

REVIEW

Assessment, management and prevention of chronic wounds in the Australian context: a scoping review

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Abstract

Aims To identify the current research on assessment, management and prevention of chronic wounds in Australia and within the global context.

Methods Electronic databases, trial registries and professional organisation websites were searched from 1 January 2010 to 31 May 2022. All original human research studies on chronic wounds conducted in Australia and reviews (systematic reviews (SRs), evidence-based guidelines (EBGs), evidence summaries, consensus documents) conducted worldwide were included. Results were tabulated and synthesised in a narrative review.

Results Overall, 365 Australian studies and 569 worldwide reviews were included. The designs of Australian studies were mostly cohort (31%) or cross-sectional (20%), with a few randomised trials (10%). Australian studies were mostly concentrated on wound management (43%) or assessment (40%), and only 17% on prevention; this profile was similar for worldwide reviews. The chronic wound types focused on in Australian studies were 43% pressure injuries (PIs), 27% diabetes-related foot ulcers (DFUs), 16% venous leg ulcers (VLUs), 8% mixed chronic wounds, 6% mixed leg/foot ulcers, <1% fungating wounds.

Conclusions This review found Australian chronic wound research focused on PIs and DFUs, with few randomised trials (10%), which is likely related to the lack of national competitive funding and difficulties in infrastructure support for adequately powered trials.

Keywords chronic wounds, Australia, pressure injury, leg ulcers, diabetes-related foot ulcers

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Introduction

Chronic wounds have protracted progression in healing, often taking months or years to heal, and are typically linked to underlying health conditions¹⁻³. Any wound may become

chronic, however, frequently found chronic wound types include venous leg ulcers (VLU), arterial leg ulcers (ALU), pressure injuries (PI) and diabetes-related foot ulcers (DFU)⁴. It can be anticipated that with an ageing population, chronic

diseases such as diabetes, venous insufficiency, peripheral arterial disease and malignant disorders will increase in prevalence, with a corresponding increase in the number of chronic wounds^{4,5}. Thus, there is a significant need for research to identify effective strategies to assess, manage and prevent chronic wounds across all health settings.

In Australia, there is clear evidence that chronic wounds significantly impact healthcare expenditure and health-related quality of life (HRQoL) for persons with wounds^{2,6-8}. To optimise effective care of chronic wounds, it is important to have a sound understanding of, and access to, available research evidence.

In 2020, the Australian Health Research Alliance Wound Care Initiative was established to develop strategies to optimise wound management in Australia. The Wound Care Initiative was divided into four streams, investigating the cost of wound care, wound care practice standards, education and research. The research stream included reviews of current research evidence for chronic wounds, acute wounds and fundamental wound science, to identify gaps and form the basis for consensus research on priorities for wound research in Australia.

This scoping review aimed to identify the existing research on assessment, management and prevention of chronic wounds to detect gaps in chronic wound research relevant to Australia. The review encompassed two arms: firstly original research studies conducted in Australia (termed Australian studies); and secondly worldwide reviews of research, i.e., systematic reviews (SRs), evidence-based guidelines (EBGs), evidence summaries and consensus documents, which involved review and synthesis of global research led by either Australian and/or international authors (termed worldwide reviews) to provide a global context.

Methods

The reporting of this review was guided by the standards of the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Review (PRISMA-ScR) framework⁹. The full protocol is described in an earlier paper¹⁰ and registered with Open Science Framework Registries Network.

Eligibility criteria

In this scoping review chronic wounds are defined as wounds that “do not to proceed through the normal phases of wound healing in an orderly and timely manner”^{11(p56)}. A specific timeframe to healing or non-healing was not required for inclusion.

Inclusion criteria:

- Original quantitative or qualitative research focused on prevention, assessment and/or management of chronic wounds conducted in Australia;
- EBGs, evidence summaries, consensus statements and SRs on prevention, assessment and/or management

of chronic wounds conducted worldwide (including Australia);

- Published between 1 January 2010 and 31 May 2022;
- Published in English; and
- Human studies.

Exclusion criteria:

- Case studies, case series, case reports, opinions, editorials, conference abstracts, general narrative literature reviews.
- Fundamental science articles related to wound healing, e.g., in vitro laboratory-based studies and animal studies.

Information sources

Information sources included academic databases (Medical Literature Analysis and Retrieval System Online, Excerpta Medica Database (Embase), Cumulative Index to Nursing and Allied Health Literature, Joanna Briggs Institute Library, Cochrane Library, PschINFO), clinical trial registries and professional wound organisation sites. Detailed information is published elsewhere¹⁰.

Search strategy

We used search strings for each of the databases that included keywords of chronic, hard-to-heal, wound, ulcer, leg ulcer, malignant or fungating wound, venous or varicose or stasis, arterial, pressure injury/ulcer/sore, decubitus ulcer, neuropathic, ischaemic, neuro-ischaemic, diabetes-related foot ulcers/diabetic foot ulcer. Three primary search strategies were used (published elsewhere¹⁰) and refined as needed to identify all eligible articles (see an example search string in Table 1).

Selection of documents

Identified records were uploaded to Covidence®. Titles and abstracts were screened and those that met eligibility criteria during screening had their full texts retrieved and were further assessed for eligibility – the process can be seen in Figure 1. All screening and assessments were conducted

Table 1. Search strategy example for Australian original research studies

Search ID#	Search terms
#1	(arterial ulcer* OR extremity ulcer* OR mixed ulcer* OR varicose ulcer* OR crural ulcer* OR hard-to-heal ulcer* OR leg ulcer* OR foot ulcer* OR venous ulcer*)
#2	(chronic wound* OR malignan* wound* OR fungat* wound*)
#3	(pressure ulcer* OR pressure injury OR pressure injuries OR bedsore* OR bed sore*)
#4	Australia OR Australian OR Australians
#5	#1 OR #2 OR #3
#6	#5 AND #4

independently by two authors. Any disagreements were resolved by a third author.

Data extraction and charting process

Data were extracted from included papers by one author and were independently checked by a second author. Key items extracted included study design, document type, aims, setting, population, outcomes and the chronic wound type focused on in the study.

Synthesis of results

Results were grouped and reported according to the chronic wound type the study or review focused on i.e., PIs, DFUs, VLUs, ALUs, studies with leg/foot ulcers of multiple aetiologies, malignant/fungating wounds, mixed chronic wounds (studies including chronic wounds of multiple aetiologies), and 'other' rarer wound types (e.g., Buruli ulcers, tophaceous ulcers). A narrative synthesis of findings and study outcomes was then undertaken according to the area of primary investigation – assessment, management or prevention. The topics of research studies were grouped into broad categories based on content.

Results

Overall selection results

In total, 4,917 records were identified using the search strategy, of which 2,211 unique records remained after removing duplicates, 1,112 remained after title and abstract screening, and 934 remained after full text assessment and were included in this review (Figure 1). In total there were 365 original Australian studies and 569 worldwide reviews. Of the original Australian studies, the most frequently used designs

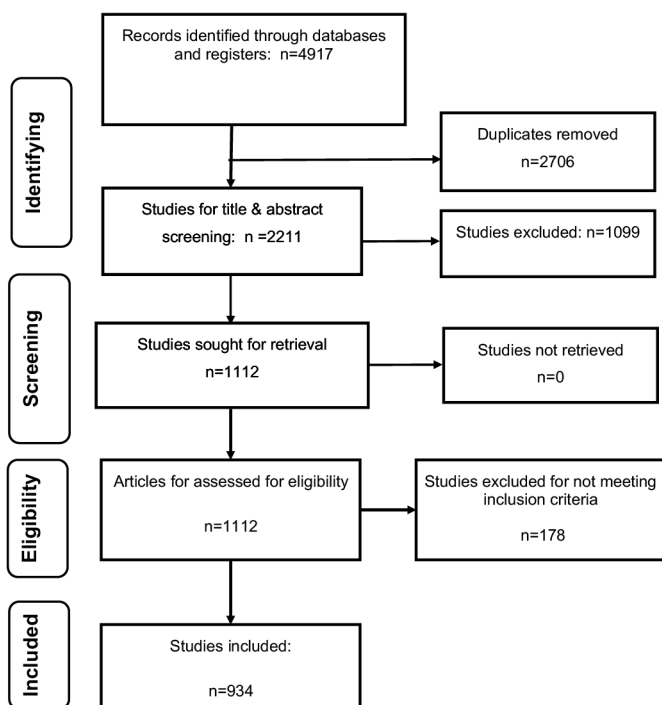


Figure 1. PRISMA flow chart

were cohort studies (31%, n=113) and cross-sectional studies (20%, n=73). Specific study designs are displayed in Table 2. Most Australian studies were primarily concentrated on wound management (43%, n=157), with 40% (n=146) on assessment and 17% (n=64) on prevention of wounds.

The largest number of documents overall (of the 934 Australian studies and worldwide reviews) were on DFUs (n=304, 33%) and PIs (n=280, 30%), followed by VLUs (n=155, 17%), mixed chronic wounds, e.g., samples combining VLUs, mixed ALUs/VLUs, PIs, DFUs (n=140, 15%), mixed types of leg/foot ulcers (n=37, 4%), malignant fungating wounds (n=9, 1%), ALUs (n=4, <1%), and 'others' (n=5, <1%), which included Buruli ulcers, tophaceous ulcers, ulcers associated with Hansen's disease, pilonidal sinus and chronic epidermolysis bullosa wounds. Original Australian studies were focused on PIs (43%, n=156), DFUs (27%, n=97) and VLUs (16%, n=60), with fewer studies in populations with mixed types of chronic wounds (8%, n=28), mixed leg/foot ulcers (6%, n=20), only one study on fungating wounds and no studies specifically on ALUs. In contrast, the worldwide reviews focused on DFUs (37%, n=207), PIs (21%, n=122), mixed chronic wounds (19%, n=112), VLUs (17%, n=95), mixed leg/foot ulcers (3%, n=17) and 1% (n=8) on malignant wounds.

The Australian studies (n=365) were mostly conducted in inpatient hospital settings (39%, n=143; 22 of these were in Intensive Care Unit (ICU)), 28% (n=103) in community wound clinics (including hospital outpatient wound clinics, high risk foot clinics, community wound clinics), 12% (n=44) in general community settings (e.g., those receiving in-home services), 4% (n=15) in residential aged care facilities (RACFs), 3% (n=10) in general practice settings, and 10% (n=38) in combined healthcare settings. Most study samples were amongst adults with or at risk of wounds (79%), 9% with healthcare professionals, 5% with residents in RACFs, 3% with healthcare professionals and adults with or at risk of wounds, 2% with 'older adults' (defined ages of older adults ranged from 45 years and older to 70 years and older), 1% with neonatal and/or paediatrics and <1% with all ages.

The most frequent topics of investigation by wound type were determined in both the Australian studies (Table 3) and the worldwide reviews (Table 4). An overview, by wound type and primary area of investigation (assessment, management or prevention), is outlined below.

Diabetes-related foot ulcers (DFUs)

A total of 33% (n=304) of documents focussed on DFU, including 97 Australian studies and 207 worldwide reviews. Study designs and topics of research are shown in Tables 2–4.

Assessment

There were 29% (n=89) DFU documents covering assessment, comprised of 46 Australian studies and 43 worldwide reviews (27 SRs, three EBGs and three evidence summaries).

Table 2. Study designs of included articles (n=934)

Wound type	Study design														
	Australian studies (n=365)										Worldwide reviews (n=569)				
	RCT	Quasi-exp	Case control	Observ/cohort	Validity	Secondary analysis	Cross-section	Costs	Mixed method	Qual	Reg trials	SR	EBG	Evidence summ	Consensus doc
All wounds	37 (10%)	13 (4%)	9 (2%)	113 (31%)	22 (6%)	10 (3%)	73 (20%)	12 (3%)	10 (3%)	31 (8%)	35 (10%)	433 (76%)	40 (7%)	63 (11%)	33 (6%)
DFUs	6 (2%)	2 (<1%)	6 (2%)	37 (10%)	9 (3%)	0 (<1%)	14 (4%)	1 (<1%)	1 (<1%)	6 (2%)	15 (4%)	175 (31%)	20 (4%)	10 (2%)	2 (<1%)
PIs	10 (3%)	7 (2%)	3 (1%)	55 (15%)	5 (1%)	2 (<1%)	37 (10%)	8 (2%)	6 (2%)	12 (3%)	11 (3%)	99 (17%)	6 (1%)	12 (2%)	7 (1%)
VLU	12 (3%)	2 (<1%)	0	11 (3%)	5 (1%)	5 (1%)	7 (2%)	1 (<1%)	1 (<1%)	9 (3%)	7 (2%)	70 (12%)	9 (2%)	12 (2%)	4 (1%)
Mixed chronic wounds	3 (1%)	1 (<1%)	0	3 (1%)	3 (1%)	0	10 (3%)	2 (<1%)	2 (<1%)	3 (1%)	1 (<1%)	63 (11%)	3 (<1%)	27 (5%)	19 (3%)
Mixed leg / foot ulcers	5 (1%)	1 (<1%)	0	6 (2%)	0	3 (1%)	5 (1%)	0	0	0	0	14 (3%)	0	2 (<1%)	1 (<1%)
ALLUs	0	0	0	0	0	0	0	0	0	0	0	2 (<1%)	2 (<1%)	0	0
Malignant wounds	0	0	0	0	0	0	0	0	0	1 (<1%)	0	8 (1%)	0	0	0
Others*	1 (<1%)	0	0	1 (<1%)	0	0	0	0	0	0	1 (<1%)	2 (<1%)	0	0	0

* included Buruli ulcer, pilonidal sinus, chronic epidermolysis bullosa, ulcers associated with leprosy, chronic tophaceous ulcers
 RCT: randomised controlled trial; Quasi-exp: quasi-experimental; Observ: observational; Qual: qualitative; Reg: registered; SR: systematic review; EBG: evidence-based guideline;
 DFU: diabetes-related foot ulcer; PI: pressure injury; VLU: venous leg ulcer; ALLU: arterial leg ulcer

Australian studies

A DFU incidence of 1.2% was reported in community-based adults¹², there was a prevalence of 5.4% in adults with diabetes aged 45 years and older^{13,14}, while point prevalence in acute hospital populations was 6.7%^{15,16}. Risk factors for developing DFUs or for complications from DFUs are shown in Table 5.

Studies assessing healing reported that: surface area change per day was superior to wound edge linear advancement¹⁷; changes in ulcer area measured by thermal imaging correlated with healing by 12 weeks¹⁸; and ulcer surface area, planimetry area and planar volume and curved volume were useful prognostic markers¹⁹. Excellent inter-rater agreement was found for the Wound Ischemia foot Infection (WIFI) score, and fair/moderate agreement for SINBAD classification score (site, ischaemia, neuropathy, bacterial infection and depth) and the Wagner and University of Texas Wound Classification System (UTWCS) scales²⁰. There was also good agreement between: a digital program and clinicians²¹; 3-D cameras^{22,23}; and reproducibility of gait and plantar pressures²⁴. However, inconsistent agreement between visual and objective periwound assessment was determined²⁵. One study found good agreement between a mobile phone application and Visitrak® wound grid and WoundVue® ulcer area measures²⁶. However, another study found mobile phone assessment images had low validity and reliability for remote assessment²⁷.

Four studies on assessing infection found: minimal correlation between the Levine swabbing technique and tissue biopsy and culture²⁸; no correlations between clinical signs of infection and the presence of wound biofilm²⁹; differing microbiomes in cases of severe and mild diabetic foot infections³⁰; and no association between skin

and wound microbiomes and healing³¹. Two studies that investigated pain assessment found observational and non-verbal cues were preferred assessment methods³²; and formal assessment tools reported higher reported pain scores as compared to a single question (e.g., how much pain do you have on a scale of 0 to 10?)³³.

Worldwide reviews

Three EBGs were reviewed and covered the assessment of DFU infection³⁴ or DFU classification^{35,36}. Two evidence summaries focused on DFU assessment^{37,38}, and one on evidence mapping³⁹. Topics and number of SRs are shown in Table 4.

Management

There were 196 (64%) DFU documents covering management, comprised of 49 Australian studies and 147 worldwide reviews (123 SRs, 15 EBGs, seven evidence summaries, and two consensus documents).

Table 3. Topics of investigation by wound type in Australian studies (n=365)

Focus topic of study	PIs	DFUs	VLUs	Mixed chronic wounds	Mixed leg/foot ulcers	ALUs	Malignant	Others
Prevalence/incidence	19	6	0	2	2	0	0	1
Risk factors or tools for wound occurrence, severity, delayed healing or recurrence	26	21	8	0	3	0	0	0
Methods of assessing healing	0	8	3	2	1	0	0	0
Classification systems	1	1	0	0	0	0	0	0
Tissue characteristics/assessment	3	1	0	1	0	0	0	0
Biomarkers	0	0	2	0	0	0	0	0
Vascular assessment	0	0	1	0	0	0	0	0
Assessing infection	0	4	0	3	4	0	0	0
Assessing pain and symptoms	0	1	1	2	0	0	0	0
Topical wound/skin treatments/dressings	8	4	1	0	2	0	0	0
Debridement	0	3	0	0	0	0	0	0
Wound infection management	0	5	0	0	0	0	0	0
Pressure offloading/relieving strategies	11	7	0	0	0	0	0	0
Compression therapy	0	0	6	0	0	0	0	0
Adjuvant therapies (NPWT, electrical/laser therapy, HBOT, growth factors, cell therapies)	1	3	6	1	2	0	0	1
Pain and symptom management	0	1	0	1	2	0	0	0
Nutrition	7	4	0	1	0	0	0	0
Physical activity/exercise	1	1	5	0	0	0	0	0
Patient education	2	0	1	0	0	0	0	0
Self-management	4	2	3	2	0	0	0	0
PROM, QoL	5	1	2	3	1	0	1	0
EBP/implementation studies	25	2	4	4	1	0	0	0
Health service management	14	7	3	4	2	0	0	0
Costs/cost-effectiveness	13	1	3	2	0	0	0	0

PIs: pressure injuries; DFU: diabetes-related foot ulcer; VLU: venous leg ulcer; ALU: arterial leg ulcer; NPWT: negative pressure wound therapy; HBOT: hyperbaric oxygen therapy; PROM: patient-reported outcome measures; QoL: quality of life; EBP: evidence-based practice

Australian studies

Studies on topical wound treatments found: cadexomer iodine^{40,41} and a surfactant gel⁴² both reduced microbial load; improved healing from topical propolis⁴³; and honey wound gel and alginate were easy to use and patients rated comfort as high⁴⁴. Small trials of 'spray on skin' (ReCell[®])⁴⁵, ultrasonic debridement⁴⁶ and topical activated protein C⁴⁷ reported improved healing, while a larger randomised controlled trial (RCT) of ReCell[®] versus standard care found no difference in healing rates⁴⁸. A qualitative study found logistical and communication issues influenced podiatrists' perceptions of hyperbaric oxygen therapy (HBOT)⁴⁹.

Research on offloading interventions found:

- a cushion-modified total contact cast (TCC) offloaded significantly more pressure than a conventional TCC⁵⁰;
- higher healing rates were associated with TCCs compared to removable non-TCCs⁵¹;

- evaluation of a DH Pressure Relief Shoe™ found significantly lower peak pressures compared to a control shoe and participants' standard shoes⁵²;
- treatment with knee-high offloading was associated with faster healing^{53,54};
- new felt padding offloaded half the pressure of plantar DFUs⁵⁵; and
- the device side walls of TCCs were found to bear considerable load⁵⁶.

Infection research indicated: an outpatient antimicrobial therapy service was as effective as inpatient services⁵⁷; overuse of anti-pseudomonal therapy⁵⁸; and heterogeneity in antimicrobial treatments⁵⁹.

One study reported factors influencing pain management³² and one trial found improved healing after a vitamin C supplement⁶⁰. Three studies investigated self-care, describing emotional isolation⁶¹, motivations to perform self-care⁶² and experience with phone apps to monitor DFUs⁶³.

Research on health services included: a model for rural settings⁶⁴; evaluation of a multidisciplinary team⁶⁵; evaluation of an Aboriginal and Torres Strait Islander foot care service⁶⁶; increased healing rates reported from telehealth⁶⁷; improved access to services⁶⁸; general adherences to EBGs with exception of non-removable offloading devices⁶⁹; and foot care management was a low priority in primary healthcare⁷⁰. Significant savings and health benefits were found when

Table 4. Topics of investigation by wound type in worldwide reviews (n=569)

Focus topic of review	PIs	DFUs	VLUs	Mixed chronic wounds	Mixed leg/foot ulcers	ALUs	Malignant	Others
Prevalence/incidence	11	2	1	0	0	0	0	0
Risk factors or tools for wound occurrence, severity, delayed healing or recurrence	18	24	3	1	0	0	0	0
Methods of assessing healing/wounds	3	7	0	4	0	0	0	0
Tissue characteristics/assessment	0	7	0	0	0	0	0	0
Biomarkers	0	0	0	2	1	0	0	0
Vascular assessment	0	0	0	0	0	0	0	0
Assessing infection	0	3	0	2	0	0	1	0
Assessing pain and symptoms	0	0	1	0	0	0	0	0
Topical wound treatments/dressings	12	51	11	14	1	1	2	0
Debridement	0	0	1	4	1	0	0	0
Wound infection management	0	4	0	0	0	0	0	0
Pressure offloading/relieving strategies	29	23	0	0	0	0	0	0
PAD management	0	3	0	0	0	0	0	0
Venous surgery	0	0	9	0	0	0	0	0
Compression therapy	0	0	13	0	0	0	0	0
Adjuvant therapies (e.g., NPWT, electrical/laser therapy, light therapy, shockwave therapy, HBOT, ozone, growth factors, cell therapies)	7	26	8	14	7	1	0	0
Multiple/complex interventions	3	5	1	1	1	0	0	2
Pain and symptom management	0	0	2	0	0	0	4	0
Pharmacological treatments	3	1	7	0	1	0	1	0
Nutrition	6	1	1	4	0	0	0	0
Physical activity/exercise	0	0	5	0	0	0	0	0
Education/psychological interventions	3	9	1	0	0	0	0	0
Self-management	1	2	0	0	0	0	0	0
PROM, QoL	0	2	2	2	0	0	0	0
EBP/implementation studies	1	0	1	0	0	0	0	0
Health service management	5	17	0	4	2	0	0	0
Costs/cost-effectiveness	3	0	5	3	0	0	0	0

PIs: pressure injuries; DFU: diabetes-related foot ulcer; VLU: venous leg ulcer; ALU: arterial leg ulcer; NPWT: negative pressure wound therapy; HBOT: hyperbaric oxygen therapy; PROM: patient-reported outcome measures; QoL: quality of life; EBP: evidence-based practice

implementing EBG care⁷¹, and staff resources and regional/remote geography influenced frequency of evidence-based practice (EBP) in debridement⁷².

Worldwide reviews

A total of 15 EBGs discussed DFU management^{34,73-86}. Evidence summary topics included debridement^{87,88}, dressings^{89,90}, offloading⁹¹, combined treatments³⁷, and evidence mapping³⁹. Consensus documents focused on DFU management⁹² and topical oxygen therapy⁹³. Topics of SRs are shown in Table 4.

Prevention

There were 36 (12%) DFU documents covering prevention of DFUs, including five Australian studies and 31 worldwide reviews (21 SRs, eight EBGs and two evidence summaries).

Australian studies

Studies on offloading reported no benefit from silicone gel sheeting to prevent ulcer recurrence⁹⁴, and significant

differences in plantar pressures between a specialised shoe compared to canvas or participants' own shoes⁵². One study found only 45% of health professionals reported removing shoes and socks of their patients for foot assessment⁹⁵, and two protocols were registered on preventive interventions^{96,97}.

Worldwide reviews

Eight EBGs^{73-75,85,86,98-100} and two evidence summaries^{101,102} focused on prevention of DFUs. Topics of SRs are shown in Table 4.

Pressure injuries (PIs)

Overall, 30% (n=280) of documents focused on PIs, including 156 Australian studies and 124 worldwide reviews. The study designs and topics are shown in Tables 2-4.

Assessment

Assessment was addressed in 98 documents, including 58 Australian studies, five EBGs, 29 SRs, four evidence summaries and two consensus documents.

Table 5. Risk factors identified for developing DFUs or complications of DFUs

DFU event/complication and risk factors identified
DFU occurrence
<ul style="list-style-type: none"> • More sedentary activities^{449,450} • Higher peak plantar pressures^{451,452} • Peripheral neuropathy^{12,453-456} • Peripheral arterial disease^{12,453,454,456} • Claudication^{12,455} • Cardiovascular disease⁴⁵⁰ • Previous foot ulcers^{453,454,457} • Previous trauma and past surgical treatment^{453,454} • Gait abnormalities⁴⁵⁸ • Retinopathy, cerebrovascular disease, HbA1c, alcohol consumption, renal impairment¹² • Longer diabetes duration^{450,455,459} • Previous hospitalisations for DFU, absent pedal pulse and Aboriginality⁴⁵⁵ • Higher rates in males^{450,459} • Overweight⁴⁵⁹ • Older age^{450,459} • Reduced cognitive functioning in comparison to population means⁴⁶⁰ • Lower circulating protein C levels⁴⁶¹ • Lower income⁴⁵⁰ • Increased foot skin temperature⁴⁶² • Three models were validated to predict risk of DFUs or amputation⁴⁶³
Increased DFU severity
<ul style="list-style-type: none"> • Low vitamin C levels⁴⁶⁴
Infection
<ul style="list-style-type: none"> • Ulcers unhealed after 3 months, deep DFUs, peripheral neuropathy, previous DFUs, foot deformity, female sex⁴⁶⁵ • Age^{450,465}

DFU event/complication and risk factors identified
DFU hospitalisation
<ul style="list-style-type: none"> • Duration of diabetes, absence of foot pulse, height, peripheral arterial disease, peripheral sensory neuropathy⁴⁶⁶ • Suboptimal glycaemic control⁴⁶⁶ • Previous revascularisation⁴⁶⁶
Delayed healing of DFUs
<ul style="list-style-type: none"> • Congestive heart failure⁴⁶⁷ • Younger age, geographical remoteness, peripheral arterial disease, larger ulcers^{53,54} • Smoking, neuropathy⁴⁶⁸ • Infection^{53,54,469}
Amputation
<ul style="list-style-type: none"> • Low vitamin C, albumin and haemoglobin⁴⁷⁰ • Vascular disease, previous amputation⁴⁷¹ • Coronary artery bypass graft (CABG) surgery⁴⁷² • Forefoot ulcers of higher severity⁴⁷¹ • Charcot's arthropathy⁴⁷² • Indigenous ethnicity^{471,472} • Retinopathy⁴⁷² • Decreased toe systolic pressure, distance from a high risk foot service⁴⁷³ • Wound, ischaemia, foot infection (WIFI) stage⁴⁶⁹
Mortality
<ul style="list-style-type: none"> • Age^{474,475} • Kidney disease, and low plasma albumin⁴⁷⁴ • Coronary artery disease⁴⁷⁵ • Infection⁴⁶⁹

Australian studies

Prevalence and incidence research reported varied ranges and there was evidence of inaccurate reporting of hospital-acquired PIs (HAPIs) incidence¹⁰³. Incidence of 1.33/1000 resident days was reported in RACFs¹⁰⁴, with no difference between respite and permanent aged care¹⁰⁵. Reported incidences of HAPIs among intensive care unit (ICU) patients varied from 6.8–16.9%^{106–110}, noting that almost 60% of PIs in ICU adults were HAPIs¹¹¹. The reported incidence of HAPIs in general acute hospital settings was lower than that observed in ICUs, and ranged from 3.3%^{109,112} to 12.8%^{113,114}. In one study, almost 11% of people aged over 65 years developed a PI in the first 36 hours hospitalised¹¹⁵. Surgically-acquired PI incidence ranged from 0.7%¹¹⁶ to 1.3%^{116,117}. The reported incidence of device-related PIs (DRPIs) ranged from 4.3%^{118–120} to 27.9%¹²¹. The PI incidence rate/1000 patient bed days in patients with contact precautions was 2.97¹²² and 0.5/1000 patient days in paediatrics¹²³.

Prevalence of PIs varied across settings, from 4–13.7%^{124,125} in hospitals, 3.6% in a regional hospital¹²⁶, 5.2% in adults transferred by ambulance¹²⁷, and 8.9% in community services¹²⁸. One study reported 137 PIs in 103 people in a district nursing service¹²⁹, another examined location of heel PIs¹³⁰, and one examined the costs of auditing PI prevalence¹³¹.

Several studies assessed validity and reliability of risk assessment tools, including Waterlow^{106,132}, Ramstadius¹⁰⁶,

the Northern Hospital-Pressure Ulcer Prevention Plan (TNH-PUPP)¹³³, Glamorgan Scale¹³⁴, Conscious level, Mobility, Haemodynamics, Oxygen, Nutrition (COMHON) Index¹³⁵, Reaper Oral Mucosa Pressure Injury Scale (ROMPIS)¹³⁶, modified ROMPIS¹³⁷, Braden Score^{138,139}, and the interRAI scale¹¹². Risk factors for developing PIs are shown in Table 6. One study found no difference in PI rates between using different PI risk assessment tools¹⁰⁶, while another found an electronic checklist significantly improved screening rates¹⁴⁰. In one study, visual and objective measures of epidermal hydration and colour were significantly correlated with Norton scores¹⁴¹.

Studies on documentation found PI location influenced reporting¹⁴², and patient mobility influenced documented care¹⁴³. Nurses and care workers reported that their beliefs related to risk of PIs influenced their care¹⁴⁴.

Worldwide reviews

Five EBGs covered PI assessment^{145–148}. Evidence summaries focused on PIs in burn patients¹⁴⁹ and risk assessment tools^{150–152}. Consensus documents were found on heel PIs¹⁵³ and medical device-related PIs (MDRPIs)¹⁵⁴. SR topics are shown in Table 4.

Management and/or prevention

Management and/or prevention of PIs was addressed in 106 Australian studies, in addition to 76 SRs, seven EBGs, eight evidence summaries and seven consensus documents.

Australian studies

Studies on pressure-relieving strategies found: repositioning was the most frequent treatment for MDRPIs¹²⁰; increased repositioning frequency halved the incidence of PIs¹⁵⁵; 2-hourly repositioning failed to prevent PIs in a third of at-risk residents¹⁵⁶; and alternative seating support surfaces decreased interface pressures compared to standard chairs¹⁵⁷. Other studies evaluated: a purpose-designed positioning device¹⁵⁸; positioning in immobile critically ill patients¹⁵⁹; changing device securement type¹⁶⁰; and that a fluidised positioning device was found feasible and effective in reducing occipital PIs¹⁶¹. An observational study investigated peak interface pressures and pressure gradients¹⁶²; a study of interface pressures in the operating theatre found difficulties in using a device to protect all heel/ankle sites¹⁶³; and the association between positioning and tissue perfusion in ICU patients was investigated¹⁶⁴.

Research on dressings found that two foam dressing types were equally effective for negative pressure wound therapy (NPWT) to treat PIs¹⁶⁵ and that silicone foam dressings were effective in preventing sacral and/or heel PIs in critically ill patients^{166,167}, high-risk residents in RACFs¹⁶⁸ and people in ICU^{169,170}. This dressing type was shown to be cost-effective¹⁷¹. A trial of two dressing types to prevent PIs found no difference in efficacy or product integrity; however, there was a difference in costs¹⁷². One study in neonatal intensive

Table 6. Risk factors for developing PIs, by population type

Population and risk factors for PIs identified
Hospital inpatients
<ul style="list-style-type: none"> • Malnutrition^{476,477,478} • Admissions from residential aged care facilities¹¹⁵ • Body shape⁴⁷⁹ • Physical activity/position^{480,481} • Multiple comorbidities^{115,482} • Increased frailty⁴⁸³ • Incontinence-associated dermatitis⁴⁸⁴
Critically ill /intensive care inpatients
<ul style="list-style-type: none"> • Use of vasoactive agents, extra corporeal membrane oxygenation and mechanical ventilation¹¹⁴ • Oxygen tubing behind ears, nasogastric tubes¹²⁰ • Endotracheal tubes^{120,121,485} • Time in a cervical collar and length of ICU stay¹¹⁰
Operative theatre
<ul style="list-style-type: none"> • Younger age⁴⁸⁶ • Longer operative duration^{486,487} • Operative speciality and hypotension⁴⁸⁷
Residents of aged care facilities
<ul style="list-style-type: none"> • Geography and socio-economic status of aged care facilities¹⁰⁴ • Healthcare factors, equipment and impaired cognition⁴⁸⁸

care found there was a high level of consensus on some skin care practices, e.g., changing body position; however, there was a low level on others such as the risk assessment tool used¹⁷³.

With respect to nutrition management and prevention/treatment of PIs: arginine supplements were associated with quicker healing^{174–176}; individualised nutrition care may have positive outcomes¹⁷⁷; and nutrition guidelines for adults with hip fractures were associated with lower PI incidence¹⁷⁸. Four studies found that nutrition interventions are cost-effective^{179–182}.

Studies on patient involvement in PI prevention found that patient educational materials were often not available¹⁸³ and there were barriers in the healthcare environment to patient participation¹⁸⁴. However, studies showed there were benefits from education^{185–187} and patients' understanding of PI prevention enhanced participation¹⁸⁸, and a Patient Participation in PI Prevention scale demonstrated acceptable validity¹⁸⁹. Good reliability and validity was found of the Pressure Ulcer Quality of Life-Prevention tool¹⁹⁰ which was more sensitive than the Short Form (SF-12) item survey to differences¹⁹¹.

A number of studies focused on PIs from the perspective of health service delivery, focussing on the practice of health professionals and challenges in delivering PI prevention and management across a range of settings^{192–209}. Cost evaluations were done of: PI management²¹⁰; non-reimbursed HAPIs²¹¹; HAPIs for people with and without dementia²¹²; reduced PI incidence^{213,214}; a PI care bundle²¹⁵; and use of prophylactic dressings^{216,217}.

Outcomes from evidence implementation studies varied – some studies found uncertain outcomes^{218,219}, others reported significant reduction in PI incidence^{220,221}, documentation²²², practice changes and/or decreased PIs^{214,223–232}. One study found registered nurses reported high compliance with the protocol²³³, another with nurses reported that workload restricted patient education²³⁴, while another found skin inspection and interprofessional communication were important strategies²³⁵.

Worldwide reviews

Seven EBGs covered the management and prevention of PIs^{145–148,236–238}. Evidence summaries were available on active support surfaces²³⁹, seat cushions²⁴⁰, pressure redistribution mattresses²⁴¹, preventive dressings²⁴², mobilising and repositioning^{243,244}, prevention strategies during surgery²⁴⁵ and heel PIs²⁴⁶. Consensus documents focused on general management of PIs²⁴⁷, MDRPIs¹⁵⁴, heel PIs¹⁵³, nutrition²⁴⁸, preventive dressings^{249,250}, and prevention for critically ill patients²⁵¹. The SR topics are shown in Table 4.

Venous leg ulcers (VLUs)

The third largest group (17%, n=155) of documents were on VLUs, including 60 Australian studies and 96 worldwide

reviews. The study designs and focus topics are shown in Tables 2–4.

Assessment

A total of 28 documents addressed the assessment of VLUs, including 15 Australian studies.

Australian studies

Excellent inter-rater reliability was obtained from a digital planimetry system²⁵², while both the EQ-5D-5L Score and SPVU-5D Score were able to discriminate between healed and unhealed VLUs²⁵³. Participants reported that it was useful to include wound care, compression and dressing items to assess QoL²⁵⁴. A study in general practices found vascular assessment is not routinely undertaken, possibly due to a lack of awareness of guidelines, resources or skills²⁵⁵.

Risk factors for delayed healing included larger ulcers, longer duration, higher exudate levels, larger calf circumference^{256,257}, severe pain-depression-fatigue-sleep disturbance symptom cluster group²⁵⁸, dehydration²⁵⁹, living alone, ulcer reduction in 2 weeks, higher ulcer severity score, and not treating with high level compression²⁶⁰. A comparative study found adults receiving home nursing for VLUs were older and had more risk factors for non-healing than those attending wound clinics²⁶¹. Granulocyte macrophage-colony stimulating factor and matrix metalloprotease-13 were identified as biomarkers predicting healing²⁶² and uric levels correlated with wound chronicity²⁶³. Validation and reliability testing of a risk assessment tool for delayed healing had good results^{256,260}. One study found thermal imaging was not associated with healing²⁶⁴; however, another found textural analysis of thermal imaging could predict healing²⁶⁵.

Worldwide reviews

There were eight EBGs on assessment of VLUs^{266–273}. SR topics are shown in Table 4.

Management

Management of VLUs was the focus of 121 documents, including 37 Australian studies, nine EBGs, 49 SRs, 12 evidence summaries, and four consensus documents.

Australian studies

Compression therapy studies indicated support for four-layer compression bandaging compared to Class three compression hosiery²⁷⁴ and three-layer tubular compression system compared with short stretch compression²⁷⁵. On adherence to compression therapy: funding of compression bandaging did not influence healing or compression use²⁷⁶; and pain, wound size and depth, and age were significant predictors of non-concordance²⁷⁷. Factors influencing adherence to treatment included understanding the management plan, compression-related body image issues, feeling overwhelmed, hot weather and discomfort, cost, ability to wear compression, patience, persistence and remembering self-care instructions²⁷⁸.

Studies on wound dressings or topical interventions found NPWT combined with compression had positive results²⁷⁹, while there were no differences in healing from a trial of wool-derived keratin dressings²⁸⁰. Electrical stimulation therapy was mostly acceptable and easier to use than compression²⁸¹; however, in people with VLUs who did not use high level compression therapy, it was not associated with improved healing rates²⁸¹. HBOT was associated with a significantly greater reduction in ulcer area, however no difference in overall healing rates²⁸². One study found no difference in time to healing associated with taking 300mg aspirin daily²⁸³, while another reported a reduction in matrix metalloproteinase-1 in wound fluid associated with high-dose oral doxycycline, however no significant change in ulcer area²⁸⁴.

Research on exercise included evaluation of a self-management home-based exercise program which resulted in improved calf muscle pump function and range of ankle motion²⁸⁵, significant relationships between self-efficacy and outcome expectations related to program adherence, and improved healing rates^{286,287}. A qualitative study concluded that while adults with VLUs were interested in exercise, they faced many obstacles²⁸⁸. One study in adults with VLUs found education was positively associated with physical activity²⁸⁹. Self-management studies found that an education program led to successful self-management²⁹⁰ and differing perspectives and priorities of patients and clinicians on management, with patients' preferences more closely aligned with EBGs²⁹¹.

Health service management was investigated in a number of studies, finding: suboptimal knowledge and implementation of EBP in VLU management^{292,293}; similar healing rates between home nursing and wound clinic care²⁶¹; and a lack of awareness of EBGs and a range of enablers and barriers to EBP in VLU care^{255,294}. Health professionals' perspectives on EBGs in primary care were also noted²⁹⁵. Cost evaluations found EBG management led to lower costs and improved QoL²⁹⁶ and shorter time to healing²⁹⁷, while the amount participants spent on ulcer care varied according to wound severity²⁹⁸.

Worldwide reviews

Nine EBGs covered the management of VLUs^{266–273,299}. The evidence summaries were on adherence to compression therapy^{300–302}, VLU management³⁰³, debridement^{304,305}, protease-modulating matrix interventions³⁰⁶, dressings^{307,308}, electromagnetic therapy³⁰⁹, ultrasound³¹⁰ and surgical interventions³¹¹. There were consensus documents on compression^{312,313}, complexities in VLU management³¹⁴ and holistic management³¹⁵. SR topics are shown in Table 4.

Prevention

A total of 30 documents covered the prevention of VLUs, including 10 Australian studies, seven EBGs, 10 SRs, one evidence summary and two consensus documents.

Australian studies

Factors identified for increased risk of VLU recurrence included: male sex³¹⁶; history of deep vein thrombosis (DVT)^{316,317}; multiple previous ulcers and longer ulcer duration³¹⁷; and decreased mobility, antidepressant medications and haemosiderosis³¹⁸. Protective factors included: leg elevation^{316,317}, compression (>20mmHg for at least 6 days/week)³¹⁶, higher social support^{316,318}, higher self-efficacy^{316,317} and increased walking³¹⁷. A qualitative study found participants reported traumatic injury, surgery and failure to replace compression as causes of recurrence³¹⁹. Although compression was perceived as important, some were unaware of different compression levels and required frequency for replacement³¹⁹. Two studies investigated the validity of a risk assessment tool for recurrence, both finding good discrimination and goodness of fit³²⁰.

Good acceptability of compression application devices was reported in one study³²¹; however, non-adherence was higher with higher compression levels and was associated with recurrence³²². Adherence to VLU preventive strategies was associated with knowledge, higher self-efficacy and lower depressive symptom scores³²³. Another study found adherence declined between 6–12 months after healing, with regular follow-up and history of multiple ulcers related to improved adherence, and depressive symptoms and restricted mobility related to decreased adherence³²⁴. Research on a multimedia education program found significant improvements in knowledge and self-care behaviours³²⁵.

Worldwide reviews

Seven EBGs covered the prevention of VLUs^{266–270,272,273}. The evidence summary³⁰¹ and consensus documents^{312,313} focused on compression. SR topics are shown in Table 4.

Mixed chronic wounds

Many studies (n=140) were focused on samples of chronic wounds in general, i.e., samples including persons with a chronic wound of any aetiology, such as chronic leg ulcers, non-healing surgical wounds, PIs and pilonidal sinuses, including 28 Australian studies, 27 evidence summaries, three EBGs, 63 SRs, and 19 consensus documents. Study designs and topics are shown in Tables 2–4.

Assessment

A total of 29 documents addressed the assessment of mixed chronic wounds, including 11 Australian studies.

Australian studies

An IT mobile wound care program facilitated data collection³²⁶, while a small study found a high prevalence of wounds in adults with dementia living in RACFs, with skin tears the most common wound identified³²⁷. A survey on wound pain assessment found it was undertaken at each visit or dressing change by 61% of respondents, with around two-thirds of practitioners using a validated assessment tool³²⁸.

High inter-rater reliability was found of a device (SD202) for measuring skin hydration and erythema³²⁹, and a telemetric sensor system for temperature, moisture and pressure (under compression) was found reliable and repeatable in pilot testing in the lab and on one human volunteer participant³³⁰. The modified TIME-H tool had moderate support to identify the likelihood of healing³³¹.

On infection, a RCT found the Levine wound swab technique had improved outcomes as compared to the Z swabbing technique³³², and a study identified varied bacterium types in non-healing wounds³³³. Delphi surveys achieved consensus on clinical indicators of wound chronicity, infection and biofilm³³⁴, and on prevention, identifying and managing chronic wound infections³³⁵. A SR of chronic wounds in Australia found costs of healthcare are >A\$3.5 billion/year, around 2% of national health expenditure and that EBP improves outcomes⁴. An education and process change intervention led to a significant decrease in wounds and increased nursing knowledge³³⁶.

Worldwide reviews

Guidelines were available on overall assessment of chronic wounds^{337,338} and on assessment of wound infection³³⁹. Evidence summaries focused on sampling techniques for culture^{340,341} and assessment of cavity wounds³⁴². Consensus documents covered chronic wound assessment^{315,343,344}, ankle brachial pressure index (ABPI)³⁴⁵, biofilms³⁴⁶ and exudate³⁴⁷. SR topics are shown in Table 4.

Management

A large number (n=115) of documents addressed the management of mixed chronic wounds, including 20 Australian studies.

Australian studies

Findings from clinical trials included that: a vitronectin; growth factor complex was safe and re-epithelialisation occurred in most participants³⁴⁸; there was no difference in wound pain from a trial of low intensity laser therapy³⁴⁹; and a standard nutrition supplement led to improved healing compared to a wound-specific supplement³⁵⁰. On patient-reported outcomes, a study found sub-optimal HRQoL and significant costs associated with chronic wounds³⁵¹, while in another study participants reported the desire to be independent³⁵² and improved HRQoL from self-treating^{352,353}. However, one study found an association between self-treating chronic wounds and reduced HRQoL and financial burden³⁵⁴. Coping strategies for living with chronic wounds included seeking support, solution-focused problem solving, finding new options to stay healthy, distraction and staying positive³⁵⁵.

Health service research reported that: an education and process change intervention led to increased uptake of EBP in RACFs³⁵⁶; link clinicians improved the uptake of TIME principles³⁵⁷; the documentation of wound care occurred

in less than one-third of residents with dementia in RACFs with wounds³⁵⁸; the use of an electronic wound management system led to improved communication³⁵⁹; an inconsistent approach was found in product utilisation in RACFs³⁶⁰; there were improved patient outcomes and/or significant cost savings from specialist wound services³⁶¹⁻³⁶³; there was high satisfaction and viability of a virtual consultant wound specialist service³⁶⁴; and there were positive outcomes from a telephone advisory service³⁶⁵.

Worldwide reviews

Three EBGs covered the management of chronic wounds^{337,366} or wound infection³³⁹. Evidence summaries were found on wound infection³⁶⁷⁻³⁷⁰, iodophors³⁷¹, biofilm³⁷², debridement³⁷³⁻³⁷⁸, cavity wounds³⁷⁹, collagen-based dressings³⁸⁰, wet-to-moist dressings³⁸¹, wet-to-dry saline gauze dressings³⁸², foam with silver dressings³⁸³, alginate dressings³⁸⁴, pain management³⁸⁵, biosynthetic skin substitutes³⁸⁶, topical negative pressure (TNP)³⁸⁷, HBOT³⁸⁸ and hydrogen peroxide³⁸⁹. There were consensus documents on biofilms^{346,390-392}, infection^{393,394}, antimicrobial stewardship³⁹⁵, exudate³⁴⁷, chronic wound management^{337,344,396}, NWPT³⁹⁷⁻³⁹⁹, patient engagement⁴⁰⁰ and aseptic technique⁴⁰¹. SR topics are shown in Table 4.

Prevention

One pre/post study in RACFs found increased uptake of EBP and decreased prevalence of wounds³⁵⁶, and two EBGs covered general prevention of wounds^{337,338}.

Mixed chronic leg and/or foot ulcers

A total of 37 documents were identified on assessment, management and/or prevention of mixed types of leg and foot ulcers, including 20 Australian studies, 14 SRs, two evidence summaries and one consensus document. Study designs and topics are shown in Tables 2-4.

Assessment

A total of 11 documents addressed the assessment of mixed leg ulcers, with ten Australian studies and one SR.

Australian studies

Studies on characteristics of populations with foot ulcers reported that: 7.4% of inpatients in acute hospitals had foot conditions as the primary reason for admission⁴⁰²; characteristics of non-DFU; and 10% of adults on dialysis had foot ulceration which was associated with a history of amputation, PAD and serum albumin⁴⁰³. A later study found additional risk factors of neuropathy and previous ulcers⁴⁰⁴.

Results from studies on infection included no relationship between the clinical assessment of infection versus bacterial burden from wound swabs, however faster healing in wounds with nil or low bacterial growth at baseline over 2 weeks in a nanocrystalline silver group compared to cadexomer iodine treatments⁴⁰⁵. Risk factors for infection in chronic leg and foot ulcers included depression, requiring

walking aids, a calf-ankle ratio <1.3, larger wound area, and slough^{406,407}. However, not all were validated in a small prospective study⁴⁰⁸. A small study found a significant relationship between transcutaneous oxygen pressure (TcPO₂) assessment and ulcer healing over 4 weeks⁴⁰⁹, and an evidence implementation study found improved EBP in wound assessment in primary healthcare professionals⁴¹⁰.

Worldwide reviews

One SR was found on biomarkers to predict ulceration or recurrence of lower leg ulcers⁴¹¹.

Management

A total of 26 documents covered the management of mixed types of leg and/or foot ulcers, including 11 Australian studies.

Australian studies

Studies on topical treatments reported no differences in healing rates between cadexomer iodine versus nanocrystalline silver⁴⁰⁵, with both dressings rated favourably by participants⁴¹², and evaluation of an acellular synthetic matrix found 36% healing rate at 12 weeks⁴¹³. Two reports on EMLA[®] topical analgesic cream found no differences in healing rates, however a significant decrease in pain and improved wellbeing in the EMLA[®] group^{412,414}. Two symptom clusters were identified in participants with mixed ALUs/VLUs which had a significant impact on HRQoL⁴¹⁵. One study found no impact on healing from antibiotics, anticoagulants, steroids or non-steroidal anti-inflammatory drugs⁴¹⁶.

Looking at models of care, one study compared health service models found significant differences in EBP and healing outcomes⁴¹⁷, and two studies investigated models to increase EBP^{410,418}, with a positive change in EBP in wound assessment and management in primary healthcare professionals⁴¹⁰. A survey of specialist providers for chronic leg ulcers found about one-third used HBOT, while the remainder did not believe it had a role or did not have access to HBOT⁴¹⁹.

Worldwide reviews

Evidence summaries were available on maggot debridement⁴²⁰ and NPWT for mixed leg ulcers⁴²¹. A consensus document covered antimicrobial prescribing for leg ulcer infection⁴²². SR topics are shown in Table 4.

Prevention

One quasi-experimental study evaluated an intervention to facilitate uptake of EBP in assessment, management and prevention of wounds. Results were inconclusive due to a small sample size⁴¹⁰.

Malignant fungating wounds

Nine articles addressed malignant fungating wounds, one Australian study and eight SRs.

Assessment

A qualitative study investigated the experience of living with malignant wounds with patients, caregivers and nurses, finding malodour was one of the worst aspects⁴²³.

Management

There were five SRs on symptom management (to manage odour and/or exudate)^{424–428}, one on topical agents and dressings⁴²⁹, one on management of bleeding from malignant wounds⁴³⁰, and one on microbiome species in malignant wounds⁴³¹.

Arterial leg ulcers (ALUs)

Two EBGs and two SRs focused on ALUs. There were no Australian studies. The EBGs^{432,433} both covered the assessment and management of ALUs, with one also providing recommendations for prevention⁴³². The SRs focused on wound dressings⁴³⁴ and autologous bone marrow cell therapy⁴³⁵.

Other chronic wound types

A small number of studies (n=5) were found on wound types not addressed in the main categories, encompassing Buruli ulcers, chronic epidermolysis bullosa wounds, pilonidal sinuses, tophaceous ulcers and ulcers resulting from Hansen's disease.

Australian studies

Australian studies reported that: Australian Buruli ulcers were mostly located on upper and lower limbs⁴³⁶; wounds healed faster after receiving intralesional allogenic cultured fibroblasts in matched wounds in adults with recessive dystrophic epidermolysis bullosa⁴³⁷; and a registered trial aimed to evaluate metronidazole ointment for pilonidal sinuses⁴³⁸.

Worldwide reviews

Two SRs were found on treatments for ulcers associated with tophaceous gout⁴³⁹ and interventions for ulceration caused by Hansen's disease⁴⁴⁰.

Discussion

Over the 12-year period scanned in this review, 365 Australian research studies on chronic wounds were identified. In general, the number of studies steadily increased each year, from 17 in 2010, up to 42 in 2020, followed by a drop in 2021 (34), possibly due to research restrictions during the COVID-19 pandemic. Over two-thirds of these studies (70%) focused on PIs and DFUs. Information on prevalence of wound types in Australia is scarce; however, a recent Australian study surveyed all (acute and chronic) wound types in hospital, RACFs and community settings, reporting that while 9.9% of the wounds were PIs and 11.9% were foot ulcers, 17.7% were leg ulcers⁷, the latter being an area which may need increased focus in Australian research. Only one Australian study was found on malignant wounds, a qualitative study with patients, carers and nurses⁴²³,

representing 0.3% of Australian studies. In comparison, the large Australian survey of wound types above reported malignant wounds represented 2.4% of wounds⁷.

Most studies in this review focused on wound management or assessment, and a smaller proportion (17%) on prevention, although there is significant potential for prevention of these wound types which are predominantly caused by underlying chronic conditions. There were relatively few Australian studies using RCT designs (10%) compared to observational study designs, such as cohort (31%) and cross-sectional (20%) studies, despite recommendations from previous authors who identified a gap in high quality evidence from well-designed trials^{441,442}. A 2019 scoping review of recommendations, guidelines and standards for chronic wound research identified a lack of RCTs and well-designed, prospective studies⁴⁴¹. The lack of these studies subsequently limits the ability to compare and combine data in meta-analyses and SRs⁴⁴¹.

The largest proportion (43%) of original Australian studies were on PIs – these were mostly cohort or cross-sectional studies. The increased focus placed on prevention of PIs in health systems, including financial penalties and monitoring of prevalence as a quality indicator, may be a reason for the higher proportion of PI research found in Australia (43%) compared to worldwide reviews (22%).

The second largest proportion (27%) of Australian studies were on DFUs, although lower than the proportion of worldwide reviews (36%), with the largest group of reviews being SRs, most related to efficacy of topical wound applications and dressings (18%). Although the overall research output for DFU research was diverse, the majority concentrated on assessment (29%) and management (64%). Only five Australian studies were on prevention (2%), highlighting the need for greater work in this critical area. Further, Australian DFU studies reported a comparatively low proportion of RCTs (6%) compared to all Australian chronic wound studies (10%), with the vast majority of DFU research utilising observational methodologies. Thus, with a comparatively low focus on DFU studies in Australia compared with worldwide reviews, and an especially low proportion of RCTs, this suggests there may be a comparatively low level of focus and funding available at a national level for DFUs. With DFUs a top 10 leading cause of national and global hospitalisation and disability burden, it is recommended the focus and funding on Australian DFU research needs to improve^{443–445}.

The third largest group of Australian original studies were on VLUs. The most frequent designs were observational studies and randomised trials, conducted primarily in community settings. Nearly two-thirds (62%) of the studies focused on VLU management, in particular health service management, with results reflecting the well-known gaps in access to EBP for this population⁴⁴⁶, despite studies showing that EBP results in significantly improved outcomes^{297,447,448}.

Studies which combined mixed types of chronic wounds included samples with non-healing wounds of multiple aetiologies. Similar to the other wound groups, most studies focused on assessment or management, with only one study including prevention strategies. A small number of intervention studies were identified; however, most studies were observational in design, with limited high quality evidence.

There is a paucity of good quality research conducted on mixed leg ulcers, with only 20 Australian studies addressing assessment or management, and only one study addressing prevention. Prevalence rates, risk factors for poor outcomes, and evaluations of models of care provide important information; however, some studies indicated non-significant results, concluding that larger sample sizes and more research is needed. Further research is imperative to drive EBP for an increasing number of leg ulcers that are of mixed aetiology.

Overall, topics of Australian research studies were disproportionately focused on either prevalence or risk factors for poor wound outcomes, or implementation of EBP (particularly for PIs), with only half the number of studies on clinical interventions to heal, manage or prevent wounds.

Limitation

These scoping review results have some limitations. Firstly, the level of detail of the findings reported in this scoping review is necessarily brief due to the size of the review. In addition, despite best intentions, the search strategies may have failed to identify all eligible studies.

Conclusions

This review maps the wound research landscape in Australia which demonstrates great variety and diversity of output. Results highlight strengths in areas of risk assessment and implementation research, and a number of gaps – the lack of national evidence being generated on wound prevention, the lack of studies on leg ulcers of mixed or arterial aetiology, and the lack of high quality clinical trials, which is likely related to the lack of national competitive funding in this area of research.

Ethics statement

An ethics statement is not applicable.

Conflict of interest

CP owns shares in a company that manufactures amniotic membrane allografts for wound applications. Other authors have no conflicts of interest to disclose.

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Author contribution

All authors contributed to study design; UTB, PET, PAL and KF contributed to document identification and review, and UTB and KF to data analysis and synthesis. KF, UTB, CP, PET, PAL and MB-J were responsible for manuscript preparation and all authors for feedback on the manuscript. All authors read and approved the final manuscript.

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