Cost-effectiveness of hip protectors in the prevention of osteoporosis related hip fractures in elderly nursing home residents
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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 use of the Impact hip protector (High Tech Bodywear Ltd.), a hard-shell protector with a soft inner lining, for the prevention of osteoporosis-related hip fractures in a high-risk Canadian nursing home population.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis and cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of 1,000 nursing home residents with characteristics based upon a real population from White Rock in British Columbia. The average age of the patient was 85 years. The majority of the population were male, with 69% receiving no treatment for osteoporosis and 29% receiving calcium and vitamin D supplements.

Setting
The setting was an institution (nursing home). The economic study was carried out in Canada.

Dates to which data relate
The effectiveness and resource use evidence were derived from published studies dating from 1992 and 2003. The cost estimates were estimated at 2001 prices.

Source of effectiveness data
The effectiveness data were derived from ad hoc use of the literature. The baseline risk of hip fracture was taken from the incidence of hip fracture in the Peace Arch Hospital nursing home population. Data on the risk of hip fracture when using a hip protector were taken from a Cochrane Review dated 2003. Data on the risk of hip fracture when using calcium and vitamin D supplements came from a further study of a large randomised controlled trial (RCT) that was published in 1992.

Modelling
A decision analytic model was used to predict the costs and effects of each treatment option. Two separate comparisons were undertaken, more specifically, hip protectors versus no treatment and hip protectors versus calcium and vitamin D supplements. The authors modelled both an intermediate clinically significant outcome (hip fracture prevented) and a long-term outcome (quality-adjusted life-year, QALY). The time horizon for estimating the number of hip fractures prevented was 12 months. A lifetime time horizon was used in the QALY analysis. The costs were only calculated for
the first year of the model.

**Outcomes assessed in the review**
The outcomes assessed in this ad hoc review were:

- the relative risk (RR) of hip fracture with no treatment,
- the RR of hip fracture with calcium and vitamin D supplements,
- the relative risk of hip fracture with hip protectors, and
- the baseline incidence of hip fracture.

Compliance rates and adverse effects were not included in the analysis.

**Study designs and other criteria for inclusion in the review**
This was an ad hoc review and there were no inclusion criteria.

**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**
The model inputs were derived from one RCT and a review of 3 RCTs.

**Methods of combining primary studies**
The authors used data from the included studies selectively.

**Investigation of differences between primary studies**
A narrative account was given of how the study samples (in terms of incidence rates and age) were comparable with the hypothetical model cohort.

**Results of the review**
The effectiveness values used in the model were:

- the RR of hip fracture with no treatment, 1.00;
- the RR of hip fracture with calcium and vitamin D supplements, 0.73;
- the RR of hip fracture with hip protector, 0.37 (range: 0.24 - 0.56); and
- baseline incidence of hip fracture, 43 per 1,000/year (range: 26 - 69).
Measure of benefits used in the economic analysis
The measures of benefit used were hip fractures prevented and QALYs gained. The utility measures were taken from a published study that used the EQ-5D instrument to obtain values for a 75- to 84-year age group for the first and second year post fracture. Mortality attributable to hip fracture was estimated from the literature to be 10% in the first year post fracture. Mortality in the second and subsequent years was assumed to be identical to that for nursing home residents without fracture (based on Canadian Life Tables). The QALYs over the lifetime of a nursing home resident were discounted at a rate of 3% per year.

Direct costs
The direct costs (using 2001 prices) included in the analysis were those relating to medical costs. These covered the costs of the hip protector, calcium and vitamin D supplements, acute hospital treatment of hip fracture, and additional nursing aid time. The costs of long-term rehabilitation or care and those relating to side effects were not included. The resource use and cost data for treating a hip fracture and extra nursing aid were obtained the Finance Department of Peace Arch Hospital and from the literature. The costs of other treatment options were derived from local retailers and pharmacies. The resource quantities and the costs were not reported separately. Discounting was not considered necessary as the costs were only calculated for the first year of the model.

Statistical analysis of costs
The costs were treated deterministically.

Indirect Costs
Although the authors stated that a societal perspective was used, there were no reported indirect costs. This is likely to reflect the lack of productivity losses that would be experienced by a population of this age.

Currency
Canadian dollars (Can$).

Sensitivity analysis
Sensitivity analyses were conducted on cost and effectiveness values, using one- and two-way methods. Effectiveness measures were varied using the limits of the 95% confidence interval for the RR of hip fracture when a hip protector is worn. The retail cost of the hip protector was increased and decreased by one third. Additional nursing time was also included in the analysis, so as to explore the variation in costs. A probabilistic sensitivity analysis was carried out to explore the uncertainty surrounding the cost-effectiveness ratios derived. Three variables were assigned distributions, which were fully characterised in the paper. The variables were baseline incidence of hip fracture, cost of hip fracture treatment, and RR of hip fracture when using a hip protector.

Estimated benefits used in the economic analysis
The incremental benefits were not reported separately (see Synthesis of Costs and Benefits).

Cost results
The total costs were not reported. However, the authors provided a breakdown of the costs included as model inputs. The costs of the intervention and comparators were as follows:

- hip protector, Can$150;
- calcium and vitamin D supplements, Can$56;
acute hospital treatment of a hip fracture, Can$16,250; and
additional nursing aid time (2.5 full-time staff per 1,000 residents), Can$112,000.

**Synthesis of costs and benefits**
The incremental benefits and costs were combined in terms of the cost per hip fracture prevented and the cost per QALY (male or female).

The cost per hip fracture prevented was -Can$10,713 for hip protector versus no treatment, and -Can$10,198 for hip protector versus calcium and vitamin D supplements.

The cost per QALY gained (female) was -Can$16,204 for hip protector versus no treatment, and -Can$15,426 for hip protector versus calcium and vitamin D supplements.

The cost per QALY gained (male) was -Can$18,272 for hip protector versus no treatment, and -Can$17,394 for hip protector versus calcium and vitamin D supplements.

Negative incremental cost-effectiveness ratios in the base-case analysis suggested that hip protectors were associated with cost-savings, whilst preventing hip fractures and providing gains in QALYs, when compared with no treatment or the use of calcium and vitamin D supplements.

The results were robust in the sensitivity analysis when the base-case analysis of hip protector was compared with no treatment (generally, negative cost-effectiveness ratios remained). The results were less robust when hip protectors were compared with the calcium and vitamin D treatment option. The cost-effectiveness of hip protectors was found to be dependent upon the baseline incidence of fracture, with cost-savings remaining until the incidence rate dropped below 12 per 1,000 persons.

**Authors' conclusions**
The use of hip protectors is cost-effective in terms of potential cost-savings, the prevention of fractures, and the improvement of the quality of life of elderly nursing home residents in Canada.

**CRD COMMENTARY - Selection of comparators**
The specific hip protector was chosen on the basis that it possessed many desirable features in terms of price and design, and was similar to that used in prior randomised controlled trials. The other options were deemed to represent common practice in the treatment of osteoporosis-related hip fractures. You should decide if these represent widely used technologies in your own setting.

**Validity of estimate of measure of effectiveness**
The model values were largely derived from studies of patients (matched for age, setting and incidence rate) in a published Cochrane review. There was no evidence to suggest that the model inputs had been derived in a systematic manner. No search methods, inclusion criteria, or validity assessment were reported. These facts potentially limit the internal validity, reliability and external generalisability of the findings. The lack of a systematic approach to identifying model inputs makes it difficult to ascertain whether the best available evidence has been used to populate the model. The sensitivity analysis conducted helps address some of the uncertainty, but does not fully deal with the issues raised.

**Validity of estimate of measure of benefit**
The measures of benefit were the hip fractures prevented and the QALYs over a lifetime. The authors used a published study, which had employed the EQ-5D to derive utility scores. There is some concern that the average age in the hypothetical cohort (which reflected the age of nursing home residents in general) did not correspond closely with the age range-related data taken from the utility-based study.
Validity of estimate of costs

The authors stated that a societal perspective was adopted for the cost analysis. However, productivity losses would not have been relevant to this population and, consequently, no indirect costs have been included. In addition, other potentially relevant direct costs, such as those relating to longer-term rehabilitation and nursing care, were excluded from the analysis. The inclusion of these would have increased the cost of hip fracture treatment, thus potentially increasing the cost-savings associated with the hip protector. The omission of costs on side effects, and the failure to account for variations in compliance rates, potentially reduces the cost-effectiveness of the hip protector. The authors acknowledged these limitations. The costs and the quantities (derived from a variety of sources) were not reported separately, which will hinder the possibility of reworking the analysis in other settings. However, the potential variation of resources and costs was appropriately explored in a sensitivity analysis, although the ranges used were not justified. Discounting was not conducted because of the time period in which the costs were analysed. The price year was reported, which will aid any future reflation exercise.

Other issues

The authors compared their findings with those from other studies, which (in general) were in agreement. They directly addressed the issue of generalisability to other settings by exploring different baseline incidence rates, concluding that hip protectors may still be cost-effective in high-risk elderly people living in the community. The author acknowledged several limitations of this study. First, some costs were omitted from the analysis. Second, the use of data from several sources increases potential measurement errors. Third, the potential effects of different levels and measurement of compliance pertaining to the use of the hip protector. Finally, the absence of quality of life measures in relation to wearing the appliance.

Implications of the study

There were no clear policy or practice implications from this study, although the authors suggested that future attention might focus upon improving compliance with this technology.

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