SA-CME

Performance Goals for an Adjunct Diagnostic Test to Reduce Unnecessary Biopsies After Screening Mammography: Analysis of Costs, Benefits, and Consequences

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Purpose: Because benign biopsies resulting from false-positive mammographic findings are a known harm of breast cancer screening, physicians and test manufacturers are searching for ways to reduce their frequency. The aim of this study was to estimate potential costs and consequences associated with using an adjunct diagnostic test for triaging women with suspicious mammographic findings before biopsy.

Methods: A decision model was developed to compare the use of an adjunct test before biopsy to the current standard of care for suspicious mammographic findings. The decision analysis was performed from the perspective of a national health payer, with a 1-year time horizon among women representative of the US screening population aged 40 to 79 years. Three primary outcomes were assessed: (1) incremental costs, (2) number of benign biopsies avoided, and (3) number of missed opportunities for diagnosing cancer per million women screened. Input parameters were obtained from the medical literature and expert opinion. Sensitivity analyses were performed to evaluate the effects of uncertainty in parameter estimates.

Results: The base-case analysis demonstrated that the use of an adjunct diagnostic test with 95% sensitivity, 75% specificity, and a cost of $1,000 would eliminate 8,127 unnecessary breast biopsies per million women screened. However, this would cost the US health care system an additional $6,462,977 and result in 255 missed opportunities for diagnosing cancer per million women screened.

Conclusions: The addition of an adjunct test for triaging women for breast biopsy after abnormal findings on screening mammography would likely eliminate many unnecessary biopsies but also increase overall health care costs. This exploratory analysis highlights the fact that mammography remains a relatively inexpensive and effective breast cancer screening and diagnostic modality.

Key Words: Screening mammography, abnormal mammographic results, breast biopsy, false-positive mammographic results

J Am Coll Radiol 2013;10:924-930.

Credits awarded for this enduring activity are designated "SA-CME" by the American Board of Radiology (ABR) and qualify toward fulfilling requirements for Maintenance of Certification (MOC) Part II: Lifelong Learning and Self-assessment.

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Dr Lee is supported in part by the GE AUR Radiology Research Academic Fellowship, which is cosponsored by GE Healthcare (Milwaukee, Wisconsin) and the Association of University Radiologists (Oak Brook, Illinois). Funding for this study was provided by a subcontract through Arizona State University (Subcontract No. 11-465) from GE Healthcare (Agreement No. 2580220935) to Dr Ramsey and used to fund the time of Drs Bensink, Berry, and Mr Musa. The content of this report is solely the responsibility of the authors and does not necessarily represent the official views of the funding organizations.

1546-1440/13/$36.00 • http://dx.doi.org/10.1016/j.jacr.2013.09.009

INTRODUCTION

False-positive mammographic findings and the associated unnecessary biopsies are a recognized harm of screening and one of the main factors that contributed to the US Preventive Services Task Force's breast screening guideline changes in 2009 [1,2]. Although mammography can detect asymptomatic malignancies at less advanced stages of disease, it is also estimated that approximately 10% of all women screened receive false-positive results, leading to additional diagnostic workup [3]. In the United States, approximately 75% of breast biopsies resulting from suspicious mammographic findings are for what ultimately prove to be benign findings [4].

The economic consequences of false-positive results on screening mammography are multiplicative because of the cascade of diagnostic studies that may result, including diagnostic mammography, ultrasound, image-guided biopsy, and surgical excisional biopsy. With a conservative estimate of 18 million US women undergoing screening mammography annually, a false-positive rate of 10% amounts to almost $1 billion in unnecessary health care spending [5]. Of these additional costs, the largest proportion is attributable to the many breast biopsies performed [6]. Decreasing the number of unnecessary breast biopsies may lead to significant savings in both patient morbidity and health care costs.

Over the past decade, the advent of protein microarrays and serum proteomic profiling has enabled researchers to identify new biomarker candidates for cancer detection [7-9]. These high-throughput methods may hold the key to revealing patterns that can ultimately be used to help detect malignancy [7,10]. In the case of breast cancer, the development of such a diagnostic blood-based test with high enough sensitivity and specificity to overtake mammography will be considerably challenging given both the biologic heterogeneity of breast cancer and the high effectiveness of mammography [11]. A breast cancer screening bioassay would need to overcome variability of histologic types, protein expression patterns, confounding patient comorbidities, and variations in human biochemistry [12,13].

The Institute of Medicine recently reported that biologically based technologies for breast cancer detection, although unlikely to supplant mammography, are realistically poised to become adjunct tools to mammography [14]. Specifically, the report suggests that the development of a bioassay for use in aiding the decision-making process for breast biopsy after suspicious findings on mammography is a realistic goal. Because breast biopsy is the current standard of care for the diagnostic evaluation of all suspicious breast lesions detected by imaging, a bioassay used to avoid biopsy would require extremely high sensitivity and negative predictive value (NPV) to be of benefit to the general screening population.

It is hoped that such a new adjunct diagnostic test would significantly reduce the economic burden associated with false-positive results on screening mammography. Because such a test may also be expensive, it is important to understand the relationship between expected diagnostic performance characteristics, associated costs, and the potential consequence of missed cancers. Therefore, to inform current breast cancer-related bioassay development efforts, our objective was to perform an exploratory analysis of a highly sensitive, hypothetical, adjunct diagnostic test that can reduce the number of breast biopsies performed after screening mammography. Specifically, we estimated the following: (1) the associated incremental costs, (2) the incremental number of biopsies avoided, and (3) the incremental number of missed opportunities to diagnose screening-detected cancer associated with using a new adjunct diagnostic test for women with suspicious mammographic findings before breast biopsy.

METHODS

Because our study did not involve primary data collection from individual patients, institutional review board approval was not required.

Model Overview

We developed a health economic decision model using Microsoft Excel 2010 (Microsoft Corporation, Redmond, Washington). The model was populated with women aged 40 to 79 years with no additional risk factors for breast cancer other than age who are called back from screening mammography (BI-RADS® category 0) and given suspicious assessments after diagnostic workup (BI-RADS category 4 or 5) [6]. We modeled two diagnostic cohorts for women with suspicious imaging findings: one intervention cohort (those who undergo the new adjunct diagnostic test to determine whether biopsy is necessary) and one control cohort (those who do not undergo the new test and go directly to breast biopsy). Our analysis takes the perspective of the US health care system (health care payer), with costs calculated in 2012 US dollars. The analysis has a time horizon of 1 year (a conservative, maximum time interval between abnormal mammography and definitive tissue diagnosis). Given the limited time horizon, no discounting or cost adjustments were necessary.

Model Structure

The model structure, including the competing diagnostic pathways that women traverse after abnormal mammographic findings and recommendation for biopsy, is detailed in Figure 1. In the control arm, women undergo breast biopsy and receive histopathologic diagnoses of either in situ or invasive cancer or benign findings. Those with benign diagnoses are categorized as having had potentially avoidable biopsies. In the intervention arm, women with suspicious imaging findings undergo the new diagnostic test for triaging rather than being sent directly for biopsy.

Women who receive positive adjunct test results will proceed to breast biopsy for tissue diagnosis. Women who receive negative adjunct test results will forgo