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Diabetic Ulcer Nursing Care: An Integrated Evidence Based Approach

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ABSTRACT

Diabetic foot ulceration (DFU) remains a leading cause of morbidity, amputation, and health care expenditure worldwide. Nurses occupy a pivotal position in the multidisciplinary management of DFU, from risk stratification and early detection to wound bed preparation, infection control, off loading, and patient education. This paper synthesises contemporary evidence (2018 2024) on nursing interventions that improve ulcer healing, prevent recurrence, and reduce amputation rates. A narrative review methodology was employed, drawing on peer reviewed journals, clinical practice guidelines (International Working Group on the Diabetic Foot IWGDF; American Diabetes Association – ADA), systematic reviews, and meta analyses. Findings reveal that a structured, protocol driven nursing care pathway incorporating comprehensive assessment, validated risk scoring tools, advanced wound care technologies (e.g., moist dressings, growth factor therapy, negative pressure wound therapy), and rigorous patient centred education significantly enhances outcomes. Gaps in the literature pertain to long term adherence to off loading devices and the cost effectiveness of emerging technologies in low resource settings. The paper concludes with practical recommendations for nursing practice, policy, and future research.

KEYWORDS

• Diabetic foot ulcer • Nursing care • Wound management • Off loading • Patient education • Multidisciplinary team

INTRODUCTION

Diabetes mellitus (DM) affects more than 537 million adults globally, and among its complications, diabetic foot ulceration (DFU) is the most debilitating (International Diabetes Federation, 2023). Approximately 15–25 %

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of individuals with DM will develop a foot ulcer during their lifetime, and 85 % of lower extremity amputations are preceded by an ulcer (Boulton et al., 2020). The economic burden is substantial; in the United States, DFU related costs exceed US$ 13 billion annually (Zhang et al., 2022).

Nurses are often the first point of contact and serve as the coordinating hub of DFU care. Their responsibilities span risk identification, wound assessment, implementation of evidence based treatments, education, and ongoing surveillance. Nevertheless, variations in nursing practice, limited resources, and insufficient integration of emerging evidence create gaps in care quality (Murray et al., 2021).

This paper aims to (1) review the current evidence regarding nursing interventions for DFU, (2) delineate a comprehensive, evidence based nursing care pathway, and (3) highlight research and policy priorities that can advance DFU outcomes.

METHODOLOGY

A narrative review design was chosen to collate and synthesize diverse sources of evidence relevant to nursing practice. The following steps were undertaken:

1. **Search Strategy** – Databases searched: PubMed, CINAHL, Scopus, and Cochrane Library. Search terms combined MeSH headings and keywords: "diabetic foot ulcer," "nursing care," "wound management," "off loading," "patient education," and "multidisciplinary." Filters: English language, human subjects, publication year 2018–2024.
2. **Selection Criteria** – Inclusion: peer reviewed original research, systematic reviews, meta analyses, clinical practice guidelines, and high quality observational studies that reported nursing specific interventions or outcomes. Exclusion: studies focusing exclusively on surgical or pharmacological interventions without a nursing component.
3. **Data Extraction & Synthesis** – Data on study design, sample size, nursing interventions, outcome measures (e.g., ulcer healing rate, time to closure, amputation incidence), and quality appraisal were extracted. Findings were grouped under thematic headings reflecting the continuum of DFU nursing care.
4. **Quality Assessment** – The Joanna Briggs Institute (JBI) critical appraisal tools were applied to observational and interventional studies; the AMSTAR 2 checklist was used for systematic reviews.

EPIDEMIOLOGY AND PATHOPHYSIOLOGY OF DIABETIC FOOT ULCERS

Understanding the aetiology of DFU underpins targeted nursing interventions. The three principal pathogenic mechanisms are:

- **Peripheral Neuropathy** – Loss of protective sensation promotes repetitive trauma (e.g., pressure, shear).
- **Peripheral Arterial Disease (PAD)** – Impaired perfusion diminishes tissue viability and slows healing.
- **Impaired Immunity & Metabolic Factors** – Hyperglycaemia hampers leukocyte function, collagen synthesis, and angiogenesis (Lipsky et al., 2020).

These mechanisms often coexist, creating a "neuro ischemic" ulcer phenotype that demands comprehensive assessment and multimodal treatment (International Working Group on the Diabetic Foot, 2021).

COMPREHENSIVE NURSING ASSESSMENT

Risk Stratification

Risk assessment tools enable early identification of patients at high risk for ulceration. The most widely validated instruments include:

Tool	Domains	Scoring	Predictive Accuracy
IWGDF Risk Classification (2021)	**Neuropathy, PAD,** previous ulcer/ amputation, foot deformities	**0–3 (low** to high)	**Sensitivity 0.85;** Specificity 0.71
Diabetic Foot Risk Score (DFRS) (Murray et al., 2021)	**Sensory loss,** foot deformities, footwear, vascular status	**0–10**	**Area under** ROC 0.78

Nurses should incorporate these tools into routine diabetic clinics and document risk status in the electronic health record (EHR).

Detailed Wound Evaluation

A systematic wound assessment follows the "TIME" framework (Tissue, Infection/ Inflammation, Moisture balance, Edge) (Falanga et al., 2020). Critical parameters:

- **Size & Depth** – Measured using calibrated tracings or digital planimetry; documented in cm^2 and mm depth.
- **Exudate** – Volume, colour, and odor guide infection suspicion.
- **Peri ulcer Skin** – Integrity, maceration, and signs of ischemia.
- **Vascular Assessment** – Ankle brachial index (ABI), toe brachial index (TBI), and trans cutaneous oxygen tension (TcPO) if PAD suspected.

Standardised documentation facilitates continuity of care and outcome tracking.

EVIDENCE BASED NURSING INTERVENTIONS

Wound Bed Preparation

1. Moist Wound Healing

Multiple randomized controlled trials (RCTs) demonstrate superior healing with moist dressings compared with dry gauze (Sheehan et al., 2020; Wang et al., 2022). Common options:

Dressing Type	Mechanism	Indications	Evidence Level
Hydrocolloid	Autolytic debridement, exudate absorption	Low-to-moderate exudate, granulating wounds	Level 1 (RCT)
Alginate	High exudate absorption	Exudative ulcers	Level 2
Foam	Protects against shear, maintains moisture	Moderate exudate, fragile skin	Level 1
Silver-impregnated	Antimicrobial activity	Colonised/infected wounds	Level 1 (meta-analysis, 2021)

Nurses must select dressings based on exudate level, infection status, and patient tolerance, and schedule dressing changes every 2–7 days.

2 Debridement

Sharp surgical debridement performed by trained nurses or wound care specialists accelerates granulation formation (Vowden et al., 2020). Adjunctive methods autolytic (using hydrogel), enzymatic, or low frequency ultrasound are appropriate when sharp debridement is contraindicated.

3 Advanced Therapies

- **Negative Pressure Wound Therapy (NPWT)** – Meta analyses show a pooled risk ratio for healing of 1.44 (95% CI 1.12–1.84) compared with standard dressings (Mihara et al., 2021). Nursing responsibilities include device set up, seal integrity monitoring, and pressure adjustments.
- **Growth Factor and Bio engineered Skin Substitute**s – Recombinant human platelet derived growth factor BB (rhPDGF BB) improves closure rates in neuropathic DFUs by 30 % (Gordon et al., 2020). Nursing roles encompass application protocol adherence and adverse event surveillance.
- **Hyperbaric Oxygen Therapy (HBOT)** – Evidence remains mixed; when indicated, nurses coordinate transport, monitor barotrauma, and assess for contraindications (Kessler et al., 2022).

Off Loading

Off loading of pressure is the cornerstone of DFU healing. Systematic reviews consistently rank total contact casts (TCC) as the most effective modality, achieving healing rates of 70–80% (Armstrong et al., 2020). However, TCC requires skilled application and close monitoring for complications.

Modality	Healing Rate	Practical Considerations	Nursing Role
Total Contact Cast (TCC)	70–80 %	Requires trained cast technician; risk of skin breakdown	Cast application, daily inspection, patient education
Removable Cast Walker (RCW)	55–65 %	Greater patient autonomy; adherence variable	Fit adjustment, adherence counseling, compliance monitoring

table cont....

Post-operative shoe/orthotic	40–50 %	Used after ulcer closure for secondary prevention	Gait assessment, footwear fitting, education
Custom-made felted off-loading device	50–60 % (selected studies)	Low-cost, adaptable to complex foot shapes	Fabrication, periodic reassessment

Adherence is a pivotal determinant of success. Studies using electronic monitors report adherence rates of only 40% with removable devices (Lipsky et al., 2021). Nurses must employ motivational interviewing techniques, set realistic goals, and involve caregivers to enhance compliance.

Infection Control

Infection is both a cause and consequence of DFU. The IWGDF 2021 infection guideline emphasizes:

- Early identification using the PEDIS (Perfusion, Extent, Depth, Infection, Sensation) grading system.
- Microbiological sampling before initiating systemic antibiotics when signs of infection are present.
- Topical antimicrobial agents for mild colonisation (e.g., iodine, honey, silver dressings).

Nurses are responsible for accurate wound swabbing (deep tissue technique), antibiotic stewardship coordination with prescribers, and monitoring for systemic signs (fever, leukocytosis).

Glycaemic and Systemic Optimisation

Though primarily managed by physicians, nurses play a supportive role through:

- Education on self monitoring of blood glucose and medication adherence.
- Facilitating multidisciplinary referrals (vascular surgery, podiatry, endocrinology).
- Screening for comorbidities (renal insufficiency, anemia) that may impede healing.

A prospective cohort study demonstrated that nurse led glycaemic optimisation programmes reduced ulcer healing time by 22% (Miller et al., 2022).

Patient Education and Self Management

Effective education reduces recurrence rates. A systematic review of 14 RCTs identified a pooled relative risk of ulcer recurrence of 0.58 for patients receiving structured education (Murray et al., 2023). Core educational components include:

1. Foot care hygiene – Daily inspection, washing, moisturising (avoid interdigital spaces).
2. Proper footwear selection – Wide toe box, low profile heel, custom inserts when indicated.
3. Risk sign recognition – Redness, swelling, drainage, or new pain.
4. Lifestyle modification – Smoking cessation, weight management, regular physical activity.

Nurses should employ adult learning principles, use visual aids, and provide culturally appropriate materials. Tele health platforms have emerged as effective adjuncts for reinforcement, particularly in remote populations (Lee et al., 2024).

MULTIDISCIPLINARY COLLABORATION

The "ABCDE" model (Assessment, Blood glucose control, Care of the ulcer, Debridement, and Education) underscores the necessity of coordinated teamwork (Boulton et al., 2020). Nurses act as:

- Case managers, ensuring timely referrals and follow up.
- Communication bridges, conveying updates between podiatrists, vascular surgeons, and diabetologists.
- Data collectors, contributing to quality improvement registries (e.g., National Diabetic Foot Registry).

Studies comparing multidisciplinary clinics with usual care report a 30% reduction in major amputation rates (Parker et al., 2021).

OUTCOMES MEASUREMENT AND QUALITY IMPROVEMENT

Clinical Indicators

Indicator	Target (IWGDF 2021)	Current Benchmarks	Nursing Impact
Ulcer healing within 12 weeks	≥70 %	45–65 % (varies by setting)	Dressing protocol adherence, timely off-loading
Re-ulceration at 12 months	≤30 %	35–45 %	Education, footwear provision
Major amputation rate	≤5 %	7–10 %	Early infection detection, referral
Patient satisfaction (VAS)	≥8/10	6–8/10	Communication, education quality

Routine audit cycles, using Plan Do Study Act (PDSA) methodology, enable nurses to identify gaps and implement corrective actions.

Economic Evaluation

Cost effectiveness analyses reveal that NPWT, despite higher upfront costs, saves US$ 1,200–2,000 per healed ulcer due to reduced hospital stay and surgical interventions (Mihara et al., 2021). Nurse led education programmes have a reported return on investment (ROI) of 4.5:1 (Lee et al., 2024).

8. BARRIERS TO OPTIMAL NURSING CARE

Barrier	Description	Potential Mitigation
Resource constraints – Limited access to advanced dressings or off-loading devices in low-income settings.	Implement low-cost alternatives (e.g., felted off-loading, locally produced alginates); seek grant funding.	
Knowledge gaps – Inadequate training on IWGDF guidelines.	Continuing professional development (CPD) modules; competency-based assessments.	
Patient adherence – Poor compliance with removable devices.	Use of adherence-monitoring technology; motivational interviewing; caregiver involvement.	
Fragmented documentation – Inconsistent EHR entries hinder continuity.	Standardised wound-care templates; interdisciplinary documentation protocols.	
Cultural and language barriers – Miscommunication about foot-care practices.	Employ culturally sensitive education materials; interpreter services.	

Addressing these obstacles requires institutional support, policy advocacy, and research focused on implementation science.

FUTURE DIRECTIONS AND RESEARCH PRIORITIES

1. Implementation Science Trials – Evaluate the scalability of nurse led care bundles across diverse health care settings.
2. Digital Health Integration – Randomised studies on mobile app based wound monitoring and tele education for DFU patients.
3. Cost Effectiveness of Emerging Technologies – Comparative analyses of bioengineered skin substitutes versus conventional dressings in resource limited environments.
4. Long Term Adherence Strategies – Investigate behavioral interventions (e.g., gamification, peer support) to sustain off loading compliance.
5. Personalised Risk Prediction Models – Incorporate machine learning algorithms using EHR data to refine risk stratification and guide nursing prioritisation.

CONCLUSION

Diabetic foot ulcer management demands an integrated, evidence based nursing approach that encompasses meticulous assessment, optimal wound bed preparation, decisive off loading, vigilant infection control, and robust patient education. When nurses operate within a structured multidisciplinary framework, clinical outcomes improve markedly: higher healing rates, fewer amputations, reduced recurrence, and enhanced quality of life. Nevertheless, challenges related to resources, education, and patient adherence persist.

Targeted quality improvement initiatives, ongoing professional development, and research focused on implementation and technology adoption are essential to sustain progress. By embracing these strategies, nursing professionals can decisively curtail the burden of diabetic ulcers worldwide.

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