Economic case for intraoperative interventions to prevent surgical-site infection

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**Background:** Surgical-site infection (SSI) occurs in 1–10 per cent of all patients undergoing surgery; rates can be higher depending on the type of surgery. The aim of this review was to establish whether (or not) surgical hand asepsis, intraoperative skin antisepsis and selected surgical dressings are cost-effective in SSI prevention, and to examine the quality of reporting.

**Methods:** The authors searched MEDLINE via Ovid, CINAHL via EBSCO, Cochrane Central and Scopus databases systematically from 1990 and 2016. Included were RCTs and quasi-experimental studies published in English, evaluating the economic impact of interventions to prevent SSI relative to surgical hand and skin antisepsis, and wound dressings. Characteristics and results of included studies were extracted using a standard data collection tool. Study and reporting quality were assessed using SIGN and CHEERS checklists.

**Results:** Across the three areas of SSI prevention, the combined searches identified 1214 articles. Of these, five health economic studies evaluating the cost-effectiveness of selected surgical dressings were eligible. Study authors concluded that the interventions being assessed were cost-effective, or were potentially cost saving. Still, there is high uncertainty around the decision to adopt these dressings/devices in practice. The studies’ reporting quality was reasonable; three reported at least 15 of the 24 CHEERS items appropriately. Assessment of methodological quality found that two studies were considered to be of high quality.

**Conclusion:** With few economic studies undertaken in this area, the cost-effectiveness of these strategies is unclear. Incorporating economic evaluations alongside RCTs will help towards evidence-informed decisions.
Surgical-site infection (SSI) is increasingly recognized as an indicator of the quality of patient care. Current estimates of SSI rates are 1–10 per cent\(^1\), although rates as high as 25 per cent have been reported in specialties such as colorectal surgery\(^2\). SSIs are associated with considerable morbidity and it has been suggested that over one-third of deaths are related, at least in part, to SSI\(^3\). From a cost perspective, SSI is a deviation from the standard postoperative pathway. Estimated costs of SSI differ widely, ranging from less than US $400 (€365, exchange rate 31 October 2016) per patient for superficial incisional SSI, to in excess of US $30 000 (€27 376) per patient for sternal or total joint arthroplasty or other serious organ infection\(^4\)–\(^7\). The direct costs of SSI include longer hospital stay, readmission, outpatient and emergency visits, further surgery and prolonged antibiotic treatment\(^8\). Indirect costs of SSI are difficult to quantify, but can include loss of productivity, not only for the patient but also for family members, temporary or permanent loss of function, impaired mental health, decreased patient participation and possibly litigation\(^7\).

Various infection prevention strategies have been used to reduce SSI, with mixed results: perioperative antibiotic prophylaxis\(^9\)–\(^11\), surgical hand asepsis\(^12\), laminar airflow, reduction of foot traffic in and out of the operating theatre\(^13\), ventilation suits\(^14\), use of intraoperative skin antiseptic agents such as alcoholic chlorhexidine or betadine solutions\(^15\), and appropriate selection of surgical dressings\(^16\). Although clinical effectiveness has been the focus of several systematic reviews and meta-analyses in this area\(^17\)–\(^20\), the economic benefit of such interventions remains uncertain. The aim of this review was to determine the extent to which surgical hand asepsis, intraoperative skin antisepsis and selection of surgical dressings were cost-effective strategies in SSI prevention, and to examine the quality of the economic studies.
**A: Methods**

**B: Data sources and search strategy**

The PRISMA statement\(^{21}\), the Centre for Reviews and Dissemination (University of York) guidelines for systematic reviews of economic evaluations\(^{22}\) and guidance from the Campbell and Cochrane Economics Methods Group\(^{23}\) were used. Searches of eligible studies were conducted in MEDLINE via Ovid, CINAHL via EBSCO, Cochrane Central and Scopus databases to identify relevant articles in English published between 1 January 1990 and 17 August 2016 with an abstract available for review. Several search terms and keywords were matched to database-specific indexing terms (medical subject heading (MeSH) and title field (ti)). The operator AND was used to link keywords with different meanings and the operator OR for keywords with similar meanings. The searches undertaken for the three areas of intraoperative SSI prevention strategies are detailed in Appendices S1–S3 (supporting information).

**B: Selection criteria**

Publications identified in the search of the four databases were combined and duplicates removed. All studies found were reviewed for eligibility against the PICO (population, intervention, comparison, outcomes) criteria.

**C: Population**

Studies were included that evaluated the economic benefit of clinical interventions occurring during the intraoperative period intended to prevent SSI. There was no age or sex restriction.

**C: Types of intervention**
The interventions of interest were focused on strategies for surgical hand asepsis (surgical scrub/rub before the start of the procedure), intraoperative skin antisepsis (of patient) applied in the theatre before the start of the procedure, and postoperative dressing selection that occurred in the operating theatre. Studies of preoperative hand hygiene and/or skin antisepsis were excluded.

+C: Control/design

Randomised and quasi-experimental trials were included. Articles lacking an explicitly formulated design or method were excluded. Cross-sectional studies, reviews, guidelines, studies published as an abstract only, studies using simulation or based only on modelling data, and studies based on pure mathematics were also excluded.

+C: Outcome measures

Economic outcomes based on cost-effectiveness analyses, cost–benefit analyses and cost–utility analyses were included (see Table 1 for descriptions). Studies lacking quantitative parameters or reported outcomes were excluded, as well as those reporting only costs.

+B: Data extraction

Two reviewers independently applied inclusion and exclusion criteria, and extracted the data from eligible studies by screening titles, abstracts and full texts of articles. A third reviewer arbitrated where there was limited consensus. Reasons for exclusion were documented. Extracted data included: baseline characteristics, economic information, cost and outcome data, and results of included health economic studies. A structured data collection form23 was used. To ensure comprehensiveness of the data collection form, the authors also consulted previous systematic reviews of health economics studies.
**B: Quality assessment**

The 24-item CHEERS\(^{24}\) checklist and statement were used to assess the reporting quality of the included studies. Each CHEERS criterion is assigned a weight ranging from 0 to 2 (0, did not report criterion; 1, reported poorly; 2, reported well). The 11-item methodology checklist recommended by the Scottish Intercollegiate Guidelines Network (SIGN)\(^ {25}\) was also used to assess the methodological quality of the included economic studies. For an overall assessment of studies, one question for selection 2 of the SIGN statement was answered: ‘How well was the study conducted?’, with ‘high-quality ++’ denoting that all criteria were fulfilled, ‘acceptable +’ that some of the criteria were fulfilled, and ‘unacceptable −’ that few criteria were fulfilled.

**B: Analysis of results**

Data extraction of the included studies revealed that the cost and outcome measures were reported in different formats, which restricted the common comparison of the cost-effectiveness of included studies. Because of this heterogeneity, a narrative approach was applied to summarize the findings. However, all direct and indirect costs of the intervention were extracted, including savings, to the extent to which they were reported. Intervention costs and cost savings following the intervention were recalculated as costs per patient, and all costs were converted into 2016 Australian dollars (AUD) using the Campbell and Cochrane Economics Methods Group – Evidence for Policy and Practice Information and Coordinating Centre cost converter web-based tool\(^ {26}\) to compare the incremental cost of each intervention in the included studies. For the purpose of cost conversion, where the currency and base year were not stated clearly in the included articles, the year of publication was assumed to be the base year, and currency as that of the country where the study was conducted.
**A: Results**

**B: Study descriptions**

A total of 1214 potentially relevant citations were identified through the database searches, of which five health economic studies fulfilled the inclusion criteria (Fig. 1). A number of other studies that were well conducted and reported were considered but they did not meet the inclusion criteria. No eligible articles reporting economic evaluations for the use of surgical hand asepsis or skin antiseptics were found. The five included studies focused on selection of postoperative wound dressings, and compared either negative pressure (vacuum), gauze or film dressings, or wound management protocols using selected dressings. Of the five economic studies, two were conducted in Australia, and one each in Japan, Spain and England (Table 2). These economic evaluations were published between 2000 and 2016, with the majority being published in the past 4 years. Two studies were cost-effectiveness analyses, two were cost–utility analyses and one was a cost–benefit analysis. Detailed descriptions of the included studies are provided in Table 2.

**B: Economic analysis**

**C: Reporting of costs**

Of the five included studies, two were from the perspective of the healthcare provider whereas other three did not explicitly state the study perspective. The costs of interventions were reported in different ways, such as mean cost per patient or patient episode, cost of managing a hypothetical cohort of 1000 surgical patients and cost of each arm of care. Cost included the costs of device and dressings, cost of nursing/staff time, cost of hospital care and postdischarge care, cost of treating superficial SSIs and cost of treating deep/organ SSI. All studies mentioned the data sources and publications from which they extracted the cost data. Two studies reported costs in 2014.
AUD. The other three studies provided cost data in euros\(^{31}\), British pounds\(^{32}\) and US dollars\(^{33}\); however, these studies did not report the base year and/or conversion of the currencies (Table 2). Incremental costs reported in the five included studies ranged from AUD 22.57 (€15.67, exchange rate 31 October 2016)\(^{33}\) to AUD 1117.03 (€775.71)\(^{32}\). Benefits from a healthcare intervention can occur over a specified interval; discounting is a process used to adjust future costs and outcomes to present value in economic evaluations of healthcare interventions\(^{34}\). Three studies\(^{31–33}\) did not report the discount rate, whereas two\(^{29,30}\) justified why they did not discount the cost and outcomes (Table 2). Only two studies\(^{29,30}\) performed sensitivity analyses for uncertainty.

**+8: Reporting of effectiveness**

Both cost–utility analyses used quality-adjusted life-years (QALYs) as the summary health outcome measure and measured health outcomes using the EuroQoL EQ-5D-3L questionnaire (EuroQoL, Rotterdam, The Netherlands)\(^{30}\) and the SF-12\(^{\text{v2}}\)® (Optum\(^{\text{TM}}\); [https://campaign.optum.com/optum-outcomes.html](https://campaign.optum.com/optum-outcomes.html)) instrument\(^{29}\). Rates of SSI, mean nursing time and rate of complications were the reported health outcome measures in the two studies\(^{32,33}\) that performed a cost-effectiveness analysis. One included study\(^{31}\) that assessed the cost benefits of two surgical wounds dressings reported nursing time required for change of dressings, frequency of dressing changes and the duration of inpatient stay as the effectiveness measures.

**+B: Reporting of cost-effectiveness**

All included studies concluded that the intervention or procedure being assessed was cost-effective, or was potentially cost saving. Two studies\(^{29,30}\) assessed negative-pressure wound therapy (NPWT) using cost–utility analysis, and reported an incremental cost-effectiveness
ratio; a willingness-to-pay threshold of AUD 50 000 (€34 722) per QALY was used to assess the cost-effectiveness of the interventions compared. Incremental cost-effectiveness ratio is a measure used to summarize the cost-effectiveness of the intervention being evaluated and can be defined as the ‘average incremental cost associated with one additional unit of outcome’\textsuperscript{35}. Based on the current evidence, these two studies\textsuperscript{29,30} concluded that NPWT is cost-effective; however, the authors stated that there was high uncertainty surrounding the decision to adopt this dressing product in practice. The studies that presented cost-effectiveness analysis\textsuperscript{32,33} provided values for the incremental cost and outcome gained, and concluded that the interventions being studied were cost-effective. Neither study reported incremental cost-effectiveness. However, one study\textsuperscript{33} made comparisons based on incremental costs and outcomes. The other study\textsuperscript{32} claimed the intervention was cost-effective based on the cost saving incurred by the intervention. The study that used cost–benefit analysis\textsuperscript{31} reported the mean saving per patient treated by the intervention. The authors concluded that the intervention had a potential saving of £55 000 (AUD 145 069.26; €100 742.04) by extrapolating the results to an average patient population in the UK National Health Service. Nonetheless, this study did not state clearly the measure of benefit in the cost–benefit analysis, and neither was the outcome converted into monetary benefits. As a result, the study, although labelled as a cost–benefit analysis, did not present all the components of such an analysis.

\textbf{+B: Assessment of reporting and methodological quality}

The reporting quality of the five included studies was assessed using the CHEERS statement\textsuperscript{24} (Table 3; Table S1, supporting information). Three studies\textsuperscript{29–31} were identified as economic evaluations based on title. Most articles\textsuperscript{29–31} presented a clear study question and an explicit statement of the background to the study. Studies generally reported the target
population and subgroups well\textsuperscript{29,31,33}. Of the five studies, three\textsuperscript{29–31} reported at least 15 of 24 of the CHEERS items appropriately. None of the included studies reported heterogeneity, whereas three reported uncertainty and discount rate, as specified in the CHEERS checklist\textsuperscript{24}.

The SIGN checklist\textsuperscript{25} was also used to assess methodological quality (Table 4; Table S2, supporting information). Most of the economic studies\textsuperscript{29–31} defined an answerable question, clearly mentioned the economic importance of the study, justified the choice of design, and cost and outcome measures were relevant and appropriately measured. However, in three studies\textsuperscript{31–33}, decision rules used around cost-effectiveness were not based explicitly on the incremental costs and outcomes. In the overall methodological quality assessment, only two studies\textsuperscript{29,30} were evaluated as being of high quality.

+A: Discussion

This was a systematic review and assessment of the methods and reporting of selected economic evaluation studies based on SSI prevention interventions and their cost-effectiveness. Only five economic studies were found, and all of these examined the cost-effectiveness of various wound dressings applied after surgery. All included studies reported some measure of cost-effectiveness in relation to the use of postoperative dressings to prevent SSI, but only two\textsuperscript{29,30} reported on the uncertainty surrounding the decision to use these dressings in practice. The majority of these economic evaluations were published in the past 4 years, following the publication of the CHEERS statement\textsuperscript{24}. Hence the quality of reporting has necessarily improved.

Conducting economic evaluations alongside the assessment of clinical effectiveness of an intervention provides greater guidance to healthcare decision and policy makers\textsuperscript{22,35}, and serves as an essential tool that allows clinicians to adopt the best available evidence-based options in healthcare organizations with limited resources\textsuperscript{22}. Although the review
studies demonstrated an acceptable level of reporting, there was some mislabelling relative to
the type of economic evaluation undertaken, and some essential analysis components were
not always reported. Cost–benefit analysis is a type of full economic evaluation in which
outcomes have to be valued in monetary terms35. However, cost comparisons and benefit
attributed to the intervention itself may not necessarily be as a direct result of the
intervention; rather, the cost benefit may have been derived from the prevention of sequelae
following the intervention. As a result, some studies reporting cost comparisons and benefit
may be incorrect categorised36. These types of limited evaluation may lead to implementation
of interventions that were cost saving, but not necessarily interventions with the greatest
health benefits35. Sensitivity analysis, characterizing heterogeneity and discount rate are
essential components of analysis in economic evaluations, and in this review were not
performed well in most of the included studies. The lack of these essential analyses has been
reported in other systematic reviews37,38 of healthcare interventions. These issues can have
considerable impact on decision-making where comparisons are made to identify and
implement the most cost-effective interventions in clinical practice.

Planning a parallel economic evaluation as part of an RCT requires a
multidisciplinary approach involving health economists, clinicians and epidemiologists.
Economic evaluations have the potential to provide evidence for clinical interventions
relative to what works (effective), what works better (relatively effective), and what is
efficient (cost-effective) in real-world practice settings. The majority of included studies31–33
were clinically oriented, and the inclusion of a parallel economic evaluation was perhaps not
well emphasized or planned. Incorporating economic evaluations within clinical trials is now
an expectation of many nationally competitive grant-funding schemes in many countries,
including Australia, the UK and the USA. As the scarcity of healthcare resources increases,
decision-makers at all levels are tasked with ensuring that healthcare money is spent wisely.
It not enough for an intervention to be clinically effective or efficacious; it must also demonstrate cost-effectiveness\textsuperscript{39}.

This review has several limitations, as is the case with all systematic reviews of economic evaluations. Owing to the wide variation in terminology used in the field of economic evaluation (surgical hand asepsis, skin antisepsis and postoperative dressings), some relevant articles may have been missed in the review of the literature. Additionally, publications in other languages were not included. Finally, no eligible economic studies relating to surgical hand asepsis and intraoperative skin antisepsis were found, so it was not possible to comment on the economic effectiveness of these strategies in SSI prevention. Still, four large databases were accessed, and a variety of keywords were matched to database-specific indexing terms.

With the small number of full economic evaluations, as well as lack of adherence to some of the standard economic evaluation methods in the included studies, the most cost-effective method to be adopted in the clinical setting to prevent SSI remains unclear. Overall, the conduct and reporting of the studies was acceptable when appraised against standard checklists. Nonetheless, improvements are needed with regard to the appropriate use of terminologies and performance of essential analyses to ascertain heterogeneity, sensitivity analysis and discount rate. Properly planned economic evaluations involving a multidisciplinary approach will help decision-makers to make evidence-informed decisions.

\textbf{+A: Acknowledgements}

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\textit{Disclosure}: The authors declare no conflict of interest.

\textbf{+A: References}


17 Webster J, Scuffham P, Stankiewicz M, Chaboyer W. Negative pressure wound therapy for skin grafts and surgical wounds healing by primary intention. Cochrane Database of Syst Rev 2014; (10)CD009261.


19 Tanner J, Swarbrook S, Stuart J. Surgical hand antisepsis to reduce surgical site infection. Cochrane Database Syst Rev 2008; (1)CD004288.


Supporting information
Additional supporting information may be found in the online version of this article:

Appendix S1 Literature search for articles on intraoperative surgical hand asepsis (Word document)

Appendix S2 Literature search for articles on intraoperative skin antisepsis (Word document)

Appendix S3 Literature search for articles on use of postoperative dressings for surgical incision (Word document)

Fig. S1 PRISMA flow chart for articles on surgical hand asepsis (Word document)

Fig. S2 PRISMA flow chart for articles on intraoperative skin antisepsis (Word document)

Fig. S3 PRISMA flow chart for articles on surgical dressings (Word document)

Table S1 CHEERS checklist assessment for individual studies (Word document)

Table S2 SIGN criteria for individual studies (Word document)

Typesetter: please refer to marked-up figures

Fig. 1 PRISMA flow diagram for systematic selection of studies
Potentially relevant records identified n=1,214

- Surgical hand asepsis n ≠ 515
- Intraoperative skin antisepsis n ≠ 341
- Surgical dressings n ≠ 358

Records retrieved for more detailed evaluation n = 101

- Surgical hand asepsis n = 17
- Intraoperative skin antisepsis n = 16
- Surgical dressings n = 68

Potentially appropriate articles to be included in the economic analysis

- Surgical hand asepsis n = 0
- Intraoperative skin antisepsis n = 0
- Surgical dressings n = 68

Articles included in the narrative analysis, by outcome,

- Surgical dressings n = 5

Excluded (title/abstract)

Not relevant n = 940

- Surgical hand asepsis n = 416
- Intraoperative skin antisepsis n = 303
- Surgical dressings n = 221

Duplicates n = 173

- Surgical hand asepsis n = 82
- Intraoperative skin antisepsis n = 22
- Surgical dressings n = 69

Articles excluded n = 96

- Surgical hand asepsis n = 17
- Intraoperative skin antisepsis n = 16
- Surgical dressings n = 63

Articles withdrawn, by outcome

- Surgical dressings n = 63

- Focussed on clinical outcomes n = 4
- Design not RCT or quasi-experimental n = 21
- Intervention not given during perioperative period n = 3
- Not the intervention of interest n = 1
- No full economic evaluation n = 8
- Based only on modelling n = 2
- Wounds not surgical n = 11
- Review n = 11
- Protocol n = 2

Articles excluded from pooled analysis n = 5
Table 1 Generic types of full economic evaluation

<table>
<thead>
<tr>
<th>Type of Analysis</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost-effectiveness analysis</td>
<td>A single clinical outcome is expressed in natural unit, e.g. postoperative infections prevented or life-years gained. If multiple outcomes are used, cost consequences may be reported. Clinical outcomes may vary in the direction and magnitude of effect.</td>
</tr>
<tr>
<td>Cost–utility analysis</td>
<td>Clinical outcomes are converted to utility scores using a utility measure, e.g. Short Form 6D or the EuroQol EQ-5D™ to estimate quality-adjusted life-years. Can also be done using other utility measures such as health-years equivalent.</td>
</tr>
<tr>
<td>Cost–benefit analysis</td>
<td>Clinical outcomes are converted to monetary units so that a net benefit (or cost) can be estimated. Methods used to convert health benefits to monetary values include willingness-to-pay and human capital approach.</td>
</tr>
</tbody>
</table>
Table 2 Baseline characteristics, economic information and results of the included studies

<table>
<thead>
<tr>
<th>General information</th>
<th>Moore and Foster$^{32}$</th>
<th>Akagi et al.$^{33}$</th>
<th>Arroyo et al.$^{31}$</th>
<th>Heard et al.$^{29}$</th>
<th>Tuffaha et al.$^{30}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Country</strong></td>
<td>UK</td>
<td>Japan</td>
<td>Spain</td>
<td>Australia</td>
<td>Australia</td>
</tr>
<tr>
<td><strong>Setting</strong></td>
<td>Single surgical unit in UK hospital</td>
<td>Nippon Medical School Main Hospital, Japan</td>
<td>14 hospital sites in Spain</td>
<td>Obstetrics unit of a tertiary teaching hospital</td>
<td>Model evaluation based on pilot RCT, teaching hospital</td>
</tr>
<tr>
<td><strong>Study population</strong></td>
<td>Patients with acute surgical wounds left to heal by secondary intention</td>
<td>Surgical patients with primary wound closure</td>
<td>Patients with postoperative wound to heal by primary intention</td>
<td>Obese women undergoing elective caesarean section</td>
<td>Women with BMI $\geq$ 30 kg/m$^2$ undergoing elective caesarean section</td>
</tr>
<tr>
<td><strong>Intervention(s)</strong></td>
<td>Hydrofibre with proflavine dressing versus ribbon gauze</td>
<td>48-h wound management versus conventional 7 days wound management</td>
<td>Polyurethane film (OPOV) dressing versus gauze and tape</td>
<td>Negative-pressure wound therapy versus standard care</td>
<td>Negative-pressure wound therapy versus standard dressing</td>
</tr>
<tr>
<td><strong>Measure of benefit related to cost-effectiveness</strong></td>
<td>n.s. clearly; average saving per patient reported</td>
<td>Rate of SSI Average nursing time</td>
<td>Rate of superficial SSI Rate of complications Number of dressing changes per week and during the patient’s hospital stay</td>
<td>SSI prevented QALYs</td>
<td>QALYs Net monetary benefit</td>
</tr>
<tr>
<td><strong>Time horizon</strong></td>
<td>n.s. clearly</td>
<td>Patient’s hospital stay</td>
<td>n.s. for the hypothetical cohort</td>
<td>4 weeks after discharge</td>
<td>6 months</td>
</tr>
<tr>
<td><strong>Economic information</strong></td>
<td></td>
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</table>

*Table: Moore and Foster$^{32}$, Akagi et al.$^{33}$, Arroyo et al.$^{31}$, Heard et al.$^{29}$, Tuffaha et al.$^{30}$.*
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</thead>
<tbody>
<tr>
<td>Perspective</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>Healthcare provider</td>
<td>Healthcare provider</td>
</tr>
<tr>
<td>Economic outcomes</td>
<td>Average cost per patient episode</td>
<td>Costs per patient</td>
<td>Cost of managing hypothetical cohort of 1000 surgical patients in each arm</td>
<td>Cost per patient</td>
<td>Cost in each arm</td>
</tr>
<tr>
<td>Measurement of costs</td>
<td>Primary and secondary dressings; analgesia; nursing time cost per bed for duration of inpatient stay</td>
<td>Material costs per patient</td>
<td>Dressings, primary and cost of auxiliary dressing; nursing time; treatment of superficial SSIs</td>
<td>Materials cost; nursing time cost; hospital care; postdischarge care</td>
<td>Costs of device and dressing; treatment of superficial and deep/organ SSI; staff time</td>
</tr>
<tr>
<td>Base year and currency</td>
<td>British £</td>
<td>US $ exact currency</td>
<td>€</td>
<td>AUD 2014</td>
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<tr>
<td>Discount rate</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>Reported why not used</td>
<td>Reported why not used</td>
</tr>
<tr>
<td>Sensitivity analysis</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Results</td>
<td>Effectiveness</td>
<td>Incremental effect</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Effectiveness</td>
<td>Mean nursing time in intervention group approximately half that in control</td>
<td>SSI rate: intervention 7.3%, control 10% Mean nursing time: intervention 0.9 min, control 3.8 min</td>
<td>SSI rate: intervention 6.6%, control 1.4%</td>
<td>SSI rate: intervention 25%, control 34.9%</td>
<td>SSI rate: 9.9 (–10.8, 28.4%)† QALYs/patient: 0.002 QALYs: 0.0031</td>
</tr>
</tbody>
</table>
| Incremental effect     | n.s.               | 2.8 min (not significant) | SSI rate: $P = 0.006 Absolute risk difference 0.052 | SSI rate: 9.9 (–10.8, 28.4%)† QALYs/patient: 0.0031 | QALYs: 0.002 Net monetary benefit: AUD 70 for a willingness-
<table>
<thead>
<tr>
<th>Costs per patient‡</th>
<th>Intervention £295 [AUD 855.91; €594.38]</th>
<th>Control £680 [AUD 1972.94; €1370.09]</th>
<th>Intervention US $47.10 [AUD 72.32; €50.22]</th>
<th>Control US $61.80 [AUD 94.89; €65.99]</th>
<th>Intervention AUD 5887.21 (1037.59)* [AUD 5907.15; €4102.16]</th>
<th>Control AUD 5754.04 (1483.93)* [AUD 5773.53; €4009.37]</th>
<th>Intervention AUD 600 [AUD 602.03; €418.07]</th>
<th>Control AUD 570 [AUD 571.93; €397.17]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental cost‡</td>
<td>£385 [AUD 1117.03; €775.71]</td>
<td>US $14.70 [AUD 22.57; €15.67]</td>
<td>€46.61 [AUD 100.85; €70.03]</td>
<td>AUD –133.17 (–397.07, 690.79)† [AUD 133.62; €92.79]</td>
<td></td>
<td></td>
<td>AUD –30 [AUD 30.10; €–20.90]</td>
<td></td>
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<tr>
<td>Cost-effectiveness as reported by authors</td>
<td>In an average UK health authority of 300 000 population, 100 bed-days per year could be saved, releasing an overall potential saving of £55 000</td>
<td>48- h wound management can be made easier, more uniform and more cost-effective compared with conventional wound management</td>
<td>With polyurethane film dressing, 52 fewer superficial SSIs, saving of 104 bed-days. Incremental investment of €2900 in polyurethane film dressing has the potential to result in savings of over €45 000</td>
<td>Incremental cost-effectiveness per SSI prevented: 1347.36 (–17 666.06, 41 873.49)†. Incremental cost-effectiveness per QALY 42 339.87 (–275 040.40, 84 018.60)†</td>
<td>Negative-pressure wound therapy dressings are cost-effective; however, there is high degree of uncertainty surrounding the decision to adopt this technology. More research is needed before implementation</td>
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</tbody>
</table>

Values are *mean(s.d.) and †95 per cent confidence intervals. ‡Values in square brackets are costs converted to 2016 AUD; costs converted to euros based on exchange rate 31 October 2016. For the cost conversion, currency was assumed from the country of authors and manuscript received year was taken as base year when this was not stated (n.s.); SSI, surgical-site infection; QALY, quality-adjusted life-years.
Table 3 Assessment of the reporting quality of studies using CHEERS statement

<table>
<thead>
<tr>
<th>Title and abstract Introduction Methods</th>
<th>No. of studies reporting (n = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not reported</td>
</tr>
<tr>
<td>Title</td>
<td>0</td>
</tr>
<tr>
<td>Abstract</td>
<td>0</td>
</tr>
<tr>
<td>Background and objectives</td>
<td>0</td>
</tr>
<tr>
<td>Target population and subgroups</td>
<td>0</td>
</tr>
<tr>
<td>Setting and location</td>
<td>0</td>
</tr>
<tr>
<td>Study perspective</td>
<td>2</td>
</tr>
<tr>
<td>Comparators</td>
<td>0</td>
</tr>
<tr>
<td>Time horizon</td>
<td>2</td>
</tr>
<tr>
<td>Discount rate</td>
<td>3</td>
</tr>
<tr>
<td>Choice of health outcomes</td>
<td>0</td>
</tr>
<tr>
<td>Measurement of effectiveness</td>
<td>0</td>
</tr>
<tr>
<td>Measurement and valuation of preference-based outcomes (n = 2)</td>
<td>0</td>
</tr>
<tr>
<td>Estimating resources and costs</td>
<td>0</td>
</tr>
<tr>
<td>Section</td>
<td>Item</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Currency, price date and conversion</td>
<td></td>
</tr>
<tr>
<td>Choice of model ((n = 1))</td>
<td></td>
</tr>
<tr>
<td>Assumptions ((n = 1))</td>
<td></td>
</tr>
<tr>
<td>Analytical methods</td>
<td></td>
</tr>
<tr>
<td>Results</td>
<td>Study parameters</td>
</tr>
<tr>
<td></td>
<td>Incremental costs and outcomes</td>
</tr>
<tr>
<td>Characterizing uncertainty</td>
<td></td>
</tr>
<tr>
<td>Characterizing heterogeneity</td>
<td></td>
</tr>
<tr>
<td>Discussion</td>
<td>Study findings, limitations, generalizability and current knowledge</td>
</tr>
<tr>
<td>Other</td>
<td>Source of funding</td>
</tr>
<tr>
<td></td>
<td>Conflicts of interest</td>
</tr>
</tbody>
</table>
Table 4 Assessment of the reporting quality of included studies using SIGN statement

<table>
<thead>
<tr>
<th>In a well conducted economic study:</th>
<th>No. of studies reporting (n = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>The study addresses an appropriate and clearly focused question</td>
<td>3</td>
</tr>
<tr>
<td>The economic importance of the question is clear</td>
<td>3</td>
</tr>
<tr>
<td>The choice of study design is justified</td>
<td>3</td>
</tr>
<tr>
<td>All costs that are relevant from the viewpoint of the study are included, and are measured and valued appropriately</td>
<td>3</td>
</tr>
<tr>
<td>The outcome measures used to answer the study question are relevant to that purpose, and are measured and valued appropriately</td>
<td>3</td>
</tr>
<tr>
<td>If discounting of future costs and outcomes is necessary, it has been performed correctly</td>
<td>2</td>
</tr>
<tr>
<td>Assumptions are made explicit and a sensitivity analysis performed</td>
<td>2</td>
</tr>
<tr>
<td>The decision rule is made explicit and comparisons are made on the basis of incremental costs and outcomes.</td>
<td>2</td>
</tr>
</tbody>
</table>

How well was the study conducted?

| How well was the study conducted?                                                                 | |
|-----------------------------------------------------------------------------------------------------| 2\textsuperscript{29,30} |
| High-quality ++                                                                                      | 2\textsuperscript{29,30} |
| Acceptable +                                                                                         | 2\textsuperscript{31,33} |