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ORIGINAL REPORT

Physicians' Experiences With *BRCA1/2* Testing in Community Settings

Nancy L. Keating, Kathryn A. Stoeckert, Meredith M. Regan, Lisa DiGianni, and Judy E. Garber

From the Division of General Internal Medicine, Brigham and Women's Hospital; Departments of Health Care Policy and Medicine, Harvard Medical School; and the Departments of Medical Oncology and Biostatistics, Dana-Farber Cancer Institute, Boston, MA.

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Corresponding author: Nancy L. Keating, MD, MPH, Department of Health Care Policy, Harvard Medical School, 180 Longwood Ave, Boston, MA 02115; e-mail: keating@hcp.med.harvard.edu.

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ABSTRACT

Purpose
We surveyed a national sample of nonacademic physicians who ordered *BRCA1/2* testing to understand their implementation of genetic testing and to assess recommendations for surveillance and cancer risk management of women with positive test results.

Patients and Methods
We surveyed physicians (N = 611 of 1,050; response rate, 58.2%) practicing in nonacademic settings who ordered *BRCA1/2* testing during 2004 to 2005. We described physicians' experiences with testing and used multivariable regression models to identify factors associated with more complete counseling and with recommendations for cancer risk management for a *BRCA1* mutation carrier.

Results
Most physicians (68.2%) usually or always discussed six counseling items before testing. In adjusted analyses, physicians who were assisted by genetic counselors, nurse geneticists, or others (*v* counseling by themselves), those who spent more than 60 minutes in counseling, and medical oncologists (*v* surgeons or geneticists) were more likely to discuss all six items (all $P < .05$). A total of 61.4% of physicians would recommend bilateral prophylactic mastectomy to a 38-year-old *BRCA1* mutation carrier who had completed childbearing. After adjustment, geneticists and gynecologists were less likely than medical oncologists and surgeons to recommend prophylactic mastectomy ($P < .001$), as were physicians in the Northeast versus those in other regions of the United States ($P = .01$).

Conclusion
Community-based physicians seem to be successfully incorporating *BRCA1/2* testing into their practices. Physicians' recommendations for surveillance of mutation carriers are generally consistent with practice guidelines, yet recommendations for preference-based procedures such as prophylactic mastectomy vary by physician characteristics such as specialty and geographic region. The providers whom patients see for testing may contribute to variations in prophylactic treatments.

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INTRODUCTION

Genetic testing for mutations in the breast/ovarian cancer susceptibility genes *BRCA1* and *BRCA2* has become the most widely ordered genetic test in the United States since the test became commercially available in 1996. A germline mutation in either *BRCA1* or *BRCA2* confers greatly increased lifetime risks of breast and ovarian cancers.[1] Knowledge of *BRCA1/2* mutation status guides recommendations for surveillance and risk-reducing interventions and may also influence therapeutic decisions for some newly diagnosed patients.

Most genetic testing in the United States is ordered by physicians, and therefore, the experiences that patients have with genetic testing likely depend in large part on the skills, attitudes, and practices of the physicians they see. As use of *BRCA1/2* testing increases, more testing is being done outside of academic centers. Academic medical centers currently account for less than 50% of all *BRCA1/2* testing performed by Myriad Genetics Laboratory (Myriad; Salt Lake City, UT), the only commercial provider of *BRCA1/2* testing. Given the complexity of cancer genetics, risk assessment, and management of patients informed by genetic test results,[2] it is important to understand how genetic testing is being implemented in the community. Physicians ordering genetic testing must provide the requisite counseling and education and make recommendations to patients based on their genetic

test results.[3,4] Although recommendations and guidelines for assessment, counseling, and follow-up care of women at high-risk for breast cancer have been available for some time,[3-5] it is not known to what extent these have diffused into clinical practice.

We surveyed a national sample of nonacademic physicians who had ordered *BRCA1/2* testing to understand how they were implementing genetic testing in their practices. We also assessed their recommendations for surveillance and management of women with positive test results.

PATIENTS AND METHODS

Study Population

This physician survey is part of a larger study of patients' experiences with *BRCA1/2* testing. Myriad distributed surveys to physicians ordering *BRCA1/2* tests for patients in the larger study. The patient cohort included all individuals testing positive for a deleterious mutation as well as the next three individuals with nonpositive (negative or variant of unknown significance) results. The study focused on testing in nonacademic centers; therefore, patients whose tests were sent from 130 academic medical centers were excluded. The physician cohort included all physicians who ordered *BRCA1/2* tests for eligible patients. Physicians were surveyed only once regardless of the number of genetic tests they ordered during the study period. Myriad provided information about each physician's sex, practice geographic location, and number of *BRCA1/2* tests ordered in the past year. The study protocol was approved by the Dana-Farber/Harvard Cancer Center institutional review board.

Questionnaire and Survey Administration

The survey instrument was designed to collect information about physicians' experiences with *BRCA1/2* testing and recommendations for additional treatment of patients with a positive test result. Questions were developed after literature review and discussions with physicians, and the questionnaire was revised after cognitive testing and debriefing with eight clinician experts.

Physicians were asked whether patients are ever referred to them by other providers specifically for *BRCA1/2* counseling and possible testing, whether they have ordered genetic tests other than *BRCA1/2*, how often they schedule specific visits for *BRCA1/2* counseling before testing, the number of minutes spent counseling for *BRCA1/2* testing, assistance with counseling from others, whether the practice bills for professional counseling time, and the topics discussed during counseling (based on American Society of Clinical Oncology statement on genetic testing[6]). Physicians were also asked whether they typically provide positive, negative, or variant results in person, by phone, or by mail and whether results are included in patients' medical records. They were asked what surveillance testing they would recommend for a 35-year old woman with a *BRCA1* mutation who desires no prophylactic surgery. Finally, they were asked whether they would recommend prophylactic surgery and other interventions for a 38-year-old healthy *BRCA1* mutation carrier who has completed childbearing. Physicians also provided their specialty and medical school graduation year.

During August 2004 through December 2005, Myriad mailed surveys with a $20 prepaid cash incentive to 1,086 physicians who had ordered *BRCA1/2* tests. Physicians not responding within 3 weeks were mailed a second survey. No further contacts were made. Of 1,086 physicians surveyed, 36 physicians were ineligible because they had never ordered genetic testing (n = 27), were affiliated with an academic center (n = 7), or practiced outside the United States (n = 2). Of the remaining 1,050 physicians, 611 responded (response rate, 58.2%). Women were more likely to respond than men (65% *v* 54%; $P = .001$), as were physicians who ordered more *BRCA1/2* tests in the past year (68.3% of high-volume, 54.8% of medium-volume, 53.2% of low-volume physicians; $P = .003$), but response rates did not differ by US census region ($P = .82$) or urban practice location ($P = .88$).

Analysis

Testing and counseling. We described physicians' experiences with *BRCA1/2* testing. We dichotomized items about counseling before testing as "always" or "usually" versus "sometimes" or "rarely." These six items (benefits and limitations of close surveillance if positive test, benefits and limitations of prophylactic mastectomy if positive test, benefits and limitations of prophylactic oophorectomy if positive test, possibility of psychological reaction, sharing test results with family members, and confidentiality and privacy issues) were among the elements of informed consent to be discussed with all patients before testing as stipulated in the American Society of Clinical Oncology statement on Genetic Testing.[6] We summed the number of the six for which providers responded "always" or "usually" and dichotomized this summary variable at six versus five or less.

We used χ^2 tests to identify bivariate associations between clinician characteristics and whether they usually/always discussed all six items. Specifically, we examined provider sex, specialty, years since medical school graduation, whether they schedule a specific counseling visit, time spent counseling, whether a nurse or genetic counselor assists them with counseling, whether they bill for counseling visits, geographic region of practice, whether other providers refer patients to them (a measure of expertise perceived by others), and number of *BRCA1/2* tests ordered in the past year (a measure of testing experience). We used logistic regression to assess factors associated with discussing all six items, including in the model all variables with $P \leq .20$ in unadjusted analyses.

Recommendations for women with BRCA1/2 *mutation.* We described recommendations for surveillance testing and management of women with *BRCA1/2* mutations. We used χ^2 tests to identify bivariate associations of provider characteristics with recommendations for prophylactic bilateral mastectomy for a 38-year-old *BRCA1* mutation carrier who had completed childbearing after dichotomizing the responses as recommended for (somewhat or strongly) versus recommended against (somewhat or strongly). Specifically, we examined sex, specialty, number of *BRCA1/2* tests ordered in the past year, whether other physicians refer patients to them for testing, and geographic region. We used logistic regression models to assess whether provider characteristics were associated with recommendations for prophylactic mastectomy, including all variables with $P \leq .20$ in unadjusted analyses.

Analyses were conducted using SAS statistical software, version 9.1 (SAS Institute, Cary, NC).

RESULTS

Of 611 respondents, 39% were women and the mean number of years since medical school graduation was 23.1 (standard deviation = 9.5; Table 1). More than half (53%) were medical oncologists, 15% were surgeons, 8% were geneticists, and 11% were gynecologist/obstetricians. The remaining physicians were primary care physicians (9.3%) and physicians of other specialties (3.6%). Nearly two thirds of physicians reported that they counsel and test patients referred to them by other physicians for *BRCA1/2* testing, suggesting that their colleagues consider them to have expertise in this area. Many (42%) have ordered genetic tests other than *BRCA1/2*, and the median number of *BRCA1/2* tests ordered in the past year was eight (interquartile range, two to 24).

Testing and Counseling

When testing for *BRCA1/2*, most physicians always (41.9%) or usually (17.5%) schedule specific visits for which counseling is the primary reason for the visit (Table 2). More than half of physicians spend more than 30 minutes counseling patients about the test before testing, and physicians are frequently assisted by genetic counselors, nurse geneticists, nurse practitioners, physician assistants, or other counselors (Table 2).

Table 1. Characteristics of Physicians Ordering *BRCA1/2* Tests

Characteristic	Physicians (N = 611)
Sex, %	
Male	60.6
Female	39.4
Specialty, %	
Medical oncologist	53.2
Surgeon	15.1
Geneticist	7.7
Gynecologist/obstetrician	11.1
Other*	12.9
No. of years since graduation from medical school†	
Mean	23.1
SD	9.5
US Census region, %	
Northeast	21.3
Midwest	21.1
South	33.1
West	24.6
Urban-rural residence, %	
Large metropolitan area	52.4
Smaller metropolitan area	38.0
Nonmetropolitan area	9.7
No. of patients seen per week‡	
Mean	77.8
SD	46.9
Counsels and tests patients who are referred by other physicians for possible *BRCA1/2* testing, %	61.7
Has ordered genetic tests other than *BRCA1/2*, %	42.2
No. of *BRCA1/2* tests ordered during study period of July 2004 through December 2005	
Median	8
Interquartile range	2-24

Abbreviation: SD, standard deviation.
*Twelve physicians with missing information on specialty were included in the other category.
†Thirty physicians were missing information on year of graduation from medical school.
‡Seventeen physicians were missing information on number of patients seen per week.

Table 2. Physicians' Reported Practice Patterns When Providing Genetic Testing

Practice Pattern	% of Physicians (N = 611)
Counseling	
Schedules specific visits for counseling	
Always	41.9
Usually	17.5
Sometimes	31.3
Never	9.0
Unknown	0.3
Total No. of minutes of counseling before *BRCA1/2* testing	
≤ 30	47.0
31-60	35.8
> 60	16.0
Unknown	1.2
Staff member(s) counseling	
Physician only	33.7
Physician assisted by genetic counselor/nurse geneticist/NP/PA	35.4
Physician assisted by other counselor	26.7
Unknown	4.3
Practice bills for professional time associated with counseling	60.9
When counseling patients before testing, always or usually discusses the following:	
Benefits and limitations of close surveillance	92.0
Benefits and limitations of prophylactic mastectomy	83.8
Benefits and limitations of prophylactic oophorectomy	82.2
Possibility of a psychological reaction	81.0
Sharing test result with family members	88.1
Confidentiality and privacy issues	91.3
Providing results	
Inform patients of positive results	
In person	74.0
By phone	23.2
By mail	0.5
Missing	2.3
Inform patients of variant results	
In person	65.8
By phone	29.0
By mail	1.2
Missing	4.1
Inform patients of negative results	
In person	50.8
By phone	45.5
By mail	2.1
Missing	1.6
Documents results of tests in medical record	
Always	62.2
Usually	15.9
Sometimes	11.5
Never	8.2
Missing	2.3

Abbreviations: NP, nurse practitioner; PA, physician assistant.

Physicians typically inform patients of positive or variant results in person, but often provide results by phone, especially negative results (Table 2). Most physicians always (62.9%) or usually (15.9%) document test results in the patient's medical record (Table 2).

Two thirds (68.2%) of physicians reported that all six counseling items are usually or always discussed with their patients before testing. In unadjusted analyses, geneticists and medical oncologists were more likely than other specialists to report discussing all six items (Table 3). Physicians who test patients referred by other physicians, those who do more testing, and those who schedule specific visits for counseling were more likely than others to report discussing all counseling items, as were physicians who spend more time counseling and those who are assisted by genetic counselors, nurse geneticists, or nurse practitioners/physician assistants.

In adjusted analyses, surgeons and geneticists were less likely than medical oncologists to report always/usually discussing all six counseling items (Table 3). Physicians assisted by genetic counselors, nurse geneticists, or other physician extenders, compared with physicians who counseled without assistance, were more likely than others to report that counseling discussions included all six items, as were physicians who (alone or in conjunction with staff) spent more than 60 minutes in counseling. Physician sex, number of *BRCA1/2* tests sent during the past year, whether the physician counsels and tests patients referred from other physicians, and whether the practice bills for professional time associated with counseling were not significantly associated with the number of counseling items discussed.

Table 3. Factors Associated With Usually or Always Discussing All Six Counseling Items

Characteristic	Unadjusted Proportion Discussing All Six Items (%)	*P*	Discussion of All Six Items*		
			Adjusted Odds	95% CI	*P*
Sex		.10			.73
Male	65.7		Reference		
Female	72.1		1.08	0.72 to 1.61	
Specialty		< .001			.06
Medical oncologist	73.5		Reference		
Surgeon	64.0		0.54	0.31 to 0.93	
Geneticist	78.7		0.41	0.18 to 0.96	
Gynecologist/obstetrician	53.9		0.62	0.33 to 1.17	
Other/missing	56.0		0.62	0.33 to 1.15	
No. of years since medical school graduation		.40			—
≤ 15	68.7		—		
16-23	68.0		—		
24-29	70.1		—		
≥ 30	64.0		—		
Unknown	82.1		—		
No. of *BRCA1/2* tests sent during past year		< .001			.20
1-3	57.9		Reference		
4-15	64.7		0.85	0.51 to 1.40	
≥ 16	80.9		1.36	0.75 to 2.5	
Counsels and tests patients who are referred by other physicians for possible *BRCA1/2* testing		< .001			.53
Yes	75.7		Reference		
No/missing	55.8		0.86	0.53 to 1.38	
Schedules specific visits for counseling		< .001			.09
Always/usually	76.8		Reference		
Never/sometimes	55.9		0.69	0.45 to 1.06	
Total No. of minutes of counseling before *BRCA1/2* testing		< .001			< .01
≤ 30	55.0		Reference		
31-60	75.2		1.48	0.91 to 2.42	
> 60	89.8		3.70	1.66 to 8.29	
Staff member(s) counseling		< .001			.05
Physician only	58.5		Reference		
Physician assisted by genetic counselor/nurse geneticist/NP/PA	82.5		2.0	1.19 to 3.37	
Physician assisted by other counselor	64.3		1.37	0.86 to 2.18	
Unknown	50.0		0.89	0.36 to 2.21	
Practice bills for professional time associated with counseling		< .001			.39
Yes	74.3		Reference		
No/missing	58.6		0.83	0.54 to 1.27	
US Census region		.78			—
Northeast	68.6		—		
Midwest	69.5		—		
South	65.6		—		
West	70.3		—		

Abbreviations: NP, nurse practitioner; PA, physician assistant.
*Using logistic regression to control for all variables in the table except for number of years since medical school graduation and geographic region. Analyses excluded 14 physicians who did not respond to the section on counseling, five physicians missing information on no. of minutes counseling, and two physicians missing information on whether they schedule a specific visit for counseling. Wald CIs are given, and *P* values are based on the likelihood ratio χ^2 test.

Recommendations for Women With BRCA1/2 *Mutation*

When asked about recommendations for surveillance of a 38-year-old woman who tested positive for a *BRCA1* mutation, most physicians reported care that was consistent with published recommendations available at the time of the survey (Table 4). Nearly all physicians (95.6%) recommended monthly breast self-examination. Approximately three quarters (74.3%) recommended clinical breast examinations every 6 to 12 months, with 23.8% recommending them quarterly. Nearly all physicians recommended mammography every 6 to 12 months (95.3%) and pelvic examination every 6 to 12 months (95.9%). Most physicians also recommended pelvic ultrasound every 6 to 12 months (84.6%) and CA-125 testing every 6 to 12 months (74.0%) Although not part of guideline recommendations at the time of the study, nearly half of physicians (51.7%) recommended breast magnetic resonance imaging (MRI) annually, and another 5.7% recommended it twice yearly.

More than half of physicians (61.4%) recommended bilateral prophylactic mastectomy for a 38-year old woman who had completed childbearing, and 85% would recommend bilateral salpingo-oophorectomy. Assuming the woman had undergone bilateral

Table 4. Recommendations for *BRCA1* Carriers

Recommendations	% of Physicians (N = 611)
Surveillance recommendations for 35-year-old woman with *BRCA1* mutation who desires no prophylactic surgery. Recommend . . .*	
Monthly breast self-examination	95.6
Clinical breast examination every 6-12 months	74.3
Mammogram every 6-12 months	95.3
Pelvic examination every 6-12 months	95.9
Pelvic ultrasound every 6-12 months	84.6
CA-125 testing every 6-12 months	74.0
Recommend surveillance breast MRI . . .	
No	34.7
Every 6 months	5.7
Yearly	51.7
Missing	7.9
38-year-old woman with *BRCA1* mutation who has completed childbearing	
Recommend bilateral prophylactic mastectomy	61.4
Recommend bilateral salpingo-oophorectomy	84.9
38-year-old woman with *BRCA1* mutation who has completed childbearing and underwent bilateral prophylactic oophorectomy with hysterectomy	
Recommend estrogen	6.6
Recommend tamoxifen	71.2
Recommend raloxifene	33.7

Abbreviation: MRI, magnetic resonance imaging.
*Time intervals for testing were categorized based on recommendations in published articles and American Society of Clinical Oncology recommendations.

oophorectomy, only 6.6% would recommend estrogen, but most (71.2%) would recommend tamoxifen, and a third (33.7%) would recommend raloxifene.

Table 5 presents unadjusted and adjusted associations of physician characteristics with recommendations for bilateral prophylactic mastectomy. In unadjusted analyses, medical oncologists and surgeons were more likely than other specialists to recommend this procedure. Physicians practicing in the Northeast were least likely to recommend this procedure, and physicians with a moderate volume of *BRCA1/2* testing were more likely than low- or high-volume testers to recommend prophylactic mastectomy.

In adjusted analyses, geneticists and gynecologist/obstetricians were significantly less likely than medical oncologists (and surgeons) to recommend prophylactic mastectomy (Table 5). Physicians in the Northeast (*v* other regions) remained less likely to recommend this procedure. Physician sex, whether others refer patients to them for counseling and testing (a marker of expertise perceived by others), and volume of *BRCA1/2* testing were not associated with recommending prophylactic mastectomy in adjusted analyses.

DISCUSSION

We surveyed community-based physicians who ordered *BRCA1/2* testing for patients during 2004 and 2005 to understand physicians' practices regarding counseling and testing as well as their recommendations for women testing positive for *BRCA1/2* mutations. Our sample of nonacademic physicians who have sent genetic tests was comprised primarily of medical oncologists; this is consistent with national estimates suggesting that oncologists are the biggest users of genetic susceptibility testing.[7] Only 8% of our cohort were geneticists.

Guidelines recommend thorough counseling for women undergoing *BRCA1/2* testing.[6,8,9] Although geneticists reported the highest rates of counseling about six important items in unadjusted analyses, when we also controlled for other factors, geneticists were less likely than medical oncologists to report always or usually counseling about all six items. Many physicians rely on the assistance of genetic counselors or others to assist with counseling, and those who have genetic counselors, nurse geneticists, or nurse practitioners/physician assistants assist are likely to have more thorough counseling discussions. Other data also suggest that nurses and genetic counselors can be effective at providing education to patients undergoing breast cancer genetic testing.[10]

Despite a prior report that 91% of physicians believe that patients with positive genetic test results are at risk for insurance discrimination,[11] studies of patients who have undergone *BRCA1/2* testing have not found evidence of actual insurance discrimination.[12,13] In our cohort, most physicians reported documenting results of tests in the medical record, suggesting that physicians who are actually testing patients are not overly concerned about the potential for test-based discrimination.

Physicians varied in how they provide results of genetic testing to patients, consistent with patients' reports in a prior study.[14] Although most physicians reported that they inform patients of positive results in person, a substantial minority (23.2%) provided the results by phone, a practice that is increasing in frequency and is currently being studied.[15] Physicians more often used telephone (and rarely mail) to inform patients of variant or negative results, although more than half of physicians gave these results in person.

Recommendations for surveillance testing at the time of our survey included breast self-examination monthly and clinical breast examination, pelvic examination, mammogram, pelvic ultrasound, and CA-125 testing every 6 to 12 months.[3,4,16] Most physicians suggested surveillance care for *BRCA1* carriers that was consistent with these recommendations. Data suggesting benefits of breast MRI for *BRCA1/2* carriers became available in late 2004[17,18] and is recommended in current treatment guidelines.[9] More than half of physicians in our study were recommending breast MRI in late 2004 and 2005.

Prophylactic surgery is an option for women with *BRCA1/2* mutations.[19] Bilateral prophylactic mastectomy substantially reduces risk of breast cancer in women with a family history of breast cancer[20] and women with *BRCA1/2* mutations,[21-23] as does contralateral mastectomy in *BRCA1/2* carriers with breast cancer.[24] Premenopausal prophylactic bilateral salpingo-oophorectomy is associated with a decreased risk of breast and ovarian cancer in *BRCA1/2* carriers,[25,26] likely leading to an increased life expectancy.[27]

In our study, most physicians (85%) recommended bilateral prophylactic oophorectomy for a 38-year old *BRCA1* carrier who had completed childbearing. However, fewer physicians (61.4%) recommended bilateral prophylactic mastectomy. Medical oncologists and surgeons were more likely to recommend prophylactic mastectomy than geneticists and gynecologists. Recommendations for this surgery also varied by geographic region, with physicians in the Midwest, South, and West more likely to recommend prophylactic mastectomy than physicians in the Northeast. This trend is consistent with preferences for mastectomy over breast-conserving surgery for breast cancer treatment in these areas.[28]

Table 5. Factors Associated With Recommendations for Prophylactic Mastectomy for a 38-Year-Old Woman With a *BRCA1* Mutation Who Has Completed Childbearing

Characteristic	Unadjusted Proportion Recommending Prophylactic Mastectomy (%)	*P*	Recommendation of Prophylactic Mastectomy*		*P*
			Adjusted Odds	95% CI	
Sex		.10			.26
Male	64.9		Reference		
Female	58.2		0.81	0.56 to 1.17	
Specialty		< .001			< .001
Medical oncologist	69.0		Reference		
Surgeon	75.6		1.44	0.83 to 2.49	
Geneticist	26.7		0.15	0.07 to 0.31	
Gynecologist/obstetrician	47.1		0.43	0.24 to 0.76	
Other	52.6		0.58	0.33 to 1.02	
No. of years since medical school graduation		.43			—
≤15	61.7		—		
16-23	63.7		—		
24-29	58.3		—		
≥ 30	66.1		—		
Unknown	50.0		—		
Counsels and tests patients who are referred by other physicians for possible *BRCA1/2* testing		.26			.60
Yes	64.1		Reference		
No	59.5		0.89	0.57 to 1.38	
No. of *BRCA1/2* tests sent during past year		.04			.38
1-3	58.0		Reference		
4-15	69.4		1.36	0.84 to 2.19	
≥ 16	59.6		1.06	0.63 to 1.77	
Geographic region		.04			.01
Northeast	52.7		Reference		
Midwest	63.2		1.65	0.97 to 2.78	
South	68.3		2.17	1.34 to 3.51	
West	61.7		1.85	1.11 to 3.08	

*Using logistic regression to control for all variables in the table except for number of years since medical school graduation. Wald CIs are given, and *P* values are based on the likelihood ratio χ^2 test. Analysis did not include nine physicians who did not respond to the item about treatment recommendations for the 38-year-old woman with a *BRCA1* mutation who has completed childbearing.

Nearly three quarters of physicians in our cohort would recommend tamoxifen for an unaffected 38-year old *BRCA1* carrier who had undergone prophylactic oophorectomy but not mastectomy, a rate higher than that of a 2002 survey of breast cancer physicians, for whom 57% recommended tamoxifen for a similar 40-year old *BRCA1* carrier.[29] Limited data suggest that tamoxifen can decrease the risk of new breast cancers in *BRCA1/2* mutation carriers who have had breast cancer.[30,31] The primary preventive benefits of tamoxifen may be limited to *BRCA2* carriers, whose cancers are more likely to be estrogen receptor positive.[32,33] Among affected *BRCA1/2* carriers, the risk-reducing benefits of tamoxifen in women after oophorectomy have been inconsistent,[30,31] and data are lacking to help guide recommendations for unaffected carriers. Potentially important differences in the management of *BRCA1* versus *BRCA2* carriers have only recently been recognized.

Although the Study of Tamoxifen and Raloxifene trial suggests that the reduction in invasive breast cancer with raloxifene in women at high risk of breast cancer is similar to that with tamoxifen,[34] few data are currently available about the use of raloxifene in *BRCA1/2* carriers. A minority of physicians in our study recommended estrogen therapy after bilateral salpingo-oophorectomy, suggesting concern about a medication that may stimulate growth of breast cancers,[35] despite a decision analysis and some data suggesting that short-term hormone therapy may be a reasonable option for women.[27,36]

Our findings should be viewed in light of several limitations. First, we surveyed physicians whose patients were tested for mutations by Myriad. Myriad provides the vast majority of clinical *BRCA1/2* genetic analysis in the United States, and thus our sample of physicians closely reflects those physicians in nonacademic centers who are ordering *BRCA1/2* genetic testing nationally. Some university and research laboratories provide limited testing, but these likely account for a small proportion of tests performed in the United States. Second, we studied only nonacademic physicians; therefore, our findings cannot necessarily be generalized to academic physicians, who may differ in their testing practices or recommendations. Third, we cannot be certain that physicians' reported behaviors and responses to vignettes reflect reality. Nevertheless, others have found clinical vignettes to be a valid tool for measuring care delivered in clinical practice.[37] Moreover, we had limited information about additional details, such as the actual role of physicians and other professionals when physicians reported being assisted in counseling by others. Finally, the survey responses are subject to response bias, despite our relatively high response rate.

In conclusion, community-based physicians seem to be successfully incorporating *BRCA1/2* testing into their practice, which may be particularly important with the increase of direct-to-consumer advertising of *BRCA1/2* testing,[38] which is likely to expand physicians' roles in counseling and testing. They often schedule specific counseling visits for patients and receive assistance with counseling from others in their practice. Medical oncologists and physicians who receive assistance from genetic counselors or other physician extenders tend to conduct the most complete counseling, but most physicians report that their patients are always or usually counseled about six topics that are recommended to be included in pretest counseling. Physicians' recommendations for surveillance of mutation carriers are generally consistent with practice guidelines. Nevertheless, recommendations for preference-based procedures such as prophylactic mastectomy vary by characteristics such as physician specialty and geographic region, suggesting that the providers that patients see for testing may contribute to variations in prophylactic treatments.

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

The author(s) indicated no potential conflicts of interest.

AUTHOR CONTRIBUTIONS

Conception and design: Nancy L. Keating, Lisa DiGianni, Judy E. Garber
Financial support: Judy E. Garber
Collection and assembly of data: Kathryn A. Stoeckert, Lisa DiGianni
Data analysis and interpretation: Nancy L. Keating, Kathryn A. Stoeckert, Meredith M. Regan, Lisa DiGianni, Judy E. Garber
Manuscript writing: Nancy L. Keating, Kathryn A. Stoeckert, Meredith M. Regan, Lisa DiGianni, Judy E. Garber
Final approval of manuscript: Nancy L. Keating, Kathryn A. Stoeckert, Meredith M. Regan, Lisa DiGianni, Judy E. Garber

REFERENCES

1. Struewing JP, Hartge P, Wacholder S, et al: The risk of cancer associated with specific mutations of BRCA1 and BRCA2 among Ashkenazi Jews. N Engl J Med 336:1401-1408, 1997

2. Weitzel JN: Genetic cancer risk assessment. Putting it all together. Cancer 86:2483-2492, 1999 (suppl)

3. Burke W, Daly M, Garber J, et al: Recommendations for follow-up care of individuals with an inherited predisposition to cancer: II. BRCA1 and BRCA2—Cancer Genetics Studies Consortium. JAMA 277:997-1003, 1997

4. Hoskins KF, Stopfer JE, Calzone KA, et al: Assessment and counseling for women with a family history of breast cancer: A guide for clinicians. JAMA 273:577-585, 1995

5. Daly M: NCCN practice guidelines: Genetics/familial high-risk cancer screening. Oncology (Huntingt) 13:161-183, 1999

6. American Society of Clinical Oncology policy statement update: Genetic testing for cancer susceptibility. J Clin Oncol 21:2397-2406, 2003

7. Wideroff L, Freedman AN, Olson L, et al: Physician use of genetic testing for cancer susceptibility: Results of a national survey. Cancer Epidemiol Biomarkers Prev 12:295-303, 2003

8. American College of Medical Genetics: Policy Statement: Genetic Susceptibility to Breast and Ovarian Cancer—Assessment, Counseling and Testing Guidelines. http://www.health.state.ny.us/nysdoh/cancer/obcancer/contents.htm

9. National Comprehensive Cancer Network: Genetic/familial high-risk assessment: Breast and ovarian, V. 1.2007. http://wwwnccnorg/professionals/physician_gls/PDF/genetics_screeningpdf 2007

10. Bernhardt BA, Geller G, Doksum T, Metz SA: Evaluation of nurses and genetic counselors as providers of education about breast cancer susceptibility testing. Oncol Nurs Forum 27:33-39, 2000

11. Freedman AN, Wideroff L, Olson L, et al: US physicians' attitudes toward genetic testing for cancer susceptibility. Am J Med Genet A 120A:63-71, 2003

12. Armstrong K, Weber B, FitzGerald G, et al: Life insurance and breast cancer risk assessment: Adverse selection, genetic testing decisions, and discrimination. Am J Med Genet A 120A:359-364, 2003

13. Peterson EA, Milliron KJ, Lewis KE, et al: Health insurance and discrimination concerns and BRCA1/2 testing in a clinic population. Cancer Epidemiol Biomarkers Prev 11:79-87, 2002

14. Chen WY, Garber JE, Higham S, et al: BRCA1/2 genetic testing in the community setting. J Clin Oncol 20:4485-4492, 2002

15. Peshkin BN, Demarco TA, Graves KD, et al: Telephone genetic counseling for high-risk women undergoing BRCA1 and BRCA2 testing: Rationale and development of a randomized controlled trial. Genetic Testing 12:37-52, 2008

16. National Comprehensive Cancer Network: Practice guidelines in oncology-breast cancer, v. 1.2005. http://wwwnccnorg/professionals/physician_gls/PDF/breastpdf 2005

17. Kriege M, Brekelmans CT, Boetes C, et al: Efficacy of MRI and mammography for breast-cancer screening in women with a familial or genetic predisposition. N Engl J Med 351:427-437, 2004

18. Warner E, Plewes DB, Hill KA, et al: Surveillance of BRCA1 and BRCA2 mutation carriers with magnetic resonance imaging, ultrasound, mammography, and clinical breast examination. JAMA 292: 1317-1325, 2004

19. Guillem JG, Wood WC, Moley JF, et al: ASCO/SSO review of current role of risk-reducing surgery in common hereditary cancer syndromes. J Clin Oncol 24:4642-4660, 2006

20. Hartmann LC, Schaid DJ, Woods JE, et al: Efficacy of bilateral prophylactic mastectomy in women with a family history of breast cancer. N Engl J Med 340:77-84, 1999

21. Hartmann LC, Sellers TA, Schaid DJ, et al: Efficacy of bilateral prophylactic mastectomy in BRCA1 and BRCA2 gene mutation carriers. J Natl Cancer Inst 93:1633-1637, 2001

22. Meijers-Heijboer H, van Geel B, van Putten WL, et al: Breast cancer after prophylactic bilateral mastectomy in women with a BRCA1 or BRCA2 mutation. N Engl J Med 345:159-164, 2001

23. Rebbeck TR, Friebel T, Lynch HT, et al: Bilateral prophylactic mastectomy reduces breast cancer risk in BRCA1 and BRCA2 mutation carriers: The PROSE Study Group. J Clin Oncol 22:1055-1062, 2004

24. van Sprundel TC, Schmidt MK, Rookus MA, et al: Risk reduction of contralateral breast cancer and survival after contralateral prophylactic mastectomy in BRCA1 or BRCA2 mutation carriers. Br J Cancer 93:287-292, 2005

25. Rebbeck TR, Lynch HT, Neuhausen SL, et al: Prophylactic oophorectomy in carriers of BRCA1 or BRCA2 mutations. N Engl J Med 346:1616-1622, 2002

26. Kauff ND, Satagopan JM, Robson ME, et al: Risk-reducing salpingo-oophorectomy in women with a BRCA1 or BRCA2 mutation. N Engl J Med 346:1609-1615, 2002

27. Armstrong K, Schwartz JS, Randall T, et al: Hormone replacement therapy and life expectancy after prophylactic oophorectomy in women with BRCA1/2 mutations: A decision analysis. J Clin Oncol 22:1045-1054, 2004

28. Nattinger AB, Gottlieb MS, Veum J, et al: Geographic variation in the use of breast-conserving treatment for breast cancer. N Engl J Med 326: 1102-1107, 1992

29. Peshkin BN, Isaacs C, Finch C, et al: Tamoxifen as chemoprevention in BRCA1 and BRCA2 mutation carriers with breast cancer: A pilot survey of physicians. J Clin Oncol 21:4322-4328, 2003

30. Narod SA, Brunet JS, Ghadirian P, et al: Tamoxifen and risk of contralateral breast cancer in BRCA1 and BRCA2 mutation carriers: A case-control study. Hereditary Breast Cancer Clinical Study Group. Lancet 356:1876-1881, 2000

31. Gronwald J, Tung N, Foulkes WD, et al: Tamoxifen and contralateral breast cancer in BRCA1 and BRCA2 carriers: An update. Int J Cancer 118: 2281-2284, 2006

32. Osin PP, Lakhani SR: The pathology of familial breast cancer: Immunohistochemistry and molecular analysis. Breast Cancer Res 1:36-40, 1999

33. Lakhani SR, Van De Vijver MJ, Jacquemier J, et al: The pathology of familial breast cancer: Predictive value of immunohistochemical markers estrogen receptor, progesterone receptor, HER-2, and p53 in patients with mutations in BRCA1 and BRCA2. J Clin Oncol 20:2310-2318, 2002

34. Vogel VG, Costantino JP, Wickerham DL, et al: Effects of tamoxifen vs raloxifene on the risk of developing invasive breast cancer and other disease outcomes: The NSABP Study of Tamoxifen and Raloxifene (STAR) P-2 trial. JAMA 295:2727-2741, 2006

35. Garber JE, Hartman AR: Prophylactic oophorectomy and hormone replacement therapy: Protection at what price? J Clin Oncol 22:978-980, 2004

36. Rebbeck TR, Friebel T, Wagner T, et al: Effect of short-term hormone replacement therapy on breast cancer risk reduction after bilateral prophylactic oophorectomy in BRCA1 and BRCA2 mutation carriers: The PROSE Study Group. J Clin Oncol 23:7804-7810, 2005

37. Peabody JW, Luck J, Glassman P, et al: Measuring the quality of physician practice by using clinical vignettes: A prospective validation study. Ann Intern Med 141:771-780, 2004

38. Wolfberg AJ: Genes on the Web: Ddirect-to-consumer marketing of genetic testing. N Engl J Med 355:543-545, 2006

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