Simulation modeling of change to breast cancer detection age eligibility recommendations in Ontario, 2002 - 2021

Hunter D J, Drake S M, Shortt S E, Dorland J L, Tran N

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
A change in the eligibility requirements for breast cancer screening was examined. This change was the inclusion of women aged between 40 and 49 years, in addition to previous recommendations for women over the age of 50 years.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised a cohort of women eligible for routine radiological screening. The eligibility criteria (age threshold) depended on the type of programme.

Setting
The setting was primary care. The economic study was carried out in Canada.

Dates to which data relate
The effectiveness data and some resource use data were derived from studies published between 1998 and 2003. The price year was not explicitly reported.

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

Modelling
A Markov model was constructed to estimate the clinical and economic impact of the change in eligibility policy for breast cancer screening in the Ontario population over a 20-year timeframe (from 2001 to 2021). The model was based on three main assumptions. One, an established screening programme in Ontario detected breast cancers in many women each year. Two, many breast cancers were detected outside of the established programme ("directed diagnosis"). Three, cancers would progress through stages over time. The model simulated a population of individuals as they progressed through the stages of breast cancer. Cancer cases moved through stages in a predictable order. Healthy women might develop Stage 0 (in situ) cancers, which would then progress in sequence through Stages I to IV. Thus, the general population of women consisted of six groups, those without breast cancer and those with undetected cancers at Stages 0 to IV.

There were five different health services groups in the population. These corresponded to a negative screening test,
positive screening test, negative diagnostic test, positive diagnostic test, and those undergoing initial treatment
(including any combination of surgical excision, adjuvant chemotherapy, hormone therapy and/or radiotherapy). Cases
with positive screening results moved to diagnostic confirmation, while cases with negative screening returned to the
general population. The cycle length was 1 year. A simplified model structure was reported.

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

the size of the population (from 2001 to 2021);

the incidence of breast cancer;

the prevalence;

the participation rate; and

the sensitivity and specificity of screening (i.e. mammography).

Study designs and other criteria for inclusion in the review
It appears that a systematic review of the literature was not undertaken. The primary studies might have been identified
selectively. Most of the clinical data came from Canadian sources, such as the Census of Canada (population size), the
Ontario Cancer Registry (cancer incidence), the National Cancer Institute (age-specific incidence) and the Ontario
Breast Screening Program (participation rate).

Sources searched to identify primary studies
Not stated.

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
Six primary studies provided clinical data.

Methods of combining primary studies
The primary estimates appear to have been combined using a narrative approach.

Investigation of differences between primary studies
Not reported.

Results of the review
The projection of size of the Ontario population showed an increase for all age groups. For example, from 2001 to
2021, the size of the Ontario population increased from 452,866 to 515,800 for the age group 30 - 34 years and from
107,580 to 202,300 for the age group 85+.
The incidence rates, prevalence rates and sensitivity rates depended on the stage and the age group.

For example, the prevalence rates (per 100,000) in Stage 0 were:

- 78 in the age group 30 - 34 years,
- 184.1 in the age group 35 - 39 years,
- 343.4 in the age group 40 - 44 years,
- 491.9 in the age group 45 - 49 years,
- 650 in the age group 50 - 54 years,
- 756.3 in the age group 55 - 59 years,
- 877.8 in the age group 60 - 64 years,
- 1,014.3 in the age group 65 - 69 years,
- 1,088.9 in the age group 70 - 74 years,
- 1,181.1 in the age group 75 - 79 years,
- 1,151.2 in the age group 80 - 84 years, and
- 1,108.3 in the age group 85+.

The incidence rates (cases per year) in Stage 0 were:

- 11 in the age group 30 - 34 years,
- 41 in the age group 35 - 39 years,
- 105 in the age group 40 - 44 years,
- 162 in the age group 45 - 49 years,
- 178 in the age group 50 - 54 years,
- 146 in the age group 55 - 59 years,
- 119 in the age group 60 - 64 years,
- 129 in the age group 65 - 69 years,
- 119 in the age group 70 - 74 years,
- 94 in the age group 75 - 79 years,
- 54 in the age group 80 - 84 years, and
- 34 in the age group 85+.

The sensitivity of mammography was 76% in the 30 - 44 age group and 74% in the 45 - 85 age group. The specificity was 91% for all age groups.
Methods used to derive estimates of effectiveness
The authors made some assumptions to derive clinical data associated with the transition probabilities used in the decision model.

Estimates of effectiveness and key assumptions
The compliance rate (follow-up after positive screen results) was 98%.

The sensitivity of fine-needle aspiration biopsy was 88% and the specificity was 96%.

The transition probabilities across health states were also based on experts’ opinions, and these depended on age and disease stage. For example, the transition probabilities from Stage none to Stage 0 were 0.065 in three age groups (30 - 34 years, 35 - 39 years and 40 - 44 years) and 0.246 in the remaining age groups.

Measure of benefits used in the economic analysis
The summary benefit measure used was the number of detected cancers. This was derived using a modelling approach. An annual discount rate of 3% was used for all model outputs.

Direct costs
The cost analysis appears to have been performed from the perspective of the third-party payer. The health services included in the economic evaluation were screening (bilateral mammogram, which included two fees for the technical and professional components of the process), directed diagnosis (including only the physician visit) and initial treatment (which depended on the stage). Several treatment options appear to have been considered. The unit costs were reported only for screening and physician visits. For other cost items, details of the unit costs and the quantities of resources used were not presented separately. In fact, the costs of cancer treatment were presented as macro-categories. The costs were estimated using data derived from several sources published in 2000 and 2003, such as the Ministry of Health, a local institution, and a published cost analysis. The source of resource use was unclear. Discounting was relevant, as the costs were incurred during a 20-year timeframe, and an annual rate of 3% was applied. A unique price year was not explicitly reported.

Statistical analysis of costs
The costs were treated deterministically.

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

Currency
Canadian dollars (Can$).

Sensitivity analysis
Sensitivity analyses were not performed.

Estimated benefits used in the economic analysis
The projected number of detected cancers over the period 2001 - 2021 was 138,469 with the screening of women aged 50+ years and 145,079 with the screening of women aged 40+ years. The extra number of detected cancers with screening for women aged 40+ years was 6,610.
Cost results
The numbers of screening and diagnostic tests were 2,724,837 and 3,354,258, respectively, for the screening of women aged 50+ years versus 4,333,454 and 3,498,328 for the screening of women aged 40+ years. Thus, there were an additional 1,608,616 screening tests and 144,070 diagnostic tests with early screening.

The projected costs over the period 2001 - 2021 were Can$1,673,954,482 for the screening of women aged 50+ years and Can$1,869,190,902 for the screening of women aged 40+ years. The extra costs associated with screening women aged 40+ years were Can$195,236,420.

Synthesis of costs and benefits
An incremental cost-effectiveness ratio (i.e. the cost per breast cancer detected) was calculated to combine the costs and benefits of the two screening programmes. The cost per case detected was Can$795 (but only treatment costs were considered, thus screening and diagnosis costs were not taken into account).

Authors’ conclusions
Modifying the age eligibility requirements, from the current recommendations for women over the age of 50 years, to include women aged between 40 and 49 years would result in the detection of an additional 6,610 women with breast cancer, costing an additional $795 per case in Canada.

CRD COMMENTARY - Selection of comparators
The selection of the comparator (i.e. screening eligibility starting at 50 years) was appropriate as it reflected standard care in Ontario. You should decide whether this is a valid comparator in your own setting.

Validity of estimate of measure of effectiveness
The effectiveness evidence came from published studies. A systematic review of the literature does not appear to have been performed to derive clinical estimates. The primary studies were identified selectively from among Canadian sources of data. The primary estimates were not combined and each study provided a series of estimates. Key model inputs, such as transition probabilities, were based on experts’ opinions because the authors had stated that the published transition rates were not appropriate to reflect unscreened populations. Sensitivity analyses, to address the issue of uncertainty surrounding such estimates, would have been helpful.

Validity of estimate of measure of benefit
The summary benefit measure was specific to the study setting and would be difficult to compare with the benefits of other health care interventions. The impact of screening on survival or quality of life, the most relevant dimensions of health in patients with breast cancer, was not investigated.

Validity of estimate of costs
Limited information on the cost analysis was provided. The perspective adopted in the study was not stated, although it might have been that of the public insurance system. The costs of cancer care were not presented, and a detailed breakdown of items was reported only for the costs of screening and direct diagnosis. The unit costs for such categories were provided. Few details on resource consumption were reported, which limits the possibility of replicating the results of the analysis in other settings. The costs were treated deterministically and were specific to the study setting. In fact, no sensitivity analyses were carried out. The price year was unclear.

Other issues
The authors did not compare their findings with those from other studies. They also did not address the issue of the generalisability of the study results to other settings. Sensitivity analyses were not performed and most estimates were specific to the study setting. Thus, the external validity of the analysis was low. The authors stated that their modelling
approach had some potential limitations, mainly in relation to the uncertainty around the validity and precision of the primary data.

Implications of the study
The study results highlighted the clinical benefits and the economic impact of extending eligibility requirements for breast cancer screening in Canada.

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Bibliographic details

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15582269

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Other publications of related interest

Plevritis SK. A mathematical algorithm that computes breast cancer sizes and doubling times detected by screening. Math Biosci 2001;171:155-78.


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