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Review Article

Overview of Wound Care Interventions for Hospital and Community Care Nurses: A Systematic Scoping Review

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Abstract

Objective: Identifying the scope of wound care interventions executed by nurses in the hospital and community care setting.

Background: Appropriate management of wounds is important to reduce the likelihood of delayed wound healing, infections and pain, all of which subsequently lower quality of life. Nurses are in need of evidence-based recommendations on what they should (not) do to deliver high-quality fundamental care.

Design: systematic scoping review.

Methods: Medline, CINAHL, Embase, PsycINFO, Cochrane and Web of Science were searched up to November 2019. Western, controlled intervention studies executed by nurses involving adult patients in the hospital or community care setting were eligible for inclusion. The reviewers independently screened the title/abstract/full text and performed a structured data extraction and methodologically assessed the quality of the studies with the Cochrane Risk of Bias 2.0 tool.

Results: 22 included studies were divided into four intervention categories: skin care, pressure wound prevention, health education and miscellaneous. Methodological assessment resulted in six studies with a high score, eight studies with a moderate and eight with a low score on quality. Four potential high value interventions standout and deserve future secondary research and one potentially low-value intervention standout for further secondary research.

Conclusion: This systematic scoping review provides an overview of the wound care interventions executed by nurses in the hospital and community care setting. Five interventions can be prioritized to follow-up with systematic reviews on effect to formulate evidence based recommendation about high and low value care interventions for nurses.

Keywords: Fundamental care; Wound; Hospital care; Community care; Low-Value nursing care; Scoping review

What does this paper add?'

- This paper provides an overview of the scope of wound care interventions executed by nurses.
- We found four main categories of wound interventions: skin care interventions, pressure prevention interventions, health education interventions and miscellaneous interventions.
- We identified wound care interventions executed by nurses, for example the use of pressure-relief suspension boots, that deserve future investigation by means of a systematic review on which evidence based recommendations can be based.

Introduction

Fundamental care poses a challenge for nurses and nursing aides worldwide. Fundamental care is defined as 'care that involves actions on the part of the nurse that respect and focus on a person's essential needs to ensure their physical and psychosocial wellbeing. These needs are met by developing a positive and trusting relationship with the person being cared for as well as their family/carers' [1,2]. One of the aspects of the physical dimension in the Fundamentals of Care Framework is keeping the patient comfortable and free of pain. Wounds can be very painful and wound-related factors such as reduced mobility, infection and smell can put a strain on the patient's physical and psychological wellbeing. These strains affect their quality of life and increase their dependence on health care professionals, all of which hamper a feeling of positive health. Wounds can embarrass or frustrate patients, not in the least when healing time is longer than expected [3].

Acute and chronic wounds affect millions of people around the world. It is estimated that 1.5-2 million people in Europe suffer from acute or chronic wounds. In addition, in the United States, chronic wounds affect around 6.5 million people at a time. Wounds are estimated to account for almost 3% of total health system costs-approximately £5 billion annually according to data from the United Kingdom [4].

Acute wounds generally last for less than 8 weeks and heal without significant interventions. Chronic wounds such as pressure ulcers or decubitus ulcers are defined as wounds that have failed to proceed through an orderly and timely process that produces anatomic and functional integrity [5]. Chronic wounds either require a prolonged time to heal, do not heal completely or recur frequently. The majority of chronic wounds are characterised by a prolonged or excessive inflammatory phase, persistent infections and the inability of dermal or epidermal cells to respond to reparative stimuli [6]. Chronic wounds are at increased risk of complications, which can have a (severe) negative impact on wound healing, patient comfort and health [7]. Whatever the cause, wounds have a substantial but often unrecognised impact on those who suffer from them, on their carers and on the health care system [4]. Therefore, all wounds need to be treated as effectively as possible.

Nurses have an important role in wound care because they are in the position to recognise in a timely fashion a badly healing wound or complications. Therefore, wounds, like pressure ulcers or wound infections, are seen as a nursing-sensitive outcome [8]. Besides wound care, nurses can stimulate a positive attitude and good nutrition, which are patient-controlled factors that can have a positive impact on wound healing [9] and reduce the risk of developing pressure ulcers [10]. By doing so, nurses can contribute to fundamental care by improving the well-being of the patient (less pain, preventing ulcers and faster wound healing), leading to patients who are less dependent on care. This improvement ultimately saves time and resources.

The routine use of ineffective and often expensive wound care products and/or inappropriate use of effective products is not uncommon [11]. The choice of wound care products is most frequently the nurse's responsibility, but physicians sometimes ask nurses to deviate from recommendations. These deviations may not provide much benefit for the patient or even cause harm, waste resources and can be considered examples of low-value care [12].

Effective and widespread dissemination of evidenced-based recommendations is crucial for positive patient outcomes [13]. The 'Choosing Wisely' recommendations, released in the Netherlands in 2014, are simple and easy to follow. For example, it is easy not to cover primarily closed wounds. Covering those wounds neither prevents infections nor improves wound healing, but it might cause more pain during dressing changes [14].

To help nurses act as a gate-keeper for low-value care when necessary [15] and to reduce the overuse of practices that are not supported by robust research evidence [16], it is necessary to provide nurses with all the information and evidence they need to make the right choices. A lack of information and poor research may turn out to be a significant burden of low-value care in surgical wound practice [17]. To increase the quality of care and to further professionalise nursing, we need to reduce the level of low-value care and increase the level of high-value care [12].

This systematic scoping review provides nurses with an overview of wound care interventions and an indication of their quality allowing them to take a step towards enhancing the uptake of practices supported by evidence and reducing the level of low-value care.

Aim

The aim of this systematic scoping review is to identify the scope of wound interventions executed by nurses for adult patients in hospital and community care settings and assess their quality.

Methods

To identify wound interventions that are carried out by nurses we used a systematic scoping review as an approach. This approach is suitable to identify interventions in a broad field of evidence when the scope is not clear and helps researchers with inclusion criteria for full systematic reviews [18]. In addition we assessed the quality of the included studies to help in prioritising interventions for further research.

This systematic scoping review was undertaken in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping reviews guidelines [19] and the Cochrane Handbook for Systematic Reviews of Interventions [20]. In October 2019, a PROSPERO registration was submitted. This systematic scoping review was performed by the Improve! Project team, which comprises five nursing scientists, an educational scientist and a researcher.

Search Strategy

We worked together with an experienced medical librarian to define a comprehensive systematic search strategy. This included both MeSH and free-text terms related to nursing interventions focused on wound care, like wound closure or wound healing, in combination with nursing and a special controlled trail filter; no additional limits were added (Appendix 1). The Medline, CINAHL, EMBASE, PsycINFO, Cochrane and Web of Science databases were searched up to November 2019. In addition, we checked the references of the included articles for additional studies.

Eligibility Criteria

Original research written in English or Dutch and published in peer journals in or after 2010 was considered eligible. We chose only to select studies published after 2010 to ensure inclusion of recent and up-to-date scientific nursing outcomes. According to the guidance of the Cochrane Effective Practice and Organization of Care group, studies were included if data could be compared with a control or baseline measure, such as randomised controlled trials, controlled before-and-after studies or interrupted time series methods. In addition, the interventions in the studies had to be of Western origin and had to be focused on wound care performed by a nurse on adult patients (>18 years). Finally, the studies had to be conducted in a hospital or community care setting of an Organisation for Economic Co-operation and Development country. Studies involving interventions aimed at wounds due to labour or breastfeeding as well as papers involving burns or special pressure-relieving mattresses were excluded. Studies concerning Chinese, alternative or non-Western medicine were also excluded.

Screening Process

All the articles found in the search were imported into Endnote version X9.2. After removing the duplicates automatically and by hand, Rayyan QCRI - a web and mobile app for systematic reviews (rayyan.qcri.org) - was used for independent title/abstract and full text screening by a team of four researchers. Studies were screened by a research couple and discrepancies were discussed until a consensus was reached; if needed, a third researcher was consulted.

Data Extraction and Synthesis

Using a structured format, the following data were extracted: author, year, country, study design, aim, participants, setting, study group, intervention, measurement scale and point and results. One research assistant extracted the data; this work was double-checked by one of the authors. All discrepancies were discussed until a consensus was reached, or a third reviewer was consulted. The study characteristics are summarised in Table 1.

Quality Appraisal

To provide an impression of the quality of the included studies we assessed them with the Cochrane Risk of Bias (RoB) 2.0 tool [21]. This was performed independently by two researchers. Again, discrepancies were discussed until a consensus was reached or a third researcher was consulted. All assessment data were recorded in the RoB 2.0 Excel form and the algorithm function was used to determine the level of bias. In addition, an intervention was identified as relevant to investigate further if the concerning study showed significant results with a low risk of bias.

Results

Description of the included articles

The literature search resulted in 7,453 hits. After removing duplicates, the titles and abstracts of 3,497 papers were screened in Rayyan QCRI, 100 full-text papers were screened for eligibility and finally 22 papers met the inclusion criteria. This process is shown in the PRISMA flow diagram (Figure 1). No additional records were identified in the references of the included articles.

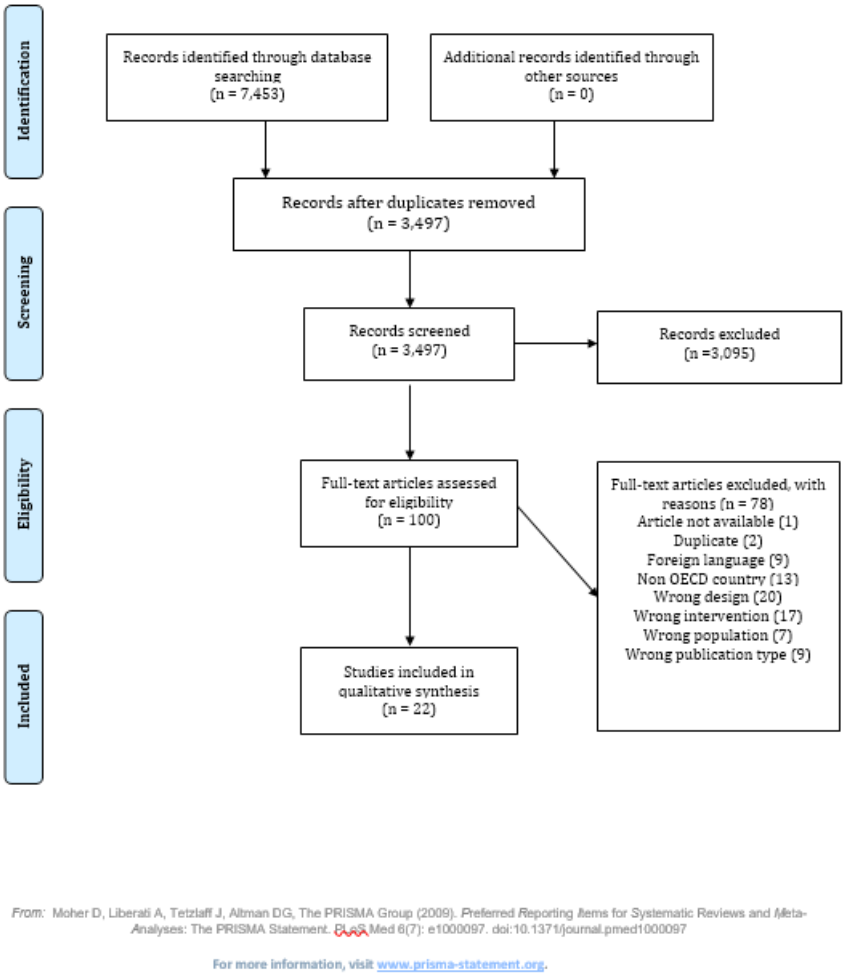

Figure 1: PRISMA flow diagram.

The 22 included studies were performed in 12 countries. Most studies were performed in the United States (n=5) and the United Kingdom (n=4), and three studies were performed in multiple countries (Table 1). In total, 16 studies had a randomised controlled trial design and five studies used a quasi-experimental design. One study had a before-and-after design. Nine of the included articles worked according to the intention-to-treat principle and 13 articles used a pre-protocol method.

The interventions regarding surgical wounds (n=4) or pressure injuries (n=9) were carried out in the hospital setting. The interventions regarding leg ulcers (n=6) or diabetic foot ulcers (n=3) were carried out in the community care setting (n=4), specialised foot or leg ulcer clinics/services (n=4) or the research unit of the department of dermatology (n=1).

A total of 4,734 participants, with a range from 20 to 1,312 per study, were included in the studies. Overall, 57% (n=2,705) of the participants were included in the pressure injury studies, 27% (n=1,257) of the participants were included in the leg ulcer studies, 8% (n=371) were included in diabetic foot care and other chronic wound care and another 8% (n=401) were included surgical wound care. The mean age of the participants was 40 years (range 7-81 years); however, Burke, et al. [22] only reported the mean age of the participants at the time of the surgery (67 years) and Robson, et al. [23] did not report a mean age, only the number of participants >65 or >75 years of age in each group. In addition, 55% of the participants were male, 45% female and in one study gender was not reported.

After data-analysis, four wound intervention subgroups emerged: skin care interventions (n=10), pressure prevention interventions (n=6), health education interventions (n=2) and four miscellaneous interventions. These subgroups were used to describe the study quality scores and the results (Table 1, Appendix 2).

Table 1: Overview of the included studies

Countries		**Design**		**Setting**		**Patients**		**Intervention**	
USA	5	RCT	16	Hospital	13	N (range)	4734 (§) (20-1312)	Skin care:	10
Australia	3	Quasi-experimental	5	Specialized Care	4	Mean age range	40,7-81	*chronic wounds*	*6*
UK (†)	4							*postoperative wounds*	*4*
Germany	2								
Ireland (†)	2	Before and after -	1	Community Care	4	Male	55 %	Pressure prevention	6
Denmark	1					Female	45 %	Health education	2
Italy	1					Not reported	1 study	Miscellaneous	4
Norway	1			Research unit (Dermatology)	1				
South Korea	1								
Spain	1								
Sweden	1								
5 countries (‡)	1								

(†) 1 England & Northern Ireland (counted as UK), 2 UK, 1 Ireland, 1 Ireland / UK (counted for Ireland and UK)
(‡) France, Spain, Italy, Germany and UK
(§) 4733 or 4734 participants

Intervention Results

In this section, we present the results according to the four wound care intervention categories: skin care interventions, pressure prevention interventions, health education interventions and miscellaneous interventions. Table 2 presents the intervention results.

Skin Care Interventions: Skin care interventions were clustered into interventions for chronic wounds and for acute wounds.

Skin Care Interventions for Chronic Wounds

The sucrose octasulfate dressing [24], significantly improved wound closure of neuro-ischaemic diabetic foot ulcers after 20 weeks of treatment. Wound closure occurred in 48% (n=60) of patients in the sucrose octasulfate dressing group and 30% (n=34) of patients in the control group who received the same dressing without the sucrose octasulfate (risk difference of 18, p=0.002).

The performance of the nanocrystalline silver and cadexomer iodine dressings [25], was comparable in terms of overall healing rate and the number of wounds healed ($\chi 2$ (1)=0.02, p>0.05). The mean wound healing rates with silver were marginally higher (average=2.10, Standard Deviation [SD]=1.89) compared with iodine (average=1.69, SD=2.46). For the first 2 weeks, the daily healing rate for the silver group (average=2.12, SD=2.94) was significantly higher than the healing rate for the iodine group (average=-0.22, SD=8.18).

Moffatt C, et al. [26], compared the performance of Oxyzyme® and Iodozyme® (active group) and found a slightly higher proportion of ulcers healed in the control group that received standard care compared with the active group (49.1% versus 44.7%). Patients with high protease activity showed an improved and faster healing in the active group (hazard ratio 1.35, 95% confidence interval [CI] 0.63-2.87, p=0.44) but this failed to achieve statistical significance (p=0.67) after adjustment for confounding factors.

Park and Kim [27], showed that patients who received a

structured skin care regimen-including regular use of a no-rinse skin cleanser, application of a skin protectant and an indwelling faecal drainage system when indicated were less likely to develop a pressure ulcer than patients in the control group (5 versus 19, $\chi 2=11.936$, p=0.001).

In the pilot study by Purcell et al. [28], there were no statistically significant differences in wound size between groups at week 4 (p=0.50) or week 12 (p=0.78). The daily use of EMLA cream as a primary dressing (directly on the wound bed underneath the secondary dressing) resulted in complete wound closure in 20% of the participants (intervention group, n=5; control group, n=7) by the end of the 12-week study period.

In the case of hard-to-heal venous leg ulcers, the use of a collagen and an alginate dressing instead of an alginate dressing alone did not result in statistically significant different healing times [29].

Skin Care Interventions for Postoperative Wounds

In the study by Bredow et al. [30], only one patient developed blisters on the sixth postoperative day. This patient belonged to the intervention group but was mistakenly given a conventional adhesive (control) dressing instead of the trial dressing.

Brindle and Wegelin [31], found no statistically significant differences (all ps>0.058) in pressure ulcer incidence between the group that received a zinc-based skin protectant and the group that was given a silicone border foam dressing (intervention). It is, however, not possible to determine whether the absence of statistically significant differences between groups reflects a type 2 (ß) error caused by insufficient power to detect a clinically relevant difference.

The jubilee dressing (a hydrofibre inner layer derived from 100% sodium carboxymethyl cellulose [Aquacel, ConvaTec] with a viscoelastic hydrocolloid outer layer that is vapour permeable [DuoDerm, ConvaTec]) used in the study by had a significantly lower complication rate compared with the traditional adhesive dressing when examining blistering (4.8% versus 17.7%, $p < 0.04$) and leakage (6.4% versus 20.9%, $p < 0.034$) [22].

Furthermore, participants in the feasibility study by Robson et al. [23], who had a sterilised, medical-grade antibacterial honey applied to their wounds stayed in hospital for a significantly shorter time after operation (median 12 days versus 18 days, p=0.047). At 7 days, there were positive wound swabs for 20% (5/25) of the honey group and 13% (3/24) of the control group (p=0.70). A larger randomised controlled trial is necessary to show a clinical benefit for honey.

Pressure Prevention Interventions: Pressure prevention interventions were clustered into turning care interventions, pressure relief interventions and pressure mapping interventions.

Turning Care

Manzano et al. [32], reported that a pressure ulcer of at least grade II developed in 10.3% (17/165) of mechanically ventilated patients turned every two hours versus 13.4% (22/164) of those turned every four hours (hazard ratio 0.89, 95% CI 0.46-1.71, p=0.73) The increased turning frequency did increase device-related adverse events (47.9% versus 36.6%) as well as the nursing workload with a median (interquartile range) daily nursing workload for manual repositioning of 21 (14-27) versus 11 (8-15) minutes per patient.

On the other hand, turning care can be positively influenced by using a wearable patient sensor: it was associated with a significant increase in the total time with turning compliance for patients at high risk for pressure injuries [33]. In that study, the researchers used a dynamic target: turning with a minimum angle of 20°and with at least 15 minutes of cumulative tissue depressurisation every two hours. Changes in position were calculated based on data generated by the wearable patient sensor to determine the degree of position change, as well as the duration of time spent in each position. The intervention had a significant protective effect against pressure injury (odds ratio 0.33, 95% CI 0.12-0.90, p=0.031).

Pressure Relief

Pressure ulcers on the heel can be prevented more successfully by using a heel protector that ensures off-loading and maintains the foot in a neutral position rather than by using pillows to position the heel and redistribute pressure [34]. None of the patients in the intervention group developed hospital-acquired pressure injuries of the heels, while seven patients in the control group did ($p<0.001$).

When examining the pressure-relief suspension boot, none of the patients in the intervention group developed signs or symptoms of pressure, whereas 40% (6/15) of patients who used intravenous bags to relieve pressure to the Achilles or heel area developed signs and symptoms of pressure [35]. Those six patients had blanchable erythema and warmth present upon assessment and there was a significant association (p=0.006).

Pressure Mapping

Continuous bedside pressure mapping displays the patient's pressure points in real-time colour imagery, showing how pressure is distributed at the body-mat interface. In the study by Behrendt et al. [36], hospital-associated pressure ulcers (stage II) developed in 0.9% (2/213) of patients with continuous bedside pressure mapping compared with 4.8% (10/209) of patients in the control group (p=0.02).

Gunningberg et al. [37] did not find a significant difference on any study day (3, 7 and 14) (p=0.3-0.7) in the prevalence of

pressure ulcers between the intervention group that received continuous bedside pressure mapping (24.2% on day 1 and 28.2% on day 14) and the control group (18.2% on day 1 and 23.8% on day 14). Of note, 10.1% (7/69) of patients in the intervention group and 8.6% (7/81) of patients in the control group who had no pressure ulcers on admission developed pressure ulcers category 1 and 2 during their hospital stay. The incidence rate ratio between the intervention and control groups was 1.13 (95% CI 0.34-3.79).

Health Education Interventions

Two interventions-the use of a thermometer for monitoring alongside theory-based counselling by a specialist diabetes nurse were implemented in the pilot feasibility study by Skafjeld et al. [38]. Because they were implemented together, it is difficult to separate the effect of each component. There were no significant differences in foot ulcer development between the two groups. During the 1-year follow-up, the incidence of foot ulcers in the intervention and control groups was 39% (n=7/21) and 50% (n=10/20), respectively (p=0.532).

Zarchi et al. [39], reported that advice on wound management given to home-care nurses by a team of hospital-based wound experts significantly improves wound healing compared with the best available conventional practice. During the 1-year follow-up, complete wound healing was achieved in 70% (n=35) of patients in the telemedicine group compared with 45% (n=18) of patients in the conventional group (adjusted hazard ratio 2.19, 95% CI 1.15-4.17, p=0.017).

Miscellaneous Interventions

Compression Hosiery

According to Ashby et al. [40], two-layer compression hosiery that delivers 35-40 mmHg of compression at the ankle is a viable alternative to four-layer bandages that delivers 40 mmHg of compression at the ankle because it is equally effective at healing venous leg ulcers (p= 0.96). The median time to ulcer healing was 99 days (95% CI 84-126) in the hosiery group and 98 days (85-112) in the bandage group; moreover, the proportion of ulcer healing was almost the same in the two groups (70.9% for hosiery and 70.4% for bandage). The rate of recurrence was greater with bandages than with hosiery (p=0.026). However, a higher rate of treatment changes in participants in the hosiery group than in the bandage group (38.3% versus 27.0%, p=0.02) suggests that hosiery might not be suitable for all patients.

Combined Preventive Measures

Coyer et al. [41], showed that the InSPiRE protocol that consists of a bundle of preventive processes was successful in reducing the cumulative incidence of pressure ulcers from 30.4% (31/102) of patients in the control group to 18.1% (19/105) of patients in the intervention group ($\chi 2$=4.271, df=1, p=0.039). The intervention group also showed significantly fewer pressure injury events developing over time (Logrank [Mantel-Cox]=11.842, df=1, p<0.001) as most patients in that group only had one pressure injury and fewer skin injuries (stage II-IV) (4/105) compared with patients in the control group (17/102). There was also a significant reduction in the severity of skin pressure injuries and a longer length of time for pressure injuries to develop.

Incisional Negative Pressure Wound Therapy

The incisional negative pressure wound therapy device in the study by Nordmeyer et al. [42], was attached to the skin over the wound immediately after surgical wound closure. The seroma volume underneath the surgical wound was significantly lower at day 5 and day 10 in the incisional negative pressure wound therapy group (day 5: incisional negative pressure wound therapy group 0 ml versus standard treatment 1.9 ml, p=0.0007; day 10: incisional negative pressure wound therapy group 0.5 ml versus standard treatment 1.6 ml, p<0.024).

Ultrasound Therapy

Finally, low dose, high frequency ultrasound administered weekly for 12 weeks during dressing changes in addition to standard care did not significantly reduce ulcer recurrence (p=0.68) or increase ulcer healing rates (log rank test statistic 0.25, p=0.61; Wilcoxon test statistic 0.33, p=0.56). After adjustment for the baseline ulcer area, the baseline ulcer duration, the use of compression bandaging and the study centre, there was still no evidence of a difference in time to healing (hazard ratio 0.99, 95% CI 0.70-1.40, p=0.97) [43].

	Participants	Measurement	Outcome	p-value	Mean (SD)/ percentage points(%) (CG)	Mean (SD)/ percentage points (%) (IG)	Mean/ percentage difference (IG)	SD /Odds ratio (OR)/ Harrzar ratio [HR]	CI (Lower limit)	CI (Upper limit)
Skin care interventions										
CHRONIC WOUNDS										
Edmonds et al. (2018)	240	2 weeks after randomisation, then monthly until the end of the study. Wound area tracing was done and photos were taken after debridement at each assessment, and if wound closure occurred.	Wound closure Time to wound closure Wound area reduction (Absolute) Adverse event: infection of target wound	P=.002* P=.029* P=.022* NR	30% 180 days 1.2 (0.6-2.4) 28%	48% 120 days 1.8 (0.9-3.8) 20%	18%↑ 60↓ 0.6↑ 8%	2.60 OR NR NR NR	1.43 47 NR NR	4.73 75 NR NR
Miller et al. (2010)	266	Photographs were taken at recruitment (baseline) and at two weekly intervals for 12 weeks or less if the client healed. Wound size was measured using the Advanced Medical Wound Imaging System V2.2 (AMWIS) software.	Wound healing rate nr of healed wounds within 12 weeks	p>.05 p>.05	1.69 (2.46) 63%	2.10 (1.89) 64%	0.41↑ 1%↑	NR NR	NR NR	NR NR
Moffatt et al. (2014)	100	Weekly assessment visits to re-measure wound area. Wound swabs at each weekly dressing change.	Complete ulcer closure (up to 24 weeks) Complete ulcer closure (up to 12 weeks) Dressing changes	P=.67 NR P=.033*	NR 49.1% 14.8	NR 44.9% 10.0	NR 4.2% 4.8↓	1.13 [HR] NR NR	0.64 NR NR	2.02 NR NR
Park & Kim (2014)	76	Once a day for 7 days. The highest IADS scores and PU stage (NPUAP) documented during the 1-week period were used for data analysis.	Reduced IADS PU occurrence Relation between IADS and PU	p<.001* p=.001* p=.001*	14.13 (11.7) 13.2% .	5.19 (3.41) 50% .	8.94↓ 36.8↑ 0.155	NR NR 0.043 (1.168)	NR NR 1.074	NR NR 1.271
Purcell et al. (2017)	60	Wound size: collected at baseline and weeks 4 and 12. Wound size was assessed by measuring the surface areas of CLUs using digital planimetry software (Integrated Clinical Information System, Central Coast Local Health District) that was calibrated prior to each measurement	Wound size (4w) Wound size (12W)	P=.50 P=.78	5.0 (2.5-9.9) 0.4 (0.0-5.6)	2.4 (1.3-12.7) 0.7 (0.1-5.0)	2.6↓ 0.3 ↑	NR NR	NR NR	NR NR
Romanelli et al. (2015)	40	At each visit. The dressings were changed twice a week for 12 weeks or until the ulcer was healed. The VLU area was measured with a non-invasive laser scanning system.	Ulcer area reduction (Wound size) Granulation tissue formation Complete ulcer healing Side effects	p<.001* p<.001* NR NR	20% 38% 5 patients NR	45% 65% 6 patients NR	25%↑ 27%↑ 1↓ NR	NR NR NR NR	NR NR NR NR	NR NR NR NR
POSTOPERATIVE WOUNDS										
Bredow et al. (2018)	208	Patients were followed up on postoperative days 2, 3 and 6. Assessment of photograph for postoperative blister formation. Parameters: skin status, including edema and temperature assessments, status with regard to , sensation of the patient underneath the dressing, wound exudate quantity and quality, absorbency of the dressing.	Blister formation Dressing changes (day 2) Dressing changes (day 3) Dressing changes (day 6)	NR P<.001* P<.001* P=.497	0 59% 59% 96.2%	(n=1)# 15.7% 18.4% 94.2%	0 43.3%↓ 40.6%↓ 2%↓	NR NR NR NR	NR NR NR NR	NR NR NR NR
Brindle & Wegelin (2012)	85	Daily skin assessments	Pressure ulcer incidence CG vs IG (unadjusted)	p>.058 p=.0185	11.7% .	2.0% .	9.7%↓ .	NR 4.4 [HR]	NR 0.49	NR 39.4
Burke et al. (2012)	124	The number of dressing changes, incidence of blistering, leakage, appearance of inflammation was recorded for each patient. Dressings were changed only when there was a more than a 50% strikethrough of the inner layer visible.	Wound blistering Leakage Inflammation Infection Dressing changes: only one dressing change needed before discharge	p<.04 P<.0034 NR NR P=.03*	17.7% 20.9% 4.8% 0% 13%	4.8% 6.4% 4.8% 0% 62%	12.9%↓ 14.5%↓ 0% 0% 49%↓	NR NR NR NR NR	NR NR NR NR NR	NR NR NR NR NR
Robson et al. (2012)	49	Wound swabs at any time up to 28 days after operation.	Positive wound swabs Positive wound swabs (MRSA) Positive wound swabs (7 days)	p>.90 p>.90 P=.70	38% 25% 13%	36% 28% 20%	2%↓ 3%↑ 7%↑	NR NR NR	NR NR NR	NR NR NR
#This patient was in the IG, but had accidentally received a control wound dressing.										
Pressure prevention interventions										
Bales (2012)	30	daily assessments of heels/Achilles area for signs and symptoms of pressure: redness, warmth, coolness, and pain. (visualization of the heels, palpation to assess for pain, and blanching to assess for nonblanchable erythema)	Signs and symptoms of pressure	p.006*	40%	0%	40%↓	NR	NR	NR
Behrendt et al. (2014)	422	All patients' skin is assessed at least every 8 hours for areas of erythema over bony prominences	Hospital Acquired PU	p.02	4.8%	0.9%	3.9%↓	NR	NR	NR
Gunningberg et al. (2017)	190	On days 3, 7, and 14. Prevalence and incidence of PUs according to pressure injury staging system NPUAP, 2014. Observation of preventive measures. Interface pressure was collected from the CBPM-monitor after the patient had been in the same position for 5 min.	Prevalence PU (day 1) Prevalence PU (day 3) Prevalence PU (day 7) Prevalence PU (day 14) PU development during hospital stay	P=.304 P=.634 P=.697 P=.666 NR	18.2% 20.2% 22.1% 23.8% 8.6%	24.2% 23.1% 25.3% 28.1% 10.01%	6.0%↑ 2.9%↑ 3.2%↑ 4.3%↑ 1.5%↑	NR NR NR NR 1.13 [IRR]	NR NR NR NR 0.34	NR NR NR NR 3.79
Manzano et al. (2014)	329	Not specified: between enrolment in the study and ICU discharge Incidence of a PU (>grade II) at any anatomic site between enrolment in the study and ICU discharge as assessed by a study nurse (PU evaluator). The associated nursing workload was also assessed, defined as the median min/day devoted to the turning.	Development PU at least grade 2 Repositioning total Device-related adverse events Daily nursing workload	p=.73 NR P=.02* p=<.001*	13.4% 45.8% (19.9) 36.6% 11 min/p	10.3% 44.1% (18.1) 47.9% 21 min/p	3.1%↓ 1.7↓ 11.3%↑ 10 min/p↑	0.89[HR] NR 150 [HR] NR	0.46 NR 1.06 NR	1.71 NR 2.11 NR

Meyers (2017)	54	Assessment of heel skin by nursing staff every shift and by data collectors every other day. Goniometric measurements were conducted and recorded on study admission, day 3, every other day, and on the last day of the study. Braden Scale for Pressure Sore Risk-scores were recorded every shift.	Development of heel PI Decrease in goniometric scores (day 3) Decrease in goniometric scores (day 7)	p<.001* p=.004* p<.001*	41% 0.1 (0.52) 0.07 (0.96)	0% 1.4 (2.25) 2.0 (3.02)	41%↓ 1.3↑ 1.93↑	NR NR NR	NR NR NR	NR NR NR
Pickham et al. (2018)	1312	Head-to-toe skin assessment for PrIs (pressure injuries) every shift (nursing staff). If a HAPI was present, it was staged using the NPUAP staging criteria and documented in the clinical record using standard documentation procedures. Any remarkable findings are documented and a daily report is generated for assessment within 24h by an independent Certified Wound, Ostomy, and Continence Nurse. The wearable patient sensor measures patient turning by assessing its relative position within a three-dimensional space, and every ten seconds relays these data through a mesh network of antennae to a secure SQL database.	Hospital Acquired PU Turning compliance Turning magnitude Depressurization time	p=.031 p<.001 p=.923 p=.145	2.3% 54% . .	0.7% 67% . .	1.6%↓ 13%↑ 21% 39%	0.33(OR) 0.11(OR) NR NR	0.12 0.08 NR NR	0.90 0.13 NR NR
Health education interventions										
Skafjeld et al. (2015)	41	IG: Temperature was to be monitored at the same six points under both feet and recorded in a log book daily. CG: inspect feet under, below and between the toes, and record their observations in a log book daily. Clinical examinations at baseline and at study-end. Foot ulcer occurrence (end point in the study) was classified according to Wagner foot classification system.	Incidence of foot ulcer	0.532	50%	39%	11%↓	NR	NR	NR
Zarchi et al. (2012)	90	An integrated Flash-based image tool (Danish Telemedicine) was used to spatially calibrate images and to measure wound surface area. Digital images of wounds in all participants were recorded on the day of inclusion and subsequently during updates in the telemedicine group. Web-based charts, including digital images, were updated as frequently as possible by home care nurses, but at a minimum of every second week, unless decided otherwise by the wound-expert team.	Complete wound healing	0.017	45%	70%	25%↑	2.19 [HR]	1.15	4.17
Miscellaneous interventions										
Ashby et al. (2014)	453 (†)	Time of ulcer healing in days from randomization (assessed by photographs). When the treating nurse judged the reference ulcer healed, a digital photograph was taken of the healed site and thereafter once per week for 4 weeks. After the reference leg healed, nurses assessed ulcer recurrence on a monthly basis. Nurses recorded when a participant changed from their allocated treatment and moved to a non-trial treatment and the reason why.	Ulcer Healing rates Time to Ulcer healing Serious Adverse events Non- serious adverse events Treatment changes	p=.96 NR NR P=.05* P=0.02*	70.4% 99 days 15% 58% 27%	70.9% 98 days 14% 67% 38.3%	0.5%↓ 1 ↓ 1%↓ 9% 11.3%↑	0.99[HR] 0.91[HR] NR 1.12[RR] NR	0.79 0.73 NR 0.95 NR	1.25 1.12 NR 1.32 NR
Coyer et al. (2015)	207	Skin assessment on admission + ongoing assessment. IG: skin integrity physical assessment every 12 hours. Clinical examination of the nare, lips and mouth for loss of skin integrity is undertaken every 12 hours. CG: daily skin assessment. Skin surrounding the NGT or ETT is assessed on a 12 hourly basis.	Pressure injury cumulative incidence Total pressure injuries (PrIs) Mucous injury >3 PrI events/patient	P=0.39 P<.0001* p<.001 p=.018*	30.4% 62 39/31 10/102	18.1% 24 15/19 1/105	12.3%↓ 38↓ . .	NR NR NR NR	NR NR NR NR	NR NR NR NR
Nordmeyer et al. (2016)	20	Examination by ultrasound to measure seroma volumes. Measurements in both groups on the 5th and 10th day after surgery. Postoperatively, the immediate amount of wound secretion in the Redon drain canisters was quantified.	Wound size Wound secretion (2days) Seroma volume (day 5) Seroma volume (day 10) Dressing changes	P=.26 P=.16 P=.0007* P=.024* P <0·0001*	17.25 (5.70) 621.5 ml (286.5) 1.9 ml (2.7) 1.6 ml (2.6) 7.9 pp	14.60 (4.38) 454 ml (229.6) 0 ml (0) 0.5 ml (1.0) 4.8 pp	2.65↓ 167↓ 1.9↓ 1.1↓ 3.1↓	NR NR NR NR NR	NR NR NR NR NR	NR NR NR NR NR
Watson et al. (2011)	337	Digital photographs of the reference ulcer were taken every four weeks, at point of healing and seven days after healing to determine date of healing If no photographs were available for a patient, then the date of healing decided by the treating nurse was taken as the healed date. (*)	Difference in healing time (adjusted) Median healing time All ulcers healed (12 months) Recurrence of healed ulcers Serious adverse events Ulcer size (at 4 weeks)	P=.097 P=.61 P=.39 P=.68 P=.39 P=.50	. 328 days 169 14/31 45% NR	. 365 days 78 17/31 55% NR	. 37↑ 91↓ 3↑ 10↑ NR	0.99[HR] NR NR NR 0.23 0.05	0.70 NR NR NR -0.34 -0.09	14.0 NR NR NR 0.79 0.19
	† 453 or 454 participants									

Table 2: Results.

Quality: Risk of Bias

To provide an impression of the quality of the included studies we assessed them with the Cochrane Risk of Bias (RoB) 2.0 tool. Table 3 presents the results of the risk of bias analysis.

Of the 10 skin care intervention studies, only three scored high quality. Four studies were found to be of moderate quality due to concerns on one assessment item or a high risk of bias on the assessment item 'Deviations from intended interventions'. Three skin care intervention studies scored a high risk of bias on the assessment item 'Missing outcome data' and were therefore assessed as low quality.

Of the six studies researching pressure prevention interventions, two were assessed as high quality. For four of the six studies, there were some concerns regarding the risk of bias on the assessment item 'Randomisation process'. Three of those studies were assessed as moderate quality. The other one also scored a high risk of bias on two assessment items and was therefore assessed as low quality.

The two studies on health education interventions were found to be of low quality due to a high risk of bias on the assessment items 'Missing outcome data' and 'Measurement of the outcome'.

One of the remaining four studies was found to be of high quality. Two studies noted a high risk of bias on one assessment item and were therefore assessed as low quality. The other study only noted concerns regarding the risk of bias on the assessment item 'Randomisation process' and was therefore assessed as moderate quality.

	Randomization process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall
Skin care interventions						
Chronic wounds						
Edmonds et al. (2018) (i)	+	+	+	+	+	+
Miller et al. (2010) (i)	+	+	+	+	+	+
Moffatt et al. (2014) (i)	+	-	+	+	+	/
Park & Kim (2014) (p)	/	+	+	+	+	/
Purcell et al. (2017) (i)	+	+	+	+	+	+
Romanelli et al. (2015) (p)	+	+	-	+	+	-
Postoperative wounds						
Bredow et al. (2018) (i)	+	+	+	/	+	/
Brindle et al. (2012) (p)	/	-	-	+	+	-
Burke et al. (2012) (p)	+	+	+	/	+	/
Robson et al. (2012) (i)	/	+	-	+	+	-
Pressure prevention interventions						
Turning care						
Manzano et al. (2014) (p)	+	-	+	+	+	+
Pickham et al. (2018) (i)	+	+	+	+	+	+
Pressure relief						
Bales (2012)(p)	/	+	+	+	+	/
Meyers (2017) (p)	/	+	-	-	+	-

Pressure mapping						
Behrendt et al. (2014) (p)	/	+	+	+	+	/
Gunningberg et al. (2017) (p)	/	+	+	+	+	/
Health education interventions						
Skafjeld et al. (2015) (i)	+	+	-	-	+	-
Zarchi et al. (2015) (p)	/	+	-	-	+	-
Miscellaneous interventions						
Ashby et al. (2014) (i)	+	+	+	+	+	+
Coyer et al. (2015) (p)	/	+	+	-	+	-
Nordmeyer et al. (2016) (p)	/	+	+	+	+	/
Watson et al. (2011) (p)	+	+	-	+	+	-
+ Low Risk, / Some concerns, - High risk; (i)=intention-to-treat; (p)=per-protocol						

Table 3: Assessment of the Risk of Bias.

Discussion

Summary of Evidence

Our systematic scoping review provides an overview of wound care interventions executed by nurses in the hospital or community care setting. In total, 22 studies were included from a comprehensive search through six databases up to November 2019. We identified four categories of nursing interventions in wound care: skin care interventions, pressure prevention interventions, health education interventions and a few miscellaneous interventions. For the quality assessment, we used the RoB 2.0. The inability to blind patients, health care professionals or outcome assessors increased the risk of bias.

In this systematic scoping review, we focused on providing insight regarding which nursing interventions in wound care are relevant for further investigation. Three pressure prevention interventions standout and deserve future follow-up to formulate evidence based recommendation for: the use of real-time data and a wearable patient sensor, the use of pressure-relief suspension boots and the use of a heel protector. On the other hand, one standout for further investigation as possible low-value: repositioning the patient every two hours instead of every four hours.

The use of a two-layer compression hosiery failed to show significant results regarding the ulcer healing rate but showed significant results regarding the rate of recurrence. When we take the results and the low risk of bias of that study into account as well as the difficulty of applying four-layer bandages – which could compromise the compression that is delivered and the discomfort caused by four layers – it is worthwhile to investigate the two-layer compression hosiery further because it contributes to person-centred care.

Comparison with Other Studies

In this systematic scoping review, we focused on providing insight regarding wound care interventions executed by nurses. For that reason we used a nursing filter for this scoping review. For example, the study by Bröllman et al. [44], was not included in the search results even if it is about a wound care intervention.

As reported by Meyers [34], pressure ulcers on the heel can be prevented more successfully by using a heel protector that ensures off-loading and maintains the foot in a neutral position rather than by using pillows to position the heel and redistribute pressure. A pressure-relief suspension boot was found to be more effective than intravenous bags [35]. The use of a heel cushion/ heel protector that distributes the pressure over the calf without putting pressure on the Achilles tendon is also recommended in the Dutch guideline for pressure ulcers (2021)[45]. One of the included studies for this recommendation is the study by Meyers [34].

Prior studies evaluating the association between patient turning and the development of hospital-acquired pressure injuries have failed to establish sufficiently a benefit [46]. While Chaboyer et al. [47] analysed a hospital-acquired pressure injury prevention care bundle with 1,600 hospitalised patients, they failed to produce sufficient evidence to indicate an effect (hazard ratio 0.58, 95% CI 0.25-1.33, p=0.198). Pickham et al. [33] showed that a wearable patient sensor had a positive influence on turning care. This device may overcome the limitation that direct observation or self-reported data are needed to record turning compliance by providing an objective recording of patient turning practices. Moreover, the 'aSSKINg' model (assess risk; skin assessment and skin care; surface; keep moving; incontinence and moisture; nutrition and hydration; and giving information or getting help) could be useful in pressure ulcer prevention and care planning [48]. The InSPiRE protocol, a bundle of pressure injury prevention processes, resulted in a reduced cumulative incidence of intensive care unit–acquired pressure injury and a reduced number and severity of pressure injuries that developed over time. Systematic and ongoing assessment of the patient's skin and pressure injury risk as well as implementation of tailored prevention measures are central to preventing pressure injuries [41]. Risk assessment is also a key element in the Dutch guideline for pressure ulcers [45].

Areas for Further Research

We identified the scope of wound interventions executed by nurses that are relevant for further research but their effectiveness needs to be evaluated in future studies. A systematic review on clusters of wound care interventions without the nursing filter in the search strategy is necessary to determine if the interventions are high- or low-value care.

Regarding recommendations for further research, a small or insufficient sample size was a common methodological issue identified in six of the 22 included studies. A need for well powered, randomised controlled trials with high quality methods exists. For example, Bales [35], suggested that the use of the intravenous bags as a pressure-relieving intervention must be eliminated and an intervention proven to be effective, such as the pressure-relief suspension boot, should be used in its place. A small convenience sample was used in this moderate-quality study; thus, more research is needed to generalise the results.

Blinding of participants or caregivers is not always possible, so future studies will also face this concern regarding the randomisation process. However, this issue can when possible be resolved by blinding the assessor.

In addition, the transferability of wound interventions to other settings should be researched. Of the included studies on pressure injuries, six were performed on patients hospitalised in the intensive care unit. For example, the InSpiRE protocol [41] was developed for critically ill patients and is context specific for the intensive care unit; it has not been used outside this setting. The use of the InSpiRE protocol, supported by education and ongoing support, has raised awareness of the problem. Other settings may also benefit from an increased awareness.

Better evidence is needed to improve health care. Mapping research questions against published systematic reviews may identify evidence-rich and evidence-poor areas of clinical practice, an endeavour that could help identify and prioritise directions and focus of future research [17]. To help nurses to act as a gate-keepers for low-value care when necessary [15] and to deliver high-value wound care, it is necessary to provide them with all the information and evidence they need to make the right choices. Person-centred care values the patient's perspectives, beliefs and autonomy. Gethin et al. [49] found that the evidence base to support person-centred care in wound management is developing and improved outcomes in the areas of pressure ulcer prevention, patient satisfaction, patient knowledge and quality of life have been reported, but the clinical outcomes remain under-explored.

Only 22 studies met the inclusion criteria. In health services, nursing care is the most provided care but the least evidence based. Focusing on the fundamentals of care will counterbalance devaluation of basic care and support improving the quality of nursing care [50].

Limitations

In this systematic scoping review we attempted to give a complete overview of the wound care interventions executed by nurses. A few considerations should be made with regard to the results. First, we have missed wound care studies not identified by

using a nursing filter in our search strategy. Second, some studies were underpowered to detect differences between groups; those studies need to be replicated in adequately powered investigations. Studies with a small sample size or carried out in a specific context (for example, the intensive care unit) limit the possibility to generalise the findings and warrant the exploration of other contexts and populations.

Third, the risk of bias was increased because blinding patients, health care professionals or outcome assessors was not possible due to the nature of the intervention-for example, when a turning schedule was used in the intervention. We chose to use the algorithm function in the RoB 2.0 tool to determine the risk of bias for transparency, but this approach may not be suitable for assessment of the quality of nursing studies. Finally, all studies presented limited statistical results, such as confidence intervals, hence, it is hard to determine the impact of effects.

Conclusion

In this systematic scoping review, we assessed 22 studies on nursing wound interventions. We identified four wound intervention categories: skin care, pressure prevention, health education interventions and miscellaneous.

Three pressure prevention interventions standout and deserve future follow-up to formulate evidence based recommendation for: the use of real-time data and a wearable patient sensor, the use of pressure-relief suspension boots and the use of a heel protector. The use of a two-layer compression hosiery also deserves future follow-up because it contributes to person-centred care as to healing, recurrence discomfort and easy of applying. On the other hand, one standout for further investigation as possible low-value care: repositioning the patient every two hours instead of every four hours. We recommend systematic reviews on clusters of wound care interventions that can be executed by nurses without the nursing filter in the search strategy to determine if these interventions are high- or low-value care.

Relevance to Clinical Practice

This systematic scoping review provides an overview of the wound care interventions executed by nurses in the hospital and community care setting. Five interventions can be prioritized to follow-up with systematic reviews on effect to formulate evidence based recommendation about high and low value care interventions for nurses.

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Contribution

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Registration

PROSPERO Registration: ID CRD4202153093.

References

1. Feo R, Conroy T, Jangland E, Athlin ÅM, Brovall M, et al. (2017) Towards a standardised definition for fundamental care: a modified Delphi study. J Clin Nurs 27: 2285-2299.
2. Kitson A, Conroy, T, Kuluski K, Locock L, Lyons R (2013) Reclaiming and redefining the fundamentals of care: nursing's response to meeting patients' basic human needs. Adelaide, South Australia: School of Nursing, the University of Adelaide.
3. McCaughan D, Sheard L, Cullum N, Dumville J, Chetter I (2018) Patients' perceptions and experiences of living with a surgical wound healing by secondary intention: a qualitative study. Int J Nurs Stud 77: 29-38.
4. Lindholm C, Searle R (2016) Wound management for the 21st century: combining effectiveness and efficiency. Int Wound J 2: 5-15.
5. Lazarus GS, Cooper DM, Knighton DR, Margolis DJ, Pecoraro RE, et al. (1994) Definitions and guidelines for assessment of wounds and evaluation of healing. Arch Dermatol. 130: 489-493.
6. Demidova-Rice TN, Hamblin MR, Herman IM (2012) Acute and impaired wound healing: pathophysiology and current methods for drug delivery, part 1: normal and chronic wounds: biology, causes, and approaches to care. Adv Skin Wound Care 25: 304-314.
7. Jung K, Covington S, Sen CK, Januszyk M, Kirsner RS, et al. (2016) Rapid identification of slow healing wounds. Wound Repair Regen. 24:181-188.
8. Tuinman A, De Greef MHG, Finnema EJ, Roodbol PF (2021) A systematic review of the association between nursing staff and nursing-sensitive outcomes in long-term institutional care. J Adv Nurs 77: 3303-3316.
9. Dryden SV, Shoemaker WG, Kim JH (2013) Wound management and nutrition for optimal wound healing. Atlas Oral Maxillofac Surg Clin North Am 21: 37-47.
10. Roberts S, Chaboyer W, Desbrow B (2015) Nutrition care-related practices and factors affecting nutritional intakes in hospital patients at risk of pressure ulcers. J Hum Nutr Diet 28: 357-365.

11. Gillespie BM, Chaboyer W, St John W, Morley N, Nieuwenhoven P (2015) Health professionals' decision-making in wound management: a grounded theory. J Adv Nurs 71: 1238-1248.

12. Verkerk EW, Huisman-de Waal G, Vermeulen H, Westert GP, Kool RB, et al. (2018) Low-value care in nursing: a systematic assessment of clinical practice guidelines. Int J Nurs Stud 87: 34-39.

13. Kuhnke JL, Keast D, Rosenthal S, Evans RJ (2019) Health professionals' perspectives on delivering patient-focused wound management: a qualitative study. J Wound Care 28: S4-S13.

14. Ubbink DT, Brölmann FE, Go PM, Vermeulen H (2015) Evidence-based care of acute wounds: a perspective. Adv Wound Care (New Rochelle). 4: 286-294.

15. Colla CH, Mainor AJ, Hargreaves C, Sequist T, Morden N (2017) Interventions aimed at reducing use of low-value health services: a systematic review. Med Care Res Rev 74: 507-550.

16. Gray TA, Rhodes S, Atkinson RA, Rothwell K, Wilson P, et al. (2018) Opportunities for better value wound care: a multiservice, cross-sectional survey of complex wounds and their care in a UK community population. BMJ Open 8: e019440.

17. Gillespie BM, Walker RM, McInnes E, Moore Z, Eskes AM, et al. (2020) Preoperative and postoperative recommendations to surgical wound care interventions: A systematic meta-review of Cochrane reviews. Int J Nurs Stud 102: 103486.

18. Munn Z, Peters MDJ, Stern C, Tufanaru C, McArthur A, et al. (2018) Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. BMC Med Res Methodol 18: 143.

19. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, et al. (2018) PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med 169: 467-473.

20. Higgins J, Thomas J, Chandler J, Cumpston M, Li T, et al. (2021) Cochrane Handbook for Systematic Reviews of Interventions version 6.2 (updated February 2021).

21. Higgins JPT, Altman DG, Gøtzsche PC, Jüni P, Moher D, et al. (2011) The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ 343: d5928.

22. Burke NG, Green C, McHugh G, McGolderick N, Kilcoyne C, et al. (2012) A prospective randomised study comparing the jubilee dressing method to a standard adhesive dressing for total hip and knee replacements. J Tissue Viability 21: 84-87.

23. Robson V, Yorke J, Sen RA, Lowe D, Rogers SN (2012) Randomised controlled feasibility trial on the use of medical grade honey following microvascular free tissue transfer to reduce the incidence of wound infection. Br J Oral Maxillofac Surg 50: 321-327.

24. Edmonds M, Lazaro-Martinez JL, Alfayate-Garcia JM, Martini J, Petit JM, et al. (2018) Sucrose octasulfate dressing versus control dressing in patients with neuroischaemic diabetic foot ulcers (Explorer): an international, multicentre, double-blind, randomised, controlled trial. Lancet Diabetes Endocrinol 6: 186-196.

25. Miller CN, Newall N, Kapp SE, Lewin G, Karimi L, et al. (2010) A randomized-controlled trial comparing cadexomer iodine and nanocrystalline silver on the healing of leg ulcers. Wound Repair Regen. 18: 359-367.

26. Moffatt C, Stanton J, Murray S, Doody V, Davis PJ, et al. (2014) A randomised trial to compare the performance of Oxyzyme® and Iodozyme® with standard care in the treatment of patients with venous and mixed venous/arterial ulceration. Wound Medicine 6: 1-10.

27. Park KH, Kim KS (2014) Effect of a structured skin care regimen on patients with fecal incontinence: a comparison cohort study. J Wound Ostomy Continence Nurs 41: 161-167.

28. Purcell A, Buckley T, Fethney J, King J, Moyle W, et al. (2017) The Effectiveness of EMLA as a Primary Dressing on Painful Chronic Leg Ulcers: Effects on Wound Healing and Health-Related Quality of Life. Int J Low Extrem Wounds 16: 163-172.

29. Romanelli M, Mulder G, Paggi B, Macchia M, Panduri S, et al. (2015) The use of a collagen matrix in hard-to-heal venous leg ulcers. J Wound Care 24: 543-544, 546-547.

30. Bredow J, Hoffmann K, Oppermann J, Hellmich M, Eysel P, et al. (2018) Evaluation of Absorbent Versus Conventional Wound Dressing. Dtsch Arztebl Int 115: 213-219.

31. Brindle CT, Wegelin JA (2012) Prophylactic dressing application to reduce pressure ulcer formation in cardiac surgery patients. J Wound Ostomy Continence Nurs 39: 133-142.

32. Manzano F, Colmenero M, Perez-Perez AM, Roldan D, Jimenez-Quintana Mdel M, et al. (2014) Comparison of two repositioning schedules for the prevention of pressure ulcers in patients on mechanical ventilation with alternating pressure air mattresses. Intensive Care Med 40: 1679-1687.

33. Pickham D, Berte N, Pihulic M, Valdez A, Mayer B, et al. (2018) Effect of a wearable patient sensor on care delivery for preventing pressure injuries in acutely ill adults: A pragmatic randomized clinical trial (LS-HAPI study). Int J Nurs Stud 80:12-19.

34. Meyers T (2017) Prevention of Heel Pressure Injuries and Plantar Flexion Contractures With Use of a Heel Protector in High-Risk Neurotrauma, Medical, and Surgical Intensive Care Units: A Randomized Controlled Trial. J Wound Ostomy Continence Nurs 44: 429-433.

35. Bales I (2012) A comparison between the use of intravenous bags and the Heelift suspension boot to prevent pressure ulcers in orthopedic patients. Adv Skin Wound Care 25:125-131.

36. Behrendt R, Ghaznavi AM, Mahan M, Craft S, Siddiqui A (2014) Continuous bedside pressure mapping and rates of hospital-associated pressure ulcers in a medical intensive care unit. Am J Crit Care 23:127-133.

37. Gunningberg L, Sedin IM, Andersson S, Pingel R (2017) Pressure mapping to prevent pressure ulcers in a hospital setting: A pragmatic randomised controlled trial. Int J Nurs Stud 72: 53-59.

38. Skafjeld A, Iversen MM, Holme I, Ribu L, Hvaal K, et al. (2015) A pilot study testing the feasibility of skin temperature monitoring to reduce recurrent foot ulcers in patients with diabetes--a randomized controlled trial. BMC Endocr Disord 15:55.

39. Zarchi K, Haugaard VB, Dufour DN, Jemec GBE (2015) Expert advice provided through telemedicine improves healing of chronic wounds: prospective cluster controlled study. J Invest Dermatol 135: 895-900.

40. Ashby RL, Gabe R, Ali S, Adderley U, Bland JM, et al. (2014) Clinical and cost-effectiveness of compression hosiery versus compression bandages in treatment of venous leg ulcers (Venous leg Ulcer Study IV, VenUS IV): a randomised controlled trial. Lancet 383: 871-879.

41. Coyer F, Gardner A, Doubrovsky A, Cole R, Ryan FM, et al. (2015) Reducing pressure injuries in critically ill patients by using a patient skin integrity care bundle (InSPiRE). Am J Crit Care 24: 199-209.

42. Nordmeyer M, Pauser J, Biber R, Jantsch J, Lehrl S, et al. (2016) Negative pressure wound therapy for seroma prevention and surgical incision treatment in spinal fracture care. Int Wound J 13:1176-1179.

43. Watson JM, Kang'ombe AR, Soares MO, Chuang LH, Worthy G, et al. (2011) Use of weekly, low dose, high frequency ultrasound for hard to heal venous leg ulcers: the VenUS III randomised controlled trial. BMJ 342: d1092.

44. Brölmann FE, Eskes AM, Goslings JC, Niessen FB, de Bree R, et al. (2013) Randomized clinical trial of donor-site wound dressings after split-skin grafting. Br J Surg 100: 619-627.

45. Dutch guideline for pressure ulcers (2021) Available.

46. Gillespie BM, Chaboyer WP, McInnes E, Kent B, Whitty JA, et al. (2014) Repositioning for pressure ulcer prevention in adults. Cochrane Database Syst Rev 2014: CD009958.

47. Chaboyer W, Bucknall T, Webster J, McInnes E, Gillespie BM, et al. (2016) The effect of a patient centred care bundle intervention on pressure ulcer incidence (INTACT): A cluster randomised trial. Int J Nurs Stud 64: 63-71.

48. Young C (2021) Using the 'aSSKINg' model in pressure ulcer prevention and care planning. Nurs Stand 36: 61-66.

49. Gethin G, Probst S, Stryja J, Christiansen N, Price P et al. (2020) Evidence for person-centred care in chronic wound care: a systematic review and recommendations for practice. J Wound Care 29: S1-S22.

50. Zwakhalen SMG, Hamers JPH, Metzelthin SF, Ettema R, Heinen M, et al. (2018) Basic nursing care: the most provided, the least evidence based - A discussion paper. J Clin Nurs 27: 2496-2505.

(Wound closure.fs. or exp Burns/ or exp Soft Tissue Injuries/ or exp Surgical Wound/ or exp Wounds, Nonpenetrating/ or exp Wounds, Penetrating/ or exp Skin Ulcer/ or Self Mutilation/ or (Blunt Injur* or burn or burns or Diabetic Feet or Diabetic Foot or Foot Ulcer* or Leg ulcer* or Nonpenetrating Injur* or Pressure ulcer* or decubitus or Skin Ulcer* or Soft Tissue Injur* or Sunburn* or Surgical Incision* or Wound* or Automutilation or self mutilation).ti,ab,kf. or exp Wound Closure Techniques/ or exp Wound Healing/ or (Wound Healing* or tissue repair* or Negative-Pressure Wound Therap* or Topical Negative-Pressure Therap* or Negative-Pressure Dressings or Vacuum-Assisted Closure* or wound closure).ti,ab,kf.) AND (nursing.fs. or exp Nursing/ or nurses/ or nurse administrators/ or exp nurse specialists/ or nurses, community health/ or nurses, international/ or nurses, male/ or nurses, public health/ or exp Nursing Staff/ or exp Nursing Care/ or nursing process/ or exp nursing assessment/ or Licensed Practical Nurses/ or (Nurse or Nurses or nursing).ti,ab,kf.) AND ((exp clinical trial/ or (Randomi#ed or Placebo or Randomly or Quasi-experimental or Experimental group* or Intervention group* or Control group* or Clinical trial or Quasiexperimental or Semiexperimental or Semi-experimental or Nonrandomized group*).ti,ab,kf. or trial.ti. or clinical trials as topic/) not (exp animals/ not humans/))

Appendix 1: Medline Search.

Appendix 2: Summary of study characteristics of wound interventions

Author (year)	Study design	Aim	Participants/ Study group, Country	Intervention
Skin care interventions				
Edmonds et al. (2018)	RCT	Assessing efficacy of sucrose octasulfate dressing vs control dressing on wound closure (diabetic foot ulcers)	Diabetic patients with neuroischaemic diabetic foot ulcers of specialised diabetic foot clinics - France Spain, Italy, Germany, UK Total: n=240 / Age: years (SD): / Gender: n (%) IG: n=126 / IG: 64.2 (11.2) / IG: Male: 108 (86) / Female: 18 (14) CG: n=114 / CG: 64.9 (10.77) / CG: Male: 93 (82) / Female: 21 (18)	IG: sucrose octasulfate wound dressing CG: same dressing without sucrose octasulfate
Burke et al. (2012)	RCT	Comparing efficacy of jubilee dressing method vs standard traditional adhesive dressing in reducing wound complications	Patients with elective total hip/knee replacement (orthopedic hospital) - Ireland Total: n=124 / Age total group: years / Gender: n IG: n= 62 / 67 / Male: 77 CG: n= 62 / Female: 47	IG: jubilee dressing (absorbent hydrofiber inner layer and a hydrocolloid viscoelastic outer layer) CG: standard dressing with self-adhesive outer aspect and a centrally located absorbent wound pad)
Park & Kim (2014)	Quasi-experimental	Measuring the effect of a structured skin care regimen for critically ill patients with fecal incontinence	ICU patients with fecal incontinence of a hospital - South Korea Total: n=76 / Age: years (SD): / Gender: n (%) IG: n=38 / IG: 66.2 (15.2) / IG: Male: 18 (47.4) / Female: 20 (52.6) CG: n=38 / CG: 69.7 (13.6) / CG: Male: 22 (57.9) / Female: 16 (42.1)	IG: structured skin care regimen (regular use of a no-rinse skin cleanser, application of a skin protectant, and indwelling fecal drainage system when indicated) CG: standard skin care protocol
Romanelli et al (2015)	RCT	Evaluating the effects of a collagen membrane on granulation tissue formation and ulcer healing in patients with hard-to-heal venous leg ulcers (VLUs)	Outpatients with venous insufficiency and a hard-to-heal VLU of a Wound Healing Research Unit of the Department of Dermatology - Italy Total: n=40 / Age: years (SD): / Gender: n (%) IG: n=20 / IG: 68 (5) / IG: Male: 7 (35.0) / Female: 13 (65.0) CG: n=20 / CG: 65 (2) / CG: Male: 5 (25.0) / Female: 15 (75.0)	IG: collagen and alginate dressing CG: alginate dressing only
Miller et al. (2010)	RCT	Comparing the effectiveness of cadexomer iodine vs nanocrystalline silver in the antimicrobial treatment of leg ulcers	Clients with infection of lower leg ulcers of community nursing services - Australia Total: n=266 / Age: years (SD): / Gender: n (%) IG: n=133 / IG: 79.99 (10.90) / IG: Male: (38.3) / Female: (61.7) CG: n=133 / CG: 79.35 (12.66) / CG: Male: (44.4) / Female: (55.6)	IG: cadexomer iodine dressing CG: nanocrystalline silver dressing
Purcell et al. (2017)	RCT	Assessing the effectiveness of EMLA as a primary wound dressing on wound healing and quality of life for painful chronic leg ulcers (CLUs)	Patients with painful CLUs of Community clinics - Australia Total: n=60 / Age: years (SD): / Gender: n (%) IG: n=30 / IG: 73.4 (12.5) / IG: Male: 13 (43.3) / Female: 17 (56.6) CG: n=30 / CG: 73.8 (10.1) / CG: Male: 12 (40.0) / Female: 18 (60.0)	IG: daily application of EMLA cream (1-2 g per 10cm²) for 4 weeks as a primary dressing, followed by usual care (8 weeks) CG: usual evidence-based wound care
Bredow et al. (2018)	RCT	Comparing efficacy of absorbent vs conventional wound dressing in prevention of blister formation	Patients with knee/hip replacement/spinal surgery (orthopedic surgery) - Germany Total: n=208 / Age: years (range): / Gender: n (%) IG: n=103 / IG: 66.8 (37–92) / IG: Male: (47.6) / Female: (52.4) CG: n=105 / CG: 66.2 (33–90) / CG: Male: (55.2) / Female: (44.8)	IG: absorbent wound dressing, only changed before the sixth postoperative day if medically indicated, as recommended by the manufacturer. CG: conventional adhesive dressing, changed not later than on the second postoperative day and subsequently as required, but not later than every second day
Moffatt et al. (2014)	RCT	Comparing the effectiveness of Ozyzyme/Iodozyme vs standard care in the treatment of venous and mixed venous/arterial ulceration	Patients with venous and mixed venous/arterial ulceration of a leg ulcer service - UK Total: n=100 / Age: years (SD): / Gender: n (%) IG: n=47 / IG: 69.7 (13.2) / IG: Male: 23 (48.9) / Female: 24 (51.1) CG: n=53 / CG: 69.4 (13.5) / CG: Male: 29 (54.7) / Female: 24 (45.3)	IG: Ozyzyme/Iodozyme dressing regimen CG: standard care
Brindle & Wegelin (2012)	Quasi-experimental	Comparing prophylactic efficacy of self-adherent silicone border foam dressing vs zinc-based skin protectant in reduction of PU incidence	Cardiac surgery patients of a hospital - USA Total: n=85 / Age: years (SD): / Gender: n (%) IG: n=50 / IG: 61.2 (13.6) / IG: Male: 31 (62) / Female: 19 (38) CG: n=35 / CG: 62.7 (12.7) / CG: Male: 25 (71) / Female: 10 (29)	IG: silicone border foam dressing CG: zinc-based skin protectant
Robson et al. (2012)	RCT	Assessing the use of medical grade honey following microvascular free tissue transfer to reduce the incidence of wound infection	Cancer patients admitted for free tissue reconstruction of a maxillofacial unit - UK Total: n=49 / Age 65+ N (%) / Gender: n (%) IG: n=25 / IG: 8 (32) / IG: Male: 16 (64) / Female: 9 (36) CG: n=24 / CG: 13 (54) / CG: Male: 17 (71) / Female: 7 (29) Age 75± N (%) IG: 13 (54) CG: 6 (25)	IG: honey dressing CG: conventional dressing
Pressure prevention interventions				
Pickham et al. (2018)	RCT	Assessing the effectiveness of a wearable patient sensor to improve care delivery and patient outcomes by increasing the total time with turning compliance and preventing heel PrI	ICU patients of a medical centre - USA Total: n=1312 / Age: years (SD): / Gender: n (%) IG: n=659 / IG: 60 (17) / IG: Male: 366 (56) / Female: 293 (44) CG: n=653 / CG: 60 (18) / CG: Male: 352 (54) / Female: 301 (46)	IG: turning care influenced by real-time data derived from a wearable patient sensor CG: turning care relying on traditional turn reminders and standard practices (sensor recording but no feedback to bedside clinicians
Manzano et al. (2014)	RCT	Comparing effectiveness of 2 repositioning schedules for preventing PU development	ICU patients under mechanical ventilation of a hospital - Spain Total: n=329 / Age: years (SD): / Gender: n (%) IG: n=165 / IG: 62.1 (14.5) / IG: Male: 109 (66.1) / Female: 56 (33.9) CG: n=164 / CG: 61.1 (15.1) / CG: Male: 110 (67.1) / Female: 54 (32.9)	IG: repositioning every 2 hours. CG: repositioning every 4 hours.
Bales (2012)	Quasi-experimental	Comparing efficacy of intravenous bags vs pressure-relieving suspension boots in the prevention of PU	Patients admitted for hip/knee replacement of an orthopedic unit of a hospital - USA Total: n=30 / Age: years (range): / Gender: n (%) IG: n=15 / 60.97 (51-70) / Male: (36.7) CG: n= 15 / Female: (63.3)	IG: pressure-relieving suspension boots CG: intravenous bags

Behrendt et al. (2014)	Quasi-experimental	To determine the utility of the CBPM system in repositioning patients to prevent hospital-associated pressure ulcer (HAPU) formation.	Patients admitted to the MICU at Henry Ford Hospital - Detroit, Michigan Total: 422 IG: n=213 CG: n= 209	Age: Years (SD) IG: 58.7 (14.9) CG: 57.2 (18.3)	Gender (%): IG: Male: 49% / Female: 51% CG: Male: 53% / Female: 47%	IG: Continuous Bedside Pressure mapping (MAP system) in addition to care as usual. CG: Care as usual (2 hour turning protocol)
Gunningberg et al. (2017)	RCT	Evaluating effect of pressure mapping on PU prevalence and incidence	Patients of a geriatric/internal medical ward of a hospital - Sweden Total: n=190 IG: n=91 CG: n=99	Age: years (SD): IG: 81 (8.5) CG: 81 (9.6)	Gender: n (%) IG: Male: 35 (38.5) / Female: 56 (61.5) CG: Male: 56 (56.7) / Female: 43 (43.4)	IG: pressure-sensing mat + monitoring (Continuous Bedside Pressure Mapping system) CG: same pressure-sensing mat without monitoring
Meyers (2017)	RCT	Comparing a heel protector vs standard care in the prevention of PrI of the heels and plantar flexion contractures	ICU patients with preexisting heel PrI or plantar flexion contractures of a hospital - USA Total: n= 54 IG: n=37 CG: n=17	Age: years (SD): IG: 44.6 (17.15) CG: 40.7 (14.96)	Gender: n (%) IG: Male: 25 (67.6) / Female: 12 (32.4) CG: Male: 14 (82.4) / Female: 3 (17.6)	IG: heel protector CG: standard care (1 to 2 pillows)
Health education interventions						
Skafjeld et al (2015)	RCT	Testing the feasibility of monitoring foot skin temperatures in combination with counselling to standard foot care to reduce diabetic foot ulcer recurrence	Outpatients with diabetic neuropathy and previous foot ulcers of a diabetes specialty clinic - Norway Total: n=41 IG: n=21 CG: n=20	Age: years (SD): IG: 57.1 (10.2) CG: 59.4 (13.0)	Gender: n (%) IG: Male: 18 (86.0) / Female: 3 (14.0) CG: Male: 15 (75.0) / Female: 5 (25.0)	IG: self-monitoring of skin temperature+counseling CG: standard foot care
Zarchi et al. (2012)	Quasi-experimental	Testing the efficacy of telemedicine in wound management	Chronic wound patients with hard to heal wounds of nurse-led, home-based health-care - Denmark Total: n=90 IG: n=50 CG: n=40	Age: years (SD): IG: 78.4 (14.4) CG: 74.2 (10.6)	Gender: n (%) IG: Male: 21 (42) / Female: 29 (58) CG: Male: 20 (50) / Female: 20 (50)	IG: telemedicine (advice by wound-care specialists) CG: conventional practice
Miscellaneous interventions						
Ashby et al. (2014)	RCT	Comparing efficacy of two-layer compression hosiery vs four-layer bandage in treatment of venous leg ulcers	Patients with venous leg ulcers of Community services and clinics/family doctor practices - England and Northern Ireland Total: n=453 or 454 IG: n=230 CG: n=224	Age: years (SD): IG: 68.3 (15.1) CG: 68.9 (13.8)	Gender: n (%) IG: Male: 117 (51) / Female: 113 (49) CG: Male: 113 (50) / Female: 111 (50)	IG: two-layer compression hosiery CG: four-layer bandage
Nordmeyer et al. 2016	RCT	Evaluating the effectiveness of negative pressure wound therapy (NPWT) on seroma prevention and surgical incision treatment	Patients with large surgical wounds - Germany Total: n=20 IG: n=10 CG: n=10	Age: years (SD): IG: 52.30 (16.32) CG: 57.80 (15.24)	Gender: n (%) Not reported	IG: negative pressure wound therapy (NPWT) CG: standard wound dressing (dry wound coverage)
Coyer et al. (2015)	Before and after design with CG	Testing a skin care protocol for reducing pressure injuries (PrI)	Critically ill ICU patients of a hospital - Australia Total: n=207 IG: n=105 CG: n=102	Age: years (SD): IG: 56 (16.3) CG: 54 (18.0)	Gender: n (%) IG: Male: 61 (58.1) / Female: 44 (41.9) CG: Male: 62 (58.8) / Female: 40 (41.2)	IG: InSPiRE protocol, a bundle of PrI prevention processes targeting key areas of nursing clinical assessment and documentation, hygiene measures, repositioning and prevention strategies CG: standard skin care
Watson et al (2011)	RCT	Assessing the clinical effectiveness of weekly delivery of low dose, high frequency therapeutic ultrasound in conjunction with standard care for hard to heal venous leg ulcers.	Patients with venous leg ulcers of community and district services, leg ulcer clinics - UK/Ireland Total: n=337 IG: n=168 CG: n=169	Age: years (SD): IG: 68.91 (14.80) CG: 69.92 (14.21)	Gender: n (%) IG: Male: 64 (38) / Female: 104 (62) CG: Male: 73 (43) / Female: 96 (57)	IG: weekly administration of low dose, high frequency ultrasound therapy and standard care CG: standard care

Abbreviations: Randomised controlled trail (RCT), Intervention Group (IG), Control Group (CG), Male, (M), Female (F), Standard deviation (SD)