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The Long-Term Effectiveness and Cost-Effectiveness of Organized versus Opportunistic Screening for Breast Cancer in Austria

Irmgard Schiller-Fruehwirth, MD, MPH, PhD[1,2,], Beate Jahn, PhD[2,3], Patrick Einzinger, PhD[4,5], Günther Zauner, MSc[4], Christoph Urach, MSc[4], Uwe Siebert, MD, MPH, ScD[2,3,6,7]*

[1]Department of Evidence-Based Economic Health Care, Main Association of Austrian Social Security Institutions, Vienna, Austria; [2]Department of Public Health and Health Technology Assessment, UMIT—University for Health Sciences, Medical Informatics and Technology, Hall in Tirol, Austria; [3]Division of Health Technology Assessment and Bioinformatics, ONCOTYROL—Center for Personalized Cancer Medicine, Innsbruck, Austria; [4]dwh Simulation Services, Vienna, Austria; [5]Institute for Analysis and Scientific Computing, Vienna University of Technology, Vienna, Austria; [6]Institute for Technology Assessment and Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA; [7]Department of Health Policy and Management, Center for Health Decision Science, Harvard T.H. Chan School of Public Health, Boston, MA, USA

ABSTRACT

Background: In 2014, Austrian health authorities implemented an organized breast cancer screening program. Until then, there has been a long-standing tradition of opportunistic screening. **Objectives:** To evaluate the cost-effectiveness of organized screening compared with opportunistic screening, as well as to identify factors influencing the clinical and economic outcomes. **Methods:** We developed and validated an individual-level state-transition model and assessed the health outcomes and costs of organized and opportunistic screening for 40-year-old asymptomatic women. The base-case analysis compared a scenario involving organized biennial screening with a scenario reflecting opportunistic screening practice for an average-risk woman aged 45 to 69 years. We applied an annual discount rate of 3% and estimated the incremental cost-effectiveness ratio in terms of the cost (2012 euros) per life-year gained (LYG) from a health care perspective. Deterministic and probabilistic sensitivity analyses were performed to assess uncertainty. **Results:** Compared with opportunistic screening, an organized program yielded on average additional 0.0118 undiscounted life-years (i.e., 4.3 days) and cost savings of €41 per woman. In the base-case analysis, the incremental cost-effectiveness ratio of organized screening was approximately €20,000 per LYG compared with no screening. Assuming a willingness-to-pay threshold of €50,000 per LYG, there was a 70% probability that organized screening would be considered cost-effective. The attendance rate, but not the test accuracy of mammography, was an influential factor for the cost-effectiveness. **Conclusions:** The decision to adopt organized screening is likely an efficient use of limited health care resources in Austria.

Keywords: breast cancer, cost-effectiveness analysis, mass screening, microsimulation.

Introduction

Breast cancer is the most common malignancy for women in Austria, afflicting 1 in 13 by the age of 75 years. Approximately 5000 invasive breast cancers are diagnosed each year. For women, breast cancer also has the highest cancer mortality, resulting in about 1500 deaths each year [1]. Even though the age-standardized breast cancer mortality rates have been decreasing since the mid-1990s, the incidence rates have been increasing. This increase is correlated with the introduction of opportunistic mammography screening in Austria at the beginning of the 1990s.

Because of a lack of systematic reporting, the quality and performance of opportunistic mammography screening in Austria are difficult to evaluate. European guidelines for quality assurance in breast cancer screening recommend an organized population-based breast screening program [2]. The feasibility of quality-assured organized screening programs within the Austrian health care setting has been demonstrated in small pilot studies as well as in a statewide organized screening program in Tyrol [3,4]. After these studies, in 2014, Austria implemented a national but decentralized organized screening program inviting average-risk women, aged 45 to 69 years, to attend biennial screening involving bilateral two-view mammograms. In dense

* *Address correspondence to:* Irmgard Schiller-Fruehwirth, Department of Evidence-Based Economic Health Care, Main Association of Austrian Social Security Institutions, Kundmanngasse 21, Vienna 1030, Austria.

E-mail: irmgard.schiller-fruehwirth@sozialversicherung.at.

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breasts, breast ultrasounds are allowed as an adjunct screening tool.

Nevertheless, evidence on long-term health and economic outcomes is lacking for Austria. The objective of this study was to assess the long-term effectiveness and cost-effectiveness of an organized breast cancer screening program compared with an opportunistic screening approach for women who are at average risk of developing breast cancer within the Austrian health care context.

Methods

Model Structure

We developed a decision-analytic, individual-level (microsimulation) state-transition model [5] that encompassed three main components: 1) a breast cancer natural progression pathway, including clinical diagnosis; 2) opportunistic screening; and 3) an organized screening pathway [6]. The expected health and economic consequences of introducing an organized or opportunistic screening approach for each simulated individual were assessed. The base-case analysis compared a scenario involving organized biennial breast cancer screening with a scenario reflecting current opportunistic screening practice (i.e., status quo in Austria) over the remaining lifetime of average-risk women aged 45 to 69 years. Every 3 months, women transitioned between mutually exclusive and collectively exhaustive health states. This cycle length was short enough to ensure that an event occurred at most once per cycle; half-cycle correction was also applied [7]. We used a health care payer's perspective, and therefore included only direct health care costs. We calculated the incremental cost-effectiveness ratios (ICERs), defined as the additional costs of a strategy divided by the additional life-years, compared with the next most costly strategy, after eliminating dominated strategies [8]. Model outcomes also included the number of cancers diagnosed, stage distribution, and mortality reduction associated with each strategy. We applied an annual discount rate of 3% to both costs and effects [9].

Data from the national statistics bureau, Statistics Austria, categorize breast cancer detection rates by the simplified Tumor, Node, and Metastasis classification [10]. Because of the data structure, we applied ductal carcinoma in situ (DCIS) and invasive tumors defined as local, regional, and distant as relevant health states, which determined the probability of screen detection and affect survival, treatment, and associated costs. Because the in situ stage is a noninvasive cancer that is present only in the layer of cells where it begins, we assumed that only DCIS represented a precursor of invasive breast cancer.

The model schematic, reflecting the natural history of breast cancer, used in this analysis is depicted in Figure 1, which shows the Markov model structure we developed for breast cancer screening with the possible courses of the disease represented by a state-transition ("bubble") diagram as recommended by Siebert et al. [7]. Similar structures have been used in published decision analyses by Rojnik et al. [11] and de Gelder et al. [12]. The blue arrows in the figure indicate possible breast cancer progression pathways during each cycle. Women enter the model at the age of 40 years, and every 3 months, each woman faces a probability of progressing to the next health state, which is based on transition probabilities that vary between cycles and are conditional on the woman's current health states.

We followed international modeling recommendations for building and reporting the model and analysis [7,13]. We performed several validation steps to evaluate face validity, internal validity, external validity, and cross validation according to the International Society for Pharmacoeconomics and Outcomes Research-Society for Medical Decision Making best practice recommendations for validation [14].

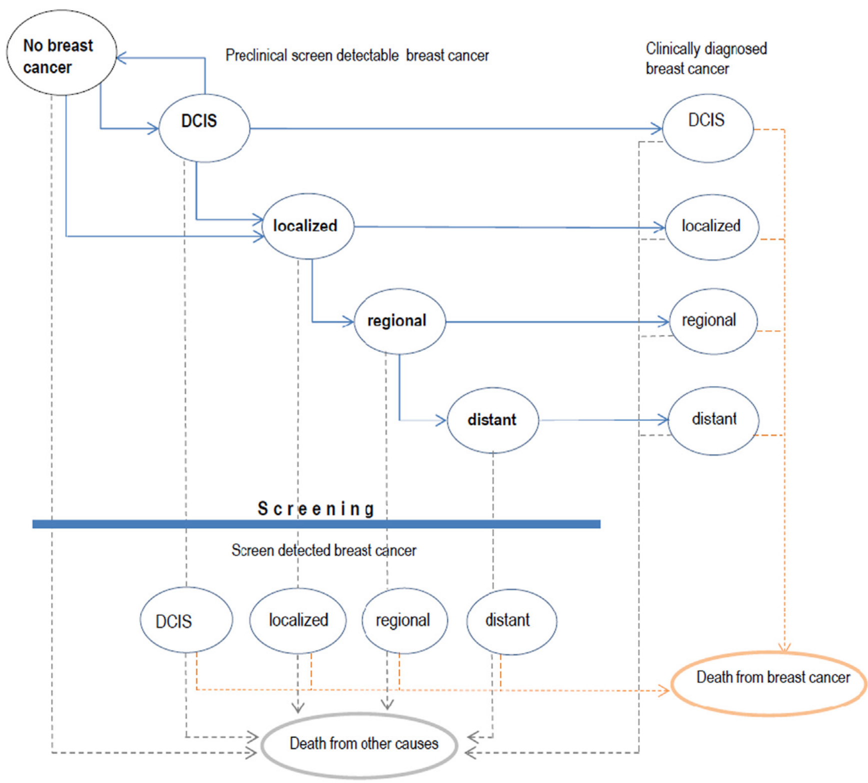

Fig. 1 – Flow diagram representing the natural history of breast cancer in the model. DCIS, ductal carcinoma in situ.