A cost-benefit analysis of external hip protectors in the nursing home setting
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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
The study examined the use of external hip protectors in the nursing home setting.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised hypothetical permanent residents in nursing home facilities who were Medicare beneficiaries and had not previously fractured their hip.

Setting
The setting was institutional. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness data were derived from studies published between 1982 and 2003. Most of the cost data were derived from studies published between 1993 and 2002. The unit cost of the hip protector and annual replacement frequency were derived from personal communication with suppliers and user experience. The quantities were derived from the model. The price was inflated to 2002 US dollars using the Consumer Price Index.

Source of effectiveness data
The effectiveness data were derived from a review of published studies and authors' opinions.

Modelling
A Markov model was constructed to estimate the short- and long-term outcomes of hip protectors for a hypothetical cohort of nursing home residents. The time horizon of the model was lifetime and the cycle length was 1 year. A distinction was made between patients who could walk independently of assistance and those who depended on assistance. The health states of the participants included pre-fracture independent (or dependent), fracture, post-fracture independent (or dependent) and dead. Individuals at any state could die. It was assumed that dependence on assistance was irreversible.

Outcomes assessed in the review
The effectiveness outcomes assessed were:
the proportion of individuals who were dependent at initial state;

the estimated population without a previous fracture;

the probability of a first fracture of the dependent and the independent;

the relative risk of a second fracture of the independent and dependent;

the probability of functional outcomes with and without fracture remaining independent (or dependent), becoming dependent, and dying before independent (or dependent);

the relative risk with hip protector; and

annual replacement frequency.

**Study designs and other criteria for inclusion in the review**
The primary study used to derive the effectiveness of hip protectors in the base-case was a randomised controlled trial. A variety of other studies were included. The authors do not appear to have conducted a systematic review of the literature.

**Sources searched to identify primary studies**
Not reported.

**Criteria used to ensure the validity of primary studies**
Not reported.

**Methods used to judge relevance and validity, and for extracting data**
Not reported.

**Number of primary studies included**
Twenty-six primary studies were included in the review.

**Methods of combining primary studies**
Not reported.

**Investigation of differences between primary studies**
Not reported.

**Results of the review**
The base-case outcomes are reported below, with the sensitivity range shown in brackets:

The probability of a first fracture for an independent person was 0.0040 (0.00147 - 0.00981) for women aged 65 - 69, 0.0072 (0.00258 - 0.0195) for men aged 65 - 69, 0.0112 (0.00392 - 0.0318) for women aged 85 and older and 0.0115 (0.00272 - 0.0328) for men aged 85 and older.

The probability of a first fracture for a dependent person was 0.0162 (0.00557 - 0.0318) for women aged 65 - 69, 0.0293 (0.0196 - 0.0419) for men aged 65 - 69, 0.0451 (0.0111 - 0.0751) for women aged 85 and older and 0.0462 (0.0115 - 0.0795) for men aged 85 and older.
The relative risk of a second fracture for an independent or dependent person was 2.8 for women aged 65 - 69, 7.5 for men aged 65 - 69, 1.4 for women aged 85 and older and 2.2 for men aged 85 and older, with ranges between 0.5 and two times the base-case.

The relative risk with the use of a hip protector was 0.43 (0 - 0.99).

The readers were referred to the original paper for transition probabilities.

**Methods used to derive estimates of effectiveness**
It appears that the ranges used in the sensitivity analysis for some parameters were based on authors' opinions.

**Estimates of effectiveness and key assumptions**
For relative risk of a second fracture and probability of functional outcome with and without fracture, the ranges for the sensitivity analysis were 0.5 to two times the base-case.

**Measure of benefits used in the economic analysis**
The measures of benefit were the lifetime absolute risk reduction (ARR) and life expectancy gain.

**Direct costs**
The costs and the quantities were analysed separately. The cost/quantity boundary adopted was that of Medicare. The medical costs, medical costs of death and hip fracture repair costs were obtained from published studies. The cost per hip protector was derived from personal communication with suppliers and user experience. The quantities were derived from the Markov model. The lifetime costs were discounted at a rate of 3%. The price year was 2002.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
The indirect costs were not assessed.

**Currency**
US dollars ($).

**Sensitivity analysis**
One-way sensitivity analyses were carried out on all model parameters. A threshold analysis was carried out on variables over whose range cost-savings became negative for both individual cohorts and the overall nursing home population. The ranges for some of the parameters were obtained from published studies, whilst those for other parameters were based on authors’ opinions.

**Estimated benefits used in the economic analysis**
For the annual replacement of three pairs of hip protectors, the lifetime ARR was:

- 11.8% for female residents at age 65, 14.4 at age 70, 12.1 at age 75, 12.0 at age 80 and 7.9 at age 85; and
- 7.7% for male residents at age 65, 5.3 at age 70, 4.7 at age 75, 5.2 at age 80 and 4.5 at age 85.
A weighted average lifetime ARR was 8.5%.

The programme resulted in 6,640 life-years gained (LYG) for the hypothetical cohort of US nursing home female residents at age 65, 13,400 LYG for 85-year-old women, 2,450 LYG for 65-year-old men and 273 LYG for 85-year-old men.

**Cost results**
It appears that the authors only reported the cost-savings resulting from the replacement of hip protectors.

**Synthesis of costs and benefits**
The annual replacement of three pairs of hip protectors resulted in cost-savings of $91 in the first year and $199 during the lifetime of the average female nursing home resident.

The annual replacement of three pairs of hip protectors resulted in cost-savings of $17 in the first year and $24 during the lifetime of the average male nursing home resident.

For the hypothetical cohort of US nursing home residents, the programme saved Medicare $136 million in the first year and $283 million over their remaining lifetime.

Sensitivity analyses revealed hip protectors were cost-saving to Medicare if the annual cost of a hip protector was no greater than $151 per person, the relative risk of fracture was no larger than 0.65, or adherence was not less than 42%. The authors also presented ranges of other parameters over which the hip protector was cost-saving.

**Authors' conclusions**
Hip protectors were cost-saving for US nursing home residents aged at least 65 years as long as the relative risk was less than or equal to 0.65 over their remaining lifetime.

**CRD COMMENTARY - Selection of comparators**
It would appear that the comparator represented current practice in the authors' setting. You should decide if the comparator is current practice in your own setting.

**Validity of estimate of measure of effectiveness**
The model parameters were derived from published studies, including randomised trials and a meta-analysis. However, it is likely that the authors did not conduct a systematic review of the literature and, therefore, the clinical or epidemiological parameters could be biased. All key variables were varied in the sensitivity analysis.

**Validity of estimate of measure of benefit**
The Markov model applied to the estimation of benefit was appropriate. The use of ARR as a measure of benefit was able to reflect the effect of the hip protector appropriately. Extended life expectancy only permits partially health technology comparisons, as quality of life is not taken into consideration.

**Validity of estimate of costs**
The authors stated explicitly which perspective was adopted in the study. As such, it appears that all the relevant categories of costs have been included in the analysis. The costs and the quantities were reported separately, which raise the generalisability of the authors' results. The costs of the intervention were not provided, which may limit the possibility of replicating the study. The costs were treated deterministically in the base-case, but extensive sensitivity analyses were conducted and the economic inputs were varied over plausible ranges. Discounting was performed on the lifetime costs, and the price year was reported. This aids reflation exercises in other settings.
Other issues
The authors compared their findings with those from other studies in various countries. The issue of the generalisability of the study results to other settings was explicitly addressed by performing extensive sensitivity analyses, the results of which were satisfactorily reported. This enhances the external validity of the analysis. The authors' conclusions reflected the scope of the analysis. Several limitations to the study were reported. For instance, the risk of fracture and death may have been underestimated for the younger nursing home population, which would lead the model to underestimate the lifetime cost-savings. The study did not consider the side effects related to hip protectors, nor did it consider quality of life of wearing hip protectors.

Implications of the study
The study suggested that, from the perspective of Medicare, hip protectors should be recommended in the nursing home environment.

Source of funding
Supported by the National Institute on Aging and the Hartford/AFAR Academic Fellowship Program in Geriatric Medicine and Geriatric Psychiatry, 2002.

Bibliographic details

PubMedID
15673340

DOI
10.1111/j.1532-5415.2005.53102.x

Other publications of related interest


Indexing Status
Subject indexing assigned by NLM

MeSH
Aged; Aged, 80 and over; Cost-Benefit Analysis; Decision Trees; Direct Service Costs; Female; Hip Fractures /economics /prevention & control; Humans; Male; Markov Chains; Medicare; Nursing Homes; Protective Devices /economics; United States