Breast Cancer Screening

Version 03.0; last updated Jan 06, 2018

Prepared by
Michael V. Maciosek, PhD[1]
Amy B. LaFrance, MPH[1]

HealthPartners·Institute

[1]HealthPartners Institute
8170 33rd Avenue South
PO Box 1524, MS 23301A
Minneapolis MN 55440-1524

This report summarizes estimates of health impact and cost-effectiveness that were created to assess the relative value of most of the clinical preventive services recommended by the United States Preventive Services Task Force (USPSTF) and the Advisory Committee on Immunization Practices (ACIP). This ranking of clinical prevention priorities is guided by the National Commission on Prevention Priorities (NCPP).

A. USPSTF Recommendation

The U.S. Preventive Services Task Force (USPSTF) recommends biennial screening mammography for all women aged 50 to 74 years of age (B grade), and recommends that screening between ages 40 to 49 be left to individuals based upon their personal valuation of benefits and harms of screening (including false positives, unnecessary biopsies and overdiagnosis) and family history (C grade).[1] In addition the USPSTF concluded that the current evidence is insufficient to assess the additional benefits and harms of screening mammography in women 75 years and older (I grade).

B. Population
We assess screening for breast cancer among women ages 40 to 74. Although the Prevention Priorities project generally includes only A and B grade recommendations of the USPSTF, we include screening for ages 40 to 49 (C grade) because a large portion of 40 to 49 year olds elect to be screened and because screening for this age group is included in the zero out-of-pocket cost provision for evidence based preventive services in the Affordable Care Act.

C. Model Type
For this service, we use results from existing Markov models published in the literature. We used average results across six models. Stout et al. published the impact of screening on QALYs and costs from five Cancer Intervention and Surveillance Modeling Network (CISNET) models.[2] We also included results that were produced for this report using a sixth model originally reported by Schousboe et al.[3] In our average estimates of clinical preventable burden (CPB, measured as undiscounted QALY saved) and cost-effectiveness, results from each of the six models is given equal weight.

D. Calculation of CPB and CE from published model results
We use results in from Supplementary Table 5 of Stout et al[2] to calculate the CPB and CE of biennial screening with digital mammography compared to no screening. We chose digital mammography due its wide adaptation in the U.S. Estimates from the Schousboe model were produced to be comparable to the results presented by Stout et al. At the time of the analysis the Schoesboe model did not include digital mammography and therefore the results from this model represent biennial film mammography.

For each model, we used separate estimates for ages 40 to 49 and 50 to 74 in order to incorporate rates of adherence by age group in the overall estimates for ages 40 to 74. Stout et al. reported results for screening from ages 40 to 74 and ages 50 to 74. We estimated the incremental impact of screening between ages 40 to 49 as the difference between these age groups.

<u>D.1 Adjustments for consistency across Prevention Priorities services</u>
We calculated the change in undiscounted QALYs (CPB) and discounted QALYs and discounted costs (for CE calculations) of biennial screening compared to no screening by each age group. Results were originally reported per 1,000 women. For CPB we scaled the results to the number among women alive age the beginning of each age group from a birth cohort of 4,000,000 persons at age zero.

For CPB, we adjusted undiscounted QALYs saved to account for the portion of women who choose not to be screened between ages 40 to 49 and for incomplete adherence with clinician advice to be screened between ages 50 to 74. We did not find data on uptake of screening in a population of women limited to those who were offered or recommended. As a proxy, we use utilization of mammography reported in the 2013 National Health Interview Survey – 60% for women ages 40 to 49 and 73% for women ages 50 to 74.[4] The Behavioral Risks Factor Surveillance Survey yields slightly higher estimates.[5]

For cost effectiveness, we add to costs the value of patient time needed for screening and for biopsy to confirm diagnosis. We calculated the number of screens in a birth cohort with biennial screening, taking into account all-cause mortality rates. We used the reported false positive screens by age group as a proxy for the number of follow-up biopsies, recognizing that this understates biopsies because true positives are omitted. Patient time for screening and biopsy visits was valued at the average hourly earnings plus benefits of all U.S. employees ($31 per hour).[6] Time costs were discounted to present value at age 40 using a simplifying assumption that the distribution of biopsies with respect to age is shifted two years later than the distribution for screenings.

D. Sensitivity Analysis
For the Prevention Priorities analyses, we typically base sensitivity analysis ranges on multivariate sensitivity analysis from a single model to indicate plausible low and high estimates of CBP and CE. However for breast cancer screening, where we have estimates from six different models, we instead define plausible levels of low and high estimates as the range of the base case estimates from the six models as we calculated (as described above).

E. Clinically Preventable Burden (CPB) Estimate
Across the six models, the mean estimate of CPB of offering breast cancer screening from ages 40 to 49 and recommending breast cancer screening from ages 50 to 74 among a birth cohort of 4 million persons is 154,000 QALYs (Table 1). The range of model estimates is 83,000 to 209,000 QALYs saved.

Table 1. Results of calculated CPB and CE by breast cancer screening model

Model that produced the results that are the basis for calculated estimates	Calculated CPB Estimate	Calculated CE Estimate
Stout et al Model D	154,000	42,000
Stout et al Model E	163,000	38,000
Stout et al Model G-E	170,000	40,000
Stout et al Model M	83,000	89,000
Stout et al Model W	209,000	35,000
Schousboe et al.	143,000	72,000
Mean of models	154,000	53,000

F. Cost-Effectiveness (CE) Estimate

The average cost-effectiveness across the 6 models as described above is 53,000 per $/QALY. The range of model estimates is 35,000 to 89,000 $/QALY saved.

G. Limitations

Estimates are subject to the usual model limitations of uncertain model inputs and model structures that cannot capture the full complexity of disease processes and the full variation of experience in among a population. In addition, our adjustments of undiscounted QALYs saved for incomplete adherence are limited both by limited data and the simplifying assumption that there is a direct, proportional relationship to a one percent change in population wide adherence and health benefit. In reality, the effect of non-adherence will vary with the disease risk among those who chose not to be screened and the length of time that they are not current with recommended screening intervals. Nevertheless, alternative plausible impacts of non-adherence would not change the CPB score of breast cancer screening in the Prevention Priorities Ranking.

References

1.   Siu AL, Force USPST. Screening for Breast Cancer: U.S. Preventive Services Task Force Recommendation Statement. *Ann Intern Med* 2016; **164**(4): 279-96.
2.   Stout NK, Lee SJ, Schechter CB, et al. Benefits, harms, and costs for breast cancer screening after US implementation of digital mammography. *J Natl Cancer Inst* 2014; **106**(6): dju092.
3.   Schousboe JT, Kerlikowske K, Loh A, Cummings SR. Personalizing mammography by breast density and other risk factors for breast cancer: analysis of health benefits and cost-effectiveness. *Ann Intern Med* 2011; **155**(1): 10-20.
4.   National Center for Health Statistics. Health, United States, 2015: With Special Feature on Racial
and Ethnic Health Disparities. Hyattsville, MD: US Government Printing Office; 2016.
5.   Center for Disease Control and Prevention. Behavioral Risk Factor Surveillance System. WEAT - Web Enabled Analysis Tool.
6.   Bureau of Labor Statistics. Employer Costs for Employee Compensation - September 2012. 2012. http://www.bls.gov/news.release/archives/ecec_12112012.pdf.