



Interventions for pressure ulcers: a summary of evidence for prevention and treatment

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1 **TITLE:**

2 Interventions for pressure ulcers: a summary of evidence for prevention and treatment

3 **RUNNING TITLE:**

4 Interventions for pressure ulcers

5

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1 **STRUCTURED ABSTRACT**

2 *Study Design*

3 Narrative review.

4 *Objectives*

5 Pressure ulcers are a common complication in people with reduced sensation and limited mobility,
6 occurring frequently in those who have sustained spinal cord injury. This narrative review
7 summarises the evidence relating to interventions for the prevention and treatment of pressure
8 ulcers, in particular from Cochrane systematic reviews. It also aims to highlight the degree to which
9 people with spinal cord injury have been included as participants in randomised controlled trials
10 included in Cochrane reviews of such interventions.

11 *Setting*

12 Global.

13 *Methods*

14 The Cochrane library (up to July 2017) was searched for systematic reviews of any type of
15 intervention for the prevention or treatment of pressure ulcers. A search of PubMed (up to July
16 2017) was undertaken to identify other systematic reviews and additional published trial reports of
17 interventions for pressure ulcer prevention and treatment.

18 *Results*

19 The searches revealed 38 published systematic reviews (27 Cochrane and 11 others) and six
20 additional published trial reports. An array of interventions is available for clinical use, but few have
21 been evaluated adequately in people with SCI.

22 *Conclusion*

1 The effects of most interventions for preventing and treating pressure ulcers in people with spinal
2 cord injury are highly uncertain. Existing evaluations of pressure ulcer interventions include very few
3 participants with spinal cord injury. Subsequently, there is still a need for high quality randomised
4 trials of such interventions in this patient population.

5

6 **KEYWORDS**

7 Cochrane; evidence; pressure ulcer; spinal cord injury; systematic review; wound.

1 **INTRODUCTION**

2 *Aetiology and prevalence of pressure ulcers*

3 Pressure ulcers (PUs), sometimes known as pressure injuries, decubitus ulcers or bed sores, are
4 wounds which involve the skin or underlying tissue, or both. They are localised areas of injury
5 occurring most often over bony prominences, such as at the sacrum or heel, where prolonged
6 pressure and sheer forces act to damage tissues and reduce perfusion, causing changes in the tissue
7 and ultimately leading to the wound¹. PUs are graded according to a number of systems, one widely
8 recognised system being that of the National Pressure Ulcer Advisory Panel (NPUAP)². These wounds
9 have a range of serious negative consequences and can severely impair quality of life³.

10 Prevalence estimates vary dependent on the population assessed, the methods of data collection
11 and how a PU is defined (for example, whether stage I PUs are included). It has been estimated that
12 the point prevalence of pressure ulceration in the total adult population is 0.31 per 1000
13 population⁴. As well as poor perfusion and poor skin status, reduced mobility and autonomic
14 dysreflexia are major risk factors for pressure ulceration⁵⁻⁸. Therefore people with spinal cord injury
15 (SCI) are a particular group in whom PUs are common due to impaired sensation, reduced mobility
16 and prolonged sitting; a number of studies have estimated the prevalence of PUs among people with
17 SCI, which may be in the range of 30-60%⁹⁻¹⁶. Whilst reducing pressure injuries is a major target for
18 many health systems in general, those with SCI are a group at particularly high risk of this
19 complication, and which may be underserved by research evidence.

20 This article aims to provide an overview of the evidence relating to PU prevention and treatment, in
21 particular drawing on Cochrane systematic reviews since they are widely regarded as rigorous and
22 comprehensive summaries of research^{17,18}. It also aims to assess the degree to which people with
23 SCI have been included as participants in trials of PU interventions.

24

1 *Interventions for pressure ulcer prevention and treatment*

2 A wide range of interventions is used in the prevention and treatment of PUs. Key preventative
3 interventions include those which aim to redistribute pressure at the interface between the skin and
4 the support surface (e.g. the many types of mattress and cushion). Key treatment interventions
5 include support surfaces and also wound dressings. The UK National Institute for Health and Care
6 Excellence (NICE) commissioned the National Clinical Guideline Centre to produce a detailed clinical
7 guideline for the prevention and management of PUs in primary and secondary care, which contains
8 a list of interventions used in clinical practice¹⁹. The main types of intervention are summarised in
9 Box 1.

10

11

[INSERT BOX 1]

12

13

14

1 *Systematic reviews*

2 Systematic reviews address clear, focused questions and use systematic and explicit methods to
3 identify, select, and critically appraise all the relevant research. Within a systematic review, data are
4 collected from the included studies, re-presented and frequently re-analysed. Sometimes the data
5 analysis in a systematic review involves combining the results of several separate studies (“meta-
6 analysis”) to provide a more precise estimate of the effect of an intervention²⁰. The Cochrane
7 Database of Systematic Reviews is one source of such reviews.

8

9 The aim of this narrative review is to summarise the evidence in relation to the effectiveness of
10 interventions for the prevention and treatment of PUs, in particular from Cochrane systematic
11 reviews. It also aims to highlight the degree to which people with SCI have been included as
12 participants in randomised controlled trials (RCTs) of such interventions.

13

14 **METHODS**

15 *Systematic reviews of interventions for the prevention and treatment of pressure ulcers: Search of*
16 *The Cochrane Library*

17 A range of Cochrane systematic reviews has been undertaken to summarise the current evidence
18 from RCTs of interventions for the prevention and treatment of PUs. A search of The Cochrane
19 Library (see Box 2) up to July 2017 revealed 50 results (reviews only), 27 of which are relevant to this
20 review (i.e. they evaluate interventions for the prevention or treatment of PUs) (see Figure 1). Of
21 these, 23 reviews evaluate interventions specifically relating to PUs, and four relate to several types
22 of chronic or complex wound including PUs. Twenty one reviews found trials which were eligible for
23 inclusion, whilst five were ‘empty’ reviews (see ‘Empty reviews’) and another, whilst including

1 various types of wound, did not include any patients with PUs. Of the 50 retrieved results from the
2 search, 23 reviews were not relevant to this overview (i.e. because they focused on other wound
3 types).

4

5

[INSERT BOX 2]

6

7 *Search of PubMed*

8 A search of PubMed was undertaken to determine which other (non-Cochrane) systematic reviews
9 of interventions for PUs specifically in people with SCI had been carried out. The search used the
10 following terms: systematic[sb] AND (((pressure injur*) OR (pressure ulcer*)) AND (spinal cord
11 injur*)). This search revealed eight relevant results (see 'Other published systematic reviews'); a
12 further three were found using a general Internet search (see 'Other published systematic reviews').

13 A second PubMed search of trials (published results and protocols) using the terms
14 (Therapy/Narrow[filter]) AND (((pressure injur*) OR (pressure ulcer*)) AND (spinal cord injur*))
15 revealed six trial reports and one trial protocol in addition to those that had been included in
16 Cochrane systematic reviews (see 'Additional pressure ulcer trials in people with spinal cord injury').

17

18 **RESULTS**

19 *Prevention of pressure ulcers*

20 Five Cochrane reviews which together include 73 RCTs specifically focus on interventions to prevent
21 PUs²¹⁻²⁵ whilst two evaluate interventions for both prevention and treatment of PUs^{26,27}. Table 1
22 summarises the number of RCTs and participants included in the four prevention reviews for which

1 data were available from the searches undertaken, the main conclusions drawn from these reviews
2 and the quality of the evidence on which they are based (see also 'Empty reviews').

3

4

[INSERT TABLE 1]

5

6 It is evident that a very small proportion of participants in the 73 prevention trials covered by the
7 five Cochrane reviews on PU prevention were people with SCI. Just 18 participants from two
8 RCTs^{28,29} included in a review of support surfaces for PU prevention²¹ were reported as having SCI
9 out of a total of 12 471 participants across 59 trials in that review (0.14%). None of the other
10 Cochrane reviews of interventions for prevention of PUs included participants with SCI²²⁻²⁵, meaning
11 that only 0.12% (18/14 959) participants were affected by SCI across all five prevention reviews.
12 One review of nine trials (1 501 participants) which investigated dressings and topical agents for
13 preventing PUs²⁴ included a trial in which 100 participants underwent posterior spinal surgery³⁰.
14 However, those participants underwent surgery for cervical spondylosis, lumbar spinal stenosis,
15 lumbar herniated disc or spinal cord tumour, and so have not been classed here as being
16 participants with SCI.

17

18 *Treatment of pressure ulcers*

19 Sixteen Cochrane systematic reviews assessed the evidence for the effectiveness of interventions for
20 PU treatment³¹⁻⁴⁶, with two others assessing interventions for both prevention and treatment^{26,27}.
21 Table 2 summarises the number of RCTs and participants included in the 14 reviews which included
22 at least one trial (three reviews which included no trials are described later in 'Empty reviews'), the

1 main conclusions drawn from these reviews and the quality of the evidence on which they are
2 based.

3

4 [INSERT TABLE 2]

5

6 Across the 14 systematic reviews of treatment interventions there were 145 included RCTs involving
7 14 166 participants. Only 604 (4.3%) of these participants were described as having SCI (confined to
8 10 of the trials⁴⁷⁻⁵⁶; note that Nussbaum et al. 1994⁴⁹ was included in three reviews^{31,43,57}; Hollisaz et
9 al. 2004⁴⁷ was included in two reviews^{31,33}; and Kaya et al. 2005⁵⁰ was included in two reviews^{31,34}).
10 Although a trial⁵⁸ included in one review³¹ did include participants with 'disorders of the spinal cord'
11 it was unclear whether these participants had SCI, or how many participants were included.

12

13 *Systematic reviews investigating interventions for 'chronic' or 'complex' wounds more generally*

14 In addition to the PU-focussed reviews mentioned above, a further four Cochrane reviews relate
15 more broadly to 'wounds,' 'chronic wounds' or 'acute and chronic wounds,' some of which were
16 PUs.

17 A systematic review of autologous platelet-rich plasma for treating chronic wounds⁵⁹ included 10
18 trials (442 participants). The Cochrane review concluded that it was unclear whether platelet-rich
19 plasma influences the healing of chronic wounds other than foot ulcers associated with diabetes.
20 Whilst two trials appeared to include two participants with PUs, these were not participants with
21 SCI⁶⁰⁻⁶².

22 A systematic review of honey as a topical treatment for wounds⁵⁷ included a total of 26 RCTs (3 011
23 participants). The review concluded that although honey may speed the healing of partial thickness

1 burns and surgical wounds, its effect on other wounds such as PUs is highly uncertain. Whilst one
2 trial included adult orthopaedic patients with PUs⁶³, there was no evidence from the review that
3 these were participants affected by SCI.

4 Dat et al. conducted a systematic review of Aloe vera for treating acute and chronic wounds, which
5 included seven trials (347 participants)⁶⁴. The review concluded that there was an absence of high
6 quality evidence from RCTs to support the use of Aloe vera (in the form of topical agents or
7 dressings) as a treatment for acute and chronic wounds. One included trial was an RCT which
8 compared a hydrogel dressing derived from the Aloe plant with a saline gauze dressing (applied
9 daily) and included only participants with PUs (n=41)^{65,66}. However, it is unclear whether this
10 included people with SCI.

11 Whilst concluding that hyperbaric oxygen therapy may improve the healing of diabetic foot ulcers, a
12 review of 12 trials of this intervention for treating chronic wounds (577 participants) identified none
13 investigating its use in PUs⁶⁷.

14

15 *'Empty' reviews*

16 Of the 27 reviews identified by the search of The Cochrane Library, five are 'empty' reviews in that
17 the systematic searches undertaken revealed no published data from RCTs. These include
18 reconstructive surgery⁴⁴ and repositioning⁴⁵ for treating PUs, and bed rest for PU healing in
19 wheelchair users⁴⁶; wound care teams for preventing and treating PUs²⁶ and massage therapy for
20 prevention²⁵. This is somewhat surprising, given that some of these treatments are widely
21 administered to people with SCI.

22 Whilst no conclusions can be drawn from such 'empty' reviews, they can be useful in highlighting the
23 paucity of evidence in these particular areas and perhaps increase their priority as a research topic.

24 This may hopefully lead to high quality trials being carried out on interventions where there is a

1 theoretical basis that they may work (perhaps informed by existing evidence from non-RCTs).
2 Indeed, the process of systematic reviewing facilitates the provision of some insight into the type of
3 research which could be undertaken to address a particular problem, for example in the
4 'Implications for research' section. Specifically, systematic reviews may be able to shed light on what
5 types of *patient, intervention, comparison* and *outcome* might be worthy of investigation (known as
6 the 'PICO' model). However, despite being updated three times since the initial version, the most
7 recent version of the review on repositioning for treating PUs has still failed to unearth any relevant
8 evidence from RCTs⁴⁵. This possibly implies either that the research community has not been
9 responsive to this important review, or that a high quality RCT of this type of intervention may be
10 extremely difficult to undertake.

11

12 *Other published (non-Cochrane) systematic reviews*

13 Of course the evidence synthesised only by Cochrane systematic reviews is not a comprehensive
14 summary of the entire field of PU research. Nor does this review represent all of the studies which
15 include participants with SCI.

16 As well as Cochrane systematic reviews, a number of other systematic reviews of interventions for
17 PUs have been published. These include behavioural and educational interventions⁶⁸⁻⁷⁰; electrical
18 stimulation⁷¹⁻⁷³; and nutritional support⁷⁴. Others have more broadly assessed a range of
19 interventions for treatment^{75,76} or prevention^{77,78} of PUs within a single review.

20 Eight of the 11 systematic reviews which were returned by the search focussed specifically on
21 people with SCI, which may be an added benefit. Two reviews which included meta-analyses (seven
22 trials, 386 participants⁷²; eight trials, at least 302 participants⁷³) suggested that electrical stimulation
23 may aid the healing of PUs in people with SCI^{72,73}. However heterogeneity was shown to be high in
24 the studies included in both of these reviews, which also included at least one non-RCT^{72,73}. An

1 upcoming Cochrane review of electrical stimulation for treating PUs will further add to the evidence
2 base for this intervention⁷⁹.

3 Another review of enteral nutritional support for the prevention and treatment of PUs also included
4 a meta-analysis of five RCTs (1 325 participants) , but this included studies of patients both with and
5 without SCI⁷⁴. Whilst that review concluded that some oral nutritional supplements were associated
6 with lower incidence of PUs in at risk patients (compared with routine care), a more recent Cochrane
7 review (23 RCTs, 7 047 participants) suggested that there is no clear evidence of benefit associated
8 with nutritional interventions for either prevention or treatment of PUs²⁷.

9 A systematic review of therapeutic interventions for PUs following SCI provided a narrative summary
10 of a number of studies evaluating wheelchair cushions⁷⁶. The review highlighted evidence that
11 suggests various types of cushion or seating system are associated with potentially beneficial
12 reductions in seating interface pressure or PU risk factors (such as skin temperature)⁷⁶. However,
13 the incidence of new PUs was not included as an outcome in that review, thereby limiting the ability
14 to draw useful conclusions which may inform clinical practice. A more recent review by Groah and
15 colleagues focussed on positioning for PUs, and explicitly excluded any studies in which the main
16 outcomes were related to cushion and mattress comparisons (and not the positioning strategies)⁷⁷.
17 It is currently unclear as to which types of wheelchair cushion may best prevent pressure ulcers in
18 people with SCI. This is an important area which would benefit from further high quality research.

19 The methodological quality of the studies included in some of these reviews was assessed using a
20 variety of methods, with some reviews not providing any quality assessment at all^{69,78}. A further
21 limitation included restrictions on publication language^{69,70,72-77}. The lack of meta-analysis in many
22 reviews limits the conclusions which can be drawn from those reviews with regards to effectiveness.

23

24 *Upcoming reviews*

1 A number of additional systematic reviews have been registered with the Cochrane Wounds
2 Editorial Base, the protocols for which are currently in the process of being developed, or the
3 reviews themselves undertaken⁷⁹⁻⁸⁵ (Table 3). In addition to these, protocols for other (non-
4 Cochrane) systematic reviews have recently been published which look specifically at interventions
5 for PUs in people with SCI (e.g. self-management interventions to improve skin care for PU
6 prevention⁸⁶).

7

8 [INSERT TABLE 3]

9

10 *Additional pressure ulcer trials in people with spinal cord injury*

11 A range of trials of interventions for PUs appears in the published literature, specifically in people
12 with SCI, some of which may not be captured in existing systematic reviews. Preventative
13 interventions include those which involve self-efficacy enhancement⁸⁷ and lifestyle management^{88,89},
14 whilst interventions for treatment include irradiation with ultraviolet-C⁹⁰, telephone-based support⁹¹
15 and negative pressure wound therapy⁹². These are clearly candidates for future consideration in
16 systematic reviews and updates.

17 The rise in use of clinical trial registers, such as the BioMed Central ISRCTN registry, clinicaltrials.gov
18 and the EU Clinical Trials Register, is a particularly welcome practice when determining which trials
19 are in progress. Registration not only allows the clinical and research communities to better plan
20 further trials and systematic reviews (by avoiding unnecessary duplication, reducing research waste
21 and appropriately timing review searches), but it holds investigators to account inasmuch as it
22 publicises up front the aims of the study and its intended outcome measures. This ultimately helps
23 to minimise publication bias when the study is eventually reported^{93,94}. The Cochrane Central
24 Register of Controlled Trials (CENTRAL)⁹⁵ brings together much of the published information about

- 1 past, current and ongoing trials, making this an essential component of the searches for many
- 2 systematic reviews.

3

4

1 **DISCUSSION**

2 This review aimed to summarise the evidence in relation to interventions for the prevention and
3 treatment of PUs, in particular from Cochrane systematic reviews. It is clear from this review that
4 there is a great deal of uncertainty of the effectiveness of such interventions, despite the fact that
5 many are carried out frequently within health services. This review also aimed to highlight the
6 degree to which people with SCI have been included as participants in RCTs of these interventions:
7 this appears to be less than 3% (for prevention and treatment combined). This seems somewhat
8 counter-intuitive, given that those with SCI are among those at highest risk of pressure ulceration.

9 It will never be possible for all of clinical practice, in any area, to be based on high quality research
10 evidence. Therefore, in the absence of good research evidence arising specifically from research in
11 people with SCI, we can learn something indirectly from research in people without SCI, though this
12 is unlikely to be as valid as direct evidence.

13 It is essential to appraise the quality of research evidence before applying the evidence to people in
14 the clinical setting. In addition to assessing the risk of bias for individual studies, authors of
15 systematic reviews should also grade the quality of the evidence across other domains (such as
16 precision, heterogeneity and directness) for each particular outcome (e.g. healing) across a number
17 of studies using a standardised method such as the Grading of Recommendations, Assessment,
18 Development and Evaluations (GRADE) approach⁹⁶. Together with the use of Summary of Findings
19 tables⁹⁷, GRADE enables the reader to interpret the evidence in a more transparent way, helping
20 them to make better informed judgements. Cochrane adopted the use of GRADE in 2011 and its use
21 is encouraged in all new systematic reviews it publishes.

22

23 *What do Cochrane reviews tell us about pressure ulcer prevention and treatment?*

1 A large number of interventions are available to clinicians to treat and prevent PUs. Unfortunately,
2 the evidence for many such interventions is often limited, either by the low volume of research or by
3 the quality of the trials which have been undertaken. The best indication from Cochrane systematic
4 reviews of interventions for PUs is that people at high risk of pressure ulceration should use higher-
5 specification foam mattresses, rather than standard hospital foam mattresses, to prevent ulceration.
6 Although Australian medical grade sheepskins have been identified as potentially useful in the
7 prevention of PUs in people without SCI, they will not be an adequate solution on their own for
8 people with SCI.

9 Only 16 trials out of a total of 218 included in 18 PU-focussed reviews included participants with SCI.
10 Evidence suggests that approximately only 2% (622/29 125) of included participants were people
11 with SCI, with only four reviews including 30 or more such participants. None of the four reviews
12 relating more broadly to 'wounds,' 'chronic wounds' or 'acute and chronic wounds' appear to have
13 included PU patients with SCI.

14 The evidence from Cochrane systematic reviews to support use of any other intervention for the
15 prevention and treatment of PUs is currently lacking. Of course, *absence of (good quality) evidence*
16 does not mean that these interventions are ineffective, just that their effectiveness is not known; it
17 may be that existing research has been too small in scale or at high risk of bias.

18 Whilst future trials should be undertaken carefully to minimise bias, it is recognised that there is a
19 need for them to remain sufficiently pragmatic to be relevant to clinical practice. A particular
20 challenge for investigators may include the minimisation of performance through appropriate
21 blinding.

22

23 *Prioritisation in pressure ulcer research*

1 Given the wide variety of interventions available for clinical use to treat and prevent PUs, coupled
2 with the uncertainty of their effects, it is crucial to ensure there is a meaningful way of prioritising
3 future research. The James Lind Alliance (JLA) Priority Setting Partnership (PSP) sought to establish
4 research priorities in pressure ulceration by including the views of patients, carers and healthcare
5 professionals. Many of the top priorities identified by that exercise overlap with those questions
6 raised by Cochrane systematic reviews, but where current evidence is unable to draw useful
7 conclusions⁹⁸. The results of this PSP have become a valuable springboard for researchers wishing to
8 improve the evidence base in PU care and it is clear that many of these questions should be
9 addressed in research in people with SCI.

10 Trials recently identified through a search of such registers include investigations of text messages
11 for PU prevention in SCI (ISRCTN38320572), a topical wound gel (NCT02001558) and subcutaneous
12 injection and ultrasonic dispersion of cefazolin into chronic PUs in the pelvic region (NCT02584426),
13 among others.

14 However, it will never be possible to do an RCT for every clinical uncertainty for reasons of
15 resourcing and logistics. Whilst registry data can offer up observational data about the real world
16 effects of alternative interventions^{99,100}, there is always the risk of drawing the wrong conclusions
17 because bias and confounding have not been properly acknowledged or accounted for. Indeed, the
18 development of evidence-based, clinical practice guidelines in this field is hampered by the lack of
19 evidence, and recommendations are often based on low level evidence¹⁰¹.

20 In summary, although there is a relatively large volume of primary research on PU prevention and
21 treatment per se, the quality of the evidence results in a lack of direction for practice. Whilst the use
22 of high specification foam mattresses and medical grade sheepskins (compared with standard
23 hospital mattresses) may help to prevent PUs in the general population at high risk, the low quality
24 of evidence on which this conclusion is based is likely to mean that the estimate of effect is
25 uncertain and this research will be of low relevance to many people with SCI. It is unclear which

1 type of wheelchair cushion may be beneficial for PU prevention in people with SCI. Furthermore,
2 people with SCI make up less than 3% of participants included in trials within Cochrane systematic
3 reviews summarising interventions for PUs. Whilst a number of published and ongoing trials
4 specifically in people with SCI have been identified, there is clearly an opportunity to develop further
5 high quality research in this field in order that promising interventions can be evaluated in this
6 patient group. This may include RCTs, but registry or database studies may also provide useful
7 evidence when high quality RCTs do not yet exist or are not feasible. However it is conducted, future
8 research should be of high quality and address questions which are of high priority to both
9 healthcare providers and people with SCI.

10

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22

23 **CONFLICT OF INTEREST STATEMENT**

24 The authors declare no conflicts of interest.

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20

21 **FIGURE LEGENDS**

22 Figure 1. Flow chart summarising results from search of The Cochrane Library.

Box 1. Key interventions for pressure ulcers

Prevention

Pressure ulcer risk assessment

Skin assessment

Repositioning

Pressure redistribution devices, e.g. mattresses, cushions, limb protectors

Treatment

Pressure redistribution devices, e.g. mattress, cushion

Wound dressings

Nutritional assessment

Box 2. Cochrane Library search strategy

- #1 MeSH descriptor: [Pressure Ulcer] explode all trees
- #2 (pressure near/2 (ulcer* or sore* or injur*)):ti,ab,kw
- #3 (decubitus near/2 (ulcer* or sore*)):ti,ab,kw
- #4 (bedsore* or bed next sore*):ti,ab,kw
- #5 #1 or #2 or #3 or #4

Table 1. Trials and participants included in Cochrane reviews of interventions for preventing pressure ulcers.

Lead author (date published)	Title	Total no of included studies	Total no of participants	No of trials with SCI participants (no of participants with SCI)	Main observations of effect*	Quality of evidence
McInnes (September 2015) ²¹	Support surfaces for pressure ulcer prevention	59	12 471	2 (18)	Foam alternatives to standard hospital foam mattresses may reduce the incidence of pressure ulcers in people at risk; pressure relieving overlays on the operating table may reduce post-operative pressure ulcer incidence ; Australian standard medical sheepskins may prevent pressure ulcers.	Mixed (no GRADE assessment performed)
Gillespie (April 2014) ²²	Repositioning for pressure ulcer prevention in adults	3	502	0 (0)	There is insufficient evidence to conclude whether more frequent repositioning or use of different positions is effective in reducing pressure damage.	Very low (using GRADE)
Moore (February 2014) ²³	Risk assessment tools for the prevention of pressure ulcers	2	485	0 (0)	There is no reliable evidence to suggest that the use of structured, systematic pressure ulcer risk assessment tools reduces the incidence of pressure ulcers.	One study at overall high risk of bias; one study at overall low risk of bias (no GRADE assessment performed)
Moore (August 2013) ²⁴	Dressings and topical agents for preventing pressure ulcers	9	1 501	0 ⁵ (0)	There is insufficient evidence from RCTs to support or refute the use of topical agents applied over bony prominences to prevent pressure ulcers.	Very low (using GRADE)
Total		73	14 959	2 (18)		

*For main outcome relating to prevention (e.g. incidence of pressure ulceration); ⁵One trial included patients admitted for posterior spinal surgery (procedures including cervical spondylosis, lumbar spinal stenosis, lumbar herniated disc and spinal cord tumour), but these patients were not classed as having spinal cord injury (Han et al. 2011³²)

Table 2. Trials and participants included in Cochrane reviews of interventions for treating pressure ulcers.

Lead author (date published)	Title	Total no of included studies	Total no of participants	No of trials with SCI participants (no of participants with SCI)	Main observations of effect*	Quality of evidence
Westby (June 2017) ³¹	Dressings and topical agents for treating pressure ulcers ⁵	51	2 947	4 [§] (132)	There is insufficient evidence to determine which dressings or topical agents are the most likely to heal pressure ulcers, and it is unclear whether any treatments examined are more effective than saline gauze.	Low or very low (using GRADE)
Naing (June 2017) ³²	Anabolic steroids for treating pressure ulcers	1	212	1 (212)	There is no high quality evidence to support the use of anabolic steroids in treating pressure ulcers.	Very low (using GRADE)
Hao (February 2017) ³³	Topical phenytoin for treating pressure ulcers	3	148	2 (109)	It is uncertain whether topical phenytoin improves ulcer healing for patients with grade I and II pressure ulcers.	Low (using GRADE)
Norman (April 2016) ³⁴	Antibiotics and antiseptics for pressure ulcers	12	576	1 (27)	The relative effects of systemic and topical antimicrobial treatments on pressure ulcers are not clear.	Low (using GRADE)
Aziz (September 2015) ³⁵	Electromagnetic therapy for treating pressure ulcers	2	60	1 (30)	The results provide no strong evidence of benefit in using electromagnetic therapy to treat pressure ulcers.	Overall unclear risk of bias (no GRADE assessment performed)
Dumville (May 2015) ³⁶	Negative pressure wound therapy for treating pressure ulcers	4	149	1 (12)	There is currently no rigorous RCT evidence available regarding the effects of negative pressure wound therapy compared with alternatives for the treatment of pressure ulcers.	Very low (using GRADE)
Dumville (May 2015) ³⁷	Alginate dressings for treating pressure ulcers	6	336	0 (0)	The relative effects of alginate dressings compared with alternative treatments are unclear.	Very low (using GRADE)
Dumville (February)	Hydrogel dressings for treating pressure ulcers	11	523	0 (0)	It is not clear if hydrogel dressings are more or less effective than other treatments in healing	Very low (using GRADE)

2015) ³⁸					pressure ulcers or if different hydrogels have different effects.	
Chen (July 2014) ³⁹	Phototherapy for treating pressure ulcers	7	403	1 (20)	The effects of phototherapy in treating pressure ulcers are uncertain.	Very low (using GRADE)
Langer (June 2014) ²⁷	Nutritional interventions for preventing and treating pressure ulcers	23	7 047†	1‡ (14)	There is currently no clear evidence of a benefit associated with nutritional interventions for either the prevention or treatment of pressure ulcers.	Unclear or high risk of bias (no GRADE assessment performed)
McGinnis (February 2014) ⁴⁰	Pressure-relieving devices for treating heel pressure ulcers	1	141	0 (0)	There is insufficient evidence to inform practice regarding the use of pressure-relieving devices for treating heel pressure ulcers.	Moderate to high risk of bias (no GRADE assessment performed)
Moore (March 2013) ⁴¹	Wound cleansing for pressure ulcers	3	169	1 (28)	There is no good trial evidence to support use of any particular wound cleansing solution or technique for pressure ulcers.	All included at some risk of bias (no GRADE assessment performed)
McInnes (December 2011) ⁴²	Support surfaces for treating pressure ulcers	18	1 309	0 (0)	There is no conclusive evidence about the superiority of any support surface for the treatment of existing pressure ulcers.	Quality of most evidence poor and results unclear (no GRADE assessment performed)
Baba-Akbari (July 2006) ⁴³	Therapeutic ultrasound for pressure ulcers	3	146	1 (20)	There is no evidence of benefit of ultrasound therapy in the treatment of pressure ulcers.	Includes only three small RCTs, two with methodological limitations mostly relating to risk of bias for randomisation methods and allocation concealment (no GRADE assessment performed)
Total		145	14 166	14 (604)		

*For main outcome relating to treatment (e.g. ulcer healing); †Includes network meta-analysis; ‡An additional trial included participants with 'disorders of the spinal cord' but did not define whether this was SCI, or the number of participants (Sebern et al. 1986⁶⁰); ‡Number of patients included in meta-analysis of prevention trials = 6 062; ‡Trial including patients with SCI was of an intervention to treat pressure ulcers (Brewer et al. 1967⁵⁷).

Table 3. Registered Cochrane review protocols (as of September 2017)

Lead author	Date published	Title
Arora ⁷⁹	May 2016	Electrical stimulation for treating pressure ulcers
Joyce ⁸⁰	March 2016	Organisation of health services for preventing and treating pressure ulcers
O'Connor ⁸²	December 2015	Patient and lay carer education for preventing pressure ulceration in at-risk populations
Porter-Armstrong ⁸¹	April 2015	Education of healthcare professionals for preventing pressure ulcers
Walker ⁸³	October 2014	Foam dressings for treating pressure ulcers
Choo ⁸⁴	October 2014	Autolytic debridement for pressure ulcers
Keogh ⁸⁵	February 2013	Hydrocolloid dressings for treating pressure ulcers

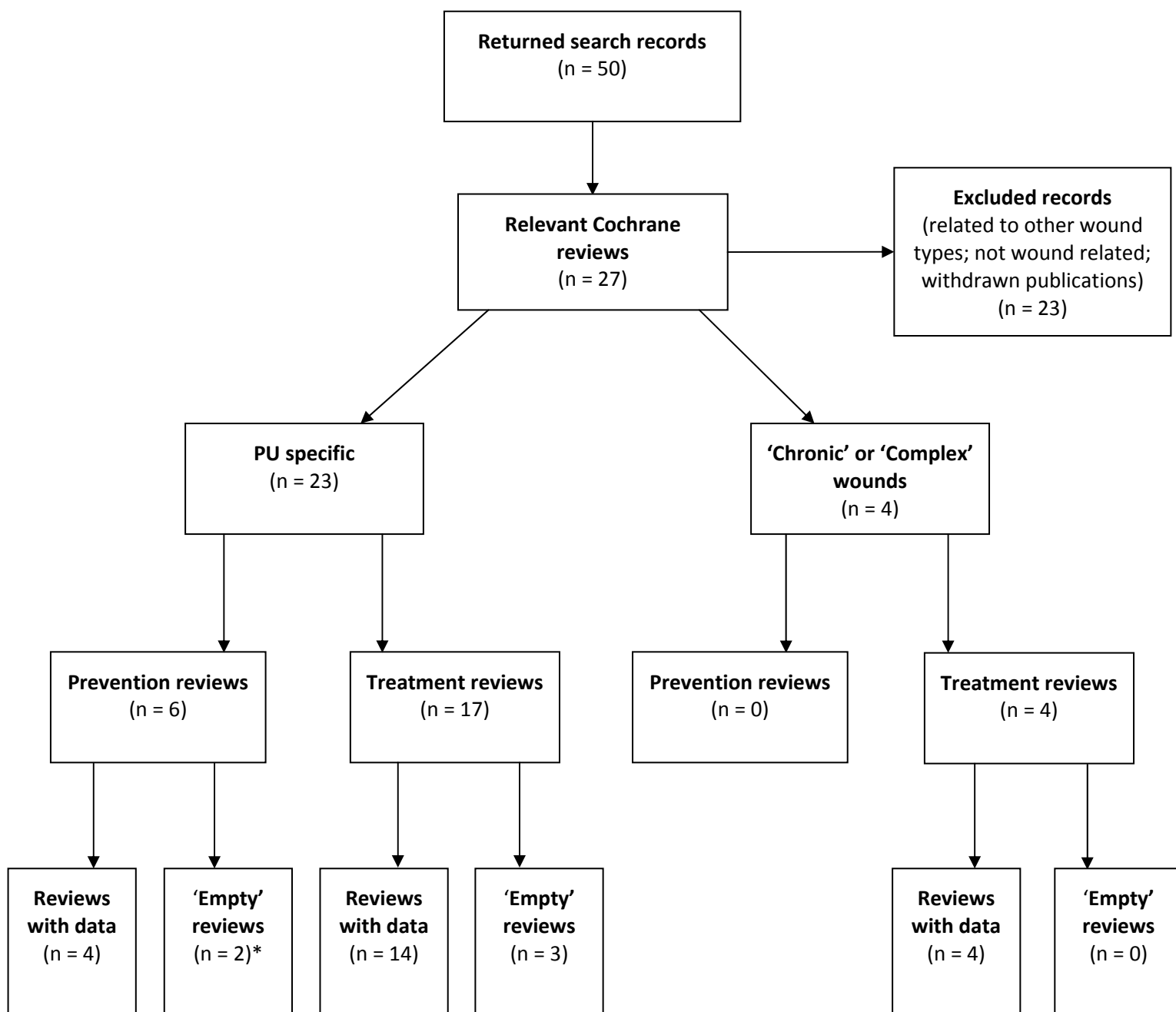


Figure 1. Flow chart summarising results from search of The Cochrane Library.

PU – pressure ulcer; *One ‘empty’ review was of wound-care teams for both preventing and treating pressure ulcers (Moore et al. 2015).