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Foam dressings for treating pressure ulcers (Protocol)

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[Intervention Protocol]

Foam dressings for treating pressure ulcers

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ABSTRACT

This is the protocol for a review and there is no abstract. The objectives are as follows:

To assess the clinical and cost-effectiveness of foam wound dressings for healing PUs in patients with an existing PU in any care setting

BACKGROUND

Description of the condition

Pressure ulcers (PUs) are an internationally recognised patient safety problem, estimated to affect 2.5 million people annually (House 2011). Also known as pressure injury, pressure sores, decubitus ulcers, or bedsores, PUs are a localised injury to the skin, underlying tissue, or both, usually occurring over a bony prominence, as a result of pressure, or pressure in combination with shear stress (EPUAP/NPUAP 2009). The development of a PU in any patient is a serious complication resulting in pain, decreased quality of life and significant expenditure of both time and money for the healthcare industry (VanGilder 2009).

The main factors associated with the development of PUs are exposure of the skin to excessive pressure, and a reduced tolerance of the skin to pressure. Pressure is exerted on the skin, soft tissue, muscle, and bone by the weight of an individual or a device applied against the surface. Tissue tolerance is the ability of the skin and its supporting structures to tolerate the effects of pressure by distributing it (cushioning) and by the transfer of pressure loads from the skin surface to the skeleton (AWMA 2012). Tissues are capable of withstanding enormous pressures briefly, but prolonged exposure to pressure initiates a series of events that lead potentially to necrosis and ulceration of tissue.

Factors that increase pressure on the skin include impairments in mobility, activity or sensory perception, because then the pressure is not relieved by movement or changes to body position. Intrinsic risk factors for the development of PUs include advancing age, poor nutrition, poor perfusion and oxygenation, whereas, extrinsic risk factors include increased moisture, shear and friction. Shear forces and friction aggravate the effects of pressure upon tissue and are important components of the mechanism of injury. A combination of pressure, shear forces, and friction causes microcirculatory occlusion (blockage), resulting in ischaemia and tissue anoxia (lack of oxygen) and stimulation of inflammatory processes, which may lead to cell death, ulceration, and tissue necrosis. Irreversible tissue damage may occur in vulnerable patients after as little as 30

minutes of uninterrupted pressure (Kirman 2008). In addition, excessive contact of the skin to fluids impairs its barrier function, causes maceration and an increased risk of the development of a PU.

A number of systems for describing the degree of tissue damage exist, but PUs are generally staged 1, 2, 3 and 4, according to the depth of tissue damage; category/stage 1 PUs are the least severe and are often difficult to detect and categorise/stage, and category/stage 4 are the most severe with complete tissue destruction (Moore 2005), as illustrated in Table 1 (EPUAP/NPUAP 2009). The majority of PUs occur on the sacrum (base of the spine) or heel, but they also occur frequently over the elbow, hip - including the ischium, shoulder, spinous processes on vertebrae, ankle, toe, head or face (Lahmann 2006; Shanin 2008; Vanderwee 2007).

Prevalence of pressure ulcers

The prevalence of PUs is dependent upon patient factors and treatment settings (Vanderwee 2007; VanGilder 2009). A study undertaken in European acute care settings found an overall prevalence of 18.1% - or 10.5% if stage 1 PUs were excluded - with individual countries reporting prevalence rates of between 8.3% and 23% (Vanderwee 2007). A more recent survey of the USA estimated a per annum PU prevalence of 12% to 13% in acute care settings and 29% to 32% in longer-term acute care settings (VanGilder 2009). It should be noted that this study excluded stage I PUs from prevalence calculations due to the substantial inaccuracies associated with their assessment (VanGilder 2009). Within Australia, PU point prevalence studies conducted by the Victorian Government in 136 metropolitan and rural health service sites between 2003 and 2006 resulted in a decrease in the prevalence of patients with PUs (stages 1 to 4) from 26.5% to 17.6%. However the proportion of patients with PU acquired in hospital did not change (67.6% in 2003 versus 67.7% in 2006; QSB 2006).

These international studies of prevalence illustrate the extent of the burden of PU, however variability in prevalence in similar settings suggests PUs are amenable to intervention, with substantial potential for improvement in patient and financial outcomes.

Economic burden of pressure ulcers

Internationally, there has been substantial investment over recent decades in monitoring, preventing and treating PUs. For example, Graves and colleagues estimated the overall annual opportunity cost of treating PUs in Australia as being between AUD 300 million to AUD 350 million (Graves 2005). The total annual cost for PU management in the UK has been estimated to be approximately GBP 1.4 billion to GBP 2.1 billion annually with an expected average cost of healing a category III or category IV ulcer of between GBP 9000 and GBP 14,000. This equates to 4% of the total UK healthcare expenditure (Bennett 2004; Dealey 2012). The main costs incurred for the treatment and management of PUs are due to prolonged hospitalisation and the extent of nursing care required. Although the independent effects of a PU on length of hospital stay are likely to vary between studies, authors of a report from the USA identified that the average length of acute hospital stay for adults with a PU (stage not identified) was longer for younger age groups, and ranged from 14.1 days for patients aged between 18 and 44 years, 12.4 days for patients aged 65-84 and 10.2 days for patients aged 85 and older (Russo 2003). In comparison, the average length of stay for all hospitalisations in 2003 was 4.6 days. In addition to the increased time spent in hospital, the discomfort and pain experienced, the burden upon the patient with the PU - and the cost to the health services - are compounded by the increased risk of mortality, altered body image and reduced quality of life, together with the potential cost associated with financial penalties for this largely preventable condition (VQC 2004), such as those imposed by the Queensland Government for severe PUs (Miles 2013).

In spite of the level of investment in prevention and monitoring of PUs, many people continue to develop them. This is the case particularly in acute and long-term care settings where people may present with a several risk factors such as decreased mobility, impaired perfusion, poor nutrition, and fluctuating health status (Bennett 2004; Dealey 2012). PU treatment strategies are often costly and complex.

Description of the intervention

Treatment of a PU is primarily two-fold and involves the relief of pressure allied with wound management. Other general strategies include patient education, pain management, optimising circulation/perfusion, optimising nutrition and the treatment of clinical infection (AWMA 2012). Wound management may involve surgical or chemical debridement (removal of dead tissue) and dressings to protect the wound and possibly promote healing. Dressings can be divided into four main categories, namely, basic wound dressings, advanced wound dressings, anti-microbial dressings and specialist dressings. Classification of a dressing depends on its purpose and the key material used in its composition. Key attributes of a dressing have been described (BNF 2013), and include:

- the ability of the dressing to absorb and contain exudate without leakage or strike-through (saturation);
- lack of particulate contaminants left in the wound;
- thermal insulation;
- level of permeability to water and bacteria;
- avoidance of wound trauma on dressing removal;
- frequency with which the dressing needs to be changed;
- provision of pain relief; and,
- comfort.

The focus of this review is foam dressings, the properties of which are described below. However, as foam dressings are likely to be evaluated against one of the many wound dressings available, a de-

scription of potential comparators has been categorised, according to the British National Formulary (BNF 2013). These are listed alphabetically below, by their generic names and, where possible with their corresponding trade names and manufacturers. Dressing names, manufactures and distributors may vary between countries.

Absorbent dressings are applied directly to the wound and maybe used as secondary absorbent layers in the management of heavily exuding wounds. Examples include Primapore (Smith & Nephew), Mepore (Mölnlycke) and absorbent cotton gauze (BP1988).

Alginate dressings are highly absorbent fabrics/yarns that come in the form of calcium alginate or calcium sodium alginate and can be combined with collagen. The alginate forms a gel when in contact with the wound surface; this can be lifted off at dressing removal, or rinsed away with sterile saline. Bonding to a secondary viscose pad increases absorbency. Examples include: Curasorb (Covidien), SeaSorb (Coloplast) and Sorbsan (Unomedical).

Capillary-action dressings consist of an absorbent core of hydrophilic fibres held between two low-adherent contact layers. Examples include: Advadraw (Advancis) and Vacutex (Protex).

Films, i.e. permeable film and membrane dressings are permeable to water vapour and oxygen, but not to water or micro-organisms. Examples include Tegaderm (3M) and Opsite (Smith & Nephew).

Foam dressings contain hydrophilic polyurethane foam and are designed to absorb wound exudate and maintain a moist wound surface. There is a variety of versions and some include additional absorbent materials, such as viscose and acrylate fibres, or particles of superabsorbent polyacrylate, which are silicone-coated for non-traumatic removal. Examples include: Allevyn (Smith & Nephew), Biatain (Coloplast) and Tegaderm (3M).

Honey-impregnated dressings contain medical-grade honey that is purported to have antimicrobial and anti-inflammatory properties and can be used for acute or chronic wounds. It is important to note that, when such dressings are used on patients with diabetes, the patients should be monitored for changes in blood-glucose concentrations. Examples include: Medihoney (Medihoney) and Activon Tulle (Advancis).

Hydrocolloid dressings are usually composed of an absorbent hydrocolloid matrix on a vapour-permeable film or foam backing. Examples include: Granuflex (ConvaTec) and NU DERM (Systagenix). Fibrous alternatives that resemble alginates and are not occlusive have also been developed: Aquacel (ConvaTec).

Hydrogel dressings consist of a starch polymer and up to 96% water. These dressings can absorb wound exudate or rehydrate a wound depending on the wound moisture levels. They are supplied in either flat sheets, an amorphous hydrogel or as beads. Examples include: ActiformCool (Activa) and Aquaflo (Covidien).

Iodine-impregnated dressings release free iodine, which is thought to act as a wound antiseptic when exposed to wound exudate. Examples include Iodoflex (Smith & Nephew) and Iodozyme (Insense).

Low-adherence dressings and wound contact materials usually consist of cotton pads that are placed directly in contact with the wound. They can be non-medicated (e.g. paraffin gauze dressing) or medicated (e.g. containing povidone iodine or chlorhexidine). Examples include paraffin gauze dressing, BP 1993 and Xeroform (Covidien) dressing - a non-adherent petrolatum blend with 3% bismuth tribromophenate on fine mesh gauze.

Odour-absorbent dressings contain charcoal and are used to absorb wound odour. Often this type of wound dressing is used in conjunction with a secondary dressing to improve absorbency. An example is CarboFLEX (ConvaTec).

Other antimicrobial dressings are composed of a gauze or low-adherent dressing impregnated with an ointment thought to have antimicrobial properties. Examples include: chlorhexidine gauze dressing (Smith & Nephew) and Cutimed Sorbact (BSN Medical).

Protease-modulating matrix dressings alter the activity of proteolytic enzymes in chronic wounds and are thought to promote natural debridement. Examples include: Promogran (Systagenix) and Sorbion (H&R Healthcare).

Silver-impregnated dressings are used to treat infected wounds, as silver ions are thought to have antimicrobial properties. Silver versions of most dressing types are available (e.g. silver foam, silver hydrocolloid etc). Examples include: Acticoat (Smith & Nephew) and Urgosorb Silver (Urgo).

Soft polymer dressings are composed of a soft silicone polymer held in a non-adherent layer; these are moderately absorbent. Examples include: Mepitel (Mölnlycke) and Urgotul (Urgo).

The diversity of dressings available to clinicians (including variation within each type listed above) makes evidence-based decision-making difficult when determining the optimum treatment regimen for a particular patient (Gillespie 2012). Some dressings are formulated with an 'active' ingredient such as silver that is promoted as a dressing treatment option to reduce infection and possibly to promote healing. With increasingly sophisticated technology being applied to wound care, practitioners need to know how effective these - often expensive - dressings are compared with more traditional and usually less costly dressings. However, far from providing critical evaluation of dressing types for clinical use, studies have shown wide variation in practice and wound (PU) care knowledge (Reddy 2008; Maylor 1997; Pieper 1995), and the number of economic evaluations of would dressings available is limited (NCCWCH 2008).

How the intervention might work

The principle of moist wound healing governs wound care practice today. This is optimised through the application of occlusive or semi-occlusive dressings and preparation of the wound bed (AWMA 2012). Animal experiments performed 50 years ago suggested that acute wounds healed more quickly when their surface was kept moist, rather than being left to dry and scab (Winter

1962; Winter 1963a; Winter 1963b). Winter 1962 examined the rate of epithelialisation in experimental wounds cut into the skin of healthy pigs, comparing wounds with a natural scab exposed to the air with wounds that were covered with polythene film. He found that epithelialisation occurred more quickly in the latter. Wounds exposed to the air lose water vapour, the upper dermis dries and healing takes place beneath a dry scab. Covering a wound with an occlusive dressing prevents scab formation and radically alters the pattern of epidermal wound healing. This research focused only on acute, superficial wounds, but the results have been used to generate a theory of moist wound healing for all types of wounds of varying aetiologies (Winter 1962). However, the theory of moist wound healing may not provide a basis for satisfactory management of every type of wound encountered. Whilst a moist environment at the wound site has been shown to aid the rate of epithelialisation in superficial wounds, excess moisture at the wound site can cause maceration of the peri-wound (surrounding) skin (Cutting 2002). Some early studies also suggested that keeping wounds moist might predispose them to infection (Hutchinson 1991). It is not entirely clear which type(s) of wound should be kept moist, how much moisture is required, when moisture should be applied, and with which other factors it needs to be combined to really confer benefit. However, Bishop and colleagues have proposed a general principle of moisture balance (Bishop 2003), that is, that dressings must absorb exudate away from the wound surface, while ensuring that the wound surface remains moist. Despite a plethora of research into wound care, the optimal level of moisture to promote wound healing has yet to be established.

Moist wound healing has underpinned the development of several commercially available wound dressings to support optimal healing processes. These have revolutionised wound management (Benbow 2005); products include hydrogels that retain moisture in contact with the wound, hydrocolloids that absorb small amounts of excess moisture without drying the wound bed, absorbent foams, alginates, adhesive dressings, non-adhesive dressings and silicone-based low-adherent dressings. Foam dressings (the subject of this review) vary in their ability to absorb exudate, thereby increasing their suitability for lightly or heavily exuding wounds (AWMA 2012; O'Meara 2013). Thus foam dressings have various manufactured compositions including open cell, hydrophobic, polyurethane, or foam sheet varieties as well as additional absorbent materials, such as viscose and acrylate fibres, or particles of superabsorbent polyacrylate, which are silicone-coated for non-traumatic removal. Examples include: Allevyn (Smith & Nephew), Biatain (Coloplast) and Tegaderm (3M), Mepilex (Mölnlycke) (AWMA 2012; BNF 2013; SMTI).

The advantages of foam dressings are purported to be:

- promotion of a moist wound environment that supports healing; exudate is absorbed into the fabric of the dressing, and also absorbed via transmission through a top layer that keeps moisture away from the wound;
- the long time that the dressings can remain in place compared to other dressing types, potentially decreasing the frequency of dressing changes and reducing cost; and
- non-traumatic removal of the dressing (AWMA 2012; O'Meara 2013).

Why it is important to do this review

PU prevention and management is a significant burden to all healthcare systems. It is an internationally recognised patient safety problem and serves as a clinical indicator of the standard of care provided. PUs are a significant source of suffering for patients and their care givers (Reddy 2008). Over recent decades significant investment has been placed in strategies aimed at PU prevention. Treatment strategies for PUs can be costly and complex, and there is a plethora of wound care products - especially dressings - available. The variation, cost and increasing complexity of dressings available means that current evidence requires evaluation and presentation to the clinician to assist with effective decision-making. Existing previous systematic reviews suggest there is currently no evidence that one particular dressing type is more clinically effective or cost effective than another, although more up to date assessments are required (Chaby 2007; Hamilton 2008; Reddy 2008). This review is part of a suite of reviews investigating the use of individual dressing types in the treatment of PUs. Each review will focus on a particular dressing type. These reviews will then be summarised in an overview of reviews which will draw together all existing Cochrane review evidence regarding the use of dressing treatments for pressure ulcers.

OBJECTIVES

To assess the clinical and cost-effectiveness of foam wound dressings for healing PUs in patients with an existing PU in any care setting

METHODS

Criteria for considering studies for this review

Types of studies

All randomised controlled trials (RCTs) and cluster-RCTs irrespective of publication status or language. Clinical controlled trials and cross-over trials will be excluded.

The critical review of health economic evidence will include comparative full and partial economic evaluations conducted within the framework of eligible RCTs and cluster-RCTs (i.e. cost-effectiveness analyses, cost-utility analyses, cost-benefit analyses and

cost-analyses of a dressing intervention and a relevant comparator), as well as RCTs reporting more limited information, such as estimates of resource use or costs associated with dressings and a comparator. We will only consider health economics studies conducted alongside effectiveness studies that are included in the clinical effectiveness component of the review.

Types of participants

People of any age with an existing PU of stage/category 2 or above in any care settings. Studies including people with only stage/category 1 PUs are excluded, as, although 'at-risk' signs and symptoms of potential PU such as non-blanchable redness, pain, hardness or softness, heat or coolness are present, the skin remains intact (AWMA 2012).

Types of interventions

The primary intervention under investigation is the use of any foam wound dressing for treating stage/category 2 PUs or above. We will include any trial in which the presence or absence of a foam dressing is the only systematic difference between treatment groups. Comparisons may include the following:

- different types of foam dressings compared with each other;
- foam dressings compared with other dressings or active treatments, or both, and;
- foam dressings compared with no dressing treatment.

Types of outcome measures

Primary outcomes

- Incidence of healed PUs (proportion of patients in whom a PU healed).
- Time to complete healing.
- Adverse events per patient (such as wound or systematic infection, or both, or increase in ulcer size and severity).

Secondary outcomes

- Reduction in ulcer size.
- Quality of life (measured using any validated tool).
- Patient satisfaction/acceptability measured using any validated tool.
- PU recurrence (stage/category 2 or above).
- Pain (associated with a PU or dressing removal, or both, measured by any validated tool).

Economic outcomes

- Cost (including but not limited to: costs of dressings; costs of related nursing or other health practitioner time or consultations; treatment costs per patient per PU; costs to treat adverse events, infections or complications associated with the PU; duration or costs of hospital stay for PU wound healing, adverse events and complications; indirect costs to society associated with PU such as lost productivity).
- Utility scores representing health-related quality of life.
- Incremental cost per event such as per additional PU healed; incremental cost per life year gained; incremental cost per quality adjusted life year (QALY); net health or monetary benefit).

Search methods for identification of studies

Electronic searches

We will search the following databases:

- the Cochrane Wounds Group Specialised Register (latest);
- the Cochrane Central Register of Controlled Trials (CENTRAL) in *The Cochrane Library* (latest issue);
- Ovid MEDLINE (1946 to present);
- Ovid EMBASE (1974 to present);
- EBSCO CINAHL (1982 to present).

We will search CENTRAL using the provisional search strategy below:

#1 MeSH descriptor: [Occlusive Dressings] explode all trees
#2 MeSH descriptor: [Biological Dressings] explode all trees
#3 MeSH descriptor: [Alginates] explode all trees
#4 MeSH descriptor: [Hydrogels] explode all trees
#5 MeSH descriptor: [Silver] explode all trees
#6 MeSH descriptor: [Silver Sulfadiazine] explode all trees
#7 MeSH descriptor: [Honey] explode all trees
#8 MeSH descriptor: [Bandages, Foam] explode all trees
#9 (dressing* or alginate* or hydrogel* or hydrocolloid* or "foam" or "bead" or "film" or "films" or tulle or gauze or non-adherent or "non adherent" or silver* or honey or matrix): ti,ab,kw
#10 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #9
#11 MeSH descriptor: [Pressure Ulcer] explode all trees
#12 (pressure next (ulcer* or sore* or injur*)):ti,ab,kw
#13 (decubitus next (ulcer* or sore*)):ti,ab,kw
#14 ((bed next sore*) or bedsore):ti,ab,kw
#15 #11 or #12 or #13 or #14
#16 #10 and #15

We will adapt this strategy to search Ovid MEDLINE, Ovid EMBASE and EBSCO CINAHL. We will combine the Ovid MEDLINE search with the Cochrane Highly Sensitive Search Strategy for identifying randomised trials in MEDLINE: sensitivity- and precision-maximising version (2008 revision) (Lefebvre 2011). We will combine the EMBASE search with the Ovid EMBASE filter

developed by the UK Cochrane Centre (Lefebvre 2011). We will combine the CINAHL searches with the trial filters developed by the Scottish Intercollegiate Guidelines Network (SIGN 2011). We will not restrict studies with respect to language, date of publication or study setting.

Separate searches with economic filters will be conducted to identify economic studies. We will use the following databases for economic studies:

- NHS Economic Evaluation Database, in *The Cochrane Library* (latest issue);
- Ovid MEDLINE (1948 to present);
- Ovid EMBASE (1974 to present);
- EBSCO CINAHL (1982 to present);
- Health Economics Evaluations Database HEED (http://onlinelibrary.wiley.com/book/10.1002/9780470510933).

We will search the following Ongoing Trials registers to identify ongoing or recently completed studies:

- the meta-Register of Controlled Trials (www.controlled-trials.com);
- the US National Institutes of Health ongoing trials register (www.clinicaltrials.gov);
- the Australian and New Zealand Clinical Trials Registry (www.anzctr.org.au);
- the World Health Organization International Clinical Trials Registry platform (www.who.int/trialsearch).

Searching other resources

We will search bibliographies of all retrieved and relevant publications identified by these strategies for further studies and consult with experts in the field for information related to the review.

Data collection and analysis

Selection of studies

Two review authors will independently assess titles and abstracts of all citations retrieved by the search for relevance against the inclusion criteria. After this initial assessment, we will retrieve full versions of all potentially eligible studies. The same two authors will then independently check the full papers for eligibility. Discrepancies between review authors will be resolved through discussion and, where required, a third independent review author will be consulted (Higgins 2011a). For transparency, we will publish a list of studies for which we retrieved full trial reports that we subsequently excluded from the review, with the reasons for their exclusion. We plan to include a study flow diagram as recommended by the PRISMA statement to illustrate the results of all searching activity and the process of screening and selecting studies for inclusion in the review (Liberati 2009).

Data extraction and management

Details from eligible studies will be extracted and summarised using a pre-designed data extraction sheet. Two review authors will extract data independently and then perform a cross-check for accuracy and agreement. Any discrepancies will be resolved though discussion and arbitration by a third review author, if necessary. Where studies have been reported multiple times, we will obtain all publications. Whilst the study will be included only once in the review, we will extract data from all reports to ensure that we obtain the maximum amount of relevant data. If there are any data missing from the papers, we will make attempts to contact study authors to retrieve the missing information. The following data will be extracted:

- country of origin;
- type/stage/category of PU;
- location of PU;
- unit of investigation (per patient) - single injury versus multiple injuries per participant;
- care setting;
- eligibility criteria and key baseline participant data;
- number of participants randomised to each trial arm;
- details of the dressing treatment/regimen received by each group;
- details of any co-interventions;
- primary and secondary outcome(s) with definitions;
- outcome data for primary and secondary outcomes (by group);
- duration of follow-up;
- number of withdrawals (by group); and,
- source of funding.

For economic studies, additional data extracted will include:

- estimates of specific items of resource use per participant;
- estimates of unit costs (extracted separately to resource use);
- price year and currency;
- decision-making jurisdiction;
- analytic perspective;
- both a point estimate and a measure of uncertainty (e.g. standard error or confidence interval) for measures of incremental resource use, costs and cost-effectiveness, if reported; and,
- details of any sensitivity analyses undertaken, and any information regarding the impact of varying assumptions on the magnitude and direction of results.

Assessment of risk of bias in included studies

Two review authors independently will assess each eligible study for risk of bias using the Cochrane Collaboration 'Risk of bias' assessment tool. The tool addresses six specific domains (see Appendix 1), namely sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting and other issues that may potentially bias the study (Higgins 2011b). A 'Risk of bias' table will be completed for each eligible study. A

separate assessment of blinding and completeness of outcome data will be conducted for each outcome. Discrepancies between review authors will be resolved through discussion. Findings will be presented using the 'Risk of bias' summary figure, which presents all of the judgements in a cross-tabulation of study by entry. We will classify trials as being at high risk of bias if they are rated 'high' for any of three key criteria, namely, randomisation sequence, allocation concealment and blinded outcome assessment.

Within economic evaluations, we will use the Consolidate Health Economic Evaluation Reporting Standards (CHEERS) checklist to assess the methodological quality of full and partial economic evaluations (Husereau 2013).

Measures of treatment effect

For dichotomous outcomes, we will calculate risk ratio (RR) plus 95% confidence intervals (CI). For continuous outcomes, we will calculate the mean difference (MD) plus 95% CIs. We will analyse time-to-event data (e.g. time-to-healing) as survival data using the appropriate analytical method, and express the intervention effect as a hazard ratio (HR) (Deeks 2011). We will not analyse time-to-event data that is incorrectly presented as continuous data, but present the data in a narrative format in the review. Skewed data are difficult to enter into a meta-analysis unless 'normalised' by log transformation. If scale data, however, have finite upper and lower limits, we will apply a conventional approach to test for skewness. If the standard deviation, when doubled, is greater than the mean, it is unlikely that the mean is the centre of the distribution and this data will not be entered into the meta-analysis (Altman 1996). Where continuous data have less obvious finite boundaries, the situation is more problematic and may be a matter of judgement. If we find relevant data that are skewed, we will present these data in 'Other data' tables. In addition, some of our secondary outcomes may be measured using ordinal scales. For simplicity, we will assume that these are continuous, and analyse data with the standardised mean difference (SMD). It is also possible that different tools may be used to measure the same outcome (e.g. quality of life). We will collect data only from those studies where scales have been validated and are self-reported, or completed by an independent rater or relative (not the therapist or investigator). We will use the SMD as the summary statistic in any meta-analysis of such data (Deeks 2011).

Review of economic evaluations

We will present a tabulated analysis of the identified economic data in accordance with advice outlined in the CHEERS checklist (Husereau 2013). We will tabulate the main characteristics and results of the identified economic evaluation studies and expand these with a narrative description. In this table we will discuss the methods used and compare the key results of those studies.

The results of economic evaluations will probably vary according to the particular circumstances of each study. For instance, the comparator dressing and standard care may differ for different groups of patients and in different settings. Given the likely lack of direct comparability in resource use and cost data between different healthcare contexts and settings, caution is advised in pooling economic outcomes, and it is not our intention to pool the economic data. Our review will place the results of the economic studies in context and will entail a discussion of key drivers and impact of assumptions on the cost-effectiveness of foam dressings, scenarios that are likely to lead to the most and least cost-effective use of foam dressings, as well as guidance on future research that might be required to assess the economic value of foam dressings as an intervention for PU treatment.

Costs

All substantial costs that are observed to differ between patients receiving foam dressing for PU treatment and patients receiving the comparator (i.e. standard care) are intended to be captured and reported as part of the review of economic evaluations.

We will report resource utilisation and unit costs separately, along with the currency and price year in each original study. These costs will then be converted to 2014 values by employing a web-based conversion tool that applies implicit price deflators for gross domestic produce (GDP) of that currency and then converted into the currency most frequently observed in the articles reviewed using GDP Purchasing Power Parities (Shemilt 2011). This will allow readers of the review to make meaningful comparisons between costs in studies that may have been conducted in different countries and at different times.

The main costs are likely to be those associated with the development of PUs and their treatment (e.g. dressings), nursing time for dressing changes, specialist and other practitioner costs as measured by time or number of visits, potential cost-savings from a reduced length of stay in hospital, and costs stemming from differing rates of adverse events and complications (including procedures initiated due to the failure of wounds to heal, such as amputation). We will identify the key cost drivers from the studies included. This will enable users of the review to gain a clear understanding of the nature of resource use associated with foam dressing for PU treatment.

Health state utility scores

We will examine information on the change in health-related quality of life (HR-QoL) reported by the included trials via utilities measured by a multi-attribute utility instrument (MAUI) or other approaches (such as the time trade-off, standard gamble). The utility data will need to be assessed for comparability and representativeness considering issues such as the stage of PUs, the patient populations, timing of the baseline and follow up measurement, the MAUI used and the algorithm for scoring the MAUI. We will present discussion of the potential impact on HR-QoL attributable to the intervention as part of the review.

Unit of analysis issues

In all trials included in our review, the participant will be the unit of analysis and we will take into account the level at which randomisation occurred. The number of observations will match up with the number of 'units' (participants) that are randomised. For parallel group designs we will analyse a single measure for each outcome for each person participating. Ensuring the participant is the unit of analysis will enable the independence of observations, thereby avoiding 'unit-of-analysis' errors that can result in a false positive conclusion that the intervention had an effect (Higgins 2011c). For cluster-RCTs, we will adjust sample size based on methods described in the *Cochrane Handbook for Systematic Reviews of Interventions* (Deeks 2011). Where possible, we will use an estimate of intra-cluster correlation coefficient (ICC) derived from the trial, or calculate the design effect using the formula: DE = 1 (M-1) x ICC (Deeks 2011).

As a part of the 'Risk of bias' assessment we will record how individual PUs were studied and analysed. This will include the grading of ulcers, location of ulcers, number of ulcers per participant, and whether they have (incorrectly) been treated as being independent in the study, rather than applying a within-patient analysis.

Dealing with missing data

It is likely that studies included in our review will have missing data, which will increase the possibility of bias. If there is evidence of missing data, we will make attempts to contact the study authors to request the missing information. In cases where this approach is unsuccessful, we will assume that missing data is due to loss of follow-up (missing at random) and analyse the available information. If we consider that data are not missing at random, we will consider imputing missing data acknowledging that these were imputed with uncertainty or use statistical models to allow for missing data by making assumptions about their relationship with the available data (Higgins 2011c), or both. Intention-to-treat (ITT) analysis (keeping participants in the intervention groups to which they were randomised, regardless of the intervention they actually received) may be considered where some randomised participants are excluded from the analysis. Where ITT analysis is considered inappropriate (in cases of unintended/adverse events), available case analysis may be attempted (Higgins 2011c). We will perform a sensitivity analysis to assess how robust the results are to reasonable changes in the assumptions that are made. The potential impact of missing data on the findings of the review will be addressed in the discussion section.

Assessment of heterogeneity

The included studies may have considerable heterogeneity due to clinical variation (differences in participants, interventions and outcomes), and methodological diversity related to design and risk of bias difference (Deeks 2011). If this occurs it is highly likely that statistical heterogeneity will also exist (Higgins 2003). Therefore, we will consider clinical, methodological and statistical heterogeneity prior to meta-analysis. Studies of each intervention will be analysed and data presented separately. If studies are sufficiently homogenous, data will be pooled using meta-analysis with Review Manager 5.3 (RevMan 2013). However, we will not pool studies with high heterogeneity - classed as when I^2 exceeds 75% (Higgins 2011a).

We will assess heterogeneity of selected studies by a combination of methods including visual inspection of the meta-analytic model and by using the Chi^2 test with significance being set at P value less than 0.10. This test assesses whether observed differences in results are due to heterogeneity or chance alone. In addition, the degree of heterogeneity will be investigated by calculating the I^2 statistic (an equation combining the Chi^2 statistic relative to its degree of freedom) (Higgins 2002). If there are sufficiently similar studies to consider pooling, we plan to use a fixed-effect model for low to moderate levels of heterogeneity (I^2 0% to 50%). Where appropriate, in the absence of clinical heterogeneity and in the presence of statistical heterogeneity (I^2 > 50%), we will use a random-effects model.

Assessment of reporting biases

Reporting biases arise when the dissemination of research findings is influenced by the nature and direction of results (Sterne 2011). Publication bias is one example of a number of possible 'small study effects', such as a tendency to over-estimate the effect of interventions in smaller RCTs. We will explore reporting bias using funnel plots, A funnel plot is a simple scatter plot that enables a visual assessment of intervention effects estimates from individual RCTs against some measure of each trial's size or precision (Sterne 2011). Funnel plots will be presented if at least 10 studies are available for the meta-analysis of a primary outcome. .

Data synthesis

Initially we will conduct a structured narrative summary of the studies reviewed. We will enter quantitative data into RevMan 5.3 (RevMan 2013), and analyse the data using the RevMan analysis software. For dichotomous outcomes, we will calculate RR plus 95% CI. For continuous outcomes, we will calculate SMD and MD plus 95% CI. For time-to-event outcomes we will calculate pooled HR with 95% CI. The decision to pool data in a meta-analysis will depend upon the availability of outcome data and assessment of between-trial heterogeneity.

Subgroup analysis and investigation of heterogeneity

If there is evidence of significant heterogeneity, potential causes will be further investigated where possible using subgroup analyses or meta-regression.

If sufficient data are available we will undertake the following subgroup analysis: type of setting (community, hospital, inpatient, outpatient).

Sensitivity analysis

We will conduct sensitivity analysis to explore the influence of risk of bias on clinical, methodological and statistical heterogeneity (Deeks 2011). As a result of this process, we will exclude those studies assessed as having high risk of bias from meta analysis and will consider the effects of those studies at unclear risk of bias on the results. We consider studies as having overall low risk of bias if they have low risk of bias in all key domains, namely adequate generation of the randomisation sequence, adequate allocation concealment and blinding of outcome assessor, for the estimates of treatment effect.

'Summary of findings' table

We will present the main results of the review in 'Summary of findings' tables. These tables present key information concerning the quality of the evidence, the magnitude of the effects of the interventions examined, and the sum of the available data for the main outcomes (Schunemann 2011a). The 'Summary of findings' tables also include an overall grading of the body of evidence related to each of the main outcomes using the GRADE (Grading of Recommendations Assessment, Development and Evaluation) approach (Schunemann 2011b). The GRADE approach defines the quality of a body of evidence as the extent to which one can be confident that an estimate of effect or association is close to the quantity of specific interest. Assessment of the quality of a body of evidence involves consideration of within-trial risk of bias (methodological quality), directness of evidence, heterogeneity, precision of effect estimates and risk of publication bias (Schunemann 2011b). We plan to present the following outcomes in the 'Summary of findings' tables:

- time to complete ulcer healing;
- number of ulcers healed during the trial period;
- rates of adverse events per participant (such as wound or systemic infection or both, increase in ulcer size and severity); and
- quality of life.

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REFERENCES

Additional references

Altman 1996
Altman DG, Bland JM. Detecting skewness from summary information. *BMJ* 1996;**313**(7066):1200.

AWMA 2012
Australian Wound Management Association and Pan Pacific Partners. *Pan Pacific Clinical Practice Guideline for the Prevention and Management of Pressure Injury - draft for consultation*. Perth WA: Cambridge Publishing, 2012.

Benbow 2005
Benbow M. *Evidence-Based Wound Management*. London (UK): Whurr publishers, 2005.

Bennett 2004
Bennet G, Dealey C, Posnett J. The cost of pressure ulcers in the UK. *Age and Ageing* 2004;**33**(3):230–5.

Bishop 2003
Bishop SM, Walker M, Rogers AA, Chen WY. Importance of moisture balance at the wound-dressing interface. *Journal of Wound Care* 2003;**12**(4):125–8.

BNF 2013
British Medical Association, British Royal Pharmaceutical Society of Great Britain. British National Formulary Appendix 8: wound management products and elastic hosiery. *British National Formulary*. 9th Edition. London: British Medical Assocation, 2010.

Chaby 2007
Chaby G, Senet P, Vaneau M, Martel P, Guillaume JC, Meaume S, et al. Dressings for acute and chronic wounds: a systematic review. *Archives of Dermatology* 2007;**143**: 1297–304.

Cutting 2002
Cutting KF, White RJ. Maceration of the skin and wound bed. 1: Its nature and causes. *Journal of Wound Care* 2002; **11**(7):275–8.

Dealey 2012
Dealey C, Posnett J, Walker A. The cost of pressure ulcers in the United Kingdom. *Journal of Wound Care* 2012;**21** (6):261-2, 264, 266.

Deeks 2011
Deeks JJ, Higgins JPT, Altman DG. Chapter 9: Analysing data and undertaking meta-analyses. In: Higgins JPT,

Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

EPUAP/NPUAP 2009
EPUAP/NPUAP. Prevention and treatment of pressure ulcers: quick reference guide. European Pressure Ulcer Advisory Panel and National Pressure Ulcer Advisory Panel. Washington DC: National Pressure Ulcer Advisory Panel 2009.

Gillespie 2012
Gillespie BM, Chaboyer W, Niuewenhoven P, Rickard CM. Drivers and barriers of surgical wound management in a large healthcare organisation: results of an environmental scan. *Wound Practice and Research* 2012;**20**(2):90–202.

Graves 2005
Graves N, Birrell F, Whitby M. Modelling the economic losses from pressure ulcers among hospitalized patients in Australia. *Wound Repair and Regeneration* 2005;**13**:462–7. [PUBMED: 16176454]

Hamilton 2008
Hamilton C. Speculating to accumulate: reducing the cost of wound care by appropriate dressing selection. *Journal of Wound Care* 2008;**17**(8):359–63.

Higgins 2002
Higgins JPT, Thompson SG. Quantifying heterogeneity in a meta-analysis. *Statistics in Medicine* 2002;**21**(327): 1539–58.

Higgins 2003
Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ* 2003;**327**: 557–60.

Higgins 2011a
Higgins JPT, Deeks JJ. Chapter 7: Selecting studies and collecting data. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

Higgins 2011b
Higgins JPT, Altman DG. Chapter 8: Assessing risk of bias in included studies. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

Higgins 2011c
Higgins JPT, Deeks JJ, Altman DG. Chapter 16: Special topics in statistics. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

House 2011
House S, Giles T, Whitcomb J. Benchmarking to the international pressure ulcer prevalence survey. *Journal of Wound, Ostomy and Continence Nursing* 2011;**38**(3):254–9.

Husereau 2013
Husereau D, Drummond M, Petrou S, Carswell C, Moher D, Greenberg D, et al. Consolidated Health Economic Evaluation Reporting Standards (CHEERS)--explanation and elaboration: a report of the ISPOR Health Economic Evaluation Publication Guidelines Good Reporting Practices Task Force. *Value Health* 2013;**16**:231–50.

Hutchinson 1991
Hutchinson JJ, Lawrence JC. Wound infections under occlusive dressings. *Journal of Hospital Infection* 1991;**17**(2): 83–94.

Kirman 2008
Kirman CN, Molnar JA. Pressure ulcer, nonsurgical treatment and principles. Medscape 2008.

Lahmann 2006
Lahmann N, Halfens R, Dassen T. Pressure ulcers in German nursing homes and acute care hospitals: prevalence, frequency and ulcer characteristics. *Ostomy/Wound Management* 2006;**52**(2):20–33.

Lefebvre 2011
Lefebvre C, Manheimer E, Glanville J. Chapter 6: Searching for studies. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

Liberati 2009
Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Medicine* 2009;**6**:e1000100.

Maylor 1997
Maylor ME. Knowledge base and use in the management of pressure sores. *Journal of Wound Care* 1997;**6**(5):244–7.

Miles 2013
Miles SJ, Fulbrook P, Nowicki T, Franks C. Decreasing pressure injury prevalence in an Australian general hospital: A 10-year review. *Wound Practice & Research: Journal of the Australian Wound Management Association* 2013;**21**: 148–156.

Moore 2005
Moore Z. Pressure ulcer grading. *Nursing Standard* 2005; **19**:56–64.

NCCWCH 2008
National Collaborating Centre for Women's and Children's Health. Surgical site infection: prevention and treatment of surgical site infection.. *Surgical site infection: prevention and treatment of surgical site infection. Clinical Guideline*. London: RCOG Press at the Royal College of Obstetricians and Gynaecologists, 2008.

O'Meara 2013
O'Meara S, Martyn-St James M. Foam dressings for venous leg ulcers. *Cochrane Database of Systematic Reviews* 2013, Issue 5. [DOI: 10.1002/14651858.CD009907.pub2]

Pieper 1995
Pieper B, Mott M. Nurses' knowledge of pressure ulcer prevention, staging, and description. *Advances in Wound Care* 1995;**8**(3):34, 38, 40 passim.

QSB 2006
Quality, Safety Branch. PUPPS 3 - Pressure ulcer point prevalence survey: Statewide report 2006. *PUPPS 3 - Pressure ulcer point prevalence survey: Statewide report*. Melbourne: State of Victoria, Department of Human Services, 2006.

Reddy 2008
Reddy M, Gill SS, Kalkar SR, Wu W, Anderson PJ, Rochon PA. Treatment of pressure ulcers: a systematic review. *JAMA* 2008;**300**(22):2647–62.

RevMan 2013 [Computer program]
The Nordic Cochrane Centre. Review Manager (RevMan) 5.3. The Cochrane Collaboration, 2013.

Russo 2003
Russo CA, Elixhauser A. Hospitalizations related to pressure sores, 2003. Statistical brief #3. Agency for Healthcare Research and Quality 2006.

Schunemann 2011a
Schünemann HJ, Oxman AD, Higgins JPT, Vist GE, Glasziou P, Guyatt GH. Chapter 11: Presenting results and 'Summary of findings' tables. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

Schunemann 2011b
Schünemann HJ, Oxman AD, Higgins JPT, Deeks JJ, Glasziou P, Guyatt GH. Chapter 12: Interpreting results and drawing conclusions. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

Shanin 2008
Shanin E, Dassen T, Halfens R. Pressure ulcer prevalence and incidence in intensive care patients: a literature review. *Nursing in Critical Care* 2008;**13**(2):71–9.

Shemilt 2011
Shemilt I, Mugford M, Byford S, Drummond M, Eisenstein E, Knapp M, et al. Chapter 15: Incorporating economics evidence. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

SIGN 2011
Scottish Intercollegiate Guidelines Network (SIGN). Search filters. http://www.sign.ac.uk/methodology/filters.html#random (accessed 27 June 2014).

SMTI
Surgical Materials Testing Laboratory. Dressings Datacards. http://www.smtl.co.au (accessed 30 June 2014).

Sterne 2011
Sterne JAC, Egger M, Moher D. Chapter 10: Addressing reporting biases. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

Vanderwee 2007
Vanderwee K, Clark M, Dealey C, Gunningberg L, Defloor T. Pressure ulcer prevalence in Europe: a pilot study. *Journal of Evaluation in Clinical Practice* 2007;**13**:227–35.

VanGilder 2009
VanGilder C, Amlung S, Harrison P, Meyer S. Results of the 2008-2009 International Pressure Ulcer Prevalence ™ Survey and a 3-year, acute care, unit-specific analysis. *Ostomy Wound Management* 2009;**55**:39–45.

VQC 2004
Victorian Quality Commission. State-wide pressure ulcer point prevalence survey report. Victoria Government, Melbourne 2004:8–15.

Winter 1962
Winter GD. Formation of the scab and the rate of epithelization of superficial wounds in the skin of the young domestic pig. *Nature* 1962;**193**:293–4.

Winter 1963a
Winter GD, Scales JT. Effect of air drying and dressings on the surface of a wound. *Nature* 1963;**197**:91–2.

Winter 1963b
Winter GD. Effect of air exposure and occlusion on experimental human skin wounds. *Nature* 1963;**200**: 378–9.

* *Indicates the major publication for the study*

ADDITIONAL TABLES

Table 1. ***National Pressure Ulcer Advisory Panel (NPUAP)/European Pressure Ulcer Advisory Panel (EPUAP) classification system (2009)***

Category/Stage	*Definition*
Category/Stage 1	Intact skin with non-blanchable redness of a localised area usually over a bony prominence Darkly pigmented skin may not have visible blanching; its colour may differ from the surrounding area The area may be painful, firm, soft, warmer or cooler compared to adjacent tissue May be difficult to detect in individuals with dark skin tones
Category/Stage 2	Partial thickness loss of dermis presenting as a shallow open ulcer with a red-pink wound bed, without slough May also present as an intact or open/ruptured serum-filled or sero-sanguinous filled blister Presenting as a shiny or dry shallow ulcer without slough or bruising
Category/Stage 3	Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle is not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunnelling The depth varies according to anatomical location. The bridge of the nose, ear, occiput and malleolus do not have subcutaneous tissue and stage III pressure ulcers (PUs) can be shallow. In contrast, areas of significant adiposity can develop extremely deep stage III PUs
Category/Stage 4	Full thickness tissue loss with exposed bone, tendon or muscle. Slough or eschar may be present on some parts of the wound bed The depth of a stage IV pressure injury varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have subcutaneous tissue and these PUs can be shallow. Stage IV PUs can extend into muscle and/or supporting structures (e.g. fascia, tendon or joint capsule) making osteomyelitis possible Exposed bone or tendon is visible or directly palpable

APPENDICES

Appendix 1. Risk of bias criteria

1. Was the allocation sequence randomly generated?

Low risk of bias

The investigators describe a random component in the sequence generation process such as: referring to a random number table; using a computer random number generator; coin tossing; shuffling cards or envelopes; throwing dice; drawing of lots.

High risk of bias

The investigators describe a non-random component in the sequence generation process. Usually, the description would involve some systematic, non-random approach, for example: sequence generated by odd or even date of birth; sequence generated by some rule based on date (or day) of admission; sequence generated by some rule based on hospital or clinic record number.

Unclear

Insufficient information about the sequence generation process to permit judgement of low or high risk of bias.

2. Was the treatment allocation adequately concealed?

Low risk of bias

Participants and investigators enrolling participants could not foresee assignment because one of the following, or an equivalent method, was used to conceal allocation: central allocation (including telephone, web-based and pharmacy-controlled randomisation); sequentially numbered drug containers of identical appearance; sequentially numbered, opaque, sealed envelopes.

High risk of bias

Participants or investigators enrolling participants could possibly foresee assignments and thus introduce selection bias, such as allocation based on: using an open random allocation schedule (e.g. a list of random numbers); assignment envelopes used without appropriate safeguards (e.g. if envelopes were unsealed or non opaque or not sequentially numbered); alternation or rotation; date of birth; case record number; any other explicitly unconcealed procedure.

Unclear

Insufficient information to permit judgement of low or high risk of bias. This is usually the case if the method of concealment is not described or not described in sufficient detail to allow a definite judgement, for example if the use of assignment envelopes is described, but it remains unclear whether envelopes were sequentially numbered, opaque and sealed.

3. Blinding - was knowledge of the allocated interventions adequately prevented during the study?

Low risk of bias

Any one of the following.

- No blinding, but the review authors judge that the outcome and the outcome measurement are not likely to be influenced by lack of blinding.
- Blinding of participants and key study personnel ensured, and unlikely that the blinding could have been broken.
- Either participants or some key study personnel were not blinded, but outcome assessment was blinded and the non-blinding of others was unlikely to introduce bias.

High risk of bias

Any one of the following.

- No blinding or incomplete blinding, and the outcome or outcome measurement is likely to be influenced by lack of blinding.
- Blinding of key study participants and personnel attempted, but likely that the blinding could have been broken.
- Either participants or some key study personnel were not blinded, and the non-blinding of others was likely to introduce bias.

Unclear

Either of the following.

- Insufficient information to permit judgement of low or high risk of bias.
- The study did not address this outcome.

4. Were incomplete outcome data adequately addressed?

Low risk of bias

Any one of the following.

- No missing outcome data.
- Reasons for missing outcome data unlikely to be related to true outcome (for survival data, censoring unlikely to be introducing bias).
- Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups.
- For dichotomous outcome data, the proportion of missing outcomes compared with observed event risk not enough to have a clinically relevant impact on the intervention effect estimate.
- For continuous outcome data, plausible effect size (difference in means or standardised difference in means) among missing outcomes not enough to have a clinically relevant impact on observed effect size.
- Missing data have been imputed using appropriate methods.

High risk of bias

Any one of the following.

- Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups.
- For dichotomous outcome data, the proportion of missing outcomes compared with observed event risk enough to induce clinically relevant bias in intervention effect estimate.
- For continuous outcome data, plausible effect size (difference in means or standardised difference in means) among missing outcomes enough to induce clinically relevant bias in observed effect size.
- 'As-treated' analysis done with substantial departure of the intervention received from that assigned at randomisation.
- Potentially inappropriate application of simple imputation.

Unclear

Either of the following.

- Insufficient reporting of attrition/exclusions to permit judgement of low or high risk of bias (e.g. number randomised not stated, no reasons for missing data provided).
- The study did not address this outcome.

5. Are reports of the study free of suggestion of selective outcome reporting?

Low risk of bias

Any of the following.

- The study protocol is available and all of the study's pre-specified (primary and secondary) outcomes that are of interest in the review have been reported in the pre-specified way.
- The study protocol is not available but it is clear that the published reports include all expected outcomes, including those that were pre-specified (convincing text of this nature may be uncommon).

High risk of bias

Any one of the following.

- Not all of the study's pre-specified primary outcomes have been reported.
- One or more primary outcomes are reported using measurements, analysis methods or subsets of the data (e.g. subscales) that were not pre-specified.
- One or more reported primary outcomes were not pre-specified (unless clear justification for their reporting is provided, such as an unexpected adverse effect).

- One or more outcomes of interest in the review are reported incompletely so that they cannot be entered in a meta-analysis.
- The study report fails to include results for a key outcome that would be expected to have been reported for such a study.

Unclear

Insufficient information to permit judgement of low or high risk of bias. It is likely that the majority of studies will fall into this category.

6. Other sources of potential bias

Low risk of bias

The study appears to be free of other sources of bias.

High risk of bias

There is at least one important risk of bias. For example, the study:
- had a potential source of bias related to the specific study design used; or
- had extreme baseline imbalance; or
- has been claimed to have been fraudulent; or
- had some other problem.

Unclear

There may be a risk of bias, but there is either:
- insufficient information to assess whether an important risk of bias exists; or
- insufficient rationale or evidence that an identified problem will introduce bias.

WHAT'S NEW

Date	Event	Description
24 February 2015	Amended	Contact details updated.

CONTRIBUTIONS OF AUTHORS

Rachel Walker led the co-ordination of edits of subsequent drafts of the original protocol, made an intellectual contribution, approved the final version prior to submission and is the guarantor of the protocol.

Samantha Keogh developed the first protocol used in this suite of reviews that investigates the use of individual dressing types in the treatment of pressure ulcers, made an intellectual contribution to and approved the final version of the protocol prior to submission.

Niall Higgins edited the protocol, made an intellectual contribution and approved the final version of the protocol prior to submission.

Jennifer Whittyedited the protocol, made an intellectual contribution and approved the final version of the protocol prior to submission.

Lukman Thalib edited the protocol, made an intellectual contribution and approved the final version of the protocol prior to submission.

Brigid Gillespie edited the protocol, made an intellectual contribution and approved the final version of the protocol prior to submission.

Jo Dumville edited the protocol, made an intellectual contribution and approved the final version of the protocol prior to submission.

Contributions of editorial base

Nicky Cullum: advised on content, edited the protocol and approved the final protocol prior to submission.
Sally Bell-Syer: co-ordinated the editorial process. Advised on methodology, interpretation and content. Edited the protocol.
Amanda Briant: designed the search strategy and edited the search methods section.

DECLARATIONS OF INTEREST

Rachel Walker is currently employed by the National Health and Medical Research Council's Centre of Research Excellence in Nursing (NCREN), Griffith University Australia. Skin integrity including pressure ulcers is a research foci of NCREN

Jennifer Whitty has provided health economic advice to Coloplast Denmark under a small commercial research contract that was paid to her Institution

Jo C Dumville: none known

Brigid M Gillespie: none known

Niall S Higgins: none known

Samantha J Keogh: none known

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