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ORIGINAL ARTICLE – BREAST ONCOLOGY

Germline Genetic Testing: What the Breast Surgeon Needs to Know

Jennifer K. Plichta, MD, MS[1], Molly L. Sebastian, MD[2], Linda A. Smith, MD[3], Carolyn S. Menendez, MD[1], Anita T. Johnson, MD[4,5], Sussan M. Bays, MD[6], David M. Euhus, MD[7], Edward J. Clifford, MD[8], Mena Jalali, MS[9], Scott H. Kurtzman, MD[10], Walton A. Taylor, MD[11], and Kevin S. Hughes, MD[12]

[1]Department of Surgery, Duke University Medical Center, Durham, NC; [2]Reinsch Pierce Family Center for Breast Health, Virginia Hospital Center, Arlington, VA; [3]Comprehensive Breast Care, Albuquerque, NM; [4]Cancer Treatment Centers of America, Atlanta, GA; [5]Department of Surgery, Morehouse School of Medicine, Atlanta, GA; [6]Covenant Cancer Care Center, Saginaw, MI; [7]Department of Surgery, Johns Hopkins University Hospital, Baltimore, MD; [8]Baylor Scott & White Healthcare System, Dallas, TX; [9]American Society of Breast Surgeons, Dallas, TX; [10]Department of Surgery, Waterbury Hospital, Waterbury, CT; [11]True Surgical Partners, Dallas, TX; [12]Department of Surgery, Division of Surgical Oncology, Massachusetts General Hospital, Boston, MA

ABSTRACT

Purpose. The American Society of Breast Surgeons (ASBrS) sought to provide educational guidelines for breast surgeons on how to incorporate genetic information and genomics into their practice.

Methods. A comprehensive nonsystematic review was performed of selected peer-reviewed literature. The Genetics Working Group of the ASBrS convened to develop guideline recommendations.

Results. Clinical and educational guidelines were prepared to outline the essential knowledge for breast surgeons to perform germline genetic testing and to incorporate the findings into their practice, which have been approved by the ASBrS Board of Directors.

Recommendations. Thousands of women in the USA would potentially benefit from genetic testing for *BRCA1*, *BRCA2*, and other breast cancer genes that markedly increase their risk of developing breast cancer. As genetic testing is now becoming more widely available, women should be made aware of these tests and consider testing. Breast surgeons are well positioned to help facilitate this process. The areas where surgeons need to be knowledgeable include: (1) identification of patients for initial breast cancer-related genetic testing, (2) identification of patients who tested negative in the past but now need updated testing, (3) initial cancer genetic testing, (4) retesting of patients who need their genetic testing updated, (5) cancer genetic test interpretation, posttest counseling and management, (6) management of variants of uncertain significance, (7) cascade genetic testing, (8) interpretation of genetic tests other than clinical cancer panels and the counseling and management required, and (9) interpretation of somatic genetic tests and the counseling and management required.

STATEMENT OF PROBLEM

An estimated 12 million women between the ages of 25 and 70 years in the USA may potentially benefit from genetic testing for *BRCA1*, *BRCA2*, and other cancer genes that markedly increase their risk of developing breast cancer and dying from that disease.[1] If these women could be identified before they develop cancer, management strategies could be implemented that may prevent cancer or detect it at an earlier and more treatable stage.[2] As genetic testing is now available from a variety of laboratories at more reasonable costs, women should be made aware of these tests and consider testing. It is reasonable to expect women to meet with a practitioner who is familiar with genetic testing and can guide them through the testing process. While in the past this was considered the purview of genetic counselors only, this is no longer a viable

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K. S. Hughes, MD
e-mail: kshughes@partners.org

solution.[3,4] As of May 2017, there were only 4242 certified genetic counselors in the USA.[5] Clearly other providers are needed, and breast surgeons, in particular, receive education regarding genetics as part of their training and have been managing mutation carriers for decades

Genetic testing is a process that includes pre and posttest activities, both of which are responsibilities of physicians. Genetic counselors and geneticists have an important role to play however, this resource may be best utilized by focusing on complex patients who might benefit from more extensive pretest counseling and patients who are found to carry a pathogenic variant. Some patients with a variant of uncertain significance (VUS) may also benefit from additional counseling with a genetic counselor

The American Society of Breast Surgeons (ASBrS) has extensive experience producing educational activities and is willing to further develop this approach in collaboration with other national groups to augment the surgeon's ability to take on the role of genetic testing. Herein, the ASBrS Genetics Working Group outlines a summary of the knowledge needed by surgeons, which has been approved by the ASBrS Board of Directors. We feel that this material is familiar to most breast surgeons, and it can be taught in a directed educational effort.

INTRODUCTION

Genetics and genomics are becoming a routine part of medical practice, especially in the management of breast disease. Physicians in general, and breast surgeons in particular, need to have sufficient working knowledge regarding genetics and genomics, and they must take an active role in this process. Thus, the question that is most commonly posed as "Who should do genetic testing?" should be more accurately reframed as "Who is responsible for managing a patient's genetic breast cancer risk?"

When considered this way, genetic management requires:

- Identification of appropriate patients for a variety of genetic tests
- Informing the patient of the risks and benefits of genetic testing
- Arranging for the appropriate test to be performed
- Interpreting the results
- Imparting the meaning of genetic test results to the patient
- Developing a management plan for screening and/or prevention of future disease, or treatment of existing disease
- Obtaining appropriate consultations to help implement that plan
- Discussing implications for the patient's family

The surgeon has an integral role to play in all of these areas. The purpose of this paper is to describe the various areas of cancer genetics where breast surgeons need to be knowledgeable.

Despite the fact that clinical cancer genetic testing has been available for more than 20 years, the vast majority of patients who stand to benefit from genetic testing have yet to be tested.[1,6–9] Only a small number of *BRCA1* and *BRCA2* carriers, and even fewer carriers of cancer susceptibility genes, have been identified to date.[7,9,10] When looking specifically at the underserved, the medical system is doing even more poorly.[11–13] Patients and their families may lack critical insight into their medical susceptibilities and are not benefiting from management strategies that may decrease their risk of developing cancer or find it at an earlier, more treatable stage.

Based on national guidelines, the eligibility criteria for genetic testing have become more inclusive over time, which has led to a huge increase in the number of patients eligible for testing (and likely covered by insurance). Initially, patients needed a 10 % or greater risk of mutation, then a 5 % or greater risk of mutation, and now, based on the National Comprehensive Cancer Network (NCCN) criteria, patients with a negligible risk of mutation are eligible for testing.[2] In addition to the 12 million women mentioned above, there are now calls for all women with breast cancer to undergo testing.[14,15] While the idea of testing all breast cancer patients may be disconcerting, it should be noted that similar recommendations have been made for all patients with pancreatic cancer [16] and metastatic prostate cancer.[17]

Given these factors and the loosening of guidelines for testing,[2] there has been a dramatic increase in the number of patients who should have testing, not only cancer susceptibility gene-directed testing, but also for sequencing of cancer predisposition genes as part of whole genome sequencing[18] and sequencing of tumors themselves.[19,20] With the large number of patients now eligible for testing, continuation of the current model where all patients must see a genetics professional prior to testing may not be feasible. Furthermore, a recent study suggests that nearly half of breast cancer patients with a clinically relevant mutation may be missed by current guidelines.[14] Regardless, surgeons will continue to be responsible for managing their patients informed by their genetic makeup, even if the patient sees a genetics professional for testing. As some physicians may feel overwhelmed by the speed of change in this field,[21,22] surgeons should be continually educated to give them the tools they need to facilitate involvement.

We outline here the areas in which surgeons must be current and proficient (Table 1). We hope that this list will serve as an outline for future educational courses for

TABLE 1 What the breast surgeon should know about germline genetic testing and potential topics for genetic testing courses

Key topic	Take-home points
Identification of patients for initial breast cancer-related genetic testing	Understand the best practices for identifying patients who may benefit from testing
	Understand the testing guidelines and how to use the risk estimation models
	Make a good-faith effort to identify patients who need testing and put a process in place to get testing done expeditiously
	Have a mechanism in place for collecting and interpreting information required for making genetic testing decisions
	Know how to record this information and track patients
Identification of patients who tested negative in the past but now need updated testing	Understand the need for retesting those who tested negative in the past with what would now be considered inadequate testing
	Be cognizant of how the choice of test may lead to retesting in the future
	Make an earnest effort to identify patients who need retesting and put a process in place to get retesting done expeditiously
Initial cancer genetic testing	Understand the implications of cancer genetic testing and be able to articulate to patients the importance of testing when appropriate
	Be able to discuss any and all of ASCO's elements of informed consent with patients[31]
Retesting of patients who need their genetic testing updated	Similar to initial testing
Cancer genetic test interpretation, posttest counseling and management	Interpret cancer genetic tests and provide posttest counseling
	Know how to manage a person with a pathogenic variant, a VUS, and a negative result
	Understand the potential for nonbreast cancers and make appropriate referrals to colleagues or a genetic counselor
Management of variants of uncertain significance	Understand the meaning of a VUS, articulate this information to the patient, and convey it to other providers
	Understand how to manage patients based on family history
	Understand potential testing strategies that can help characterize a VUS
	Understand the need to recontact patients and/or relatives when they are informed that a VUS has been recharacterized
Cascade genetic testing	Understand the value of cascade testing and be able to articulate this to patients
	Encourage patients to contact relatives and help facilitate testing of relatives
Interpretation of genetic tests other than clinical cancer panels and the counseling and management required	Interpret cancer genetic tests, even when initiated for unrelated reasons, and provide counseling
	Know how to manage a person with a pathogenic variant, a VUS, and a negative result
	Know when a test requires repeating in a clinical laboratory
	Understand the potential for nonbreast cancers and make appropriate referrals to colleagues or a genetic counselor
Interpretation of somatic genetic tests and the counseling and management required	Interpret somatic cancer genetic tests that uncover possible germline pathogenic variants and provide counseling
	Know how to manage a pathogenic variant, including the need for confirmatory testing
	Understand the potential for nonbreast cancers and make appropriate referrals to colleagues or a genetic counselor

ASCO American Society of Clinical Oncology, *VUS* variant of uncertain significance

surgeons and highlight the areas where clinical decision support (CDS) tools may help facilitate patient management.

DEFINING THE SURGEON'S ROLE IN VARIOUS ASPECTS OF CANCER GENETIC TESTING

Identification of Patients for Initial Cancer-Related Genetic Testing

Every breast surgeon should know how to assess a patient's risk of hereditary cancer and identify patients who may benefit from testing. Every patient should be evaluated for their hereditary risk of cancer and potential need for genetic testing by the surgeon, advanced practice provider (APP = nurse practitioner or physician assistant), nurse, or some other member of the surgeon's staff. In some practice settings, this is done by radiology technologists during mammography.[23] Breast surgeons should have ready access to risk assessment tools and cancer genetic testing.

Identification of Patients Who Tested Negative in the Past but Now Need Updated Testing

Every patient being seen by a breast surgeon and who has had genetic testing in the past should be reevaluated to determine whether there is a need for updated testing. Any patient who had negative germline *BRCA1/2* testing but did not have a complete panel, or anyone tested before 2013 when panels began, should be considered for retesting.[24–26] The surgeon should also be cognizant that, if an abbreviated panel is chosen now and is negative, the patient may need retesting in the future. It is recognized that, for newly diagnosed patients, there is value in running limited gene panels whose results can be available in a week, and that reflex testing to a larger panel may be appropriate for patients with negative results.

Initial Cancer Genetic Testing

One barrier to cancer genetic testing that needs to be addressed is the requirement by some hospital systems and some insurers that genetic counselors must be involved prior to testing. While the intention of this requirement is noble, the consequence has been to limit the number of patients tested, due to an inadequate workforce in clinical genetic counseling and a geographic maldistribution of counselors.[3,4] This has been especially true for the underserved, for whom these policies further increase disparities.[27,28] Many notable national organizations, such as the ASBrS, American Society of Clinical Oncology (ASCO), National Accreditation Program for Breast Centers (NAPBC), and American Medical Association (AMA), strongly assert that genetic testing is in the purview of any physician who has expertise in genetics.[29–32] This is defined by the NAPBC as "a board certified/eligible physician or other trained healthcare professional with expertise and experience in cancer genetics (defined as providing cancer risk assessment on a regular basis) employing a model that includes both pre-test and post-test counseling."[30] Many breast surgeons meet these criteria,[27,33,34] and most could after some directed education, similar to that proposed herein.

Cancer genetic testing is often ordered by physicians or APPs, either working alone or with genetic counselors. The physician who orders testing may be a geneticist, obstetrician, oncologist, surgeon, or from some other discipline. Approximately one-half of cancer genetic testing is done by physicians and APPs, and the other half via genetic counselors and their associated physicians.[35]

Cancer genetic testing can be done in multiple ways:

- The surgeon or his/her APP can order all cancer genetic testing, with appropriate pretest counseling.
    - This can be done with on-demand access to genetic counselors. Elements of the pretest counseling have been defined by the NAPBC and ASCO,[31] but these elements need to be readdressed in the current age; For example, one element suggests describing what a positive test means. In the age of panel testing, a description of every possible pathogenic result is not practical or useful.
    - Surgeons who order their own testing should be knowledgeable of and comfortable with genetics. Taking the educational course that we propose is one way in which this can be accomplished.
- The surgeon can order cancer genetic testing for relatively simple cases but refer more complex cases to a genetic counselor.
- The surgeon can refer all patients to a genetic counselor to perform counseling and testing.

Regardless, the surgeon is responsible for having his/her patients receive testing in a timely fashion and to organize subsequent management decisions.

Retesting of Patients Who Need Updated Genetic Testing

This process might be similar to that described above. However, as the majority of patients have already had genetic counseling, this might be the perfect group for abbreviated pretest counseling.

Cancer Genetic Test Interpretation, Posttest Counseling and Management

A surgeon must be able to review a genetic test result, understand how to interpret that result, and know how to manage the patient appropriately. The majority of the information needed for interpretation and management is available on the report and is also available through online services, such as Ask2Me.org[36] or through the NCCN.[2] A surgeon may consult with a genetic counselor for suggestions on management options. However, the reports, genetic counselor consultation, and online services are aids for the surgeon. The surgeon must make the final recommendation based on the unique circumstances of the patient or refer the patient to a physician who is an expert in the organ at risk (such as referring a *BRCA1* carrier to a gynecologic oncologist). The responsibility of managing the patient cannot be delegated to a genetic counselor. If the surgeon plans to manage patients with pathogenic variants, the surgeon must understand what to do, including the roles of screening, chemoprevention, surgery, and consultation of other specialties, and be able to provide recommendations for family members deemed at risk.

Management of a VUS

When patients are found to have a VUS in cancer susceptibility genes, the surgeon must understand that these results are not the same as pathogenic variants and that the patient should be managed based on his/her family history. In addition, the surgeon should help genetic testing companies, government agencies, and genetics professionals (e.g., ClinVar, PROMPT Registry) with the final characterization of these VUS results by providing additional information as appropriate. A mechanism needs to be in place so that the patient, or their next of kin (if deceased), can be informed if a VUS has been recharacterized as pathogenic.[37,38] The surgeon can take on this responsibility or refer patients to a genetics professional.

Cascade Genetic Testing

When patients are found to have pathogenic variants in cancer susceptibility genes, their blood relatives are also at risk of having that same mutation. To maximize the public health value of genetic testing, it is imperative that as many of the patient's at-risk relatives as possible undergo testing. This requires that the patient be informed of the risks for his/her family and be encouraged to share the genetic testing results with them. The surgeon, or their delegate, needs to take an active role in educating the patient and in helping facilitate cascade testing.[39,40] Since these relatives will likely not be patients in the breast surgeon's practice and might not live in the same community, the most practical approach may be to refer patients with positive results to a genetics professional for cascade testing.

Interpretation of Genetic Tests other than Clinical Cancer Panels and the Counseling and Management Required

Increasingly more patients will have whole genome sequencing, whole exome sequencing, direct to consumer (DTC) genetic testing, biobank research studies,[41,42] or other testing which may uncover pathogenic variants in cancer susceptibility genes. When the surgeon is presented with such results, he/she must know how to manage the patient appropriately. The responsibilities and alternate approaches are similar to those described in "Cancer Genetic Test Interpretation, Posttest Counseling, and Management" section. The surgeon should also know whether the test must be repeated by a Clinical Laboratory Improvement Amendments (CLIA)-approved laboratory before action can be taken.

Interpretation of Somatic Genetic Tests and the Counseling and Management Required

Increasingly more patients will have genetic testing of their tumors (somatic genetic testing). These tests may uncover pathogenic variants in cancer susceptibility genes that may or may not be germline.[43] When the surgeon is presented with such results, he/she must know how to manage the patient appropriately, and whether confirmatory germline genetic testing is required. The responsibilities and alternate approaches are similar to those described in "Cancer Genetic Test Interpretation, Posttest Counseling, and Management" section.

EDUCATIONAL PROGRAM

We propose that an educational program, including the topics presented in Table 1, would provide a thorough discussion of the essential areas in which surgeons should be proficient in order to bring the full scope of breast cancer genetics into their practice.

SUMMARY

We believe that breast surgeons are well positioned to become leaders in the area of cancer genetics, as they have been actively involved in this area for nearly two decades. However, we recognize that education and CDS tools are necessary. As such, we have suggested an outline of the areas in which surgeons need to be knowledgeable

(Table 1). In addition, we believe that CDS tools will be critically important in helping surgeons meet these responsibilities. In the area of identifying patients, multiple models and guidelines currently exist, and Mastery of Breast Surgery and others have incorporated these models into tools to help categorize patients.[44] Tools also exist to help track patients with a VUS,[45,46] to help surgeons understand the spectrum and penetrance for pathogenic variants (Ask2Me),[36] and to help determine management (NCCN).[2]

In conclusion, it is imperative that we train surgeons how to incorporate genetic information and genomics into their practice, and that surgeons take on this critical responsibility.

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REFERENCES

1. Hughes KS. Genetic testing: what problem are we trying to solve? *J Clin Oncol.* 2017;35(34):3789–91.
2. Daly MB, Pilarski R, Berry MP, et al. *NCCN Clinical Practice Guidelines in Oncology: Genetic/Familial High-Risk Assessment: Breast and Ovarian.* National Comprehensive Cancer Network; July 30, 2018.
3. 2014 Professional Status Survey: Executive Summary. 2014.
4. Noll A, Parekh JP, Zhou M, et al. Barriers to Llynch syndrome testing and preoperative result availability in early-onset colorectal cancer: a National Physician Survey study. *Clin Transl Gastroenterol.* 2018; 9(9):185.
5. Hoskovec JM, Bennett RL, Carey ME, et al. Projecting the supply and demand for certified genetic counselors: a workforce study. *J Genet Couns.* 2018;27(1):16–20.
6. Childers KK, Maggard-Gibbons M, Macinko J, Childers CP. National distribution of cancer genetic testing in the United States: evidence for a gender disparity in hereditary breast and ovarian cancer. *JAMA Oncol.* 2018;4(6):876–79.
7. Childers CP, Childers KK, Maggard-Gibbons M, Macinko J. National estimates of genetic testing in women with a history of breast or ovarian cancer. *J Clin Oncol.* 2017;35(34):3800–06.
8. Chen Z, Kolor K, Grosse SD, et al. Trends in utilization and costs of BRCA testing among women aged 18–64 years in the United States, 2003–2014. *Genet Med.* 2018;20(4):428–34.
9. Manickam K, Buchanan AH, Schwartz MB, et al. Exome sequencing–based screening for BRCA1/2 expected pathogenic variants among adult biobank participants. *JAMA Netw Open.* 2018;1(5):e182140.
10. Drohan B, Roche CA, Cusack JC, Jr., Hughes KS. Hereditary breast and ovarian cancer and other hereditary syndromes: using technology to identify carriers. *Ann Surg Oncol.* 2012;19(6):1732–37.
11. Hall MJ, Olopade OI. Disparities in genetic testing: thinking outside the BRCA box. *J Clin Oncol.* 2006;24(14):2197–2203.
12. Forman AD, Hall MJ. Influence of race/ethnicity on genetic counseling and testing for hereditary breast and ovarian cancer. *Breast J.* 2009;15 Suppl 1:S56–62.
13. Halbert CH, Kessler LJ, Mitchell E. Genetic testing for inherited breast cancer risk in African Americans. *Cancer Invest.* 2005;23(4):285–95.
14. Beitsch PD, Whitworth PW, Hughes K, et al. Underdiagnosis of hereditary breast cancer: are genetic testing guidelines a tool or an obstacle? *J Clin Oncol.* 2018:Jco1801631.
15. Guidelines miss cancer patients who could benefit from genetic testing: Part 1. In: *Perspectives in Genetics: Empowering the Medical Community through Education and Insight.* Vol 2018. Online: Invitae; 2018.
16. Syngal S, Furniss C. Germline genetic testing for pancreatic ductal adenocarcinoma at time of diagnosis. *JAMA.* 2018;319(23):2383–85.
17. Pritchard CC, Mateo J, Walsh MF, et al. Inherited DNA-repair gene mutations in men with metastatic prostate cancer. *N Engl J Med.* 2016;375(5):443–53.
18. Guo X, Shi J, Cai Q, et al. Use of deep whole-genome sequencing data to identify structure risk variants in breast cancer susceptibility genes. *Hum Mol Genet.* 2018;27(5):853–59.
19. Park S, Supek F, Lehner B. Systematic discovery of germline cancer predisposition genes through the identification of somatic second hits. *Nat Commun.* 2018;9(1):2601.
20. Liang X, Vacher S, Boulai A, et al. Targeted next-generation sequencing identifies clinically relevant somatic mutations in a large cohort of inflammatory breast cancer. *Breast Cancer Res.* 2018;20(1):88.
21. Kurian AW, Li Y, Hamilton AS, et al. Gaps in incorporating germline genetic testing into treatment decision-making for early-stage breast cancer. *J Clin Oncol.* 2017;35(20):2232–39.
22. Trivers KF, Baldwin LM, Miller JW, et al. Reported referral for genetic counseling or BRCA 1/2 testing among United States physicians: a vignette-based study. *Cancer.* 2011;117(23):5334–43.
23. Morman NA, Byrne L, Collins C, Reynolds K, Bell JG. Breast cancer risk assessment at the time of screening mammography: perceptions and clinical management outcomes for women at high risk. *J Genet Couns.* 2017;26(4):776–84.
24. Tung N, Lin NU, Kidd J, et al. Frequency of germline mutations in 25 cancer susceptibility genes in a sequential series of patients with breast cancer. *J Clin Oncol.* 2016;34(13):1460–68.
25. Maxwell KN, Wubbenhorst B, D'Andrea K, et al. Prevalence of mutations in a panel of breast cancer susceptibility genes in BRCA1/2-negative patients with early-onset breast cancer. *Genet Med.* 2015;17(8):630–38.
26. Desmond A, Kurian AW, Gabree M, et al. Clinical actionability of multigene panel testing for hereditary breast and ovarian cancer risk assessment. *JAMA Oncol.* 2015;1(7):943–51.
27. Whitworth P, Beitsch P, Arnell C, et al. Impact of payer constraints on access to genetic testing. *J Oncol Pract.* 2017;13(1):e47–56.
28. Stenehjem DD, Au T, Sainski AM, et al. Impact of a genetic counseling requirement prior to genetic testing. *BMC Health Serv Res.* 2018;18(1):165.
29. Consensus Guideline on Hereditary Genetic Testing for Patients with and without Breast Cancer 2017. https://www.breastsurgeons.org/about/statements/PDF_Statements/BRCA_Testing.pdf. Accessed 13 Aug 2018.
30. National Accreditation Program for Breast Centers Standards Manual; 2018 edition (2018). https://accreditation.facs.org/accreditationdocuments/NAPBC/Portal%20Resources/2018NAPBCStandardsManual.pdf. Accessed 13 Aug 2018.
31. Robson ME, Bradbury AR, Arun B, et al. American Society of Clinical Oncology policy statement update: genetic and genomic

testing for cancer susceptibility. *J Clin Oncol.* 2015;33(31):3660–67.
32. Code of Medical Ethics Opinion 4.1.1—Genetic Testing & Counseling. https://www.ama-assn.org/delivering-care/genetic-testing-counseling. Accessed 13 Aug 2018.
33. Agnese DM, Pollock RE. Breast cancer genetic counseling: a surgeon's perspective. *Front Surg.* 2016;3:4.
34. Beitsch PD, Whitworth PW. Can breast surgeons provide breast cancer genetic testing? An American Society of Breast Surgeons survey. *Ann Surg Oncol.* 2014;21(13):4104–08.
35. Hughes KS. Personal community with Myriad Genetics. In: Kevin Hughes M (ed); 2018.
36. Hughes KS, Parmigiani G, Braun DP. All Syndromes Known to Man Evaluator. 2018; www.ask2me.org. Accessed 8/13/2018.
37. Slavin TP, Van Tongeren LR, Behrendt CE, et al. Prospective study of cancer genetic variants: variation in rate of reclassification by ancestry. *J Natl Cancer Inst.* 2018.
38. Augusto BM, Lake P, Scherr CL, Couch FJ, Lindor NM, Vadaparampil ST. From the laboratory to the clinic: sharing BRCA VUS reclassification tools with practicing genetics professionals. *J Commun Genet.* 2018;9(3):209–15.
39. Roberts MC, Dotson WD, DeVore CS, et al. Delivery of cascade screening for hereditary conditions: a scoping review of the literature. *Health Affairs (Project Hope).* 2018;37(5):801–08.
40. Katapodi MC, Jung M, Schafenacker AM, et al. Development of a Web-based family intervention for BRCA carriers and their biological relatives: acceptability, feasibility, and usability study. *JMIR Cancer.* 2018;4(1):e7.
41. Nilsson MP, Emmertz M, Kristoffersson U, et al. Germline mutations in BRCA1 and BRCA2 incidentally revealed in a biobank research study: experiences from re-contacting mutation carriers and relatives. *J Community Genet.* 2018;9(3):201–08.
42. Buchanan AH, Manickam K, Meyer MN, et al. Early cancer diagnoses through BRCA1/2 screening of unselected adult biobank participants. *Genet Med.* 2018;20(5):554–8.
43. Mandelker D, Zhang L, Kemel Y, et al. Mutation detection in patients with advanced cancer by universal sequencing of cancer-related genes in tumor and normal DNA vs guideline-based germline testing. *JAMA.* 2017;318(9):825–35.
44. The American Society of Breast Surgeons Mastery of Breast Surgery (2018). https://www.breastsurgeons.org/programs/mastery/index.php. Accessed 13 Aug 2018.
45. Pritzlaff M, Yorczyk A, Robinson LS, et al. An internal performance assessment of CancerGene Connect: an electronic tool to streamline, measure and improve the genetic counseling process. *J Genet Couns.* 2014;23(6):1034–44.
46. CRA Health. 2018; www.crahealth.com. Accessed 9/30/2018.