The fundamental goal of wound prevention: recent best evidence

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ABSTRACT

Preventing wounds is a fundamental goal for all wound professionals and is enshrined within the Australian national wound management standards. The paper presents an overview of the recent evidence in the prevention of venous leg ulcers, pressure injuries, diabetes-related foot ulcers and skin tears. Recent literature searches identified a paucity of high-quality evidence for most wound prevention interventions. The paper presents evidence available to support current best practice. Despite the lack of strong scientific evidence, fundamental care interventions, including promoting healthy skin integrity and off-loading pressure, continue to be mainstay in preventing wounds of all aetiology.

Keywords: Wound prevention, venous leg ulcers, pressure injury, skin tears, foot ulcers.

INTRODUCTION

"An ounce of prevention is worth a pound of cure."
— Benjamin Franklin[1]

Famously advising the city of Philadelphia on fire management, US Founding Forefather and inventor Benjamin Franklin not only highlighted the importance of initiating precautions to prevent catastrophe, but also captured the essence of excellence in wound practice.

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Chronic and acute wounds are a significant burden on health care systems and have an appreciable impact on the lives of people who experience them. Prevalence of wounds is variable by aetiology, clinical setting and population. Prevalence of venous leg ulcers (VLUs), which also increase in older adults, is reported at between 0.05% and 1% in the general community, rising to 2.5% in aged care settings[2]. Diabetes-related foot ulcers (DRFUs) have a prevalence of 0.02% to 10% in the general community. In one study that focused on hospitalised people with diabetes, as many as 20% had a current DFU[2]. Pressure injuries (PIs), which occur across all age groups, have prevalence rates varying from 1% to 27% in acute care settings, 7% to 53% in aged care, and 6% to 29% in the community[2]. Skin tears (STs), which comprise a substantial proportion of all wounds found amongst older adults[3-7], have a prevalence in older adults of 41% to 59% in Australia, 14% to 22% in North America and 4% to 14% in Japan[3,5,8-11].

These prevalence rates suggest that, in combination, wounds of any aetiology are implicated as a significant burden on health, particularly that of older people. Demographic data showed that in 2015 around 15% of all Australians were aged over 65 years, with population projections indicating that by 2056 this age group will grow to 22%[12,13]. The increase in longevity and the concomitant number of older adults with age-related skin changes suggests a potentially large and increasing burden of wound care on health budgets and resources. Although acute and chronic pain, lower health-related quality of life, loss of self-esteem and reduced engagement in social activities are reported in the wound-related literature[14-18] at the present time, there is a paucity of research on the full extent of the human and economic impact of chronic wounds[19].

Preventing wounding and maximising the healing potential of every individual are enshrined in the Australian *Standards for Wound Prevention and Management* as the essential goals of wound practice and a priority for all wound professionals[20].

IDENTIFYING THE RISK OF A WOUND

As will be discussed in the next section, many preventive wound care strategies are based on avoiding specific types of wounds. Different wound aetiologies require very particular preventive strategies that address underlying pathophysiology. Implementing the full gambit of wound preventive strategies for every individual is generally unnecessary and indisputably costly. Therefore, a significant component of preventive wound care is establishing an individual's risks for a wound.

Early identification of individuals at risk of a wound permits timely and targeted implementation of preventive strategies to reduce wound incidence, optimising quality of life and minimising health care expenditure. Risk identification involves recognising underlying disease, other individual factors and environmental risks that can contribute to development of a wound. Maintaining contemporary knowledge on the aetiology of wounds and understanding the risk factors for different types of wound is key to making an initial evaluation of the risk assessments most appropriate to any particular person. In many organisations, a suite of risk-assessment tools that are broadly applicable to the clinical setting and individuals receiving care within it are used as standard clinical practice.

There is a wide range of assessment tools designed to assess the risk of specific types of wounds. Identifying factors placing a person at risk of a wound informs the appropriateness of developing a wound prevention plan and helps in selecting appropriate strategies that a prevention plan should include. Assessment tools should be selected for the demographic of the individual being assessed (for example, age and clinical setting), ensuring the tool has strong psychometric properties for that population[20]. Using a reliable and valid tool ensures that the assessment is accurately measuring the characteristics being targeted[21].

In individuals who are diagnosed with venous disease, both clinical classification and severity of disease are indicators of the risk of a VLU. The CEAP (clinical, aetiological, anatomical and pathophysiology) scale, which is recognised internationally, consists of seven classifications that describe the severity of the patient's venous disease[22,23]. Higher classifications are indicative of the higher risk of experiencing a VLU. In addition, a number of venous disease severity scales are reliable and valid for evaluating the severity of disease (Table 1)[23,24].

There are several diabetes foot risk classification systems, with most focusing on DFRU clinical measures of grade, category and prediction of ulcer outcome or risk of lower extremity amputation. The University of Texas and the International Working Group for Diabetes Foot (IWGDF) have classification systems that categorise the risk category of the foot and are widely used by podiatrists to inform clinical decision making. Although there is no gold standard for a prediction tool for amputation, most classification systems have high sensitivity, specificity and positive predictive value[25,26].

Significant work has been done in developing and refining PI risk assessment tools that provide a structured approach to assessment. Although evaluation of their effectiveness compared to clinical judgement in identifying people who have a higher risk of a PI shows mixed findings[27-29], PI risk assessment tools offer health care professionals a structure framework; reminders of risk factors to consider; and reliable measurement of specific risk factors[30]. Some of the more commonly used tools are listed in Table 1.

Table 1: Tools associated with assessing wound risk/disease severity

VLU disease severity scales[23,24]	- CEAP classifications scale - Venous Severity Scoring system (VSS) - Venous Clinical Severity Score (VCSS) - Venous Disability Score (VDS) - Villalta-Prandoni Scale
DRFU risk classification system	- IWGDF Risk Classification System - UT Diabetic Foot Risk Classification System - Wagner-Meggitt Classification of the Diabetic Foot - PEDIS - SINBAD
PI risk assessment tools[30]	- Braden Scale - Waterlow Score© - Norton Scale© - Risk Assessment Pressure Sore Scale - Ramstadius - Suriadi and Sanada Scale - Cubbin-Jackson Scale - Glamorgan scale

There is minimal literature on risk assessment for STs. A recent systematic review identified only 17 studies exploring the topic[31]. Numerous factors are identified as playing a role in increasing the risk of STs, including age-related skin changes, hydration and nutrition, sensory changes, impairments to mobility, medication use and mechanical factors related to care of the skin[31]. However, there is currently no validated risk assessment tool for STs.

BEST EVIDENCE ON WOUND PREVENTION

The most appropriate interventions for wound prevention are informed by the risk assessment and the person's needs and preferences. The following section provides an overview of the best evidence on preventive strategies specific to VLUs, DRFUs, STs and PIs. The section is based on searches of the literature published from January 1980 conducted in the following electronic databases: PubMed, Medline, CINAHL, Embase, Scopus, Evidence Based and Medicine Reviews (EBM). Searches were refined according to wound type and used search terms specific to each wound aetiology. The searches covered literature published up to February 2016 (VLUs), December 2017 (PIs) and February 2018 (DRFUs and STs).

Prevention of venous leg ulcers

The underlying pathophysiology responsible for venous ulceration is venous hypertension, commonly occurring due to venous reflux and/or obstruction in either the superficial or deep venous system or, in more progressed disease, both[32]. The complex pathophysiology involves dilatation of the lower limb veins, leading to valvular incompetence and subsequent increased venous pressure, which is exacerbated during exercise[33]. Less frequently, venous hypertension may develop subsequent to thrombotic syndrome in which deep vein thrombosis (DVT), inflammation, recanalisation and reflux (with or without venous obstruction) lead to increased venous pressure[34,35]. In the later stages of venous disease, VLUs can occur.

Management of underlying venous disease is essential in preventing progression to ulceration. Traditionally, the focus of preventive strategies has been on lifestyle change and medical management. The most recent evidence indicates there also is a role for management of venous disease with surgery or minimally invasive procedures in order to prevent progression to (or recurrence of) a VLU. To promote early intervention, people with symptomatic disease or who have already experienced a VLU should be evaluated by a specialist for candidacy for surgical/minimal invasive procedure[36-39].

Conventional surgical procedures such as vein ligation and stripping, phlebectomy and venous valvular repair are associated with reductions in incidence of VLUs. Some studies show that conventional surgery on superficial veins can reduce recurrence of a VLU by 25% more than conventional preventive strategies[40,41]. The ESCHAR trial[42,43], conducted with 500 individuals with superficial venous disease and either healed or active VLUs, compared venous stripping with gold standard medical management (compression therapy). Recurrence rates for venous ulcers were significantly lower for individuals who underwent the surgical procedure (24% versus 52%, p=0.044)[42-44]. Varicose vein surgery has increasingly been used to manage venous disease and reduce progression to VLU since the ESCHAT trial results.

Minimally invasive surgical procedures, specifically endovenous ablation and sclerotherapy, have been gaining popularity in the past 20 years. Endovenous ablation is a process in which a laser or radioactive fibre is applied to the vein to produce vein collapse, sclerosis and cauterisation. A Cochrane review that included 13 randomised controlled trials (RCTs)[45] comparing endovenous ablation to conventional surgery reported no significant difference in VLU recurrence between endovenous ablation and open surgery (odds ratio [OR] 0.72, 95% confidence interval [CI] 0.43 to 1.22; p=0.22)[45]. In the sclerotherapy procedure a chemical substance (detergent, alcohol agents or osmotic agent) is applied inside the vein to destroy the endothelium and occlude the vein with clotting[46]. In a Cochrane review[45] that pooled results of three RCTs, effect on VLU incidence was not reported; however, there was no significant difference between sclerotherapy and conventional surgery for recurrence of varicose veins (OR 1.74, 95% CI 0.97 to 3.12, p=0.06).

Selection of the most appropriate surgical/minimally invasive procedure is based on individual risks and benefits. Minimally invasive procedures can be conducted under local anaesthetic and may have lower risks[47,48], especially for older people and those with co-morbidities.

Although surgery and minimally invasive procedures are commonly used to prevent VLUs, the gold standard for VLU prevention is compression therapy. In combination with preventive lifestyle strategies, compression therapy (usually compression stockings) is highly recommended for people who have experienced a VLU and should be considered by all people who have symptomatic venous disease. Compression therapy, which aims to promote venous return, reduce venous pressure and prevent stasis, is shown to significantly reduce the risk of VLUs, compared to no compression (RR 0.46, 95% CI 0.27 to 0.76. p=0.003)[49]. Studies on the level of compression therapy necessary for reducing VLU risk have mixed results. While some RCTs show no difference between higher and more moderate strengths of compression[50,51], others suggest that the risk of a VLU decreases with higher strength compression therapy. Relative risks (RR) are reported from RR 0.57 (95% CI 0.39 to 0.81, p=0.002) to 0.82 (95% CI 0.61 to 1.12, p=0.02)[49]. In general, selection of the type and strength of compression therapy is individualised according to what can be tolerated.

Preventive lifestyle interventions are essential for all people at risk of a VLU, in conjunction with gold standard compression therapy and/or surgical interventions. The goal of lifestyle change is to reduce avoidable risk factors for VLU. Strategies include reducing excess body weight, avoiding prolonged standing and heavy lifting, elevating the legs regularly[52,53] and engaging in exercise that promotes the calf muscle pump function[52]. There is limited evidence on the effectiveness of lifestyle change. One recent analysis reported a significant reduction in VLUs associated with elevating the legs for at least 30 minutes each day (hazard ratio [HR] 0.33, 95% CI 0.19 to 0.56, p<0.001 compared to no elevation) and with walking for at least 3 hours a day (HR 0.66, 95% CI 0.45 to 0.98, p=0.04 compared to no walking)[52]. Regular skin moisturising is recommended[54], although there is no strong evidence on efficacy.

Prevention of diabetic-related foot ulcers

Foot ulceration is a common lower extremity complication, which may arise due to the presence of diabetes mellitus or other medical conditions that place an individual at increased risk. The prevention of DRFU is challenging because of the multifactorial aetiology involving both intrinsic and extrinsic factors. Once an ulcer has healed, the risk of recurrence is between 30% and 40% within the first year[55]. However, many DRFUs remain in a prolonged and stagnant inflammatory stage of healing and have increased risk of infection and amputation[56].

Early diagnosis of underlying pathophysiology that increase risk is the first step in preventing or reducing the adverse effects of foot problems in diabetes and ensuring healthy maintenance of the lower limb[57]. The key risk factors that interact and subsequently result in ulceration are a combination of neuropathy, with or without peripheral vascular disease and foot deformity, with or without trauma[58]. Approximately 20% of individuals with a DRFU will primarily have inadequate arterial blood flow, 50% will primarily have neuropathy and 80% will have both conditions[59].

Best practice management to prevent DFRU includes:

- regular monitoring of neurovascular status;
- regular monitoring of skin integrity;
- regular debridement of hyperkeratotic lesions and corns; and
- offloading of elevated pressure areas due to biomechanical abnormalities[55].

Neuropathy is a pivotal risk factor for both ulceration and amputation caused by the loss of protective sensation (LOPS) due to peripheral sensory neuropathy. The 10 g Semmes-Weinstein monofilament (SWF) and vibratory perception threshold (VPT) examinations are considered simple and effective screening instruments to identify individuals at risk of ulceration. Although both these tools are claimed to identify risk of ulceration, there is no consensus in the literature about the best method to identify LOPS. Comparative studies have generally found differences in SWF having a high level of specificity but a low sensitivity than a VPT ≥ 25 V and that prevalence of peripheral neuropathy was two times more frequent using VPT ≥ 25 V as diagnostic criteria than SWF[60]. Furthermore, studies suggest that the biothesiometer identifies far more individuals with impaired peripheral sensation than the SWF, and that the VPT measurement may identify people at an earlier stage of impairment than SWF testing[61]. From a practical perspective, the SWF is very simple, inexpensive and is quicker and easier to apply compared with the VPT. Nevertheless, the IWGDF recommends using either of these tests for screening individuals[62].

In people with diabetes, the risk of developing peripheral arterial disease (PAD) is fourfold in comparison to the general population. In diabetes, PAD tends to affect the distal arteries, which increases the risk of ulceration, infection and amputation. Detection and appropriate management of PAD is important to ensure effective wound healing in optimised. Even asymptomatic individuals with mild PAD have the same risk as individuals with symptoms[63]. Assessment of physical signs that may indicate vascular disease include colour of the limb, skin and nail changes, limb temperature and palpation of pedal pulses.

The palpation of pedal pulses alone is not considered reliable in people with diabetes[63]. To obtain a more quantitative evaluation of arterial status, the ankle brachial pressure index (ABPI), the toe brachial pressure index (TBPI) and continuous wave Doppler (CWD) ultrasound are frequently used to diagnose and estimate disease severity[64]. Although widely used, the ABPI has significant limitations in the presence of medial arterial calcification (MAC), a common condition associated with diabetes that results in a falsely elevated ABPI of >1.3 (n.b. an ABPI >0.9 is considered normal and an ABPI <0.8 is associated with claudication)[57]. A recent study demonstrated that the specificity of the ABPI was high (92.6%) in participants with and without diabetes, but the sensitivity was poor in individuals with (45%) and without diabetes (47%)[64].

Based on the assumption that the arteries in the toe are less susceptible to MAC, it is advocated that a TBPI is a better indicator of PAD for individuals with diabetes. The sensitivity of the TBPI for detecting PAD was lower in people with diabetes (63%) than those without diabetes (83%), and the specificity was higher in both those with and without diabetes[64]. However, a study investigating the reliability of the TBPI found that intra-rater reliability was 0.75 (95% limits of agreement (LOA) –0.22 to 0.28) and inter-rater reliability 0.77 (95% LOA –22.91 to 29.17), indicating that the reliability is questionable[65].

However, the most sensitive test for people with or without diabetes was CWD because this test was more likely to detect significant PAD when comparing to both TBI and ABPI assessments. CWD is a low-cost screening tool and is quick and easy to use. However, the interpretation of the waveform can be subjective and is based on the knowledge and understanding of the operator[64]. Automated systems that incorporate the ABPI, TBPI and pulse waveforms offer a simpler method for the calculation; however, further research is required to determine the accuracy of these systems.

Most DRFU occur at areas of increased pressure. Approximately 90% of plantar wounds are directly attributed to pressure, and non-plantar foot ulcers are caused by both pressure and shear forces, generally associated with ill-fitting footwear. Therefore, pressure offloading is essential in the prevention and management of DRFU[66]. Increases in pressure and shear forces are related to foot structure, limited joint mobility and biomechanical abnormalities. The elevated level of mechanical pressure, in combination with LOPS, contributes to the development of callous and eventual tissue damage. If the pressure on the anatomical site is not effectively offloaded, and the callous not debrided, resulting tissue damage will lead to ulceration[67]. Such a course is often a precursor to lower extremity amputation[67]. A comparison of offloading-customised orthotics devices with traditional podiatric treatment consisting of paring of plantar hyperkeratotic skin, moisturising and padding reported that rigid orthotic devices were associated with a greater reduction in callous grade ($p<0.02$)[68].

Preventive interventions to offload high-pressure areas include felt padding adhered to the foot, padded insoles, customised orthotic devices, therapeutic footwear and shoe modifications. A systematic review on the effectiveness of offloading interventions specifically for primary ulcer prevention in people with diabetes found limited research on the topic[69]. Several studies have demonstrated that prescribed therapeutic footwear have greater positive effect over standard footwear in pressure reduction, although one RCT showed no effect[69]. Another study found therapeutic shoes plus customised insoles might be useful in reducing plantar pressures when used for more than six months but increased after 12 months, which may suggest replacement of the insoles and footwear is required after 12-month wear. Overall, there is weak evidence to support the use of therapeutic footwear, although recent studies on pressure mapping and therapeutic footwear are showing some promising results[70]. Irrespective of the lack of strong evidence, offloading the area of high pressure has been the mainstay to heal DRFUs and prevent recurrence of foot ulceration. The IWGDF recommends that when a foot deformity or pre-ulcerative sign is present, prescription of therapeutic footwear, custom-made insoles or orthotic devices should be prescribed[67].

In cases of severe foot deformity together with a history of chronic wounds, conservative pressure offloading may not suffice, and surgical procedures such as Achilles tendon lengthening, tenotomise and arthroplasties may improve healing and reduce the risk of recurrence[66]. However, the current evidence based on surgical interventions for preventing DRFUs is also weak.

Prevention of pressure injuries

PIs essentially occur due to sustained pressure load on the skin and tissues. Pressure load causes a deformation of the skin and tissues and a resulting reduction in oxygen and nutrient supplied to the tissues, leading to ischaemia (a PI) at the point of pressure loading[30]. Other extrinsic factors such as shear and moisture increase the risk of a PI developing, as do intrinsic factors related to the individual's background and health status[71].

Best practice interventions for preventing PIs focus on interventions that reduce the risk associated with sustained pressure, shear and moisture. Promoting mobility and/or regularly repositioning people who are immobile reduces sustained interface pressure at a specific anatomical point (usually bony prominences). While ethical considerations mean there are few studies comparing repositioning to not repositioning individuals, a seminal RCT established that turning an individual at least every four hours was associated with reduction in the risk of Stage II or greater PIs (OR 0.12; 95% CI 0.03 to 0.48)[72]. The most recent research has focused on the most effective positions and frequencies of repositioning; however, there are insufficient high-quality studies in this field to definitively recommend specific repositioning regimens for preventing PIs[73]. Current international consensus supports individualising the frequency of repositioning based on assessments of tissue tolerance, skin condition, comfort and the person's overall health status and level of mobility[30].

Implemented in conjunction with repositioning, selection of an appropriate pressure redistribution support surface (mattress or seat) can dramatically reduce the risk of a PI. A Cochrane review pooled the findings from five RCTs on support mattresses for PIs in people who were assessed as having a high risk. The meta-analysis showed significant risk reduction associated with constant low-pressure, high-specification foam mattresses compared with standard hospital foam mattresses (RR 0.40, 95% CI 0.21 to 0.74, $p=0.004$)[74]. For people who have a very high risk of experiencing a PI, an alternating pressure surface (for example, low air loss) could be used. Alternating support surfaces work through inflation and deflation cycles of the air-filled cells that comprise the mattress, overlay or cushion. There is limited high-quality evidence efficacy of alternating support surfaces[30,74]; pooled of findings from nine moderate and lower quality RCTs showed no significant difference in PI incidence between alternating support surfaces and constant low-pressure surfaces (RR 0.85, 95% CI 0.64 to 1.13, p=not significant)[74]. An alternating support surface might be most appropriate when a person who has a high risk of PIs is unable to be repositioned regularly[30].

Repositioning and a pressure redistribution support surface are just as important to address for people who are seated out of bed, including people who use a wheelchair. A wide range of pressure redistribution seating cushions (air, fluid, gel and foam designs) are available, and although individual RCTs report effectiveness of most seating cushions in reducing PI risk, the evidence on which might be the best type of cushion to prevent PIs use is inconclusive[74]. Using any high-specification pressure redistribution cushion, in conjunction with redistributing the person's weight regularly is considered best practice in preventing development of a PI when a person is seated. Limiting the time spent sitting out of bed or, for individuals with sufficient upper body strength, teaching the individual to perform pressure relief manoeuvres are strategies that are supported by limited evidence[75] and international consensus[30,76].

Emerging best practice now includes application of preventive dressings for individuals at higher risk of developing a PI. A multilayered polyurethane foam dressing has been shown to reduce pressure, shear and friction[77-80], thereby decreasing the risk of a PI developing. Pooling of eight trials that compared a polyurethane foam dressing to no dressing showed a significant reduction in PIs (RR 0.17, 95% CI 0.12 to 0.26) can be achieved by applying a preventive dressing to bony prominences (particularly heels and the sacrum).

Maintaining skin integrity is recommended as best practice for PI prevention. Skin moisture is a recognised PI risk factor[71]; keeping the skin clean and dry, which includes continence management, can protect the skin[30]. General principles of promoting healthy skin, including washing the skin with a pH-neutral cleanser and promoting skin hydration by regularly moisturising are also recommended for preventing PIs[81,82].

Prevention of skin tears

To date, strategies to prevent STs are largely experiential and based on clinical expertise and collective experiences rather than structured clinical research. The primary focus of these strategies has been on identifying and utilising measures to avoid the risk of these injuries. This omission is not surprising, given the ethical difficulties of older individuals participating in clinical research in terms of obtaining informed consent and the need to minimise the risk of harm or discomfort to participants[83-85].

ST prevention strategies include application of moisturisers, limb protectors, adequate nutrition and hydration, provision of safe environments, use of safe equipment, individual education, and appropriate training of health providers in the provision of care[86-88]. Five significant primary articles that used structured clinical research to evaluate ST prevention strategies present the best evidence on their prevention[11,89-91]. The focus of all these studies was aimed at maintaining skin integrity.

A four-month quasi-experiment study of 43 aged care residents by Mason (1997) evaluated the effectiveness of emollient antibacterial soap compared to non-emollient antibacterial soap to improve skin quality and reduce STs[92]. The incidence of STs was reported to be 34.8% lower in residents using emollient soap compared to non-emollient soap.

Groom *et al.* conducted a skin care intervention study to evaluate a nutrient-based skin care product, compared to products without nutrients with the aim to measure the number of ST-free days[90]. Individuals receiving a daily nutrient-based product had more ST-free days, compared to people receiving non-nutrient-based products (179.7 versus 154.6 days).

A six-month cluster-RCT of 984 resident conducted by Carville *et al.*[93] also evaluated the effectiveness of twice-daily moisturising to the extremities compared to 'usual' skin care for reducing ST incidence in older adults. In this study, application of moisturiser twice-daily was associated with a nearly 50% reduction in the incidence of STs, compared with ad-hoc or no standardised skin-moisturising regimen (5.76 versus 10.57 per 1000 occupied bed days)[93].

Edwards *et al.* undertook a six-month pre–post study to evaluate the effectiveness of a multifaceted Champions for Skin Integrity (CSI) model to transfer evidence into practice for wound management in residential aged care[91]. The model involved using local champions, education and skills development workshops, creation of multidisciplinary networks, audit and feedback cycles, development of a comprehensive educational resource kit and awareness raising activities. Following the implementation of the CSI model and using the STAR Skin Tear Classification System, a significant reduction in Category 3 STs was reported (11% pre-implementation versus 4.5% post-implementation, p=0.02)[6,91]. However, there was no significant reduction in the prevalence of Category 1 and Category 2 STs.

Powell *et al.* conducted a pilot study of 90 participants at risk of STs of the lower extremities from a United Kingdom county care homes and primary care service[89]. Participants were randomised over a 16-week period to receive either knee-length protective socks (n=44) or usual care (n=46). Of the 79 participants (88%) who completed the trial 61% (n=27) were in the intervention arm of the study. In total, 18.2% (n=8) of the participants who used protective socks sustained an ST, compared to 21.4% (n=10) who received usual care. Participants in the usual care group were reported to have sustained more STs, repeated STs, and more severe injuries[89].

DISCUSSION

The evidence presented in the previous section outlines some of the more significant interventions for preventing a variety of wound types. The available research is generally of low quality, and many well-recognised interventions continue to be underpinned by a limited formal evidence base. However, many of the interventions discussed above, including offloading pressure and maintaining skin integrity, are fundamental nursing skills and intrinsic to the philosophy of wound prevention[20].

Maintaining skin integrity, through appropriate cleansing, drying, moisturising and protection, is a universal preventive strategy. The importance of maintaining the skin in a healthy, well-hydrated and well-nourished state is a key strategy for preventing VLUS, PIs, DRFUs and STs. The process of providing daily care also provides the opportunity to engage in regular skin inspection, whether it be to identify erythema in an individual on bed rest, dry skin on an older adult at risk of STs or calloused feet in a person with diabetes.

Other basic principles of health care provision are relevant in preventing all types of wounds. Promoting patient autonomy through education is an important component of preventing wounds. Teaching individuals at risk of a wound strategies to assess their own skin and ways in which they can adopt preventive skills into their everyday life is important, particularly for people who will continue to be at risk of wounds throughout disease or age progression. When people understand the purpose of interventions, their self-implementation of wound-preventive strategies may increase. This is of particular importance when interventions are considered uncomfortable (for example, compression stockings), unattractive (for example, orthotic shoes) or expensive (for example, a high-quality support surface).

CONCLUSION

This literature review has outlined identification of individuals at risk of a wound as the first stage in wound prevention. Regular and comprehensively conducted relevant risk assessments inform the development of a wound prevention plan. The current body of evidence for preventing VLUs, PIs, DRFUs and STs is generally quite limited. There is a need for more structured research to better understand measures to prevent wounds of all types, as well as investigation into the relative effectiveness of these measures. A combination of structured clinical research, experiential knowledge and clinical judgement is needed to identify and integrate best evidence to better guide clinical decision making in wound care. Health professionals who uphold the core wound care goal of wound prevention embrace the wisdom of Thomas Fuller who stated that "[h]e who cures a disease may be the skillfullest, but he that prevents it is the safest physician"[94].

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