



# Prophylactic mastectomy can save patients up to \$50,000 compared to lifelong screening in BRCA 1 and BRCA 2 patients

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**Background:** Awareness of value-based, quality care has become an increasingly important issue for healthcare. Patients with a BRCA mutation have a lifetime risk of developing breast cancer up to 87% by age 70. The option of high-risk screening versus risk-reducing surgery is a physical, emotional, and financial decision. Given the significant expense associated with lifetime screening for BRCA 1 and 2 patients, surgery may not only be an option to prevent cancer but may reduce healthcare cost as well. To date there are no cost analysis of surgery versus screening from the patient perspective. We designed a study to compare the expense of lifelong screening versus prophylactic mastectomy with reconstruction for BRCA 1 and 2 patients to evaluate potential cost-saving benefits.

**Methods:** We performed a projected cost analysis based the on an estimate of lifelong, high-risk screening compared to prophylactic bilateral mastectomy with deep inferior epigastric perforator (DIEP) flap reconstruction. We utilized National Comprehensive Cancer Network (NCCN) recommendations to define lifelong high-risk breast screening. The screening included the cost of 1 additional office visit per year, an annual breast magnetic resonance image (MRI), and an annual mammogram. Costs were calculated from average expenses charged to patients as well estimates from the billing hotline at our institution. The final estimates are after all discounts have been taken by the hospital and are representative of the final out of pocket fee that is paid. The high-risk screening cost was compared to the cost of a bilateral prophylactic mastectomy with DIEP flap reconstruction. Included in this surgery cost was the operating room fees, plastic surgeon fees, anesthesia fees, and the hospital stay. The patient costs were estimated based on a hypothetical insurance plan with a deductible of \$1,000 ,an 80/20 copay, and a \$5,000 annual out of pocket maximum.

**Results:** When comparing the total expenditures, we found that the estimated annual cost for screening is \$2,611. The patient out of pocket cost is then calculated to be \$1,322 annually. Thus if a patient has no events, biopsies, or cancers, high-risk screening will cost an estimated \$67,422 over the patient's lifetime. The insurance company will pay an estimated \$1,405/year with a lifetime total of \$71,075. The total lifetime screening cost is \$138,497 paid by both the patient and insurance company. The bilateral prophylactic mastectomy with DIEP reconstruction cost average reimbursement was \$94,733. Of this cost, the patient will pay her out of pocket maximum for the year, but will not have further charges associated with high-risk screening. If an insurance plan has an out of pocket maximum of \$5,000 the patient has the potential of a lifetime savings of \$62,422 with the added benefit of a significant cancer risk-reduction. Additionally as the total out of pocket for the patient is additive, it is most financially beneficial for the patient to have surgery at a younger age. The insurance provider pays \$71,075 for screening and \$89,733 for prophylactic surgery. Although the insurance provide ultimately pays more for surgery in this model, the benefit is in the reduction of cancer and its associated costs.

**Conclusions:** Patients with a BRCA mutation will save more than \$50,000 over their lifetimes by choosing

to undergo early risk-reducing prophylactic mastectomy with reconstruction. Therefore the surgery option not only reduces cancer risk, but also has a significant lifetime cost savings. Patient cost perspectives have not previously been published and we feel that's what makes this novel and an asset to future patient conversations.

**Keywords:** BRCA; cost-savings; prophylactic mastectomy

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## Introduction

Healthcare continues to advance in both treatment and screening for breast cancer, especially in high-risk women. At the same time, both patient and healthcare funds are limited. As physicians, it is imperative that we monitor the value of the services we provide ensuring both affordable and effective care. Patients with *BRCA1* or *BRCA2* mutations are at dramatically higher risk for developing breast cancer compared to the general population with a lifetime risk up to 87% by age 70 (1). There are several options to care for a woman with a BRCA mutation carrier. Current recommendations include the option of increased screening, chemoprevention, and risk-reducing surgeries. The decision is a personal one with women often initially choosing screening and desire risk-reducing surgery thereafter (2).

The current National Comprehensive Cancer Network (NCCN) screening recommendations for *BRCA* mutation carriers include biannual clinical breast exam beginning at age 25 along with an annual MRI then adding annual screening mammography, beginning at age 30 (3). The use of both mammography and MRI in high risk patients is to identify abnormalities earlier with higher sensitivity and specificity. Screening trials in BRCA patients have shown 89–100% of breast cancers were detected with the combination of MRI and mammography and only 33–50% with mammography alone. However, with the added sensitivity comes a higher false positive rate. The false positives lead to additional imaging and often biopsy (4,5). However, several studies have shown this strategy is cost-effective as it detects cancer earlier rather than at a more advanced stage. Due to the earlier detection of breast cancer with MRI in high risk patients, the overall benefit outweighs the additional screening cost and higher risk of false positives (6,7).

For high-risk women who choose risk-reducing surgery,

a bilateral mastectomy with the option of reconstruction is offered. Compared to screening, surgery offers the benefit of cancer risk reduction. The PROSE study demonstrated a 90% breast cancer risk reduction in *BRCA1* or *BRCA2* carriers who underwent bilateral mastectomy with intact ovaries and a 95% reduction in breast cancer risk for women who undergo concomitant oophorectomy (8).

Our goal is to compare the expense of lifelong screening versus prophylactic mastectomy with reconstruction for BRCA 1 and 2 patients to evaluate potential cost-savings from a patient perspective. Although the cost of early detection and cancer prevention has been confirmed, to our knowledge we are the first to compare the cost of screening versus surgery from both the patient and healthcare perspectives.

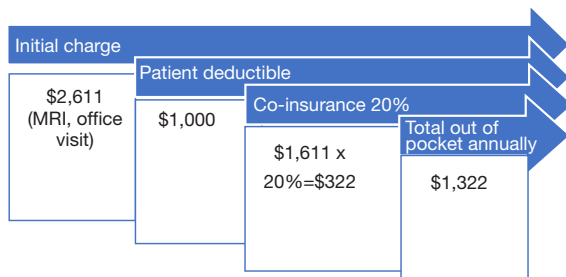
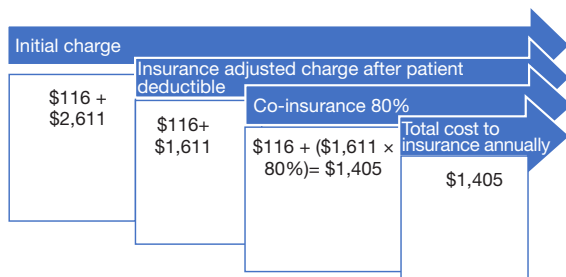
## Methods

A projected cost analysis was performed to estimate the cost of lifelong screening versus bilateral mastectomy with deep inferior epigastric perforator (DIEP) flap reconstruction in female patients within our health system between the ages of 25–75 with a *BRCA* mutation. This study was IRB approved. NCCN guidelines recommend surveillance from age 25–75 so these ages were included for the lifespan (3). The CPT codes were identified for an established visit, digital mammography with computer aided detection (CAD), 3D rendering, MRI with CAD, and the radiology interpretation fee. The total screening cost was estimated by adding these costs as calculated for the patient as well as for the insurance company. The total cost for surgery was the combined costs of the operating room time, the surgeon, the plastic surgeon, the hospital, and anesthesia fees. In order to analyze a final cost we utilized a combination of a price hotline available at our institution as well as the hospital-generated bills from 10 de-identified patients

**Table 1** CPT codes used with average cost per procedure

Description of code	CPT code	Total charge
Level 3 established patient visit	99213	\$146
Mammogram	77057	\$116, \$0 to the patient
Radiology fee Medicare		\$171
MRI with CAD	77059, 0159T	\$2,294
Total charge		\$2,611

CAD, computer aided detection.

**Figure 1** Patient's estimated annual out of pocket cost.**Figure 2** Insurance annual payment for high risk screening.

which were averaged to confirm the amount that the patient and insurance company actually pay. Finally, the high-risk screening costs were calculated to show the difference between upfront surgery versus a lifetime of screening. The patient out of pocket payments were estimated based on a hypothetical insurance plan with a deductible of \$1,000, an 80/20 copay, and a \$5,000 annual out of pocket maximum. For the surveillance group, we estimated the cost of annual screening mammogram and annual contrast enhanced MRI. We included the cost of one additional office visit per year for a total of 45 years (ages 30–75). The CPT codes used for mammography included CAD as well as 3D rendering

**Table 2** Cost of bilateral mastectomy with DIEP flap reconstruction

Description of code	Initial charge	Average reimbursement
Bilateral mastectomy with DIEP flap reconstruction: OR specific costs	\$140,915	\$65,744
Additional hospital days: average 3	\$38,164	\$17,937
Plastic surgeon charge	\$20,000	\$9,400
Anesthesia charge: 8 hours	\$3,515	\$1,652
Total costs: one time	\$202,594	\$94,733

DIEP, deep inferior epigastric perforator.

which is more costly than screening mammography alone but is the recommended modality by the American College of Radiology for high risk patients (9).

## Results

The cost of high-risk breast screening is summarized in *Table 1*. The amount attributed to the patient is dependent on her insurance plan. The total out of pocket charge will be the total charge minus the insurance plan coverage. The mammogram charge is included in most insurance plans, so it is calculated at \$0 for the patients and \$116 for the insurance company.

In our hypothetical insurance plan, the patient pays an initial \$1,000 deductible. Of the remaining bill, 20% is charged to the patient. The 20% (\$322) is added to the deductible (\$1,000) for a total annual out of pocket for the patient of \$1,322 (*Figure 1*). The insurance company pays the remaining \$1,405 [(\$1,611 × 0.8) + \$116] (*Figure 2*). This is the annual payment assuming no biopsies or additional imaging is required.

When a patient chooses risk-reducing bilateral mastectomy as the initial option following identification of a BRCA mutation, the patient will pay her out-of-pocket maximum as a one-time cost. We used an estimate of \$5,000 as a hypothetical out of pocket maximum, but this may vary based on a specific insurance plan. The prophylactic surgery charges, costs, and re-imbusement are listed in *Table 2* below.

Of the \$94,733, the patient will pay the max out of pocket, an estimated \$5,000 and the remainder would be paid by the insurance company—\$89,733.

As the patient is not charged for a screening

**Table 3** Cumulative cost of lifetime screening

Year	Patient cost	Insurance cost	Patient + insurance
1	1,322	1,289	2,611
2	2,644	2,578	5,222
3	3,966	3,867	7,833
4	5,288	5,156	10,444
5	6,610	6,445	13,055
6	7,932	7,850	15,782
10	13,220	13,470	26,690
15	19,830	20,495	40,325
20	26,440	27,520	53,960
25	33,050	34,545	67,595
30	39,660	41,570	81,230
35	46,270	48,595	94,865
40	52,880	55,620	108,500
45	59,490	62,645	122,135
50	66,100	69,670	135,770
51	67,422	71,075	138,497

**Table 4** Lifetime costs of surgery versus screening to the patient, insurance, and healthcare system

Category	Patient	Insurance	Insurance + patient
Screening: 50 years	\$67,422	\$71,075	\$138,497
Surgery	\$5,000	\$89,733	\$94,733

mammogram, her costs are the same annually for surveillance. The insurance company pays \$1,289 annually for the first 5 years then \$1,405 annually for the next 46 years for screening for ages 30–75. The cumulative cost for the patient, insurance, and healthcare system is shown below in *Table 3*.

For a side by side comparison *Table 4* shows the estimated lifetime costs.

## Discussion

High risk breast cancer screening has a significant cost. This cost is divided between the patient and the insurance company. In our insurance model, early surgical intervention is the most cost-effective option for the

patient as it does not require the continued out of pocket expense of ongoing screening. If a patient has an out pocket maximum of \$5,000, she will pay the same amount for surgery as she would for only 4 years of high risk screening. Thus, the earlier she undergoes surgery, the more cost effective surgery becomes. An additional benefit for the patient is the decrease in cancer risk, which screening does not offer. Therefore, the patient gains not only a decreased cancer risk with surgery, they gain an estimated \$62,422 in savings from up front surgery versus a lifetime of high risk screening. This is estimated as the total cost of screening for \$67,422 minus her out of pocket maximum for surgery. Also the estimate does not include inflation or potential increase in the imaging costs. Other costs which are not included are any biopsies or cancer treatment.

From the insurance company perspective it may seem that high-risk screening alone offers a more cost-effective option. However, the insurance company still pays \$71,075 in screening costs. This is only about \$20,000 less than the one time surgery costs. Additionally, the insurance company does gain the additional benefit from the risk-reducing surgery arm by decreasing the number of cancers that develop with each diagnosis costing >\$75,000 (10).

There are a number of limitations to this study. The first limitation is that there are many insurance plans; however this model allows physicians and patients to help calculate specific costs. Additionally, we do not include the costs of any required second surgeries or potential surgical complications. This cost was not estimated in our analysis in order to decrease the statistical variance of calculating all possible outcomes. Additionally, high risk screening can have the additional cost of unintended false positives and a benign biopsy rate of up to 33% with MRI in this population, quickly driving up costs in the screening arm as well (9). Finally we did not account for different insurance variables, inflation, or differences in out of pocket maximums. The goal was to create a formula by which patients and physicians could calculate and discuss the cost implications of high-risk screening versus prophylactic surgery.

## Conclusions

When counseling high risk patients with *BRCA 1* or *BRCA 2* mutations, it is important to give the patient as much information as possible to allow her to participate in the difficult decision of high risk screening versus prophylactic surgery. Annual high-risk screening with

MRI and mammography as well as the additional office visits is costly and time-consuming. In addition to the cost, it is emotionally taxing for women to undergo imaging, office visits, and potential biopsies for any abnormality on imaging. Some patients will elect to have surveillance even with this information, but it is our job to give our patients the most accurate information possible. Over time, the cost will ultimately change and better imaging techniques will become available. As always, we can continue to counsel our on every option so they may make the best personal decisions for their care.

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### Footnote

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/abs.2018.11.05>). The abstract of this work has been published in 2018 Annual Meeting Official Proceedings, Annals of Surgical Oncology. The authors have no other conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was IRB approved. Informed consent was waived due to the nature of the study.

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