Cost-effectiveness of pressure-relieving devices for the prevention and treatment of pressure ulcers
Fleurence R L

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Three strategies for the prevention and treatment of pressure ulcers (PUs) in patients admitted to hospital were examined. The strategies were alternating pressure mattress replacements (APMRs), alternating pressure overlays (APOs), and high-specification foam mattress (standard care strategy, SC).

Type of intervention
Primary prevention and treatment.

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of adult patients admitted to hospital and requiring management for the prevention or treatment of PUs.

Setting
The setting was a hospital. The economic study was carried out in the UK.

Dates to which data relate
The clinical evidence came mainly from a study published in 2002; studies published between 1987 and 2002 were also used. The resource use data and costs came from studies published from 1996 to 1999. The price year was 2003.

Source of effectiveness data
The effectiveness evidence was derived from a synthesis of completed studies and experts' opinions.

Modelling
A decision-tree model was used to examine the clinical and economic implications of the different strategies under evaluation in the analysis in a hypothetical cohort of 1,000 patients. Patients could develop single or multiple ulcers and superficial or severe ulcers. Superficial ulcers were defined as ulcer Grade 1 (nonreactive erythema) or Grade 2 (superficial break in the skin). Severe ulcers were defined as Grade 3 (destruction of the skin without cavity) or Grade 4 (destruction of the skin with cavity involving the underlying tissues). Ulcers could heal and patients could remain in the hospital with a PU, be discharged with a PU, be discharged without a PU, or die. The time horizon of the model was 12 weeks. The structure of the model was reported.

Outcomes assessed in the review
The outcomes estimated from the literature were:

- the proportion of patients admitted to the hospital at risk of developing an ulcer,
- the risk of developing new ulcers in hospitals,
- the proportion of patients admitted with established ulcers,
- the proportion admitted with ulcers that were superficial,
- the proportion of patients with new ulcers that were superficial,
- the proportion with multiple ulcers,
- the proportion of patients who die in a week,
- the proportion of patients discharged at the end of 1 week,
- the proportion of patients with superficial ulcers that heal in 1 week, and
- the proportion with severe ulcers that heal in 1 week.

**Study designs and other criteria for inclusion in the review**

A review of the literature was undertaken to identify primary studies for populating the decision model. The characteristics of the primary study (Clark et al. 2002, see ‘Other Publications of Related Interest’ below for bibliographic details) used as the main source of evidence were reported. This study was a multi-centre, prospective, nonrandomised cohort study that involved 2,507 UK patients. Eligible patients were at least 16 years old, remained in the hospital for at least 2 days, and were not admitted to the following specialty wards: psychiatry, ophthalmology, gynaecology, paediatrics, obstetrics, or mental illness.

**Sources searched to identify primary studies**

MEDLINE was searched but no information on the search strategy was provided.

**Criteria used to ensure the validity of primary studies**

Not stated.

**Methods used to judge relevance and validity, and for extracting data**

Not stated.

**Number of primary studies included**

Seventeen primary studies were initially identified, but clinical evidence was mainly retrieved from one study. Other references were used to determine ranges of values.

**Methods of combining primary studies**

Not relevant since a single study was used.

**Investigation of differences between primary studies**

The authors stated that the primary studies initially identified differed in population, setting, inclusion and exclusion criteria, and level of detail in data reporting.
Results of the review
The proportion of patients admitted to the hospital at risk of developing an ulcer was 41% (range: 20 - 70).

The risk of developing new ulcers in hospitals was 2.9% per week (range: 0 - 5.5).

The proportion of patients admitted with established ulcers was 4% (range: 0 - 10), while the proportion admitted with superficial ulcers was 76% (range: 50 - 80).

The proportion of patients with new ulcers that were superficial was 88.2% (range: 80 - 100), while the proportion with multiple ulcers was 26% (range: 10 - 60).

The proportion of patients who die in a week was 2.1% (range: 1 - 3).

The proportion of patients discharged at the end of 1 week was 75% (range: 70 - 100).

The proportion of patients with superficial ulcers that heal in 1 week was 7% (range: 2 - 12), while the proportion with severe ulcers that heal in 1 week was 2% (range: 1.5 - 4).

Methods used to derive estimates of effectiveness
Expert opinion was used to derive clinical estimates and utility weights. Estimates of utility weights were derived from five health professionals with expertise in wound-care management. The mean of the expert panel response was used in the model.

Estimates of effectiveness and key assumptions
For prevention, a relative risk (RR) of 0.6 (range: 0.4 - 1.2) was used for APOs compared with SC, while an RR of 0.5 (range: 0.4 - 1.2) was used for APMRs.

For treatment, a factor of 1.5 (range: 0.9 - 2) was used to represent the effectiveness of APOs in comparison with SC, while a factor of 1.7 (range: 0.9 - 2) was used for APMRs (a larger factor indicates that the treatment is more effective).

In terms of utility weights, patients with a single superficial PU were estimated to have a quality of life score of 0.68 (range: 0.3 - 1), while patients with multiple superficial PUs obtained a score of 0.5 (range: 0.1 - 1). The quality of life score was 0.36 (range: 0.1 - 1) for a patient with a single severe PU and 0.31 (range: 0.1 - 1) for a patient suffering from multiple severe PU. The utility score for patients discharged with no PU was 0.8 (range: 0.5 - 1).

Measure of benefits used in the economic analysis
The summary benefit measure used in was the quality-adjusted life-years (QALYs). These were estimated using the decision model. The utility values were obtained from a panel of five health professionals using a simple visual rating scale. No discounting was applied. The number of PU-free days was also reported.

Direct costs
Discounting was not relevant since the costs were incurred during a short timeframe. The unit costs were presented only for devices, while treatment and prevention costs were presented as macro-categories. The economic evaluation considered the costs of the treatment and prevention of PUs (of different severity) and the costs of devices under investigation. The cost of prevention was assumed to be the same as treating less severe PUs. The cost/resource boundary of the NHS was used. The costs and resource use data for the prevention and treatment of PUs were derived from a study published in 2003. The costs for devices were estimated from manufacturers and from the literature. Assumptions were also made to derive some resource use data. All the costs were inflated to 2003 values using the Retail Price Index.
Statistical analysis of costs
The costs were treated deterministically in the base-case.

Indirect Costs
The indirect costs were not included in the economic evaluation.

Currency
UK pounds sterling (€).

Sensitivity analysis
A probabilistic sensitivity analysis was carried out in which a probability distribution was assigned to each model input. A Monte Carlo simulation was then run to obtain 10,000 iterations of the model. Cost-effectiveness acceptability curves (CEACs) were also generated.

The ranges of values used were based on published evidence or were set by the experts.

The model was also run with the assumption that the hospital owned no mattress replacements or overlays (and rented all necessary equipment) and then with the assumption that the hospital owned 500 of each type of device.

Estimated benefits used in the economic analysis
All results were reported for a hypothetical cohort of 1,000 patients.

In scenario 1, the estimated QALYs (PU-free days in brackets) were 15.71 (6,760) with SC, 15.74 (6,798) with APOs and 15.74 (6,807) with APMRs at 1 week. The corresponding results at 4 weeks were 62.29 (26,269), 62.61 (26,714) and 62.69 (26,828).

In scenario 2, the estimated QALYs (PU-free days in brackets) were 15.59 (6,655) with SC, 15.61 (6,687) with APOs and 15.61 (6,695) with APMRs at 1 week. The corresponding results at 4 weeks were 62.20 (26,125), 62.42 (26,495) and 62.47 (26,590).

In scenario 3, the estimated QALYs (PU-free days in brackets) were 15.70 (6,808) with SC, 15.71 (6,813) with APOs and 15.71 (6,814) with APMRs at 1 week. The corresponding results at 4 weeks were 62.67 (27,118), 62.76 (27,185) and 62.78 (27,202).

Cost results
In scenario 1, the estimated costs for 1,000 patients at 1 week (4 weeks) were 581,886 (829,982) with SC, 558,429 (766,247) with APOs and 560,158 (786,773) with APMRs.

In scenario 2, the estimated costs for 1,000 patients at 1 week (4 weeks) were 149,995 (285,754) with SC, 121,569 (205,511) with APOs and 114,415 (185,276) with APMRs.

In scenario 3, the estimated costs for 1,000 patients at 1 week (4 weeks) were 105,114 (213,920) with SC, 92,513 (168,580) with APOs and 89,491 (157,805) with APMRs.

Synthesis of costs and benefits
An incremental analysis (incremental cost-utility ratio) was used to combine the costs and QALYs of the alternative strategies under examination.

In scenario 1 and using a time horizon of 1 week, SC was dominated (more costly and less effective than at least another intervention), APO was the reference strategy, and APMR had an incremental cost per QALY far higher than
the threshold of 30,000 per QALY set in the UK.

In scenarios 2 and 3, APMR dominated the other strategies.

Similar results were observed with a time horizon of 4 weeks for all scenarios.

CEACs were reported. These showed the uncertainty associated with the choice of the most cost-effective device. In particular, in scenario 1, given a threshold of 30,000 per QALY, the APMR had a probability of between 42 and 43% of being the preferred strategy at 1 week and between 19 and 32% at 12 weeks. The APO had a probability of 45% of being the preferred strategy at 1 week and between 38 and 45% at 12 weeks. In scenario 2, the APMR had a probability of 64% of being the preferred strategy at 1 week and between 59 and 60% at 12 weeks. The APO had a probability of 36% of being the preferred strategy at 1 week and between 38 and 40% at 12 weeks. Finally, in scenario 3, the APMR had a probability of 61% of being the preferred strategy at 1 week and between 59 and 61% at 12 weeks. The APO had a probability of 38% of being the preferred strategy at 1 week and between 39 and 40% at 12 weeks.

The sensitivity analysis showed that it was less expensive for the hospital to own devices than to rent them, as the total costs decrease with the increase in ownership.

Authors' conclusions
Alternating pressure mattress overlays (APOs) might be cost-effective for the prevention of pressure ulcers (PUs) in patients admitted to hospital, while alternating pressure mattress replacements (APMRs) are likely to be cost-effective for the treatment of superficial or severe PUs.

CRD COMMENTARY - Selection of comparators
The authors justified the choice of the comparators, which were appropriate for the study question. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The effectiveness evidence came from published studies. A review of the literature was undertaken to identify key model inputs. The methods and conduct of the review were not reported. Owing to the variability among the primary studies, the bulk of the evidence came from a single study, with other studies providing ranges of values. No information on the validity of the primary sources was given. Thus, it was not possible to examine the validity of the primary sources. Some experts' opinions were also used. The issue of uncertainty was investigated by performing extensive sensitivity analyses.

Validity of estimate of measure of benefit
The summary benefit measure (QALYs) was appropriate and captures the impact of the interventions on quality of life and survival. No discounting was applied because of the short time horizon of the analysis. The utility weights were derived from expert opinion. The approach used to calculate the QALYs was not extensively described. However, the authors noted that the use of a visual analogue scale to elicit experts' preferences could have been inappropriate.

Validity of estimate of costs
The costs included were consistent with the perspective adopted in the analysis. The unit costs were presented separately from the quantities of resource use for some items, while for other costs a detailed breakdown of the cost categories was not provided. This reduces the possibility of replicating the analysis in other settings. The source of the data was reported. The costs were treated deterministically in the base-case, but probabilistic distributions were assigned to economic inputs in the sensitivity analysis. Variations in the cost estimates were investigated. The price year was reported, which aids reflation exercises in other time periods.
Other issues
The author was unable to make comparisons of the findings with those from other studies as no others were available in this particular field. The issue of the generalisability of the study results to other settings was implicitly addressed in the sensitivity analysis, which enhances the external validity of the study results. The authors noted some limitations of their analysis, such as the use of simplifying assumptions and the fact that the model did not allow for switches in treatment strategies. In general, the cost-effectiveness results do not appear to be very robust given the strong uncertainty around some parameters.

Implications of the study
The study results suggested that more recently developed pressure-relieving systems, such as mattress overlays or mattress replacements, might be cost-effective as an alternative approach to traditional approaches for the management of PUs in patients admitted to hospital.

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Bibliographic details

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Other publications of related interest


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