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Preoperative and postoperative recommendations to surgical wound care interventions: A systematic meta-review of Cochrane reviews

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ABSTRACT

Background: The increasing numbers of surgeries involving high risk, multi-morbid patients, coupled with inconsistencies in the practice of perioperative surgical wound care, increases patients' risk of surgical site infection and other wound complications.

Objectives: To synthesise and evaluate the recommendations for nursing practice and research from published systematic reviews in the Cochrane Library on nurse-led preoperative prophylaxis and postoperative surgical wound care interventions used or initiated by nurses.

Design: Meta-review, guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.

Data sources: The Cochrane Library database.

Review methods: All Cochrane Systematic Reviews were eligible. Two reviewers independently selected the reviews and extracted data. One reviewer appraised the methodological quality of the included reviews using A Measurement Tool to Assess Systematic Reviews 2 checklist. A second reviewer independently verified these appraisals. The review protocol was registered with the Prospective Register of Systematic Reviews.

Results: Twenty-two Cochrane reviews met the inclusion criteria. Of these, 11 reviews focused on preoperative interventions to prevent infection, while 12 focused on postoperative interventions (one review assessed both pre-postoperative interventions). Across all reviews, 14 (63.6%) made at least one recommendation to undertake a specific practice, while two reviews (9.1%) made at least one specific recommendation not to undertake a practice. In relation to recommendations for further research, insufficient sample size was the most predominant methodological issue (12/22) identified across reviews.

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Conclusions: The limited number of recommendations for pre-and-postoperative interventions reflects the paucity of high-quality evidence, suggesting a need for rigorous trials to address these evidence gaps in fundamentals of nursing care.

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What is already known about the topic?

- Surgical wounds are the most common wounds managed in acute care settings.
- Surgical wound care is an interprofessional activity, although it is predominantly nurse-led.
- There is considerable variability in surgical wound care practice, which may reflect overuse of ineffective care, underuse of effective care or uncertainty as to what constitutes appropriate care.

What this paper adds

- The quality of the primary studies included in Cochrane Reviews may determine the level to which clinicians are able, or feel compelled, to implement reviewers' recommendations in clinical practice.
- Clinical recommendations made in pre-and postoperative surgical wound management are weak or conditional because of methodological limitations and gaps in the current evidence base.
- Analysis of design and methodological rigour of included reviews identified the need for larger sample sizes, longer follow-up periods and inclusion of economic evaluations.

1. Introduction

Worldwide, an estimated 4511 operations per 100,000 population occur annually, equating to 1 surgical procedure each year for every 22 people (Lancet Commission on Global Surgery, 2018). Surgical wounds are the most common wounds managed in acute care settings and are associated with a variety of complications such as bleeding and dehiscence. However surgical site infections are the most common complication—and they are also the most preventable hospital acquired infection (Haley et al., 2011). Internationally, surgical site infection rates are estimated to range from 1.9% (Berrios-Torres et al., 2017) to 40% of surgeries (Maehara et al., 2017). One-in-four patients develop postoperative complications within 14 days of hospital discharge (Kassin et al., 2012). Consequently, current estimates suggest surgical wound complications account for almost 4% of total healthcare system costs, and that proportion is rising. One case of surgical site infection can cost up to \$30,000 depending on its severity (Lee et al., 2010).

In acute care settings, there is considerable variability in surgical wound care, reflecting overuse of unhelpful and ineffective care, underuse of effective care, or clinician uncertainty as to what constitutes appropriate care. Inconsistent practices often arise due to conflicting research evidence and variations in clinician preferences, which compromise attempts to limit or reduce iatrogenic harm and patients' risk of surgical site infection and other wound complications (Verkerk et al., 2018). Although there are many surgical site infection prevention Clinical Practice Guidelines, they are of variable quality and differ in their recommendations (Gillespie et al., 2018a, 2018b). Further, the plethora of wound care products and aggressive marketing strategies in the absence of strong supporting evidence accentuates the complexities bedside

nurses face when attempting to use an evidence-based approach (Gillespie et al., 2014). The routine use of ineffective and often expensive wound care products and/or inappropriate use of effective products is not uncommon (Gillespie et al., 2014; Harvey and McInnes, 2015).

While surgical wound care involves interprofessional teams, Registered Nurses often lead these teams and frequently make nursing decisions, or recommendations to other health professionals, regarding various interventions for managing surgical wounds. High-quality systematic reviews of the literature, such as Cochrane Reviews, provide evidence syntheses upon which to base these decisions. Cochrane Reviews follow a stringent, peer-reviewed methodology that ensures all relevant studies are retrieved, are appraised for risk of bias, and their findings synthesised with the aim of generating and grading recommendations that guide both current practice and future research. Additionally, we have followed a similar process in focusing on only Cochrane Reviews (for the reason already stated) as have a previous group who undertook a meta-review of wound care five years ago (Ubbink et al., 2014).

This meta-review aimed to synthesise and evaluate the recommendations for practice and research contained within published Cochrane Systematic Reviews relating to preoperative and postoperative surgical wound care interventions for preventing surgical site infection that were within the scope of nursing practice.

2. Materials and methods

2.1. Design

A meta-review of systematic reviews was undertaken in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines (Moher et al., 2009) and quality of individual reviews was assessed using *A Measurement Tool to Assess Systematic Reviews* checklist 2 (Shea et al., 2017). The review protocol was registered with the Prospective Register of Systematic Reviews (number withheld for blinded review).

2.2. Inclusion/exclusion criteria

The setting (S), population (P), intervention (I), comparison (C), and evaluation (E) framework (Booth, 2006) was used to guide inclusion criteria, and report review characteristics.

Setting. The setting for this meta-review was any care environment including hospital, home, residential aged care or long-term care.

Population. Authors focussed on Cochrane reviews that included patients with a surgical wound, defined by the World Health Organisation as "a wound created when an incision is made with a scalpel or other sharp cutting device and then closed in the operating room by suture, staple, adhesive tape, or glue and resulting in close approximation to the skin edges."p.10 (World Health Organization, 2016). As such, episiotomies and full thickness skin grafts were included as types of surgical wounds. For reviews that examined multiple wound types including chronic wounds (e.g., venous, arterial or diabetic ulcers), only those studies or data relating to surgical wounds were included. Reviews which examined wounds

outside the World Health Organisation definition of a surgical wound were excluded.

Intervention. Reviews were required to examine nursing interventions for surgical wound care, defined as pre- or post-operative interventions for surgical wounds that may be implemented by registered nurses or interventions that registered nurses may recommend to other health professionals to implement in any care setting. Thus, interventions included but were not limited to, skin preparation, dressing removal, negative pressure therapy devices, debridement and use of topical agents, e.g., silver or aloe vera, and use of topical antibiotics and antiseptics. Reviews could comprise individual studies with randomised and/or non-randomised designs.

Reviews were excluded if they focused only on interventions provided by other health professionals such as surgeons or interventions for which nurses cannot make recommendations. These comprised interventions performed during the intraoperative period, (e.g., surgery), electromagnetic therapy or medication prescriptions.

Comparator. There were no restrictions on the comparators used, and comparators were as defined by review authors.

Evaluation. This review assessed specific recommendations made as described in the “implications for practice” and “implications for research” sections of the reviews and within the abstract. Practice recommendations were categorised according to: a) the level of certainty of the evidence underpinning that particular recommendation which, in some reviews, was determined using the Grading of Recommendations Assessment, Development and Evaluation criteria (Guyatt et al., 2008) of risk of bias, precision, indirectness, inconsistency, and selective reporting; and, b) how strong or unambiguous the recommendation was in regards to undertaking, or not undertaking, a specific practice. Recommendations for research were grouped into three categories (e.g., further/better quality research needed) and methodological issues included 10 categories (e.g., larger samples, greater statistical power, longer follow-up periods). Pre- and postoperative research outcomes from each review were classified based on 16 categories (e.g., cost, different setting/population, quality of life).

2.3. Search strategy

There were no date restrictions. A search of the Cochrane Library website (<https://www.cochranelibrary.com/search>) was conducted on 1 November 2018 for all published Cochrane reviews. The word ‘wound’ was the search term used in titles, abstract or keywords and these reviews screened. In the searches, only the word ‘wound’ was used to ensure that any relevant reviews were not missed. Thus, more time was allocated to screening more reviews.

2.4. Review section

Retrieved abstracts and titles were exported to an Endnote library for screening, with full-text articles obtained in cases requiring further information to enable screening. Two authors (WC, CW) independently screened all reviews to determine which should be selected based on inclusion and exclusion criteria. Instances of disagreement between the two authors regarding review inclusion were resolved by discussion and consensus.

2.5. Data extraction

Data extraction was conducted on each review independently by pairs of two authors (BG, RW, EM, ZM, AE, EH, CW) and adjudicated by a third (WC) if required. Data extraction included the following information (where available): source (author, year,

reference, number of pages in full review and reference list), sample size (number of studies and participants identified), interventions and their comparators, outcomes, risk of bias (i.e., randomisation, allocation concealment, blinding, loss to follow up) and/or certainty of the body of evidence (using Grading of Recommendations Assessment, Development and Evaluation criteria (Guyatt et al., 2008)), recommendations for practice, and implications for research. The extracted data was checked between reviewers and discrepancies resolved through discussion.

A standardised structured data extraction form was developed by the authors, with two reviewers piloting this data extraction form on two reviews, which led to further refinements. To minimise potential for conflicts of interest in the review process, authors of this meta review who were also co-authors of several included Cochrane reviews were not involved in reviewing the reviews that they co-authored. Authors who undertook data extraction underwent training and extracted data from two reviews each, with further training planned if discrepancies were seen, but there were none. As Cochrane reviews are presented in a ‘standard’ format, a data dictionary detailing where in each review the data was to be extracted from was also developed and used to ensure consistency in data extraction.

Data was also extracted on the risk of bias assessments made by the review authors on each study within their review. Notations were also made of reviews published before and after the Cochrane Library adopted the Grading of Recommendations Assessment, Development and Evaluation system of assessing certainty of evidence and strength of recommendations (Guyatt et al., 2008). Reviews preceding Grading of Recommendations Assessment, Development and Evaluation criteria used risk of bias tables only, while those following both risk of bias tables and Grading of Recommendations Assessment, Development and Evaluation criteria, with relevant information extracted for both types of review. No attempt was made to re-appraise the reviews regarding risk of bias or Grading of Recommendations Assessment, Development and Evaluation criteria, with the original authors’ ratings being accepted as valid.

2.6. Quality assessment

The methodological quality of the reviews was assessed using a validated 16 item measurement tool: *A Measurement Tool to Assess Systematic Reviews 2* checklist (Shea et al., 2017). The responses to the checklist (2017) items were scaled as ‘fully performed’; ‘partially performed’; or ‘not at all performed’; and ‘yes’ or ‘no’ as to whether data were pooled for meta-analysis. The *A Measurement Tool to Assess Systematic Reviews 2* checklist identifies critical and non-critical domains that must be met in a review, as these affect the validity of the conclusions. The creators of the tool stress that items should not be summed; rather appraisers should consider the overall quality relative to ‘critical domains’ (items 2, 4, 7, 9, 11, 13 and 15) and ‘non-critical weaknesses’ (items 1, 3, 5, 6, 8, 10, 12, 14, 16) (Shea et al., 2017). The overall rating of confidence in the quality of reviews is based on ‘high’ (no or one non-critical weakness), ‘moderate’ (more than one non-critical weakness), ‘low’ (one critical flaw with or without non-critical weaknesses), and ‘critically low’ (more than one critical flaw with or without non-critical weaknesses). For this meta-review, two appraisers (EH, CW) independently assessed a subsample of 10 (45.5%) reviews and achieved good agreement (at least 80% as recommended by tool developers (Shea et al., 2017)). Then one appraiser (EH) completed the rest of the assessments, with another author (WC, BG) contacted in instances where EH was uncertain. Any disagreements were resolved through discussion and when needed, final adjudication by a third reviewer (WC).

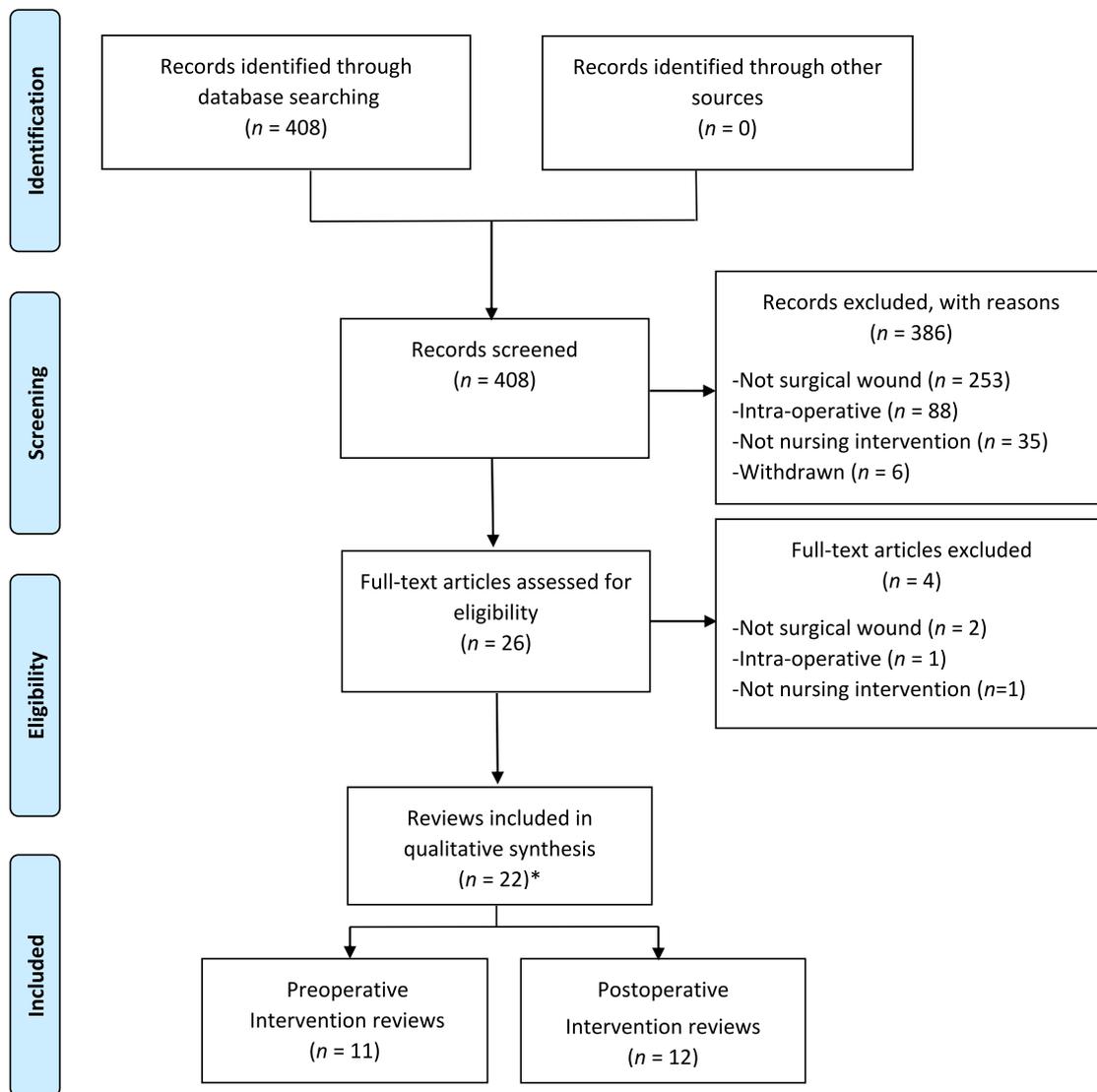


Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-analyses Flow Chart.

*1 review assessed both preoperative and postoperative Interventions for Surgical Wounds.

2.7. Data synthesis

Recommendations for practice and research were synthesised in narrative form, with evidence tables provided which contained quantitative effect estimates underpinning the recommendations, where available. Recommendations were categorised as being either 'specific' or 'general'. Specific recommendations included interventions that directly related to wound care practice and/or management, whereas general recommendations were considered as applicable to any areas of clinical practice, such as cost issues, patient condition. Content analysis of research recommendations using both inductive and deductive techniques was undertaken, and results presented in tabular format for both pre-operative and post-operative surgical wound interventions. This content analysis was directed by the following questions:

- Are practice and/or research recommendations made? (no/yes)
- What are the practice and/or research recommendations?
- How many practice recommendations are made to undertake a practice (i.e. to do something)?
- How many recommendations were made to not undertake (or stop) a practice (i.e. to not do something)?

- What is the certainty or quality of the body of evidence for each recommendation?

3. Results

3.1. Identification and selection of reviews

Fig. 1 displays the Preferred Reporting Items for Systematic Reviews and Meta-analyses flow chart of Cochrane reviews used to identify and select reviews for inclusion. Our search identified 408 records, of which 386 were excluded after screening titles and abstracts, and a further four excluded after reading full-text articles, leaving 22 reviews that were included for analysis based on selection criteria. All reviews were published between July 2006 and October 2018. Of the 22 included reviews, one review (Gurusamy et al., 2014) assessed both preoperative and postoperative interventions.

3.2. Characteristics of the included reviews

Table 1 details study information relative to preoperative and postoperative reviews respectively. Of 22 included reviews, 11

Table 1
Study characteristics for pre and postoperative reviews.

Author (year) Citation	# studies (# patients)	Population and surgery	Intervention	Comparator	Outcome	Quality/Certainty of evidence
Pre-operative Arrowsmith and Taylor (2014)	1 (102)	Scrub nurses prior to surgery	Removal of nail polish or rings	No removal	<ul style="list-style-type: none"> • # Bacterial colonising forming units 	Not reported No *
Basevi and Lavender (2014)	Review 3 (1039) Surgical wound studies 1 (458)	Women in labour	Perineal shaving before birth	No shaving or clipping	<ul style="list-style-type: none"> • Maternal fever • Perineal wound infection • Perineal dehiscence • Side effects (irritation) • Need for resuturing • Maternal satisfaction • Neonatal infection 	Very Low to Low*
Dumville et al., 2015	13 (2623)	Patients of any age undergoing clean surgery	Various skin antiseptics	Alternative antiseptics or soap	<ul style="list-style-type: none"> • Surgical site infection (risk and rate) • Adverse events • Quality of life • Resource use 	Very Low estimate or Low *
Gurusamy et al., 2014	7 (614)	Patients undergoing liver trans-plantation	Various methods to prevent liver transplantation wound complications	Other practices	<ul style="list-style-type: none"> • Mortality • Retransplantation • Adverse events • Graft rejection • Intensive therapy stay • Hospital length of stay • Quality of life 	Very low *
Haas et al., 2018	11 (3403)	Women undergoing caesarean section	Various vaginal cleaning solutions and practices prior to caesarean section	No preparation or use of saline	<ul style="list-style-type: none"> • Post-op fever • Post-op complications (endometriosis, wound infection, adverse events) 	Moderate*
Hadiati et al., 2018	11 (6234)	Women undergoing caesarean section	Various agents for skin preparation prior to caesarean section	Other practices	<ul style="list-style-type: none"> • Surgical site infection • Endometriosis • Endomyometritis • Maternal mortality • Repeat surgery • Skin irritation (or reaction) • Hospital length of stay • Readmission for infection 	Very low to Moderate*
Liu et al., 2017	2 (291)	Carriers of Staph-lococcus aureus undergoing cardiac surgery	Nasal de-contamination with antiseptic or antibiotic	Placebo or no de -contamination	<ul style="list-style-type: none"> • Mortality • Surgical site infection • Other nosocomial infections • Adverse events • Resource use • Cost • Quality of life 	Very low to Low*
O'Kelly and Moore, 2017	0 (0)	Pregnant women	Antenatal education about potential perineal wounds	Other practices	<ul style="list-style-type: none"> • Perineal wound healing • Infection rate • Re-attendance or re-admission • Postnatal pain • Quality of life • Maternal bonding • Negative emotional experiences 	Not reported No *
Stewart et al., 2006	35 (13,669)	Arterial reconstruction	Bathing/ showering with antiseptic	Normal bath/shower	<ul style="list-style-type: none"> • Wound/graft infection 	Jadad score ⁹ M = 2.7 (0 =very poor, 5=rigorous) No *
Tanner et al., 2011	14 (3638)	Adult patients undergoing surgery	Preoperative hair removal, timing and method	No hair removal or different methods/ timing of hair removal	<ul style="list-style-type: none"> • Wound complications including surgical site infection • Hospital length of stay • Cost of hair removal 	Not high quality No *

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Table 1 (Continued).

Author (year) Citation	# studies (# patients)	Population and surgery	Intervention	Comparator	Outcome	Quality/Certainty of evidence
Webster and Osborne (2015)	7 (10,157)	Adults and children undergoing any type of surgery	Bathing or showering with antiseptics	Bathing or showering without antiseptics	<ul style="list-style-type: none"> • Mortality • Surgical site infection • Allergic reaction • Hospital length of stay • Readmission 	Very low to High *
Post-operative Dat et al., 2012	Review 7 (347); Surgical wounds 2 (98)	Acute and chronic wounds	Aloe-vera dressing	Placebo	<ul style="list-style-type: none"> • Wound healing • Wound appearance • Adverse events (including infection) • Cost • Quality of life 	Poor quality trials No *
Dumville et al., 2016	29 (5718)	Adults or children who had undergone surgical procedures	Various wound dressings	Alternative dressings or no dressings	<ul style="list-style-type: none"> • Surgical site infection • Scarring • Acceptability • Ease of removal • Pain • Cost 	Very low to Low*
Fernandez and Griffiths (2012)	Review 11 (3449); surgical wounds 4 (1238)	People of all ages with a wound of any aetiology	Water, Normal saline, Tap water, Distilled water, Boiled water	No cleansing, Procaine spirit, Saline, Isotonic saline	<ul style="list-style-type: none"> • Infection • Proportion of wounds that healed • Rate of healing • Pain • Discomfort • Patient satisfaction • Staff satisfaction • Costs 	Poor quality trials No *
Heal et al., 2016	14 (6466)	Wounds healing by primary intention	Topical antibiotics	Placebo	<ul style="list-style-type: none"> • Surgical site infection • Allergic contact dermatitis • Time to healing • Proportion of wound that had healed • Patient satisfaction • Quality of life • Cost for preventing infection 	Very low to Moderate *
Jull et al., 2015	Review 26 (3011); surgical wounds 1 (50)	Acute or chronic wounds, women undergoing caesarean section or hyste-rectomy	Topical honey	Antiseptic washes followed by gauze or other practice	<ul style="list-style-type: none"> • Wound healing time • Adverse events • Infection • Quality of life • Costs 	Moderate *
Lethaby et al., 2013	11 (572)	External bone fixation and pins	Various methods to clean or dress pin sites	Other practices	<ul style="list-style-type: none"> • Pin site infection • Pin site re-siting • External fixator apparatus removal • Patient comfort • Patient acceptability • Duration of treatment and overall treatment • Cost • Limb amputation • Mortality 	Poor quality trials No *
Smith et al., 2013	5 (159)	Patients with a surgical wound that required debridement	Various debridement methods	Other debridement, placebo or no debridement	<ul style="list-style-type: none"> • Time to complete debridement • Time to healing • Proportion of wounds that healed completely • Infection • Hospital length of stay • Cost • Patient satisfaction • Quality of life 	Poor quality trials No *

(Continued on next page)

Table 1 (Continued).

Author (year) Citation	# studies (# patients)	Population and surgery	Intervention	Comparator	Outcome	Quality/Certainty of evidence
Toon et al., 2015	4 (280)	Primary closure of clean and clean contaminated surgical wounds	Early dressing removal (within 48 h)	Delayed removal	<ul style="list-style-type: none"> • Superficial surgical site infection • Wound dehiscence • Serious adverse events • <i>Quality of life</i> • <i>Time to return to work</i> • Hospital length of stay • Costs 	Very Low to Low *
Toon et al., 2015	1 (857)	Patients with a surgical procedure and had surgical closure of their wounds	Early post-operative bathing (dressing to be removed after 12 h and normal bathing resumed)	Delayed post-operative bathing (dressing to be retained for at least 48 h before removal and resumption of normal bathing)	<ul style="list-style-type: none"> • Surgical site infection • <i>Dehiscence</i> • <i>Wound delayed morbidity</i> i.e. <i>incisional hernia, keloid scar</i> • <i># dressing changes</i> • <i>Quality of life</i> • <i>Hospital length of stay</i> • <i># hospital/home visits</i> • <i>Antibiotics required</i> 	Very low *
Vermeulen et al., 2007	Review 3 (847); surgical wounds 1 (619)	Contaminated or infected wounds	Topical silver	Local practice	<ul style="list-style-type: none"> • Wound healing • <i>Pain</i> • <i>Days of wound infection</i> • Adverse effects • Systemic antibiotics • Patient satisfaction • <i>Quality of life</i> • <i>Hospital length of stay</i> • <i>Costs</i> 	Not reported No *
Webster et al., 2014	9 (785)	Skin grafts and wounds healing by primary intention	Negative pressure wound therapy	Other dressings	<ul style="list-style-type: none"> • Mortality • Surgical site infection • Wound dehiscence • Seroma/haematoma • Failed skin graft • Time to complete healing • Re-operation • Hospital length of stay • Fracture blisters • <i>Pain</i> • <i>Quality of life</i> • <i>Costs</i> 	Unclear, poor quality trials No *

Note: * = Grading of Recommendations Assessment, Development and Evaluation; italics denotes outcomes identified in the review but no primary studies had data on these outcomes; # = number; Jadad score⁹ = 3-point questionnaire using yes/no response for the following questions: *Was the study described as randomized?*, *Was the study described as double blind?* and *Was there a description of withdrawals and dropouts?* (Jadad et al., 1998); * Gurusamy et al., 2014 is also included in post-operative.

reviews focused on pre-operative interventions and 11 focused on postoperative interventions, with one (Gurusamy et al., 2014) focusing on both pre- and postoperative interventions. There were 183 primary studies on surgical wounds from 33 countries across the included reviews. The top three countries where the primary studies were conducted were; the United States ($n = 54$), the United Kingdom ($n = 32$) and Denmark ($n = 10$). Three reviews included studies that were multinational (Lethaby et al., 2013; Vermeulen et al., 2007; Webster et al., 2014).

12 (54.5%) reviews were published after 2014 and reported the additional Grading of Recommendations Assessment, Development and Evaluation criteria, and six (27.3%) (Basevi and Lavender, 2014; Gurusamy et al., 2014; Haas et al., 2018; Hadiati et al., 2018; O'Kelly and Moore, 2017; Stewart et al., 2006) were published by authors who were not members of the Cochrane Wounds group. Sixteen (72.7%) reviews were comprised solely of randomised controlled trials; while five (22.7%) included both randomised and quasi-randomised control trials. A single review had no studies (O'Kelly and Moore, 2017) although it met the inclusion criteria, and represented a gap in knowledge relative to education as a preoperative intervention.

3.3. Findings of the included systematic reviews

Across all reviews, review authors made 11 specific 'to do' recommendations and 2 specific 'not to do' recommendations. Table 2 details the recommendations for clinical practice across the preoperative and postoperative Cochrane Reviews. Of the 11 preoperative reviews, five reviews made at least one specific 'to do' recommendation while 1/11 review made at least one 'do not do' recommendation. Of the 12 postoperative reviews, six made at least one specific recommendation to do something while 1/12 review made at least one specific recommendation not to do something. In all, eight specific recommendations were made to do something, and five specific recommendations were made not to do something. Across reviews, there were 10 general recommendations, such as considering costs, patient preferences, relative benefits and potential harms.

3.4. Recommendations for research

Table 3 shows the recommendations for future research in respect to methodological issues and outcomes identified across

Table 2
Clinical recommendations for pre-operative and post-operative surgical wound practice ($n = 22$).

Area of surgical wound care practice	Specific 'to do' recommendations	Specific 'do not do' recommendations	General recommendations	Review Reference
<i>Pre-operative practices</i>				
Removal of nail polish and rings.	1. Develop local policies based on expert opinion of clinicians.			Arrowsmith et al., (2001)
Preoperative skin antiseptics.			1. Consider potential side effects of alternative skin preparation solutions. 2. Consider costs	Dumville et al., 2015
Vaginal cleansing with antiseptic solution before caesarean section.	2. Implement preoperative vaginal cleansing with povidone-iodine or chlorhexidine before caesarean deliveries.			Haas et al., 2018
Nasal decontamination in <i>Staphylococcus aureus</i> carriers.			3. Consider potential side effects when choosing between alternatives. 4. Consider costs	Liu et al., 2017
Prevention of infection in arterial reconstruction.	3. Use antibiotic prophylaxis using antibiotics that fight staphylococcal and Gram-negative bacteria.			Stewart et al., 2006
Preoperative hair removal.	4. If hair removal is needed, clip.			Tanner et al., 2011
Preoperative shaving.		1. Shaving should not be part of routine clinical practice.		Tanner et al., 2011
Preoperative bathing or showering with skin antiseptics to prevent surgical site infection.	5. Focus on interventions where effect is evident.			Webster and Osborne (2015)
<i>Post-operative practices</i>				
Negative pressure wound therapy for skin grafts and surgical wounds healing by primary intention.			1. Consider patient preferences when choosing dressings. 2. Consider costs.	Webster et al., 2014
Negative pressure wound therapy for skin grafts and surgical wounds healing by primary intention.		1. Avoid using negative pressure wound therapy following orthopaedic surgery until safety in this population is established.		Webster et al., 2014
Dressings or surgical incisions.	1. Use antibiotic prophylaxis.		3. Use existing evidence and guidelines, e.g., hand hygiene.	Dumville et al., 2016
Early versus delayed post-operative bathing or showering.	1. Consider the quality of water. 2. Consider the type of wound (i.e., primary/secondary closure).			Toon et al., 2015
Water for wound cleansing.			4. Consider relative benefits of cleansing clean surgical wounds. 5. Consider the patient's general condition, including comorbidities	Fernandez and Griffiths (2012)
Pin site care for external bone fixators.			6. Implement general strategies to reduce cross-infection.	Lethaby et al., 2013

reviews of preoperative and post-operative surgical site infection prevention interventions respectively. In terms of preoperative interventions, 10/11 reviews recommended that further research was needed in gauging the certainty of effects of the interventions trialled, with 5/11 reviews concluding more rigorous research was needed in overcoming insufficient sample sizes (7/11), short follow up periods (3/11) and suboptimal compliance with the reporting standards of the CONSolidated Standards of Reporting Trials Statement (3/11). Topics cited as in need of more investigation included adverse events/effects (6/11) and new comparisons between different interventions (5/11).

Regarding reviews of postoperative surgical site infection prevention interventions, all included reviews recommended the need for further high-quality research (Table 4) in dealing with issues of insufficient sample sizes (7/12) and limitations in allocation concealment (7/12). Analyses of cost-effectiveness (10/12)

and quality of life (7/12) were nominated as topics for future studies.

3.5. Quality of included reviews

Table 5 displays the methodological quality of the reviews as determined by the *A MeaSurement Tool to Assess Systematic Reviews* 2 checklist. For reviews that did not include any identified studies or were not able to conduct a meta-analysis, some items were not able to be analysed. Therefore, one review could not assess items 8 and 11–15, while seven reviews could not assess items 11, 12 and 15. Across reviews, the percentage of all reviews meeting each criterion ranged from 57% to 100% in regards to the denominator of assessable items. In all, 15 reviews were rated as 'high quality' (Gurusamy et al., 2014; Haas et al., 2018; Hadiati et al., 2018; Heal et al., 2016; Jull et al., 2015; Lethaby et al., 2013; Liu et al., 2017;

Table 3

Recommendations for future research, including methodological issues.

	Future Research			Methodological issues									
	Further trials needed Y/N	Better quality research needed	More research based on collaboration with decision makers	Larger sample/more sites	Powered sample	Allocation concealment	Blinding Outcomes	Longer Follow up	Appropriate statistical analysis	Inclusion of Intention to treat analysis	Clearly defined interventions	Reporting by CONSORT statement	Include baseline Comparability of groups
<i>Surgical Site Infection-Pre-op</i>													
Removal of nail polish & finger rings to prevent surgical site infection.	Y	✓		✓	✓	✓	✓				✓		
Routine perineal shaving on admission in labour.	N												
Preoperative skin antiseptics for preventing surgical wound infections after clean surgery.	Y		✓	✓									
Methods of preventing bacterial sepsis & wound complications after liver transplantation.	Y	✓										✓	
Vaginal preparation with antiseptic solution before caesarean section for preventing postoperative infections.	Y												
Skin preparation for preventing infection following caesarean section.	Y	✓		✓		✓	✓				✓		
Nasal decontamination for the prevention of wound infections in Staphylococcus aureus carriers.	Y	✓	✓	✓	✓			✓					
Antenatal maternal education for improving postnatal perineal healing for women who have birthed in a hospital setting.	Y			✓									
Prevention of infection in arterial reconstruction.	Y												
Preoperative hair removal to reduce wound infections.	Y			✓	✓			✓				✓	✓
Preoperative bathing or showering with skin antiseptics to prevent wound infection.	Y	✓		✓	✓			✓				✓	✓
<i>Surgical Site Infection Post-Op</i>													
Aloe vera for treating acute & chronic wounds.	Y	✓		✓	✓	✓	✓			✓		✓	
Dressings for the prevention of wound infections.	Y	✓	✓	✓	✓							✓	
Water for wound cleansing.	Y	✓			✓	✓	✓	✓	✓			✓	✓
Methods of preventing bacterial sepsis & wound complications after liver transplantation.	Y	✓										✓	
Topical antibiotics for preventing wound infections in wounds healing by primary intention.	Y	✓				✓							
Honey as a topical treatment for wounds.	Y	✓		✓	✓	✓	✓			✓		✓	✓
Pin site care for preventing infections associated with external bone fixators and pins.	Y	✓		✓	✓	✓							
Topical silver for preventing wound infection.	Y	✓	✓	✓	✓								
Debridement for surgical wounds.	Y	✓				✓	✓	✓				✓	
Early vs. delayed dressing removal after primary closure of clean & clean-contaminated surgical wounds.	Y												
Early vs. delayed post-operative bathing or showering to prevent wound complications.	Y	✓						✓					
Negative pressure wound therapy for skin grafts & surgical wounds healing by primary intention	Y	✓		✓	✓								

Table 4
 Recommendations in relation to other outcomes.

	Outcomes															
	Cost/ economics	Different settings	Different popula- tions/ Sub Group	Infection Incidence	Patient experience/ satisfaction	Product accept- ability	Adverse events/ effects	Quality of Life	Mortality	Hospital Length of Stay	New Compar- isons	Valid Wound Measures	Time to heal	Wound Infection measure	Wound Complica- tions	Pain
<i>Surgical Site Infection-Pre-op</i>																
<i>Removal of nail polish & finger rings to prevent surgical site infection.</i>	✓			✓			✓	✓								
<i>Routine perineal shaving on admission in labour.</i>																✓
<i>Preoperative skin antiseptics for preventing wound infection in wounds after clean surgery.</i>	✓						✓				✓ ¹					
<i>Methods of preventing bacterial sepsis & wound complications after liver transplantation.</i>							✓	✓	✓	✓						
<i>Vaginal preparation with antiseptic solution before caesarean section for preventing postoperative infections.</i>		✓									✓ ²		✓			
<i>Skin preparation for preventing infection following caesarean section.</i>							✓		✓	✓	✓ ³		✓		✓	
<i>Nasal decontamination for the prevention of wound infections in Staphylococcus aureus carriers.</i>	✓						✓	✓			✓ ⁴					
<i>Antenatal maternal education for improving postnatal perineal healing for women who have birthed in a hospital setting.</i>							✓		✓	✓	✓ ⁵					
<i>Prevention of infection in arterial reconstruction.</i>																
<i>Preoperative hair removal to reduce surgical site infection.</i>										✓	✓ ⁶					
<i>Preoperative bathing or showering with skin antiseptics to prevent wound infection.</i>																
<i>Surgical Site Infection-Post-op</i>																
<i>Aloe vera for treating acute and chronic wounds</i>	✓			✓			✓	✓								
<i>Dressings for the prevention of wound infection.</i>																
<i>Water for wound cleansing.</i>	✓	✓	✓		✓											
<i>Methods of preventing bacterial sepsis & wound complications after liver transplantation.</i>	✓						✓	✓	✓	✓						

(Continued on next page)

Table 4 (Continued).

	Outcomes															
	Cost/ economics	Different settings	Different popula- tions/ Sub Group	Infection Incidence	Patient experience/ satisfaction	Product accept- ability	Adverse events/ effects	Quality of Life	Mortality	Hospital Length of Stay	New Compar- isons	Valid Wound Measures	Time to heal	Wound Infection measure	Wound Compli- cations	Pain
<i>Topical antibiotics for preventing surgical infections in wounds healing by primary intention.</i>	✓		✓					✓			✓ ⁷					
<i>Honey as a topical treatment for wounds.</i>	✓							✓			✓ ⁸					
<i>Pin site care for preventing infections associated with external bone fixators & pins.</i>			✓													
<i>Topical silver for preventing wound infection.</i>	✓							✓				✓				
<i>Debridement for surgical wounds.</i>	✓			✓	✓		✓	✓			✓		✓	✓		
<i>Early vs. delayed dressing removal after primary closure of clean & clean-contaminated surgical wounds.</i>			✓													
<i>Early vs. delayed post-operative bathing or showering to prevent wound complications.</i>	✓		✓					✓								✓
<i>Negative pressure wound therapy for skin grafts & surgical wounds healing by primary intention.</i>	✓		✓							✓	✓ ⁹					✓

Note:

1. Comparison: Alcohol vs. aqueous solutions.
2. Intervention: Care bundles.
3. Comparison: iodine versus chlorhexidine, night versus day of surgery.
4. Intervention: Consider harm of intervention antibiotic resistance.
5. Qualitative Outcomes.
6. Hair removal using clippers v razors v depilatory cream. Different times prior to surgery; Different settings for hair removal (operating theatre, anaesthetic room, ward, patient's home).
7. Topical antibiotics alone versus systemic antibiotics alone versus a combination of systemic and topical antibiotics in preventing surgical site infections.
8. Honey versus other dressing.
9. Different types of negative pressure wound therapy and different pressures.

Table 5
Quality assessment of surgical site infection reviews using the *A MeaSurement Tool to Assess Systematic Reviews 2* checklist ($n = 22$).

Review	1. Question and inclusion	2. Protocol	3. Study design justification	4. Comprehensive search	5. Study selection	6. Data extraction	7. Excluded studies justification	8. Included studies details	9. Risk of bias (RoB)	10. Funding sources	11. Statistical methods	12. RoB on meta-analysis	13. RoB in individual studies	14. Explanation for heterogeneity	15. Publication bias	16. Conflict of interest	Rating
Pre-Operative (n = 11)																	
1	Arrowsmith and Taylor (2014)	Y	Y	N	PY	Y	Y	Y	Y	N	NMC	NMC	Y	Y	NMC	Y	Moderate
2	Basevi and Lavender (2014)	Y	Y	N	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
3	Dumville et al., 2015	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Low
4	Gurusamy et al. (2014)*	Y	Y	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
5	Haas et al., 2018	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
6	Hadiati et al. (2014)	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
7	Liu et al., 2017	Y	Y	N	Y	Y	Y	Y	Y	Y	NMC	NMC	Y	Y	NMC	Y	High
8	O'Kelly and Moore, 2017	Y	Y	N	Y	Y	Y	Y	NSI	Y	Y	NMC	NMC	NSI	NSI	NMC	High
9	Stewart et al., 2006	Y	PY	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Critically low
10	Tanner et al., 2011	Y	Y	N	Y	Y	Y	Y	PY	Y	Y	Y	Y	Y	N	Y	Low
11	Webster and Osborne (2015)	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Low
Percentage of pre-op reviews meeting each criterion																	
		100	91	9	73	100	100	100	90	100	73	100	100	90	100	50	100
Post-Operative (n = 11)																	
12	Dat et al., 2012	Y	Y	N	PY	Y	Y	Y	Y	N	NMC	NMC	Y	Y	NMC	Y	Moderate
13	Dumville et al., 2016	Y	Y	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
14	Fernandez and Griffiths (2012)	Y	Y	N	PY	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Low
15	Gurusamy et al. (2014)*	Y	Y	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
16	Heal et al., 2016	Y	Y	N	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
17	Jull et al., 2015	Y	Y	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
18	Lethaby et al., 2013	Y	Y	N	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
19	Smith et al., 2013	Y	Y	Y	Y	Y	Y	Y	Y	N	NMC	NMC	Y	Y	NMC	Y	High
20	Toon et al., 2015	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High
21	Toon et al., 2015	Y	Y	Y	PY	Y	Y	Y	Y	Y	NMC	NMC	Y	Y	NMC	Y	High
22	Vermeulen et al., 2007	Y	PY	N	Y	Y	Y	Y	PY	Y	NMC	NMC	Y	Y	NMC	Y	High
23	Webster et al., 2014	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Percentage of post-op reviews meeting each criterion																	
		100	92	50	33	100	100	100	91	100	67	100	100	100	88	100	
Percentage of all reviews meeting each criterion																	
		100	91	26	57	100	100	100	91	100	65	100	95	100	67	100	

Note: Bolded table headings denote essential *A MeaSurement Tool to Assess Systematic Reviews 2* checklist domains; Y= yes, PY= partial yes, N=no, NSI= no studies identified, NMC= no meta-analysis conducted. Bolded items are *A MeaSurement Tool to Assess Systematic Reviews 2* checklist critical domains. Reviews with NSI and or NMC in their items cell were excluded from the summary percentage.

* Gurusamy et al., 2014 is the same review, replicated as both pre and postoperative.

O'Kelly and Moore, 2017; Smith et al., 2013; Toon et al., 2015; Toon et al., 2015b; Vermeulen et al., 2007; Webster et al., 2014), two as 'moderate quality' (Arrowsmith and Taylor, 2014; Dat et al., 2012), four as 'low quality' (Fernandez and Griffiths, 2012; Jull et al., 2015; Tanner et al., 2011; Webster and Osborne, 2015) and one 'critically low quality' (Stewart et al., 2006). A single review (2017), found no studies that met their eligibility criteria and so a term "No studies identified" was used as some items could not be assessed.

4. Discussion

This meta-review of Cochrane reviews described pre- and post-operative surgical wound interventions within nurses' scope of practice and examined their methodological quality and synthesis of recommendations for practice and research. Undoubtedly, registered nurses' scope of practice varies across countries relative to what is considered extended practice (e.g., debridement, prescription of topical ointments). Therefore, the application of these recommendations may necessarily differ. Most recommendations for clinical practice were general rather than specific, e.g., within the context of cost (Dumville et al., 2015; Liu et al., 2017; Webster et al., 2014), quality of the body of evidence (Arrowsmith and Taylor, 2014; Lethaby et al., 2013; Tanner et al., 2011; Webster and Osborne, 2015; Webster et al., 2014), likelihood of harm (Dumville et al., 2015; Liu et al., 2017; Toon et al., 2015), and/or patients' and clinicians' preferences (Webster et al., 2014). Recommendations made by review authors to either stop, or not do something clearly focussed on reducing potential side effects or harm (Tanner et al., 2011; Webster et al., 2014). Our findings suggest that most clinical practice recommendations across reviews were tentative or conditional because of methodological limitations and gaps in the evidence base. Given these apparent high levels of uncertainty in wound care (Dumville et al., 2016; Gillespie et al., 2018a, 2018b; Webster et al., 2014), the guidance given to clinicians is more general than specific.

Despite a strong desire to adopt evidence-based practice, many clinicians practice within the constraints of ongoing uncertainty, and base their clinical decision-making on intuition, (Scott et al., 2017) personal experience, peer opinions, professional norms, and past teaching (Gillespie et al., 2014; Hallett et al., 2000; Lamond and Farnell, 1998). When confronted with a clinical conundrum, health professionals often make decisions founded on their internalised tacit guidelines and mental 'rules of thumb' (or heuristics) (Scott et al., 2017). Although this approach may suffice for many decisions, intuitive decision-making is predisposed to various types of 'cognitive biases' that can distort the synthesis and accurate interpretation of information presented (Scott et al., 2017).

Cognitive biases such as 'attribution bias' (*based on my clinical experience I believe this intervention is effective*), 'impact bias' (*this intervention is working well and the patient's wound seems to be improving*), and, 'ambiguity bias' (*I am unsure about what to do so I will stick with what I know and what everyone else seems to do*) (Scott et al., 2017), influence clinical decision-making in wound care. However, it is difficult to determine whether the clinical care delivered is low or high value' when the evidence is so poor or non-existent. In the absence of high-quality evidence, there is a risk that what may eventually be shown to be ineffective or even harmful care is perpetuated over time. For instance, despite the very low certainty of evidence on the prophylactic use of negative pressure wound therapy in preventing surgical site infection, the use of these devices is increasing in surgical care because of clinicians' preferences and the prolific marketing by industry (Gillespie et al., 2014; Webster et al., 2014). Therefore, there is a propensity to make clinical decisions based on limited/weak evidence, or on outdated evidence, which increases the risk that at least some of this care is likely to be of low value. Low value care is care that

provides limited or no benefit, may cause patient harm, or may yield costs that are disproportionate to added benefits (Verkerk et al., 2018).

While all but one review (Basevi and Lavender, 2014) recommended that further trials be undertaken to expand the base of high quality evidence, what remains unclear is the extent to which some of the questions/topic areas highlighted in these reviews are most important to clinicians and consumers. For example, it is questionable whether more research would be of value in investigating removal of nail polish prior to surgery. Further, in surgical wound care and recovery, attention is now being focussed more on lifestyle interventions (e.g., nutrition, early postoperative mobilisation) in combination with other wound care interventions. Nonetheless, interventions such as nutrition have more upstream and diffuse impacts and are not the subject of these Cochrane Reviews which focus on 'just in time' prevention. In all reviews, authors recommended comparisons with multiple other interventions, not just one or two, to be included in the same trials. Mapping research questions against published systematic reviews may identify evidence-rich and evidence-poor areas of clinical practice which can help identify and prioritise directions and focus of future research. For example, one analysis demonstrated that over 50% of published studies are designed without reference to existing systematic reviews of the evidence (Chalmers and Glaziou, 2009), contributing to wasted effort on researching practices for which the evidence is already well established. Compounding this problem are estimates of over 50% of published research being seriously flawed in design or being unusable because of poor reporting, or both (Glaziou and Chalmers, 2018).

4.1. Limitations

We were selective in our approach and included only systematic reviews drawn from the Cochrane database because of their robust methodological approach. While we are aware of other systematic reviews in the area of wounds, such as Chaby et al. (2007); Tardaguila-Garcia et al. (2019) and Sun et al. (2014), we focused on Cochrane Reviews because of their explicit sections on implications for practice and research. However, the results of this review are inherently limited by not only the quality of the reviews, but also the quality of the evidence from the primary studies. Over the 12-year period these Cochrane reviews were published, methodological and reporting standards have improved. However, appraising the overall quality of the reviews using the *A Measurement Tool to Assess Systematic Reviews 2* checklist has some limitations. First, the recommended scoring system marks reviews down where meta-analyses (Q11, 12 and 13) are not possible because of high heterogeneity among primary studies. Second, the tool does not assess the logic underpinning the choice of methods for conducting a particular review. Third, the tool does not specify which risk of bias instruments review authors should use to assess non-randomised trials and downgrades all such studies irrespective of differences in risk of bias.

4.2. Conclusions

The results of this meta-review suggest much uncertainty persists around the evidence to support many of the practices used in surgical wound care. To provide better healthcare, there is a compelling need for better evidence. Despite the availability of well-conducted systematic reviews, their contribution to clinical practice and research is ultimately determined by the quality of the primary studies. Clearly, there is a link between poor research and poor information, making clinical decision making difficult, and perpetuating what may turn out in the future to be a significant burden of low-value care in surgical wound practice.

Conflict of interests

None.

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