A quantitative analysis of the costs and benefits of prostate cancer screening

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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 prostate specific antigen (PSA), either alone or in combination with digital rectal examination (DRE), in screening for prostate cancer.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
The (model) study population comprised males aged between 50 and 70 years with at least a 10-year life expectancy, who had been screened using either PSA and DRE, or PSA alone techniques.

Setting
The setting was not stated, but it was assumed to have been primary and secondary care. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness data were derived from studies published in 1993, with proxy control data from a study (of non-screened men) published in 1994. The resource use and cost data were derived from the Medicare database (1992), and from published studies dating from 1990 to 1994. The price year was not stated clearly.

Source of effectiveness data
The effectiveness data (for subsequent use in a model) were derived from published studies.

Modelling
A screening model (type unspecified) was developed to estimate the cost-effectiveness of screening and treatment. In the screening model, men with suspicious findings on screening examinations then underwent a transrectal ultrasound (TRUS) of the prostate and a TRUS-guided prostate biopsy. All men with clinically localised disease then underwent RP treatment. Several assumptions from the literature were used in the construction of the model, as follows.

Historical material from Sweden concerning men with prostate cancer diagnosed before the introduction of PSA was compatible with a population of men with cancers detected by PSA screening.

Men with organ-confined prostate cancer treated with RP have a survival advantage over men with organ-confined prostate cancer treated conservatively.
Men with clinically significant, pathologically organ-confined prostate cancer detected by screening will have benefited from that screening.

Men with pathologically organ-confined prostate cancer treated with RP will have the same expected survival as age-matched men without prostate cancer.

There was no benefit from screening in those men with pathological cancer Stages C and D.

It was also assumed that all men with prostate cancer would undergo a radioisotope bone scan for staging purposes. In terms of complications, where patients chose intracorporal injections as the preferred treatment, an average of 50 injections per year (per person) would be needed. In cases of urinary incontinence, it was assumed that 20% would be treated with a urinary sphincter, 20% with a Cunningham clamp (4 clamps per year) and 60% with diapers or pads.

**Outcomes assessed in the review**
The main outcomes assessed in the economic evaluation from this review were:

- the cancer detection rate of screening tests;
- the survival rate of men with prostate cancer, and in the general population; and
- the morbidity rates.

The survival rates were assessed according to sub-groups of age (50 - 59 years, 60 - 69 years, and 50 - 69 years).

**Study designs and other criteria for inclusion in the review**
Prostate screening outcomes were derived from two large-scale screening trials (Richie et al. 1993 and Catalona et al. 1993, see 'Other Publications of Related Interest' for bibliographic details). The authors used outcomes results that were also derived from a published paper (Gronberg et al. 1994, see 'Other Publications of Related Interest' for bibliographic details). This study used data from the Swedish cancer registry.

**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**
Two studies were used to formulate parameters for the model, along with a third study for the purposes of proxy control data.

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

**Investigation of differences between primary studies**
Not applicable.
Results of the review
The latent cancer detection rate was 8.0% for PSA and DRE screening and 2.9% for screening with PSA alone.

The other outcomes assessed in the review were not reported in the present study. However, using these outcomes the authors calculated the benefits of screening.

Methods used to derive estimates of effectiveness
The authors determined the loss of life expectancy due to prostate cancer by comparing the survival rate of all men who had prostate cancer with the Swedish national standard population survival rate. Authors' assumptions were also used to supplement the effectiveness evidence to populate the model.

Estimates of effectiveness and key assumptions
The years of life lost due to prostate cancer were:

- 11.9 years in the 50- to 59-year age group,
- 6.6 years in the 60- to 69-year age group, and
- 7.4 years in the 50- to 69-year age group.

The authors assumed:
- a preoperative mortality rate of 0.3%;
- a rate of incontinence of 10%;
- a rate of impotence following RP treatment of 25%; and
- there would be a 9% rate of bladder neck contracture following RP, and transurethral resection of the bladder neck would be conducted in one third of these men.

Measure of benefits used in the economic analysis
The measure of benefit used was the number of life-years saved (LYS). The health benefits were not discounted.

Direct costs
The direct costs for screening and staging were calculated using the Medicare database. Treatment costs were calculated using a mixture of Medicare charge data and published RP costs (for non-Medicare patients). The cost of complications was calculated using the Medicare database and (for the final analysis) a percentage to reflect this was added to the cost of treatment with RP. The resource quantities and the costs could be calculated separately for screening (the number of men screened and total cost were given), but not for treatment. There was some separation of the quantities and costs in the analysis of late complications. The annual discount rate was 10%. Average costs were used in the analysis and the (Medicare) price year was 1992.

Statistical analysis of costs
Descriptive (average cost) data were presented.

Indirect Costs
There were no reported indirect costs.
Currency
US dollars ($).

Sensitivity analysis
A one-way sensitivity analysis was carried out to explore variations in complication costs, surgical mortality, the
detection of organ-confined cancers and rates of clinically insignificant cancers. The ranges used were largely derived
from published studies. The analysis tested a 100% increase in complication costs, a surgical mortality rate of 1.1%,
organ defined detection rates of less than 10% and 20%, and a doubling of rates for clinically insignificant cancer.
Discount rates of 5 and 10% on future years of life were also tested in the sensitivity analysis.

Estimated benefits used in the economic analysis
Screening with PSA and DRE resulted in:

- 22,926 LYS in the 50- to 59-year age group,
- 27,377 LYS in the 60- to 69-year age group, and
- 23,364 LYS in the 50- to 69-year age group.

Screening with PSA alone resulted in 11,542 LYS in the 50- to 70-year age group.

Cost results
The total cost of screening with PSA and DRE per 100,000 men screened was:

- for age 50 - 59 years, $53,614,208 - $68,888,726;
- for age 60 - 69 years, $106,907,986 - $138,806,659; and

The total cost of screening with PSA alone per 100,000 men screened was $44,116,797 - $57,208,677 for those aged 50
- 70 years.

The total cost of RP treatment ranged from $13,528 to $18,140.

The total cost (per case) of complications for men with organ-confined disease was:

- for age 50 - 59 years, $2,342 (additional cost of complications over RP, 17.3%);
- for age 60 - 69 years, $2,255 (additional cost of complications over RP, 16.7%); and
- for age 50 - 69 years, $2,263 (additional cost of complications over RP, 16.7%).

The total cost (per case) of complications for men with non organ-confined disease was $2,018 for men of all ages
(additional cost of complications over RP, 14.9%).

Synthesis of costs and benefits
For screening with PSA and DRE, the cost per LYS (in the first year of screening) was:

- for age 50 - 59 years, $2,399 - $3,005;
- for age 60 - 69 years, $3,905 - $5,070; and
for age 50 - 69 years, $3,574 - $4,627.

For screening with PSA alone, the cost per LYS (in the first year of screening) was $3,822 - $4,956 for those aged 50 - 70 years.

The sensitivity analysis showed that the cost per LYS by prostate cancer screening would not change substantially, even when the model assumptions were underestimated or overestimated by 100%. When future years of life were discounted by 5%, the cost per LYS increased to $7,147 - $9,524 in men aged 50 - 69 years who were screened by PSA and DRE. This increased to $7,646 - $9,915 for men aged 50 - 70 years who were screened by PSA alone. Discounting the benefits by 10% increased the cost per LYS to $13,222 - $17,121 in men aged 50 - 69 who were screened by PSA and DRE, and to $14,145 - $18,343 in those aged 50 - 70 who were screened by PSA alone.

Authors' conclusions
Prostate cancer screening appears to be a cost-effective intervention, but randomised controlled trials are needed to confirm this proposal.

CRD COMMENTARY - Selection of comparators
There was no explicit justification for the selection of the comparator, other than the authors' reliance upon evidence from two large-scale screening trials that PSA can detect prostate cancer at an early stage. You should decide if this represents a widely used technology in your own setting.

Validity of estimate of measure of effectiveness
The authors did not state that a systematic review of the literature had been undertaken. Since the methods used to find and select the primary studies and to extract the data were unclear, it was difficult to assess the validity of the estimates. The authors appear to have used data from the available studies selectively, and did not consider the impact of potential differences between those studies when estimating effectiveness. This, together with the absence of details of reporting methods or results on the relevance, validity and data extraction of studies, potentially limits the reliability of the findings.

Validity of estimate of measure of benefit
The measure of benefit was the LYS. This was appropriate given the nature of the disease under investigation.

Validity of estimate of costs
The authors did not explicitly report the perspective of the study. The unit costs and the resource quantities were separated for screening, but not for most other items. This means that a comprehensive analysis could not easily be reworked in other settings. The resource quantities and costs (charges) were largely derived from the Medicare database. The authors justified the use of Medicare on the basis that it is acceptable for use within the US health care system. However, such charges do not reflect true opportunity costs (due to profit margin) and (in the absence of a cost-to-charge ratio) may limit the generalisability of the results beyond the authors' clinical setting. The price year was not stated for all cost components, and this will limit any future reflation exercise. A wide range of resource use and costs was appropriately explored in the sensitivity analysis.

Other issues
The authors compared their results with those from other studies. This comparison highlighted some disagreement, which was defended on the basis of generalisability between populations in different countries. The results of the analysis were not adequately reported since relevant outcomes were not given in the present paper. However, the authors' conclusions reflected the scope of the analysis. Limitations of the study (as the authors acknowledged) were the two critical assumptions. First, men with organ-confined prostate cancer treated with RP have a survival advantage over men with organ-confined prostate cancer treated conservatively. Second, historical material from Sweden concerning
men with prostate cancer diagnosed before the introduction of PSA was compatible with a population of men with
cancers detected by PSA screening. When considering these assumptions, the benefits of screening would be
overestimated.

Implications of the study
The authors made no specific recommendations for practice. They did, however, refer to the need for randomised
controlled trials (including the analysis of serial screening over a longer term) to appropriately quantify the costs and
benefits of prostate cancer screening.

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None stated.

Bibliographic details
Benoit R M, Gronberg H, Naslund M J. A quantitative analysis of the costs and benefits of prostate cancer screening.
Prostate Cancer and Prostatic Diseases 2001; 4(3): 138-145

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Other publications of related interest

Catalona WJ, Smith DS, Ratliff TL, et al. Detection of organ confined prostate cancer increase through prostate-
specific antigen-based screening. JAMA 1993;270:948-54.


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