



SCIENTIFIC PRESENTATION AWARD

# Physician Knowledge of Breast Cancer Recurrence and Contralateral Breast Cancer Risk is Associated with Increased Recommendations for Contralateral Prophylactic Mastectomy: a Survey of Physicians at NAPBC-Accredited Centers

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## ABSTRACT

**Background.** Physician recommendation for contralateral prophylactic mastectomy (CPM) has been shown to influence whether a patient chooses CPM. Few studies have explored physician knowledge about contralateral breast cancer (CBC) and local recurrence (LR) risk and whether knowledge is associated with recommendation for CPM.

**Methods.** We conducted a cross-sectional survey of physicians at National Accreditation Program for Breast Centers-accredited breast centers across the USA. Physician knowledge levels of CBC and LR were assessed and correlated with recommendations for CPM.

**Results.** A total of 2412 physicians were surveyed with a 51% response rate ( $n = 1226$ ). The results showed that 66% had correct knowledge about CBC risk and 57% had correct knowledge about LR. Moreover, 634 had high knowledge, viz. 176 (55.4%) breast surgeons, 171 (58.0%) medical oncologists, 196 (62.0%) radiation oncologists, and 72 (29.9%) plastic surgeons ( $p < 0.01$ ). Compared with high knowledge, low knowledge was associated with favoring insurance coverage for patients at average CBC risk (53.8% vs. 39.8%,  $p < 0.01$ ). Low knowledge was also associated with feeling that CPM was indicated in patients with high recurrence anxiety (39.2% vs. 28.9%), young patients with estrogen receptor (ER)-negative cancer (25.3% vs. 18.5%), and patients with two first-degree relatives with breast cancer (40.0% vs. 32.3%) (all  $p < 0.01$ ). Multivariable analysis found physician type [odds ratio (OR) 3.76 for surgeons] and low knowledge (OR 1.46) to be significant independent predictors of favoring insurance coverage for CPM in patients at average risk.

**Conclusions.** Physician knowledge about CBC and LR could be improved. Lower knowledge is associated with favorable physician recommendations for CPM. It is not clear whether improving physician knowledge will change recommendations for CPM.

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Contralateral prophylactic mastectomy (CPM) has been increasing in the USA for the past two decades across all ages and stages of breast cancer.<sup>1-3</sup> Much of this rise is due to patient-driven factors; “peace of mind” and “worry about cancer recurrence” are key drivers of the decision to undergo CPM.<sup>4-6</sup> A hallmark of high-quality decision-making is knowledge. Patients should be informed of the pros and cons of different surgical procedures and the impact to their outcomes, however studies have shown that patients may not always have knowledge about their contralateral breast cancer (CBC) risk<sup>7-10</sup> and the impact of CPM on survival. At the same time, few studies have assessed physician knowledge of CBC risk or recurrence risk. An American Society of Breast Surgeons survey showed that 39% of respondents had a low level of knowledge on CBC risk,<sup>11</sup> and a survey of the American Society of Plastic Surgeons also found that only 61% estimated correct CBC risk in a patient at average risk.<sup>12</sup> No studies have examined knowledge of other physicians who interface with breast cancer patients such as medical or radiation oncologists.

Surgeon recommendations for CPM can play an important role in surgical choice.<sup>4,13,14</sup> A survey of 2402 women with unilateral early-stage breast cancer in Georgia and Los Angeles found that, of the 37% of patients that surgeons recommended against CPM, only 2% underwent CPM, compared with 21% of patients with no surgeon recommendation on CPM and 59% of patients with a surgeon recommendation for CPM.<sup>4</sup> Nonetheless, surgeons are not always comfortable performing CPM and do not always bring it up with patients.<sup>15,16</sup> It is not clear whether this stems from low knowledge or other reasons. Understanding physician knowledge levels on CBC risk and local recurrence (LR) could be a potential modifiable factor that could change the physician–patient shared decision-making discussion about CPM.

The first objective of this study is to examine the knowledge level about CBC and LR risk amongst different types of physicians across the USA. The second objective is to correlate physician knowledge of CBC and LR with physician opinions on insurance coverage and indications for CPM. We utilized the NAPBC network of breast centers to survey physicians about their knowledge and opinions on indications and insurance coverage for CPM.

## METHODS

### *Study Design*

This study was a cross-sectional survey of physicians at NAPBC-accredited hospitals. The NAPBC was established in 2008 by the American College of Surgeons as a

multidisciplinary quality program for breast centers across the USA<sup>17</sup> and currently has over 650 accredited centers, mostly community centers, which makes our findings more generalizable to the breast cancer physician community. Each center was required to distribute surveys to physicians from each specialty (medical oncology, radiation oncology, plastic surgery, breast surgery). Centers with at least three specialties represented were enrolled. The survey responses were deidentified, and participation was counted towards compliance with one of the standards, but accreditation was not contingent on participation. This study was approved by the Institutional Review Board at NorthShore University HealthSystem.

The survey was developed in conjunction with the University of Chicago Survey Lab, which conducted interviews with physicians in each specialty (medical and radiation oncology, plastic, and breast surgery) to develop questions. The survey was made up of a 24-item questionnaire that covered physician knowledge of CBC and LR risk across tumor subtypes, physician opinions, and perceptions of insurance coverage for CPM and indications for CPM (see Appendix for complete survey).

Physician demographics included self-reported data on gender, age, years in practice, and number of patients with breast disease seen per week.

### *Physician Knowledge Questions*

The 10-year risk of CBC was assessed as a written-in percentage in three clinical scenarios: a patient with (1) invasive ductal carcinoma (IDC) and no additional risk factors, (2) IDC with a first-degree relative with breast cancer, and (3) IDC with *BRCA* gene mutation. Correct knowledge based on current literature was defined as answering within the respective ranges: (1) 2–10%,<sup>18-20</sup> (2) 8–15%,<sup>19,21</sup> and (3) 20–40%.<sup>22,23</sup>

To assess LR risk, physicians were asked how LR compared across tumor types for estrogen receptor (ER)-positive, triple-negative, and Her2neu (Her2)-positive tumors (lumpectomy carries higher LR risk, same LR risk for lumpectomy and mastectomy, mastectomy carries higher LR risk). Correct knowledge was “same LR risk for lumpectomy and mastectomy” for all subtypes based on current literature.<sup>24-26</sup>

We developed a composite score for “high” versus “low” correct knowledge for physicians. Answering four of six total knowledge questions (67%) correctly was considered “high” knowledge, while answering three or fewer correctly was considered “low” knowledge.

### *Physician Recommendations for CPM*

Physician opinions of insurance coverage for CPM (favor, neutral, oppose) were asked in several clinical scenarios. Different patient scenarios were used to determine which physicians felt CPM was indicated (strongly indicated, should be discouraged, neither).

### *Statistical Analysis*

Correct knowledge levels were compared with physician characteristics using Chi squared tests. All  $p$  values were two-sided, and  $< 0.05$  was considered statistically significant. Bell curves were used to illustrate physician knowledge about CBC risk in the three different clinical scenarios. Physician demographic factors were compared between high and low knowledge for each knowledge question about CBC risk and LR risk. Multivariable logistic regression was used to identify independent physician factors predictive of having high knowledge. Odds ratio (OR)  $> 1$  was associated with variables with increased odds of high knowledge level. All confidence intervals (CI) are reported at 95% level. Physician knowledge was compared with physician opinions on insurance coverage for CPM and clinical indications for CPM. A multivariable model of physician knowledge and physician demographic factors was performed to determine independent predictors of favorable physician opinions for insurance coverage for CPM and for indications for CPM. All analyses were performed using SAS 9.4 (SAS Institute, Cary, NC).

## **RESULTS**

### *Physician Demographics*

A total of 2412 physicians were surveyed at NAPBC-accredited centers nationwide, with a 51% response rate ( $n = 1226$ ). Physicians from 383 facilities responded. Only 46 (12.0%) facilities were affiliated with a medical school, and 145 (37.0%) had breast cancer case volumes of  $< 300$  per year. The breakdown by specialty included 300 (24.5%) medical oncologists, 316 (25.8%) radiation oncologists, 248 (20.2%) plastic surgeons, and 322 (26.3%) breast surgeons. Mean age was 49.5 years, and mean years in practice were 16. Physician demographics are described in Table 1.

### *Physician Knowledge About Contralateral Breast Cancer Risk and Local Recurrence*

A total of 1170 physicians responded to the knowledge questions. Physicians were asked their best guess of the 10-year risk of CBC. The mean response for CBC risk was  $6.9 \pm 5.4\%$  for a patient with IDC and no additional risk factors for CBC, with 1011 (87.4%) of physicians having correct knowledge. The mean response for IDC with first-degree relative with breast cancer was  $11.22 \pm 6.7\%$ , with 658 (57.4%) having correct knowledge. The mean response for IDC and *BRCA* gene mutation was  $36.67 \pm 19.8\%$ , with 623 (54.4%) having correct knowledge (Fig. 1). Physicians were asked how LR risks compare across tumor subtypes for lumpectomy versus mastectomy. For ER-positive tumors, 756 (67.0%) of physicians answered correctly that lumpectomy and mastectomy carry the same LR risk; for Her2-positive tumors, 706 (63.7%) answered correctly, while for triple-negative tumor, 565 (49.8%) answered correctly (Fig. 2).

Overall, 615 (52.6%) physicians had “high” knowledge, viz. 176 (55.4%) of breast surgeons compared with 171 (58.0%) medical oncologists, 196 (62.0%) radiation oncologists, and 72 (29.9%) plastic surgeons. Multivariable analysis adjusting for physician demographics demonstrated that physician type was the only independent predictor associated with high knowledge; plastic surgeons were 67% less likely to have high knowledge than medical oncologists (OR 0.33, 95% CI 0.23–0.49). Gender, years in practice, number of patients seen per week, and location were not significantly associated with knowledge.

### *Physician Opinions on Indications and Insurance Coverage for CPM*

Physicians were surveyed on opinions on insurance coverage for CPM and indications for CPM in certain clinical scenarios (Table 2), revealing that 515 (46.4%) favored insurance coverage for average CBC risk, and 392 (36.7%) in all cases. Overall, 29 (2.6%) thought CPM was strongly indicated in patients with unilateral cancer and average risk, 391 (33.5%) in patients with higher cancer recurrence anxiety, 250 (22.3%) in patients under age 40 years with breast cancer, and 395 (35.3%) in patients with two or more first-degree relatives with breast cancer.

### *Correlation of Physician Knowledge with Recommendations on CPM*

Compared with high knowledge, low knowledge was significantly associated with favoring insurance coverage for CPM in all cases and for patients at average CBC risk as well as favoring CPM in all clinical scenarios (Table 3).

**TABLE 1** Physician demographic factors ( $N = 1170$ )

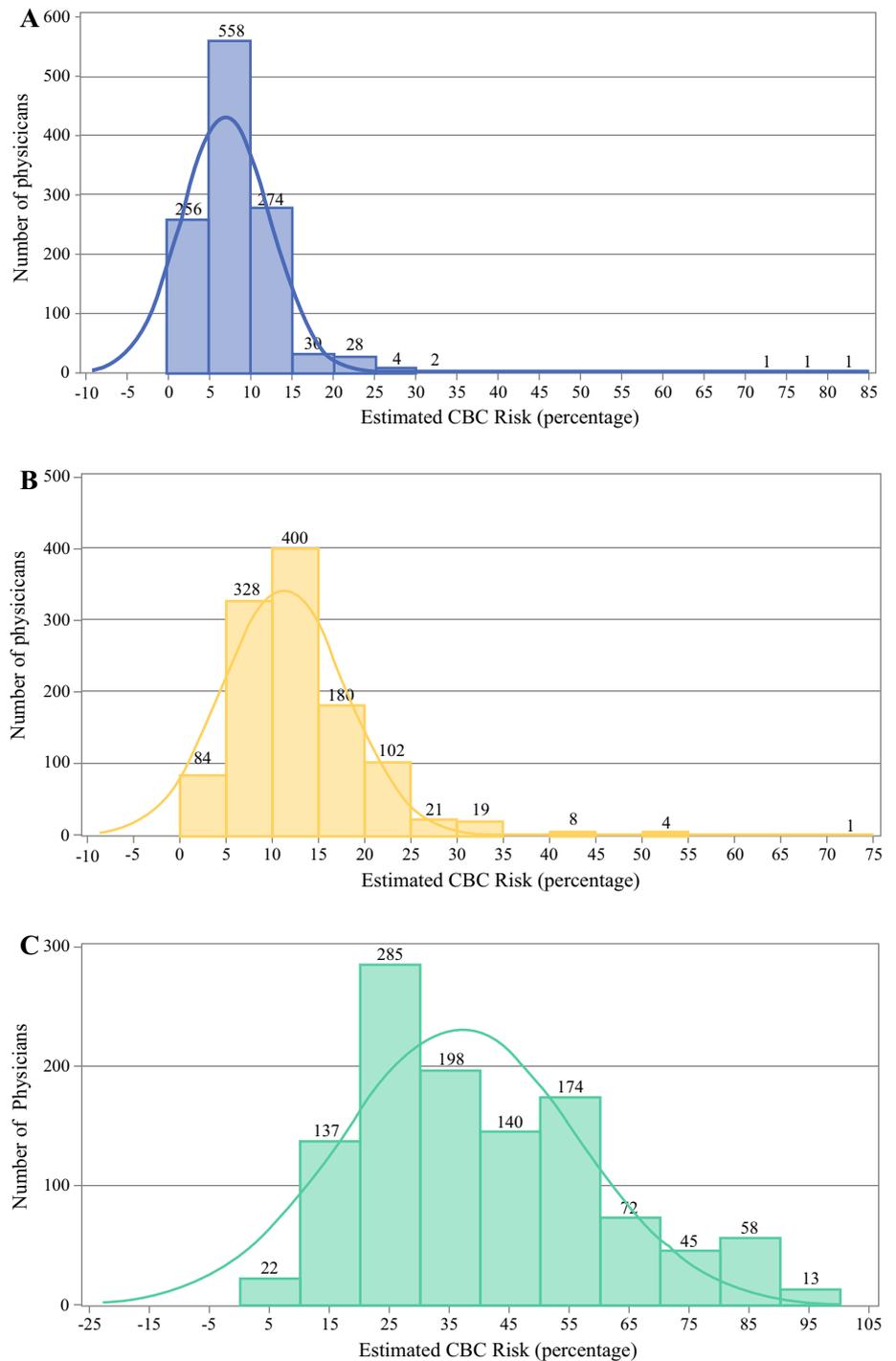
Physician characteristic ( $N = 1170$ )	<i>n</i>	%
Practice medicine as a		
Medical oncologist	295	25.21
Radiation oncologist	316	27.01
Plastic or reconstructive surgeon	241	20.60
Surgeon	318	27.18
Years in practice, mean $\pm$ SD	15.72 $\pm$ 9.91	
< 5	166	14.19
5–9	208	17.78
10–5	233	19.91
16–20	162	13.85
> 20	387	33.08
Unknown	14	1.20
Number of patients with breast disease seen per week over the past 3 months		
< 10	319	27.26
10–29	436	37.26
30–49	205	17.52
> 50	199	17.01
Unknown	11	0.94
Gender		
Male	625	53.42
Female	531	45.38
Other	2	0.17
Unknown	12	1.03
Age (years), mean $\pm$ SD	49.49 $\pm$ 9.81	
30–39	199	17.01
40–49	392	33.50
50–59	333	28.46
60–69	181	15.47
> 70	21	1.79
Unknown	44	3.76

On multivariable analysis, physician knowledge and physician type were independent predictors of favoring CPM for women to avoid future biopsies, for women with high cancer anxiety, and favoring insurance coverage for all cases and for women at average CBC risk. In general, surgeons (breast surgeons and plastic surgeons) were more likely to favor CPM than oncologists and low physician knowledge was associated with more favorable opinions on CPM (Supplementary Table 1). Surgeons were 3.8 times more likely than oncologists (OR 3.76, CI 2.99–4.88) and low-knowledge physicians were 1.5 times more likely than high-knowledge physicians (OR 1.46, CI 1.13–1.89) to favor insurance coverage for women at average CBC risk.

## DISCUSSION

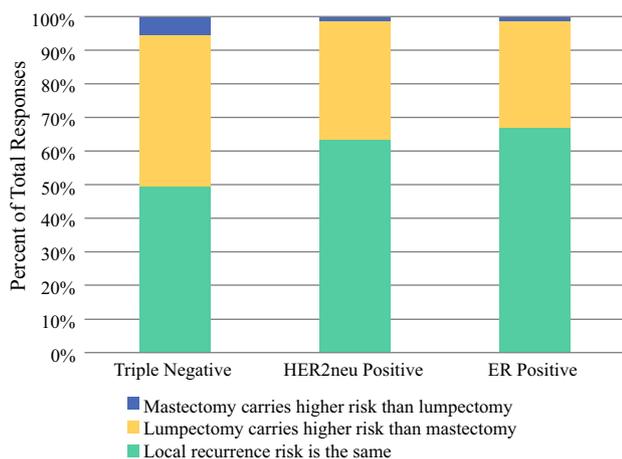
To the best of the authors' knowledge, this study is the first to correlate physician knowledge and recommendations for CPM. Overall, approximately two-thirds of physicians had accurate knowledge about CBC risk and 57% about local recurrence risk. The only physician demographic factor associated with knowledge was physician type. Lower physician knowledge was associated with more favorable attitudes toward utilization of CPM and insurance coverage for CPM. Interestingly, knowledge was only an independent predictor of favoring CPM in cases where knowledge of CBC or LR risk would not play a role in decision-making, such as avoiding biopsies or high cancer recurrence anxiety. Knowledge was not an independent predictor for favoring CPM for younger patients or for certain tumor types.

**FIG. 1** Physician knowledge about 10-year contralateral breast cancer risk in a patient with IDC and **a** no additional risk factors, **b** a first-degree relative with breast cancer, and **c** *BRCA* mutation ( $N = 1170$ ). Bars represent the number of physicians that estimated the percent risk in each range (0–100%). The overlying bell curve represents the normal distribution



Our findings suggest that overall physician knowledge could improve. Many studies have examined CBC risk on a population level, and recurrences are readily reported through clinical trials. However, predicting individualized CBC risk is more difficult. A Surveillance, Epidemiology, and End Results (SEER) analysis of CBC risk from 1975 to 2006 found that, for ER-positive patients, the incidence of CBC after initial breast cancer was 0.25–0.37% per year

for age > 30 years, but this risk increased to 0.45% per year for age < 30 years and was twice as high in ER-negative patients.<sup>18</sup> Family history has been shown to be a risk factor for CBC risk.<sup>19,21</sup> The multiinstitutional WECARE study of case-matched patients age < 55 years with breast cancer found a 10-year CBC absolute risk of 4.2% for patients with no family history of breast cancer compared with 8.3% for nonmutation carriers with any



**FIG. 2** Physician knowledge about local recurrence risk, stratified by tumor subtype ( $N = 1170$ )

first-degree relative with breast cancer.<sup>21</sup> In *BRCA* carriers, a recent metaanalysis showed a 10-year CBC risk of 27% in *BRCA1* carriers and 19% in *BRCA2* carriers,<sup>23</sup> and a prospective analysis of *BRCA* patients in the UK reported an average cumulative risk of CBC of between 62 and 83% by age 70 years.<sup>22</sup>

Rates of LR have evolved over time. Traditionally, patients undergoing breast-conserving surgery had higher LR risks than patients undergoing mastectomy.<sup>27,28</sup> However, more recent studies have shown that, when stratifying by tumor molecular subtype, LR risks for BCS are equivalent to mastectomy. Indeed, long-term follow-up of the National Surgical Adjuvant Breast and Bowel Project (NSABP) B-06<sup>26</sup> or European Organisation for Research and Treatment of Cancer (EORTC) 10801<sup>24</sup> early randomized trials of breast-conserving therapy compared with mastectomy do not show any significant differences in LR, disease-free survival, or overall survival. It is important to note that, although patients with triple-negative tumors and Her2-positive tumors have LR rates that are higher than those with ER-positive tumors, the absolute LR risk is the same between BCS and mastectomy. A study of 1434 patients after breast-conserving therapy found significantly increased 5-year LR in Her2-positive (10.9%) and triple-negative disease (8.8%) compared with luminal A tumors (1.5%).<sup>29</sup> A metaanalysis of locoregional recurrence of 12,592 patients in 15 studies found lower recurrence rates for luminal or Her2-positive patients compared with triple-negative patients after either breast-conserving therapy (RR 0.49) or mastectomy (RR 0.66).<sup>30</sup> In our study, it was clear that physicians felt that LR risks were different between BCS and mastectomy, especially among patients with triple-negative tumors, with only 50% of physicians having correct knowledge, compared with 67% in ER-positive patients.

The widest disparities in CPM recommendations by knowledge levels were in patients at average risk. Of physicians with low knowledge, 54% favored insurance coverage for CPM and 66% felt that CPM was indicated for average-risk patients. This finding is not surprising given that most national guidelines recommend against CPM for patients at average CBC risk.<sup>31,32</sup> However, only 15–20% of all physicians opposed insurance coverage for women with average CBC risk, yet over half felt that CPM should be discouraged for women with IDC and average CBC risk. These findings underscore physician variability regarding encouragement or discouragement of CPM.

Surgeons were more likely than oncologists to recommend CPM and insurance coverage for CPM in most cases despite knowledge levels. Surgeons are usually the first specialist that a newly diagnosed breast cancer patient will see, and their recommendations can have a tremendous influence on patient surgical choices. The findings of this study show that physician type was an independent predictor of overall knowledge; plastic surgeons had less knowledge than other physician types. Since many patients who undergo CPM have reconstruction, most will see a plastic surgeon, and this physician could influence choice for CPM. The low knowledge level of plastic surgeons relative to other physicians suggests a potential area of improvement. While all NAPBC centers participate in a multidisciplinary tumor board, plastic surgery attendance is not mandated but rather specified by each individual leadership team. Encouraging plastic surgery participation may be a potential target to increase physician knowledge.

Although the results of this study reveal an association between physician knowledge and recommendation for CPM, it is not clear whether improving physician knowledge would change physician recommendations for CPM. A longitudinal study on physician recommendation for CPM is needed to see whether improving physician knowledge will impact practice patterns long term. Decision aids and modeling of long-term CBC risk have the potential to be useful tools, not only for patients but for physicians as well. Decision aids have been shown to improve patient knowledge about CPM<sup>7,33</sup> but have not been studied with physician knowledge. Incorporation of modeling of CBC risk<sup>34,35</sup> into adaptable personalized bedside risk assessment tools has potential for increasing knowledge at both the physician and patient levels and to aid in informing surgical decisions. More emphasis on CBC and LR at regional and national conferences and the incorporation of updated risk ranges into societal and national guidelines may help improve physician knowledge.

Limitations of this study include the observational nature of the survey, and the fact that attitudes expressed in the survey may not correlate with bedside

**TABLE 2** Physician opinions on insurance coverage and indications for CPM, stratified by physician type ( $N = 1170$ )

	Medical oncologist ( $N = 295$ )		Radiation oncologist ( $N = 316$ )		Plastic surgeon ( $N = 241$ )		Surgeon ( $N = 318$ )		Overall ( $N = 1170$ )		<i>p</i> value
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	
<i>Do you favor or oppose insurance coverage for CPM in the following situations</i>											
Average contralateral breast cancer risk											
Favor	97	33.92	86	28.29	164	75.58	168	55.45	515	46.40	< 0.0001
Neutral	130	45.45	124	40.79	48	22.12	97	32.01	399	35.95	
Oppose	59	20.63	94	30.92	5	2.30	38	12.54	196	17.66	
In all cases											
Favor	56	20.90	49	17.50	143	63.27	144	48.98	392	36.70	< 0.0001
Neutral	163	60.82	169	60.36	68	30.09	122	41.50	522	48.88	
Oppose	49	18.28	62	22.14	15	6.64	28	9.52	154	14.42	
<i>In these situations, would you say</i>											
Patient wishes to avoid future mammograms or biopsies											
CPM is strongly indicated	38	12.88	54	17.14	106	44.17	39	12.26	237	20.29	< 0.0001
Neither	148	50.17	139	44.13	96	40.00	156	49.06	539	46.15	
CPM should be discouraged	108	36.61	119	37.78	32	13.33	123	38.68	382	32.71	
No idea	1	0.34	3	0.95	6	2.50	0	0.00	10	0.86	
Patient has high cancer recurrence anxiety											
CPM is strongly indicated	66	22.53	82	26.03	152	63.07	91	28.62	391	33.50	< 0.0001
Neither	154	52.56	156	49.52	77	31.95	172	54.09	559	47.90	
CPM should be discouraged	72	24.57	75	23.81	7	2.90	55	17.30	209	17.91	
No idea	1	0.34	2	0.63	5	2.07	0	0.00	8	0.69	
Under age 40 years with breast cancer											
CPM is strongly indicated	39	13.83	39	12.58	102	44.74	70	23.10	250	22.26	< 0.0001
Neither	179	63.48	203	65.48	113	49.56	205	67.66	700	62.33	
CPM should be discouraged	62	21.99	64	20.65	7	3.07	28	9.24	161	14.34	
No idea	2	0.71	4	1.29	6	2.63	0	0.00	12	1.07	
Two-plus first-degree relatives with breast cancer											
CPM is strongly indicated	97	34.40	69	22.62	150	66.08	79	25.99	395	35.33	< 0.0001
Neither	156	55.32	199	65.25	66	29.07	198	65.13	619	55.37	
CPM should be discouraged	26	9.22	32	10.49	3	1.32	26	8.55	87	7.78	
No idea	3	1.06	5	1.64	8	3.52	1	0.33	17	1.52	
Young with ER-negative breast cancer											
CPM is strongly indicated	35	12.41	35	11.33	113	49.56	55	18.09	238	21.19	< 0.0001
Neither	181	64.18	181	58.58	92	40.35	210	69.08	664	59.13	
CPM should be discouraged	63	22.34	89	28.80	8	3.51	39	12.83	199	17.72	
No idea	3	1.06	4	1.29	15	6.58	0	0.00	22	1.96	
Average risk with unilateral breast cancer											
CPM is strongly indicated	2	0.70	2	0.64	21	9.13	4	1.31	29	2.57	< 0.0001
Neither	77	27.11	91	29.26	149	64.78	99	32.46	416	36.81	
CPM should be discouraged	203	71.48	216	69.45	55	23.91	202	66.23	676	59.82	
No idea	2	0.70	2	0.64	5	2.17	0	0.00	9	0.80	

recommendations for or against CPM or whether patients actually had a CPM. We only queried knowledge on CBC and LR but did not assess physician knowledge on impact of CPM on survival or knowledge about risks of CPM such

as operative complications. There may be other factors that were not analyzed here that play a role in physician knowledge.

**TABLE 3** Physician knowledge association with physician opinion for CPM (*N* = 1170)

	High knowledge level ( <i>N</i> = 615)		Low knowledge level ( <i>N</i> = 555)		<i>p</i> value
	<i>N</i>	% row	<i>n</i>	% row	
<i>Do you favor or oppose insurance coverage for CPM in the following situations</i>					
Average contralateral breast cancer risk					
Favor	235	45.63	280	54.37	< 0.0001
Neutral	224	56.14	175	43.86	
Oppose	131	66.84	65	33.16	
In all cases					
Favor	178	45.41	214	54.59	0.0006
Neutral	289	55.36	233	44.64	
Oppose	95	61.69	59	38.31	
<i>In these situations, would you say</i>					
Patient wishes to avoid future mammograms or biopsies					
CPM is strongly indicated	104	43.88	133	56.12	< 0.0001
Neither	287	53.25	252	46.75	
CPM should be discouraged	224	58.64	158	41.36	
Patient has high cancer recurrence anxiety					
CPM is strongly indicated	177	45.27	214	54.73	< 0.0001
Neither	303	54.20	256	45.80	
CPM should be discouraged	133	63.64	76	36.36	
Under age 40 years with breast cancer					
CPM is strongly indicated	119	47.60	131	52.40	0.0026
Neither	379	54.14	321	45.86	
CPM should be discouraged	99	61.49	62	38.51	
Two-plus first-degree relatives with breast cancer					
CPM is strongly indicated	189	47.85	206	52.15	0.0116
Neither	347	56.06	272	43.94	
CPM should be discouraged	50	57.47	37	42.53	
Young with ER-negative breast cancer					
CPM is strongly indicated	110	46.22	128	53.78	< 0.0001
Neither	362	54.52	302	45.48	
CPM should be discouraged	124	62.31	75	37.69	
Average risk with unilateral breast cancer					
CPM is strongly indicated	10	34.48	19	65.52	< 0.0001
Neither	191	45.91	225	54.09	
CPM should be discouraged	398	58.88	278	41.12	

## CONCLUSIONS

Lower physician knowledge of CBC and LR across patient scenarios is associated with favorable attitudes towards CPM. Future studies examining novel ways to educate physicians and improve knowledge on CBC and LR are needed. Improved modeling of individualized CBC risk will also help physicians give their patients more accurate risk assessment for future CBC and help patients with the difficult decision-making process for CPM.

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## REFERENCES

1. Tuttle TM, Habermann EB, Grund EH, Morris TJ, Virnig BA. Increasing use of contralateral prophylactic mastectomy for breast cancer patients: a trend towards more aggressive surgical treatment. *J Clin Oncol.* 2007;25(33):5203–9.
2. Yao K, Stewart AK, Winchester DJ, Winchester DP. Trends in contralateral prophylactic mastectomy for unilateral cancer: a report from the National Cancer Data Base, 1998–2007. *Ann Surg Oncol.* 2010;17(10):2554–62.

3. Kurian AW, Lichtensztajn DY, Keegan TH, Nelson DO, Clarke CA, Gomez SL. Use of and mortality after bilateral mastectomy compared with other surgical treatments for breast cancer in California, 1998–2011. *JAMA*. 2014;312(9):902–14.
4. Jagsi R, Hawley ST, Griffith KA, Janz NK, Kurian AW, Ward KC, Hamilton AS, Morrow M, Katz SJ. Contralateral prophylactic mastectomy decisions in a population-based sample of patients with early-stage breast cancer. *JAMA Surg*. 2017;152(3):274–82.
5. Ager B, Butow P, Jansen J, Phillips KA, Porter D, CPM DA Advisory Group. Contralateral prophylactic mastectomy (CPM): a systemic review of patient reported factors and psychological predictors influencing choice and satisfaction. *Breast*. 2016;28:107–20.
6. Huang J, Chagpar A. Factors associated with decision to undergo contralateral prophylactic mastectomy versus unilateral mastectomy. *Am J Surg*. 2018;S0002-9610(18)31243-1.
7. Yao K, Belkora J, Bedrosian I, et al. Impact of an in-visit decision aid on patient knowledge about contralateral prophylactic mastectomy: a pilot study. *Ann Surg Oncol*. 2017;24(1):91–9.
8. Rosenberg SM, Tracy MS, Meyer ME, et al. Perceptions, knowledge, and satisfaction with contralateral prophylactic mastectomy among young women with breast cancer: a cross-sectional survey. *Ann Intern Med*. 2013;159(6):373–81.
9. Parker PA, Peterson SK, Bedrosian I, et al. Prospective study of surgical decision-making processes for contralateral prophylactic mastectomy in women with breast cancer. *Ann Surg*. 2016;263(1):178–83.
10. Bedrosian I, Yao K. Contralateral prophylactic mastectomy: anxiety, knowledge, and shared decision-making. *Ann Surg Oncol*. 2015;22(12):3767–8.
11. Yao K, Belkora J, Sisco M, Rosenberg S, Bedrosian I, Liederbach E, Wang C. Survey of the deficits in surgeons' knowledge of contralateral prophylactic mastectomy. *JAMA Surg*. 2016;151(4):391–3.
12. Lopez CD, Bluebond-Langner R, Houssock CA, Slezak SS, Bellavance E. Plastic and reconstructive surgeons' knowledge and comfort of contralateral prophylactic mastectomy: a survey of the American Society of Plastic Surgeons. *Front Oncol*. 2019;8:647.
13. Soran A, Ibrahim A, Kanbour M, et al. Decision making and factors influencing long-term satisfaction with prophylactic mastectomy in women with breast cancer. *Am J Clin Oncol*. 2015;38(2):179–83.
14. Katz SJ, Hawley ST, Hamilton AS, Ward KC, Morrow M, Jagsi R, Hofer TP. Surgeon influence on variation in receipt of contralateral prophylactic mastectomy for women with breast cancer. *JAMA Surg*. 2018;153(1):29–36.
15. Musiello T, Bornhammar E, Saunders C. Breast surgeons' perceptions and attitudes towards contralateral prophylactic mastectomy. *ANZ J Surg*. 2013;83(7–8):527–32.
16. Bellavance E, Peppercorn J, Kronsberg S, et al. Surgeons' perspectives of contralateral prophylactic mastectomy. *Ann Surg Oncol*. 2016;23(9):2779–87.
17. Winchester DP. The National Accreditation Program for Breast Cancers: quality improvement through standard setting. *Surg Oncol Clin North Am*. 2011;20(3):581–6.
18. Nichols HB, Berrington A, Lacey JV, Rosenberg SP, Anderson WF. Declining incidence of contralateral breast cancer in the United States from 1975 to 2006. *J Clin Oncol*. 2011;29(12):1564–9.
19. Akdeniz D, Schmidt MK, Sevnavee CM, et al. Risk factors for metachronous contralateral breast cancer: a systemic review and meta-analysis. *Breast*. 2019;44:1–14.
20. Gao X, Fischer SG, Emani B. Risk of second primary breast cancer in the contralateral breast in women treated for early-stage breast cancer: a population-based study. *Int J Radiat Oncol Biol Phys*. 2003;56(4):1038–45.
21. Reiner AS, Sisti J, John EM, et al. Breast cancer family history and contralateral breast cancer risk in young women: an update from the Women's Environmental Cancer and Radiation Epidemiology study. *J Clin Oncol*. 2018;36(15):1513–20.
22. Mavaddat N, Peock S, Frost D, et al. Cancer risks for BRCA1 and BRCA2 mutation carriers: results from prospective analysis of EMBRACE. *J Natl Cancer Inst*. 2013;105(11):812–22.
23. Molina-Montes E, Perez-Nevot B, Pollan M, Sanchez-Cantalejo E, Espin J, Sanchez MJ. Cumulative risk of a second primary contralateral breast cancer in BRCA1/BRCA2 carriers with a first breast cancer: a systemic review and meta-analysis. *Breast*. 2014;23:721–42.
24. Van Dongen JA, Voogd AC, Fentiman IS, et al. Long-term results of a randomized trial comparing breast-conserving therapy with mastectomy: European Organization for Research and Treatment of Cancer 10801 trial. *J Natl Cancer Inst*. 2000;92(14):1143–50.
25. Voduc KD, Cheang MC, Tyldesley S, Gelmon K, Nielsen TO, Kennecke H. Breast cancer subtypes and the risk of local and regional relapse. *J Clin Oncol*. 2010;28(10):1684–91.
26. Fisher B, Anderson S, Bryan J, et al. Twenty-year follow-up of a randomized trial comparing total mastectomy, lumpectomy, and lumpectomy plus irradiation for the treatment of invasive breast cancer. *N Engl J Med*. 2002;347(16):1233–41.
27. Veronesi U, Salvadori B, Luini A, et al. Breast conservation is a safe method in patients with small cancer of the breast. Long-term results of three randomised trials on 1,973 patients. *Eur J Cancer*. 1995;31(10):1574–9.
28. Jatoi I, Proschan MA. Randomized trials of breast-conserving therapy versus mastectomy for primary breast cancer: a pooled analysis of updated results. *Am J Clin Oncol*. 2005;28(3):289–94.
29. Arvold ND, Taghian AG, Niemierko A, et al. Age, breast cancer subtype approximation, and local recurrence after breast-conserving therapy. *J Clin Oncol*. 2011;29(29):3885–91.
30. Lowery AJ, Kell MR, Glynn RW, Kerin MJ, Sweeney KJ. Locoregional recurrence after breast cancer surgery: a systemic review by receptor phenotype. *Breast Cancer Res Treat*. 2012;133(3):831–41.
31. National Comprehensive Cancer Network. NCCN clinical practice guidelines in oncology: breast cancer. Version 1. 2019. [https://www.nccn.org/professionals/physician\\_gls/default.aspx](https://www.nccn.org/professionals/physician_gls/default.aspx). Accessed 14 April 2019.
32. Boughey JC, Attai DJ, Chen SL, et al. Contralateral prophylactic mastectomy consensus statement from the American Society of Breast Surgeons: additional considerations and a framework for shared decision making. *Ann Surg Oncol*. 2016;23(10):3106–11.
33. Manne SL, Smith BL, Frederick S, Mitarontondo A, Kashy DA, Kirstein LJ. B-Sure: a randomized pilot trial of an interactive web-based decision support aid versus usual care in average-risk breast cancer patients considering contralateral prophylactic mastectomy. *Transl Behav Med*. 2019. <https://doi.org/10.1093/tbm/iby133>.
34. Portschy PR, Kuntz KM, Tuttle TM. Survival outcomes after contralateral prophylactic mastectomy: a decision analysis. *J Natl Cancer Inst*. 2014. <https://doi.org/10.1093/jnci/dju160>.
35. Davies KR, Brewster AM, Bedrosian I, et al. Outcomes of contralateral prophylactic mastectomy in relation to familial history: a decision analysis (BRCR-D-16-00033). *Breast Cancer Res*. 2016;18(1):93.