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ANTICIPATING THE CONSEQUENCES FOR THE PRIMARY THERAPY OF BREAST CANCER AFTER INTRODUCING SCREENING

A More Global Picture for Health Care Policy Making

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Abstract

A breast cancer screening program mainly aims at reducing mortality. However, it also has an effect, often not assessed, on the utilization of health care resources that is relevant to health care policy making. Using a simulation model, this paper forecasts the impact of introducing a breast cancer screening program on the utilization of resources for the primary therapy of breast cancer. The most important consequences from a health care point of view will be an increased use of breast-conserving therapy and an increased need for postoperative radiotherapy; there will also be a higher number of women diagnosed with noninvasive breast cancer. The results of this study could provide support for health care decision making by showing the consequences of policy decisions on the introduction of screening programs for health care utilization.

The availability of health care resources for the diagnosis and treatment of detected diseases is one criterion required to recommend the establishment of a screening

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program. This criterion is probably one of the least analyzed and discussed when a new screening test is proposed for dissemination into a health care system. However, it is an important question in any assessment of a health care technology, especially from the policy making point of view. Information regarding the impact that new technologies may have on the utilization of health care resources and the foreseeable changes that they may bring to medical practice is critical for health planning. This issue, which is common to the diffusion of any health care technology, is exemplified in this paper with breast cancer screening.

In Spain, breast cancer is the most common cancer and leading cause of cancer mortality in women. Worldwide comparisons show that Spain's incidence falls somewhere in the middle. In Girona (Catalonia, Spain), the age-adjusted rate of breast cancer is 50 cases per 100,000 women (17;23). The controversy surrounding breast screening has focused on the different recommendations for different age groups, especially regarding women between 40 and 49 years old, and the interval between mammograms (24). Based on a review of the literature (7;21), it was decided that in our region screening for women aged 50 to 64 years, with an interval of 2 years between mammograms, would be recommended. Simultaneously, an analysis that considered Catalan demographic and epidemiologic data (5) was carried out to determine the cost-effectiveness of alternative screening policies as well as to predict the consequences of implementing of such policies in the health care system. Regarding the latter point, two expected consequences are especially important: first, the temporary increase in the number of women treated during the first years after introducing the screening program (incidence plus prevalece); and second, the shift to treating cancers at earlier stages as a result of the screening may lead to a shift to breast-conserving therapy that, in turn, implies an increase in postoperative radiotherapy treatments (8;12). The selected methodological approach, which has been applied in other countries (4;13;22), was modeling the screening effects using a microsimulation technique. The objective of this paper is to forecast, using a modeling technique, the utilization of health care resources to treat patients after breast cancer screening has been introduced, and to analyze the screening program's implications for health care policy making in Catalonia. The emphasis is on the expected changes in percentage and absolute number of patients receiving each treatment because of the introduction of the screening program.

MATERIAL AND METHODS

The simulation model MISCAN was used to predict the effects of screening. This model simulates a large number of individual life histories according to assumptions about the epidemiology and natural history of cancer. These life histories are then subjected to screening according to assumptions on screening policy, attendance, test characteristics, and prognosis. The changes produced on the life histories represent the simulated effect of screening (25). In the model, breast cancer has four invasive, screen-detectable, preclinical states (size: < 0.5 cm, 0.5–1 cm; 1–2 cm, and > 2 cm) and one noninvasive state, carcinoma *in situ* (DCIS). The model was validated with data from Dutch screening projects (10;26). Key parameters in the model are the mean duration of preclinical screen-detectable disease, sensitivity of the mammography, and improvement in prognosis for screen-detectable cases (Table 1). This improvement in prognosis was based on the breast cancer mortality reduction reported in the Swedish overview of randomized trials (11;21).

Table 1. Characteristics of the Screening Program

Attendance rate (average)		
Age groups		
40–49	75%	
50–64	70%	
50–69	69%	
	First screening	Subsequent screening
Referral rate		
Age groups		
50–64	6.2%	3.6%
50–69	6.3%	3.6%
Positive predictive value of advice for biopsy		
Age groups		
40–49	21%	33%
50–64	35%	55%
50–69	37%	58%
Detection rate (1,000 examinations)		
Age groups		
40–44	0.7	0.7
45–49	1.7	1.4
50–54	2.4	1.6
55–59	2.9	1.8
60–64	4.5	2.7
65–69	6.5	3.6
Sensitivity of screening		
Tumor size	45–49	50–69
DCIS	0.32	0.40
≤0.5 cm	0.52	0.65
0.5–1 cm	0.64	0.80
1–2 cm	0.72	0.90
>2 cm	0.76	0.95

The level of mortality and the underlying incidence of breast cancer are important for assessing the needs and benefits of screening in a specific context. To that end, MISCAN allows Catalonia's demography and breast cancer epidemiology to be considered (6;23). The incidence of breast cancer was estimated from Girona's and Tarragona's cancer registries (23;27).

The screening policy recommended by the Catalonia Government's Health Department, that is, screening women from 50 to 64 years, with an interval of 2 years between mammograms, utilizing a two-view mammogram, was selected for assessing the impact of screening programs on clinical practice. The percentage of participation and the detection rate are based on Catalonian data from pilot programs or from data of other regions of Spain (2;19). The alternative policies considered in the cost-effectiveness analysis and the results have been published elsewhere (5). Results are presented for a screening program carried out during a limited 27-year period and considering an initial build-up period of 5 years before the program reaches full capacity.

To estimate the absolute number of patients receiving each treatment for breast cancer, it was assumed that all women without advanced disease received primary treatment. Data on the type of treatments performed were based on the Dutch experience (12;14), and were also checked against the available data on clinical

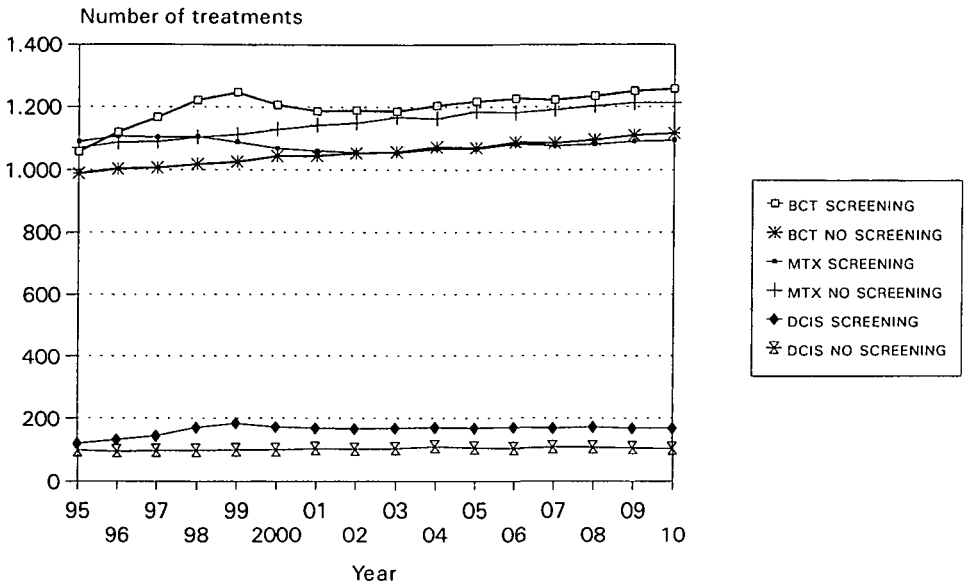

Figure 1. Impact of breast cancer screening on the frequency of breast-conserving surgery, mastectomy, and the detection of carcinoma in situ.

practice from Catalonia's main hospitals. The following types of treatment with curative intent were distinguished: total mastectomy (DCIS); local excision (DCIS); local excision with radiotherapy (DCIS); total mastectomy with axillary dissection; total mastectomy with axillary dissection and postoperative radiotherapy; and breast-conserving therapy (with postoperative radiotherapy). Women with axillary lymph node metastases are assumed to receive adjuvant systemic therapy: CMF (cyclophosphamide, methotrexate, 5-fluorouracil) for premenopausal women and tamoxifen for postmenopausal women. Women with distant metastases are assumed to receive treatment for advanced disease. Stage IIIb was individualized due to its specific therapeutic approach. Breast-conserving therapy implies brachitherapy in one of five patients (12). Results show the number of patients that are expected to receive each treatment for breast cancer, whether screen detected or not, if an organized screening program is introduced.

RESULTS

The estimated number of cases diagnosed in Catalonia (Spain) was 2,585 in 1995. The implementation of a screening program would imply an increase in the number of in-situ tumors (Figure 1). It is also predicted that the utilization of breast-conserving therapy will increase sharply, especially in the program's build-up period until the year 2000; then it will drop back to resume a steady rise during the remaining years of the prediction. There will be a slight decrease in the number of patients treated with mastectomy during the same period (Figure 1). The decrease in the number of treatments for advanced disease and for locally advanced tumor (stage IIIb) will not be observed until 4 or 5 years after the program has been instituted (Figure 2). Concerning the utilization of radiotherapy (Figure 3), there will be a major increase at the beginning of the program that will only drop back to a steady trend 5 years later. A similar but less notable trend will be observed

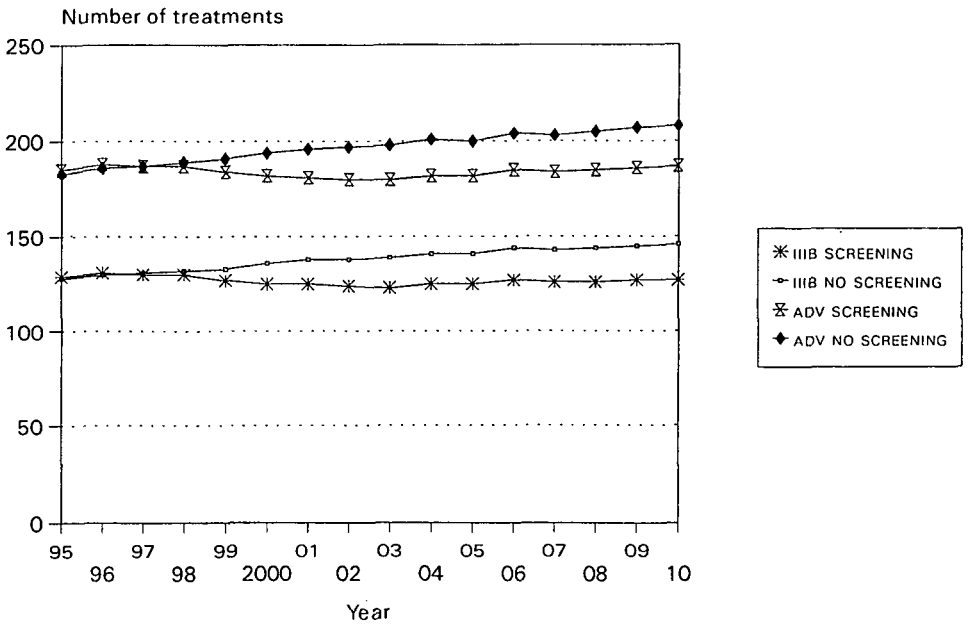

Figure 2. Impact of breast cancer screening on the frequency of stage IIIB and advanced disease.

in brachitherapy. The increase in the number of radiotherapy treatments will reach 9.6% in the year 2000. This increase would have a major impact if we consider that breast cancer accounts for 20% of radiotherapy treatments in our health care system. The increase in the absolute number of brachitherapy treatments will not be substantial, but it should not be neglected, from the health care point of view, since this kind of treatment is complex and resource consuming.

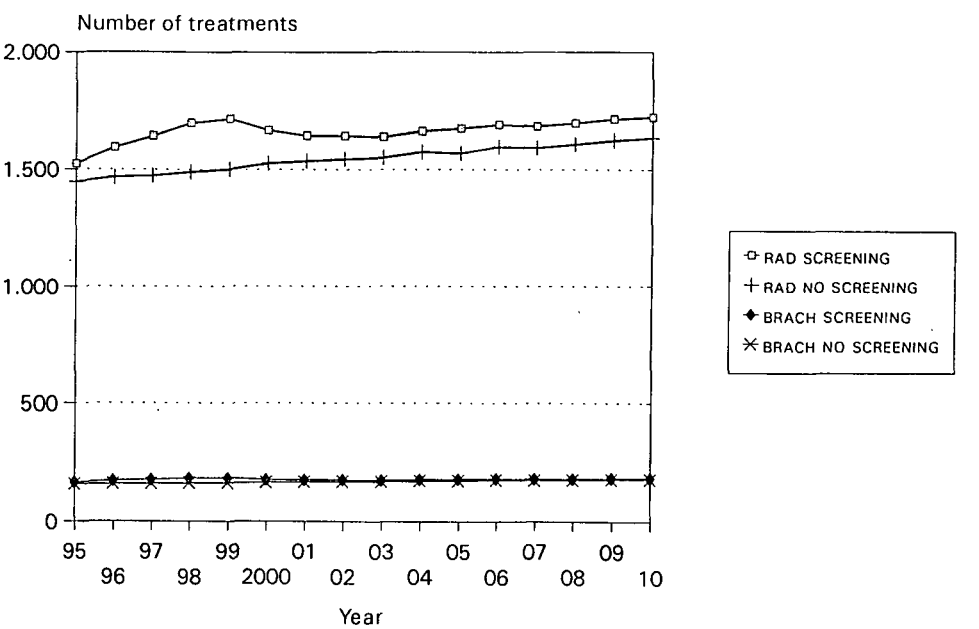

Figure 3. Impact of breast cancer screening on external radiotherapy and brachitheraphy.

Table 2. Predicted Number of Patients According to Type of Treatment and Predicted Percentage of Change with Screening in Year 2000

Treatment	Number of patients without screening in year 2000	% of change due to screening program
Breast-conserving therapy (with radiotherapy)		
With brachitherapy	168	+6.6
With external boost	876	+17.4
Mastectomy		
With radiotherapy	458	−9.0
Without radiotherapy	671	−2.8
Carcinoma in situ	75	+72.0
Adjuvant treatment		
Chemotherapy	233	0
Hormonal	666	−5.1
Locally advanced (IIIB)	136	−8.1
Advanced disease	194	−6.2

A summary of the impact produced by the introduction of screening is presented in Table 2, showing the percentage of change estimated for each strategy in the year 2000, five years after the program began to be implemented. When a screening program is introduced, the use of breast-conserving therapy and the need for post-operative radiotherapy will both increase and the number of women diagnosed with noninvasive breast cancer also will increase. From the health care point of view, these are the most important consequences if a breast cancer screening program is introduced.

DISCUSSION

Organized screening programs differ from opportunistic screening or case finding in such facts as who is responsible for the diagnosis and treatment of positive cases found. In an organized program, it is the program itself, whereas in an opportunistic situation, it is the physician who has responsibility (24). An opportunistic screening policy, which focuses on high-risk groups, was the selected approach for cervical cancer screening in Catalonia and throughout Spain, given the low incidence and mortality and the existing volume of cytologies already being performed (3;9). Breast cancer screening, on the other hand, poses a difficult question in our health system, because radiotherapy resources are in short supply (8). The results presented in this paper show that investing in treatment facilities should take into account the predicted needs derived from a screening program.

Cost-effectiveness analysis can be extremely useful in decision making. In our case it has helped to support the policy recommending screening in the 50–64 age group and demostrate the advantage of extending screening to age 69 years, in order to increase the effectiveness of screening measured by the mortality reduction (12% in the 50–64 age group compared to 14.9% in the 50 to 69 age group). Moreover, it allowed for a discussion of the policy regarding the 40–49 age group (5). However, as important as these results are to inform policy making, they do not address the important issue of the necessary investments and changes in health care practice that are needed to implement screening without compromising the

quality of care. The approach selected in this paper, based on modeling the screening consequences, makes it possible to clarify one of the major uncertainties encountered when a new technology is introduced by using explicit criteria to inform decision making.

Policy makers are greatly interested in short-term considerations (15;16;17). Their main interests do not lie in cost-effectiveness results, with benefits and costs projected in the future and adequately discounted, but in the necessary budgetary increases for the next year if such a program is to be developed. It is essential for technology assessment to influence the policy-making process to tackle these short-term considerations that heavily influence policy decisions. The results presented here have been useful in framing a discussion about the consequences of breast screening not only in terms of reduction of mortality but also in terms of the required investments, especially in radiotherapy and in radiology.

An aspect that is not easily dealt with when a breast cancer screening program is introduced deals with the policy regarding the significant amount of opportunistic screening that physicians are performing in women aged 40 to 49. In our region, 30%–40% of all mammograms performed for screening purposes are done in women aged 40 to 49 (1); these women also have a higher perception of their risk of cancer (18). This then must be dealt with at the local level, given the wide variability of this practice. The logical approach would be to discourage these practices based on official recommendations, but it is difficult to reduce them because of existing habits, the recommendations of some gynecologists or primary care physicians, and the present controversy on screening recommendations for different age groups that makes it possible to find a recommendation that echoes each personal viewpoint. It should be emphasized that the recommended breast screening policy in Catalonia was established through consensus of scientific societies related to primary health care (7). However, the problem is not easy to solve in practice and has a significant impact on costs and on women's perceptions of the consistency of recommendations (20).

To fully assess the results of this study, some limitations should be taken into account. Our major emphasis has been on the trend and percentage of change of different treatments, instead of on the absolute number of treatments performed. Patterns of care based on Dutch research (12;14), were considered to be reasonable assumptions for our health care context. Moreover, predictions were based on the existing situation regarding therapy and screening knowledge and developments, assuming no future changes. Finally, the quality of the screening process will have a major impact on its effectiveness and cost. In our case, we assumed standard values of the sensitivity of the test, which may or may not be reproducible in practice.

In summary, breast cancer screening exemplifies the situation that is common in prevention, where the benefits appear only in the future, while the costs and the increase in utilization of health care resources are immediate. In other words, the advantages of screening can be expected, but not as early as is desirable from a policy-making perspective. The results of this study could support health care decisions by showing the immediate consequences of policy decisions regarding the introduction of screening on health care utilization. It should be noted that the alternative to this organized screening program would be an incremental approach to the diffusion of opportunistic screening that, in our context and considering the experience of cervical cancer screening, would have undesirable consequences in the equity of access to screening (18). Modeling techniques can generate relevant information that could enhance a more rational approach to decision-making in health.

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