Center. BioMed Central Endocrine Disorders. 24 (1) : 252. 1-15.

Al Moteri, N.A., Alruwaili, N.H.H., Alshammari, N.A.S., Banaqy, E.A., Al-Abdali, A.M.M., Al-Anzi, A.S., Aloqayli, Y.I., Al-Anzi, B.S.S., Alruwaili, A.T., Al-Anzi, F.S.S., Alruwaili, W.M. and Alruwaili, S.M.2024. The Role of Nurses in Diabetic Foot Prevention and Care: A Comprehensive Review. Journal of International Crisis and Risk Communication Research. 7 (S8). 2501-2505

Arrais, K.R., de Araujo Filho, A.C.A, da Silva, A.P., Pacheco, E.S., e Silva, A.D.M., Rodrigues, A.D.S.D.A., da Silva, M.S.G., Arrais, K.R. and Bezerra, S.M.G. 2022. Performance and difficulties of family nurses in the prevention of diabetic foot. ESTIMA, Brazilian Journal of Enterostomal Therapy. 20 (e3122): 1-9.

Daly, B., Arroll, B., Nirantharakumar, K. and Scragg, R.K.R. 2020. Improved foot management of people with diabetes by primary healthcare nurses in Auckland, New Zealand. New Zealand Medical Journal. 133 (1527). 39-50.

Crocker, R.M., Tan, T.W., Palmer, K.N.B and Marrero, D.G. 2022. The patient's perspective of diabetic foot ulceration: A phenomenological exploration of causes, detection and care seeking. JAN Leading Global Nursing Research. 78 (8). 2482-2494.

Font-Jimenez, I., Acebedo-Uridales, M.S., Aguaron-Garcia, M.J., De Sousa, M.R., and Rubio-Rico, L. 2020. Nurses' Perspective of Treating Patients With an Amputation Due to Diabetic Foot Syndrome. Clinical Nurse Specialist. 34 (3). 107-115.

Gonçalves, P.H., Cardoso, A.G.F., Ribeiro, T.D.S., Matumoto, S., Fermino T.Z., Fortuna, C.M. and Lettiere-Viana, A. 2024. Ulcers or infection of the lower limbs in people with diabetes mellitus: Nurses' knowledge and practices*. 2024. Cogitare Nursing. 29. 1-33.

Haddaway, N.R., Page, M.J., Pritchard, C.C. and McGuinness, L.A. 2022. PRISMA2020: An R package and Shiny app for producing PRISMA2020-compliant flow diagrams, with interactivity for optimised digital transparency and Open Synthesis. Campbell Systematic Reviews. 18 (2). 1-12.

Hidalgo-Ruiz S., Ramírez-Durán M.D.V., Basilio-Fernández B., Alfageme-García P., Fabregat-Fernández J., Jiménez-Cano V.M., Clavijo-Chamorro M.Z. and Gomez-Luque A. 2023. Assessment of Diabetic Foot Prevention by Nurses. Nursing Reports. 13 (1). 73-84.

Hu, X., Zhang,Y., Chen, Y. and Zhang, Y.P. 2023. Validation and application of the 2019 International Working Group on the Diabetic Foot risk stratification for diabetic foot in Chinese patients. Journal of Diabetes Investigation. 14 (7). 893-901.

Ibrahim, A.M., Gano, F.A.E.L., Abdel-Aziz, H.R., Elneblawi, N.H., Zaghamir, D.E.F., Negm, L.M.M.A., Sweelam, R.K.M., Ahmed, S.I., Mohamed, H.A.O., Hassabelnaby, F.G.E. and Kamel, A.M. 2024. Tailoring nursing interventions to empower patients: personal coping strategies and self-management in type 2 diabetes care. BioMed Central Nursing. 23 (1) : 926. 1-13.

Jiménez-García, J.F., Jiménez-Abad, J.F., López, L.A. and García-Fernández, F.P. 2024. Diabetic foot ulcers: evaluating the role of the specialist advanced practice nurse in complex chronic wounds. British Journal of Nursing. 33 (15). S4-S15.

Kim J. 2023. The pathophysiology of diabetic foot: a narrative review. Journal of Yeungnam Medical Science. 40 (4). 328-334.

Lee, E.J., Jeong, I.S., Kim, I.J., Cho, Y.H. and Kim, Y.J. 2021. Risk assessment and classification for foot ulceration among patients with type 2 diabetes in South Korea. International Journal of Nursing Practice. 28 (3).1-10.

Lim, W.M. 2024. A typology of validity: content, face, convergent, discriminant, nomological and predictive validity. Journal of Trade Science. 12 (3). 155-179.

Mafusi, L. G., Egenasi, C.K., Steinberg, W.J., Benedict, M.O., Habib, T., Harmse, M. and Rooyen, C.V. 2024. Knowledge, attitudes and practices on diabetic foot care among nurses in Kimberley, South Africa. South African Family Practice. 66 (1). 1-10.

Nascimento, L.F., Pascoal, L.M., Lopes, M.V.D.O, Neto, M.S., Santos, F.A.A.S., Costa A.C.P.D.J. and Santos, F.S. 2024. Content analysis of the nursing diagnosis of ineffective peripheral tissue perfusion in patients with diabetic foot. Journal of Clinical Nursing WILEY. 33 (10). 3991-4004.

Nayeri, N.D., Samadi, N., Mehrnoush, N., Allahyari, I., Bezaatpour, F. and NaseriAsl, M. 2020. Experiences of nurses within a nurse-led multidisciplinary approach in providing care for patients with diabetic foot ulcer. Journal of Family Medicine and Primary Care. 9 (6). 3136-3141.

Pirani, S.A. 2024. Navigating Research Ethics: Strategies for preventing and addressing research misconduct. International Journal of Multidisciplinary Research & Reviews. 3 (2). 96-104.

Renjith, V., Yesodharan, R., Noronha, J.A., Ladd E., and George, A. 2021. A Qualitative Methods in Health Care Research. International Journal of Preventive Medicine. 12:20. 1-7.

Roupa, Z., Kalopita, E., Koulouri, A., Charalambous, C., Diamantidou, V., and Vasilopoulos, A. 2021. An Investigation of the Diabetic Patient or Its Caregivers Knowledge

Levels Regarding the Diabetic Foot Management. International Journal of Caring Sciences 14 (2). 1028-1033.

Søndergaard, S.F., Christensen, J.F, Dahl, M., Drejer, M and Høgh, A. 2024. The interplay between patients and healthcare professionals in a cross-sectoral setting in connection with the treatment and care of patients with diabetic foot ulcers: a realistic evaluation. BioMed Central Health Services Research. 24:782. 1-12.

Stasini, F.B., Margari, N., Fasoi, G., Kelesi, M. and Dafogianni, C. 2020. Quality of Life among Patients with Diabetic Foot Ulcer. International Journal of Caring Sciences. 13 (2). 1073-1080

Subrata, S.A. and Phuiphaibul, R. 2019. Diabetic foot ulcer care: a concept analysis of the term integrated into nursing practice. Scandinavian Journal of Caring Sciences. 33. 298-310.

Wang, X., Yuan, C.X., Xu, B. and Yu Z. 2022. Diabetic foot ulcers: Classification, risk factors and management. World Journal of Diabetes. 13 (12).

Walsh, A. and Kuhnke, J.L. 2024. Prioritizing the Prevention of Diabetic Foot Disease: We Each Have a Role to Play. Canadian Journal of Nursing Research. 56 (1). 61-68.

Yang, H. and Tate, M. 2012. A Descriptive Literature Review and Classification of Cloud Computing Research. Communications of the Association for Information Systems. 31: 2. 30-60. <https://doi.org/10.17705/1CAIS.03102>. Accessed 21 March 2025.

Yaprak, B. and Keskin, L. 2023. Evaluation of microvascular complications in patients with new diagnosis type 2 diabetes. European Review for Medical and Pharmacological Sciences. 27. 1601-1608.

Appendix 1: Database searches results

Database/ date/ limits	Search phrase	Total number of hits based on limitations	Papers/ records included based on title	Papers/ records included based on abstract	Papers/ records included based on full text
CINAHL / 03 March 2025 limits: 5 years, adults, english, abstract available, peer-reviewed	(nurs* role OR interventions OR management) AND hospital AND (foot ulcer OR foot ulcers OR diabetic foot ulcer OR diabetic foot ulceration OR diabetic foot OR diabetes foot OR dfu)	n=327	n=34	n=24	n=0
PubMed / 06 March 2025 limits: 5 years, adults, english, abstract available, peer-reviewed	(nurs* role OR interventions OR management) AND hospital AND (foot ulcer OR foot ulcers OR diabetic foot ulcer OR diabetic foot ulceration OR diabetic foot OR diabetes foot OR dfu)	n=49	n=12	n=11	n=1

CINAHL / 09 March 2025 limits: 5 years, adults, english, abstract available, peer-reviewed	hosp* AND (diabetic foot ulcer or dfu or diabetic foot) AND (nurs * intervention OR management OR role)	n=64	n=8	n=1	n=0
PubMed / 09 March 2025 limits: 5 years, adults, english, abstract available, peer reviewed	hosp* AND (diabetic foot ulcer or dfu or diabetic foot) AND (nurs * intervention OR management OR role)	n=24	n=0	n=0	n=0
CINAHL / 11 March 2025 limits: 5 years, adults, english, abstract available, peer reviewed	(diabetic foot ulcer* OR diabetic foot sore* OR diabetic wound) AND (nurs* management OR intervention OR role*) AND hospital	n=40	n=14	n=11	n=0
CINAHL / 11 March 2025 limits: 5 years, adults, english, abstract available, peer reviewed	nurse AND diabetic foot ulcer	n=104	n=33	n=27	n=9

PubMed /12 March 2025 limits: 5 years, adults, english, abstract available, peer reviewed	nurse AND diabetic foot ulcer	n=50	n=16	n=11	n=1
CINAHL / 14 March 2025 limits: 5 years, adults, english, abstract available, peer reviewed	nurse AND diabetic foot ulcer AND (clinical setting OR hospital OR clinical practice)	n=18	n=9	n=8	n=1
PubMed / 14 March 2025 limits: 5 years, adults, english, abstract available, peer reviewed	nurse AND diabetic foot ulcer AND (clinical setting OR hospital OR clinical practice)	n=33	n=3	n=2	n=1
Records in total	With duplicates	709	129	93	13

Records after duplicates removed	8 duplicates	709	121	93	13
Total number of included articles		-	-	-	13

Appendix 2: Summary of reviewed articles

Author(s), year, country	Topic /title	Methodology and methods	Participants	Main outcomes	Limitations
1. Nayeri et al. 2020 Iran	Experiences of nurses within a nurse led multidisciplinary approach in providing care for patients with diabetic foot ulcer	Qualitative and phenomenological research method	n= 9 nurses	Identified the involvement of nurses in multidisciplinary care. (p.3136)	The limitations of the study may include small sample size, making it hard to generalize the findings. Subjective bias from nurses´ personal experiences and recall affect accuracy. The study may focus only in nurses, overlooking other team members´ perspectives
2. Arrais et al. 2022 Brazil	Performance and Difficulties of Family nurses in the prevention of Diabetic foot.	A descriptive-exploratory study, with a qualitative approach	n= 10 nurses	Nurses' actions in the prevention of diabetic foot and factors that interfere in the preventive assessment of the feet emerged. (p.1)	Includes small sample size, potential self-reporting bias, lack of long-term data and limited scope of study.

3. Jiménez-García, Jiménez-Abad, López & García-Fernández. 2024 Spain	Diabetic foot ulcers: evaluating the role of the specialist advanced practice nurse in complex chronic wounds	A retrospective descriptive study methods	The study population comprised all patients with diabetic foot ulcers referred to the APN by nurses and doctors from the various specialist clinical hubs within the district	The findings highlights importance of a fast and effective care pathway between primary and hospital care, with advanced practice nurse plays key role. (p.4)	The limitations of this research include the use of non random convenience sampling that may affect the generalizability of results and the study only focusing on one health district limiting broader capability and patients transferred to other district are excluded impacted on completeness of data
4. Gonçalves et al. 2024 Brazil	Ulcers or infections of the lower limbs in people with Diabetes Mellitus: Nurses` knowledge and practices	Qualitative study	n= 24 nurses	The study's findings provide insight into the understanding of lower limb ulcers or infections in people with diabetes mellitus as well as the role of nurses in managing care for these people. (p. 1)	It was conducted in just one municipality, exploring the practice at a local level. This study is not intended to make generalizations.

5. Daly, Arroll, Niranthkumar, Scragg 2020 New Zealand	Improved foot Management of people with diabetes by primary healthcare nurses in Auckland , New Zealand	Two cross-sectional surveys of PHC nurses were carried out in 2006–2008 and in 2016 in Auckland, New Zealand.	n =287 (26%) in 2006 and 336 (24%) in 2016 nurses. n=308 patients with diabetes were consulted in 2006–2008 and 447 in 2016	In 2016 more patients received foot exams (58%) and education (66%) compared to 2006-2008 nurse involvement improved with more training though 43% of patients still lack foot exams. (p.39)	The study`s limitations include missing one third of district nurses in Auckland, possibly leading to underrepresentation. However, results remain valid for practice and specialist nurses due to random sampling. Patient differences may be over or underestimated, and those seen by district and specialist nurses likely had more diabetes- related complications than those seen by by practice nurse.

6. Lee, Jeong, Kim, Cho, and Kim 2021 South Korea	Risk assessment and classification for foot ulceration among patients with type 2 diabetes in South Korea.	A cross- sectional observational design study	n= 267 patients with diabetes	Foot deformity was common (38.2%). Among 261 patients without current ulcers , 17.6%-35.2% were high risk. The risk assessment tools showed moderate consistency (kappa 0.42-0.56). Insulin used was linked to increased chances of foot ulcers. (p.1)	The study may not accurately reflect the true prevalence of foot conditions due to convenience sampling , limited diagnostic methods and the exclusion of inpatients. Screening test for peripheral artery disease and neuropathy may have caused misclassification of risk levels, Since foot ulcer risk is higher in inpatients`
7. Font-Jimenez, Acebedo-Uridales, Aguaron-Garcia, De Sousa & Rubio-Rico 2020 Spain & Portugal	Nurses' Perspective of Treating Patients With an Amputation Due to Diabetic Foot Syndrome	Qualitative multicenter study	n= 24 expert nurses delivering care to patients with DFS	From the nurses' perspectives regarding the care requirements of patients with DFS needing an amputation,2 main themes were identified from the analysis of interviews: (1) poor self-care and the disease trajectory, and (2) effective hospital care. (p.109)	The nurses interviewed worked in various fields and not only with DFS patients and that the study may not completely represent DFS specialists. This could mean that their knowledge and experience do not fully represent all professionals specializing in diabetic foot care,

					limiting the study's accuracy in that field.
8. Walsh & Kuhnke 2024 Canada	Prioritizing the Prevention of Diabetic Foot Disease: We Each Have a Role to Play	Qualitative descriptive study Data were analyzed through reflexive thematic analysis	n= 23 patients living with DM from 13 months to 49 years	Respondents often struggled to stick to health decisions that is in line with the recommended self-care practices for managing diabetes and preventing foot complications. Additionally, they frequently received conflicting messages from healthcare professionals and their workplaces, which made it difficult to feel fully responsible for managing condition. The findings revealed two main themes: a) struggling to cope: Emotionally detaching from the illness b)Shifting sense of responsibility: conflicting messages (p. 63)	The study's findings may not be applicable to everyone with diabetes as it were based on a small, similar group from Eastern Canada. Research with larger groups , with or without foot complications may deliver a better understanding of self-care practices in preventing diabetic foot disease.

9. Crocker, Tan, Palmer & Marrero 2022 USA	The patient's perspective of diabetic foot ulceration: A phenomenological exploration of causes, detection and care seeking	Qualitative study	n= 15 patients with DFUs	The findings are structured around two main areas identified through data analysis: (1) how patients understands and interpret foot ulceration (as object of awareness (2) how they perceive the timing and progression of the foot ulceration and their decision to seek care.(temporal experience of illness) p.2486)	This study had limitations, including a small sample size due to missed appointments and COVID-19 recruitment problems. Additionally, there was an overrepresentation of male participants that affect the comparison of ethnic groups, gender differences and overall generalizability.

10. Søndergaard et al. 2024 Denmark	The interplay between patients and healthcare professionals in a cross-sectoral setting in connection with the treatment and care of patients with diabetic foot ulcers: a realistic evaluation.	Realist evaluation framework The Standards for Reporting Qualitative Research (SRQR) were used in this study.	n=14 patients	From the 52 CMOCs, three key themes were identified that highlights how patients and healthcare professionals interact across different care settings in managing DFU: 1. Humour helps strengthen the relationship between DFU patients and healthcare professionals. 2. Supporting DFU patients develop coping strategies enhances personalized care and teamwork. 3. DFU patients and healthcare professionals often have unclear reponsibilities in treatment and care (p.6)	This study may be limited as it was conducted in two specialized Danish centers for patients with DFUs. However, they serve patients with DFUs from more than 15 municipalities in Denmark. Additionally, the scope of cross-sectoral collaboration may be complex and by incorporating contextual perspectives through RE helps to overcome this challenge.
11. Nascimento et al. 2024 Brazil	Content analysis of the nursing diagnosis of ineffective peripheral tissue perfusion in patients with diabetic foot.	Quantitative study	n= 34 nurses with clinical, theoretical or research experience in diabetes or nursing diagnoses	The results indicated that most factors were important for diagnosing ineffective peripheral tissue perfusion in diabetic foot patients. However,	Five factors were considered invalid because of unclear and imprecise definitions: lack of disease knowledge, smoking, peripheral arterial dis

				five factors such as lack of disease knowledge, smoking, peripheral arterial disease, high liver enzymes and a sedentary lifestyle were not statistically significant and lacked of clarity and precision. .(p.3994) All 22 clinical indicators were found statistically essential in terms of significance, transparency and accuracy. However, two indicators including color does not return after 1 minute of leg elevation and cold foot; had lower relevance and precision scores, suggesting inconsistency among the reviewers. (p. 3995)	ease, elevated liver enzymes and sedentary lifestyle. Indicators had low CVI values for relevance and precision of operational definitions. They were revised to enhance their definitions and one had its name changed. Based on these findings, to ensure the relevance of the proposed elements in the studied population for higher reliability and enhanced diagnostic assessment, clinical validation is advisable.
12. Hidalgo-Ruiz et al.	Assessment of Diabetic Foot Prevention by Nurses	Cross-sectional and observational descriptive study	n= 157 nurses	The findings revealed that most participants regularly assesses patients' feet and its	The questionnaires were anonymous and were shared on nurs-

2023 Spain				risks. 96.58% asked patients to take off their footwear, 78.34% did thorough exams and 80.25% evaluated foot ulcer risk. Additionally, 84.07% frequently and 62.42% very frequently educated patients on self-care and evaluated their management skills in relation to diabetic foot, while only 19.11% conducted group workshops. (P.73)	ing pages and forums, therefore, there is no control for those who participated or address any inquiries. Additionally, the sample size was not calculated and non-probabilistic convenience sampling was used. Lastly, the survey did not undergo a preliminary peer review process for validation.
13. Mafusi et al. 2024 South Africa	Knowledge, attitudes and practices on diabetic foot care among nurses in Kimberley, South Africa	Descriptive cross-sectional analytical study	n= 128 nurses	A total of 105 participants completed the questionnaire, with most being female (95%). While 58.1% were aware that South African Diabetic Foot Guidelines, only 57.7% had read them. More than half (57%) were not familiar with the 60-second diabetic foot screening tool, and 67% unaware about	Due to the COVID-19 pandemic, some participants could not be contacted. The study focused only on nurses since doctors were involved in just 3 of the 13 clinics. Its findings may not be applicable to all of Northern Cape or South Africa as the study was conducted only in

				the 10 g monofilament test. Moreover, 29.8% had not attended a diabetic foot care class and 85.6% need additional education in diabetic foot management. (p.1)	one municipality in Northern Cape. Also, the used of self-reported data and non-homogeneous groups may create bias, and the study had limited ability to differentiate the knowledge levels between professional nurses and auxiliary nurses.

Appendix 3: Data analysis for study question 1.

Article	Meaning Units	Coding	Sub-category	Generic Category	Main Category
2	Participants indicated that during physical examinations, they assess the skin by observing various features such as color , presence of calluses or deformities, swelling ,dryness, hydration and overall hygiene. They also take notes of the patients` footwear, assess nail care practices and check for signs of fungal infections. In terms of neurological assessment some reported using monofilaments to test foot sensitivity and using touch to evaluate temperature perception. For vascular assessment, several participants mentioned palpating peripheral pulses and measuring the ankle brachial index (ABI) as part of routine evaluation. (Arrais et al. 2022, p. 4)	Participants indicated that during physical examinations, they assess the skin by observing various features such as color , presence of calluses or deformities, swelling ,dryness, hydration and overall hygiene Investigate if there are any fungal infections. Check for signs of fungal infections. Using monofilaments to test foot sensitivity and using touch to evaluate temperature perception. Palpating the pulses, adding the measurement of the (ABI)	Skin assessment Skin monitoring Sensory monitoring Circulatory monitoring	Physical assessment Infection control Neurological assessment Vascular assessment	Nurses management in DFUs

3	Over half of the patients seen by advanced practice nurse (APN) experienced full ulcer healing with 59% (61 out of 103) reaching a RESVECH score of . Among the DFU, 39% (24 out of 63) were neuroischemic , while 61% (37 out of 103) were neuropathic. (Jiménez-García, Jiménez-Abad, López & García-Fernández, p.10)	Experienced full ulcer healing with 59% (61 out of 103)	Healing	Infection control	Nurses management in DFUs
6	To encourage more frequent foot exams , Korea and similar countries need a straightforward and reliable risk classification system that nurses can use quickly and easily while patients wait to see a doctor. (Lee et al. 2021, p. 6)	Frequent foot exams. Straightforward and reliable risk classification system. Nurses can use quickly and easily while patients wait to see a doctor	Foot assessment Risk assessment Rapid assessment	Physical assessment Physical assessment Physical assessment	Nurses management in DFUs

9	Some individuals described experiencing uncomfortable physical symptoms that prompted them to examine their feet. These included pain on the soles or areas rubbing against shoes, skin dryness or thickening and presence of fluid discharge such as pus , blood or serum, staining socks or clothing. Several patients shared similar experiences , feeling that despite seeking medical attention promptly, they were left with limited options such as amputation or prolonged and complex treatment plans. (Crocker, Tan, Palmer & Marrero 2022, 2488,2491)	Experiencing uncomfortable physical symptoms that prompted them to examine their feet Seeking medical attention promptly	Stimulus Sepsis prevention	Neurological assessment Infection control	Nurses management in DFUs

11	This study supports nursing practice by aiding in the early detection of causes and clinical signs of impaired peripheral tissue perfusion in diabetic foot patients which is essential for choosing suitable interventions to prevent complications and disability. The findings indicated that all identified causes were deemed important for diagnosing impaired peripheral tissue perfusion in patients with diabetic foot (Nascimento et al. 2024, p. 3994, 4002)	Supports nursing practice by aiding in the early detection of causes and clinical signs of impaired peripheral tissue perfusion. Choosing suitable interventions to prevent complications and disability. All identified causes were deemed important for diagnosing impaired peripheral tissue perfusion in patients with diabetic foot	Early diagnosis and assessment Minimizing health risks Peripheral arterial sufficiency	Vascular assessment Physical assessment Vascular assessment	Nurses management in DFUs

Data analysis for study question 2.

Article	Meaning units	Coding	Sub-Category	Generic Category	Main Category
1	Another theme influencing nurse-led multidisciplinary care is professional worthiness which includes aspects such as nurse authority and efficiency. Participants described receiving consistent, coordinated and focused care highlighting the central role and competence of nurses. These insights reflect the professional growth of nursing in delivering high- quality care to patients with chronic conditions like diabetic foot ulcers supporting effective wound healing.(Nayeri et al. 2020, p. 3139)	Nurse-led multidisciplinary care is professional worthiness Receiving consistent, coordinated and focused care highlighting the central role and competence of nurses. Reflect the professional growth of nursing in delivering high-quality care to patients.	Nurse dominance and efficiency Systematized care Professionalism	Leadership in nursing Patient advocate Leadership in nursing	Role of nurses in the management of dfus.
4	The interview analysis revealed two main themes: Nurse` understanding of lower limb ulcers or infections in individuals with diabetes and their role in providing care for these patients. (Gonçalves et al. p.3)	Understanding of lower limb ulcers or infections in individuals with diabetes. Providing care for these patients.	Disease awareness Care	Health educator Patient advocate	Role of nurses in the management of dfus.

5	Sixty- five percent of patients seen by nurses received foot care education, primarily focused on appropriate footwear (43%), self-inspection (41%) and moisturizing the feet and heels (24%). Additionally 12% were advised on toenail care, managing complication like calluses, using orthotics and addressing sensory issues (Daly, Arroll, Nirantharakumar, Scragg 2020, p. 41)	Foot care education, primarily focused on appropriate footwear (43%), self-inspection (41%) and moisturizing the feet and heels (24%). Advised on toenail care, managing complication like calluses, using orthotics and addressing sensory issues.	Foot care guidance Foot care awareness	Health educator Health educator	Role of nurses in the management of dfus.
6	To enhance the routine practice of foot assessments, Korea and other nations with similar challenges need a simple and reliable risk classification tool that nurses can quickly and easily apply while patients wait for their medical appointments (Lee et al. 2021, p. 6)	A simple and reliable risk classification tool that nurses can quickly and easily apply	Efficiency	Patient advocate	Role of nurses in the management of dfus.

7	Based on the insights experienced nurses regarding the needs and hospital care of patients with diabetic foot syndrome (DFS) requiring amputation, two key terms identified: (1) inadequate self-care and progression of the disease and (2) the importance of effective hospital-based management (Font-Jimenez, Acebedo-Uridales, Aguaron-Garcia,De Sousa and Rubio-Rico 2020, p. 109)	Based on the insights experienced nurses regarding the needs and hospital care of patients with diabetic foot syndrome (DFS) Inadequate self-care and progression of the disease	Nurses' point of view Self- care deficits and hospital support	Leadership in nursing Health educator	Role of nurses in the management of dfus.
8	The participant expressed the confidence in the guidance provided by the diabetic nurse educator, despite infrequent interactions. (Walsh and Kuhnke 2024, p. 64)	Participant expressed the confidence in the guidance provided by the diabetic nurse	Trustworthy	Health educator	Role of nurses in the management of dfus.

9	Some patients had encountered ``foot ulcers`` but did not have enough knowledge to relate it to the symptoms or conditions they were experiencing on their feet. Every participant in the study eventually pursued medical assistance , choosing between a general practitioner ,podiatrist, emergency department or urgent care facility depending on how urgent they believed their condition was and the accessibility of services at the time. (Crocker, Tan, Palmer & Marrero 2022, p.2488, 2490)	Not have enough knowledge to relate it to the symptoms or conditions they were experiencing on their feet. Choosing between a general practitioner ,podiatrist, emergency department or urgent care facility.	Ambiguity Integrated	Health educator Collaborator	Role of nurses in the management of dfus.

10	Humour can play a valuable role in fostering positive interactions and building rapport between patients with diabetic foot ulcers and healthcare providers. Facilitating coping mechanisms in individuals with diabetic foot ulcers strengthens patient-centered care and promotes effective collaboration between patients and healthcare professionals. Individuals with diabetic foot ulcers (DFU) and the healthcare professionals managing their care often engage in unclear and unestablished roles regarding their responsibilities. (Søndergaard et al. 2024, pp. 6–8) (q2)	Humour can play a valuable role. Promotes effective collaboration between patients and healthcare professionals. Healthcare professionals managing their care often engage in unclear and unestablished roles.	Encourage patient engagement Multidisciplinary approach Assigned roles	Health educator Collaborator Leadership in nursing	Role of nurses in the management of dfus.

12	Evaluating both the act of removing shoes for inspection and the foot examination itself, It is important to recognize that routine foot checks alone do not lower risk of ulcers and amputations. However, educating patients has proven effective in improving foot-care awareness and reducing risk of ulcers and amputations, especially in high-risk individuals. (Hidalgo-Ruiz et al. 2023, p. 81)	Recognize that routine foot checks alone do not lower risk of ulcers and amputations. Educating patients has proven effective in improving foot-care awareness and reducing risk of ulcers and amputations,	Nursing awareness Immediate foot care education impact	Health educator Health educator	Role of nurses in the management of dfus.
13	The findings are encouraging as 84.8% of participants showed satisfactorily to fair understanding of diabetic foot care. This indicates a strong starting point for enhancing knowledge through education and interventions. (Mafusi et al. 2024, p. 6)	Participants showed satisfactorily to fair understanding of diabetic foot care. Indicates a strong starting point for enhancing knowledge through education and interventions.	Competency Goal-oriented actions	Leadership in nursing Health educator	Role of nurses in the management of dfus.