Cancer and genetic testing Research Literatures

Mark Herbert

Brooklyn, New York 11212, USA
Ms10012002@gmail.com

Abstract: Cancer is the general name for a group of more than 100 diseases. Although there are many kinds of cancer, all cancers start because abnormal cells grow out of control. Untreated cancers can cause serious illness and death. The body is made up of trillions of living cells. Normal body cells grow, divide, and die in an orderly fashion. During the early years of a person's life, normal cells divide faster to allow the person to grow. After the person becomes an adult, most cells divide only to replace worn-out or dying cells or to repair injuries. Genetic testing, also known as DNA testing, allows the determination of bloodlines and the genetic diagnosis of vulnerabilities to inherited diseases. In agriculture, a form of genetic testing known as progeny testing can be used to evaluate the quality of breeding stock. In population ecology, genetic testing can be used to track genetic strengths and vulnerabilities of species populations. In humans, genetic testing can be used to determine a child's parentage (genetic mother and father) or in general a person's ancestry or biological relationship between people. In addition to studying chromosomes to the level of individual genes, genetic testing in a broader sense includes biochemical tests for the possible presence of genetic diseases, or mutant forms of genes associated with increased risk of developing genetic disorders. Genetic testing identifies changes in chromosomes, genes, or proteins. The variety of genetic tests has expanded throughout the years. In the past, the main genetic tests searched for abnormal chromosome numbers and mutations that lead to rare, inherited disorders. Today, tests involve analyzing multiple genes to determine the risk of developing specific diseases or disorders, with the more common diseases consisting of heart disease and cancer. The results of a genetic test can confirm or rule out a suspected genetic condition or help determine a person's chance of developing or passing on a genetic disorder. Several hundred genetic tests are currently in use, and more are being developed. Because genetic mutations can directly affect the structure of the proteins they code for, testing for specific genetic diseases can also be accomplished by looking at those proteins or their metabolites, or looking at stained or fluorescent chromosomes under a microscope. This article introduces recent research reports as references in the related studies.
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1. Introduction

Cancer is the general name for a group of more than 100 diseases. Although there are many kinds of cancer, all cancers start because abnormal cells grow out of control. Untreated cancers can cause serious illness and death. The body is made up of trillions of living cells. Normal body cells grow, divide, and die in an orderly fashion. During the early years of a person's life, normal cells divide faster to allow the person to grow. After the person becomes an adult, most cells divide only to replace worn-out or dying cells or to repair injuries. Genetic testing, also known as **DNA testing**, allows the determination of bloodlines and the genetic diagnosis of vulnerabilities to inherited diseases. In agriculture, a form of genetic testing known as progeny testing can be used to evaluate the quality of breeding stock. In population ecology, genetic testing can be used to track genetic strengths and vulnerabilities of species populations. In humans, genetic testing can be used to determine a child's parentage (genetic mother and father) or in general a person's ancestry or biological relationship between people. In addition to studying chromosomes to the level of individual genes, genetic testing in a broader sense includes biochemical tests for the possible presence of genetic diseases, or mutant forms of genes associated with increased risk of developing genetic disorders. Genetic testing identifies changes in chromosomes, genes, or proteins. The variety of genetic tests has expanded throughout the years. In the past, the main genetic tests searched for abnormal chromosome numbers and mutations that lead to rare, inherited disorders. Today, tests involve analyzing multiple genes to determine the risk of developing specific diseases or disorders, with the more common diseases consisting of heart disease and cancer. The results of a genetic test can confirm or rule out a suspected genetic condition or help determine a person's chance of developing or passing on a genetic disorder. Several hundred genetic tests are currently in use, and more are being developed. Because genetic mutations can directly affect the structure of the proteins they code for, testing for specific genetic diseases can also be accomplished by looking at those

proteins or their metabolites, or looking at stained or fluorescent chromosomes under a microscope.

The following introduces recent reports as references in the related studies.

Angioli, R., et al. (1998). "Hereditary and sporadic ovarian cancer: genetic testing and clinical implications (review)." Int J Oncol **12**(5): 1029-1034.

The two most common forms of hereditary ovarian cancer are: the breast ovarian cancer syndrome, and ovarian cancer associated with HNPCC (hereditary nonpolyposis colorectal cancer) syndrome. Studies have shown that these diseases may be associated with mutations in a number of tumor suppressor genes, mainly BRCA1 and BRCA2. Malfunction of the protein products of these genes have also been found to be involved in sporadic ovarian cancer, which makes up the majority of ovarian cancer cases. HNPCC-ovarian cancer associated families reveal frequent mutations in at least four genes (hMSH2, hMLH1, hPMS1, and hPMS2) involved in the repair of mismatched DNA. With ovarian cancer being such an important health issue, the push is on to design reliable screening tests to detect defective inherited or somatic alleles in individual carriers. So far, most progress has been demonstrated in those patients with family histories of the disease who are at increased risk. The ramifications of such research may impact a variety of scientific, clinical, legal, ethical, and psychosocial issues. In addition to current treatment modalities, positive results of these tests may indicate the need for increased clinical surveillance, prophylactic treatment, and genetic counseling of patients on an individual basis. It remains to be seen whether the technology can be made reliable enough to not only benefit high-risk individuals but also the general population.

Arnadottir, G., et al. (2000). "[Interest in breast cancer genetic testing among Icelandic women.]." Laeknabladid **86**(11): 771-777.

OBJECTIVE: It is estimated that 6-10% of all breast cancers in Iceland can be attributed to inherited mutations in newly identified breast cancer susceptibility genes (BRCA1 and BRCA2). Before genetic testing becomes widely available in Iceland it is important to understand what motivates women s interest in undergoing testing as that will provide the data necessary for designing effective counseling interventions. Therefore, the aim of this population-based study was to examine interest in and predictors of interest in genetic testing among Icelandic women. MATERIAL AND METHODS: A randomly selected sample of 534 Icelandic women, who had not been previously diagnosed with breast cancer, completed questionnaires assessing, demographic/medical variables, interest in genetic testing, perceived risk of carrying mutations in BRCA1/2 genes, cancer-specific distress and perceived benefits and barriers of genetic testing. The mean age was 53.8 years and 197 of the women had at least one first degree-relative that had been diagnosed with breast cancer. RESULTS: Interest in testing was high with 74% of the women indicating that they were interested in testing. Family history of breast cancer was unrelated to interest in testing whereas perceived risk of being a mutation carrier was significantly and positively related to interest in testing. Interest in testing was also significantly higher among younger women and among women with higher levels of cancer-specific distress. The most commonly cited reasons for wanting to be tested were to increase use of mammography screening and to learn if one s children were at risk for developing cancer. The most commonly citied reasons against being tested were fear of being mutation carrier and worry that test results would not stay confidential. CONCLUSIONS: These results suggest that demand for genetic testing, once it becomes commercially available, among Icelandic women may be high even among women without family history of breast cancer. The results also suggest that genetic counseling needs to address women s breast cancer worries as that may increase the probability that the decision to undergo testing is based on knowledge rather than driven by breast cancer fear and distress.

Beitsch, P. D. and P. W. Whitworth (2014). "Can breast surgeons provide breast cancer genetic testing? An American Society of Breast Surgeons survey." Ann Surg Oncol **21**(13): 4104-4108.

BACKGROUND: Whether breast cancer surgeons are adequately trained, skilled, and experienced to provide breast cancer genetic assessment, testing, and counseling came under debate in September 2013 when a major third-party payer excluded nongenetics specialists from ordering such testing. A literature search having failed to uncover any study on breast surgeons' skill and practice in this area, the American Society of Breast Surgeons (ASBrS) surveyed its members on their experience with the recognized crucial components of such testing. METHODS: In late 2013, ASBrS e-mailed a link to an online questionnaire to its U.S. members (n = 2,603) requesting a self-assessment of skills and experience in genetic assessment, testing, interpretation, and counseling. After approximately 6 weeks, the results were collated and evaluated. RESULTS: By January 2, 2014, 907 responses (34.84 %) had arrived from breast surgeons nationwide working in academic settings (20 %), solo or small group private practice (39 %), large multispecialty groups (18 %), and other settings.

More than half said they performed 3-generation pedigrees, ordered genetic testing, and provided pre- and posttest counseling. Most noted that they would welcome continuing educational support in genetics. CONCLUSIONS: Currently the majority of breast surgeons provide genetic counseling and testing services to their patients. They report practices that meet or exceed recognized guidelines, including the necessary elements and processes for best practices in breast cancer genetics test counseling. Because breast cancer genetic testing is grossly underutilized relative to the size of the U.S. BRCA mutation carrier population, these appropriate services should not be restricted but rather supported and expanded.

Bonadies, D. C., et al. (2014). "Adverse events in cancer genetic testing: the third case series." Cancer J **20**(4): 246-253.

After repeated media attention in 2013 due to the Angelina Jolie disclosure and the Supreme Court decision to ban gene patents, the demand for cancer genetic counseling and testing services has never been greater. Debate has arisen regarding who should provide such services and the quality of genetics services being offered. In this ongoing case series, we document 35 new cases from 7 states (California, Connecticut, Florida, Georgia, Missouri, Pennsylvania, and Utah) and the District of Columbia of adverse outcomes in cancer genetic testing when performed without the involvement of a certified genetic counselor. We identified 3 major themes of errors: wrong genetic tests ordered, genetic test results misinterpreted, and inadequate genetic counseling. Patient morbidity and mortality were an issue in several of these cases. The complexity of cancer genetic testing and counseling has grown exponentially with the advent of multigene panels that include rare genes and the potential for more variants of uncertain significance. We conclude that genetic counseling and testing should be offered by certified genetics providers to minimize the risks, maximize the benefits, and utilize health care dollars most efficiently.

Bowen, D. J., et al. (2002). "Effects of risk counseling on interest in breast cancer genetic testing for lower risk women." Genet Med **4**(5): 359-365.

PURPOSE: A randomized trial was conducted to test the effects of two counseling methods (genetic counseling and group counseling) against a control no-intervention condition on interest in genetic testing in lower risk women. METHODS: After completing baseline surveys, women (N = 357) were randomized to one of three conditions: to receive individual genetic risk counseling, to receive a group psychosocial group counseling, or to serve as a control group. Participants completed follow-up questionnaires 6 months after randomization. RESULTS: All participants had some familial history of breast cancer, but none had a family history indicative of autosomal dominant genetic mutation. At baseline over three fourths of the sample judged themselves to be appropriate candidates for testing. By the end of the survey, two thirds (70%) of the women in the counseling group still judged themselves to be appropriate candidates for testing. Findings were similar for interest in genetic testing. Changes in beliefs about genetic testing (e.g., beliefs about potential stigma associated with testing) altered the effects of counseling. CONCLUSION: These results indicate that counseling can change interest in genetic testing only slightly and that changing women's beliefs about the properties of testing might be one mechanism of doing so.

Brierley, K. L., et al. (2012). "Adverse events in cancer genetic testing: medical, ethical, legal, and financial implications." Cancer J **18**(4): 303-309.

Cancer genetic counseling and testing are now integral services in progressive cancer care. There has been much debate over whether these services should be delivered by providers with specialized training in genetics or by all clinicians. Adverse outcomes resulting from cancer genetic counseling and testing performed by clinicians without specialization in genetics have been reported, but formal documentation is sparse. In this review, we present a series of national cases illustrating major patterns of errors in cancer genetic counseling and testing and the resulting impact on medical liability, health care costs, and the patients and their families.

Brierley, K. L., et al. (2014). ""Would you test your children without their consent?" and other sticky dilemmas in the field of cancer genetic testing." Fam Cancer **13**(3): 345-350.

Cancer genetic testing is surrounded by myriad ethical, legal, and psychosocial implications which are being revisited as testing expands into an everyday practice and into more complicated areas like whole exome and direct-to-consumer testing. We chose to survey cancer genetic counselors and physicians from a wide range of non-genetics specialties to determine what they would do if faced with the complex decisions associated with cancer genetic testing, how their views compare, and how they align with current guidelines and data. Genetic counselors were significantly more likely than non-genetics physicians to bill their insurance for testing (94.9 vs. 86.8 %; p = 0.001) and purchase life insurance before testing (86.6 vs. 68.6 %; p = 0.000) and were less likely to use an alias (3.2 vs. 13.2 %; p = 0.000) or order testing on their own DNA (15.3 vs. 24.2 %; p = 0.004). They

were also less likely to test their minor children (0.9 vs. 33.1 %; p = 0.000) or test their children without their knowledge and consent/assent (1.4 vs.11.5 %; p = 0.000). The results of our study indicate that there is wide variation regarding what clinicians predict they would do in the areas of ethical, legal and psychosocial issues in cancer genetic testing. Cancer genetic counselors' choices are more aligned with professional guidelines, likely due to their experience in the field and awareness of current guidelines. These data are a starting point for a broader discussion of who should offer cancer genetic counseling and testing to patients, particularly as the complexity of the available testing options and associated issues increase with whole exome sequencing.

Chalela, P., et al. (2012). "Breast cancer genetic testing awareness, attitudes and intentions of Latinas living along the US-Mexico border: a qualitative study." J Community Med Health Educ **2**.

BACKGROUND: Genetic testing for breast cancer may facilitate better-informed decisions regarding cancer prevention, risk reduction, more effective early detection, and better determination of risk for family members. Despite these potential benefits, significant portions of the US population-particularly Latinas-lack awareness of genetic testing for breast cancer susceptibility. Among women who are tested, less than 4% are Latina. To uncover reasons for Latinas' low participation, this study explores awareness, attitudes and behavioral intentions to undergo genetic testing among average-risk Latinas along the Texas-Mexico border. METHODS: Eight focus groups were conducted with 58 Latinas aged 19-69 living in Hidalgo County, a largely Latino region of South Texas. Focus group discussions were digitally recorded, transcribed and analyzed using qualitative content analysis to assess, categorize and interpret them. Two experienced study team members analyzed transcripts to identify major concepts grouped into theme categories. RESULTS: Participants mostly had less than a high-school education (43%), spoke primarily Spanish (52%), were of Mexican-American origin (90%) and had a family income of $30,000 or less (75%). Focus groups found that most participants had positive attitudes and strong interest in genetic testing, yet lacked general awareness and knowledge about genetic testing, its risks, benefits, and limitations. Participants also identified several key cultural-based influencers, such as family, religious beliefs and fear of testing. CONCLUSION: The delivery of culturally adapted risk information is needed to increase and ensure Latinas' understanding of breast cancer genetic testing during their decision-making processes. Key Latino values-religiosity, importance of family and the influential role of health care providers in health decisions-should also be considered when designing interventions targeting this specific group. Further research is needed to identify effective ways to communicate genetic risk susceptibility information to Latinas to help them make informed testing decisions.

Chan-Smutko, G., et al. (2008). "Professional challenges in cancer genetic testing: who is the patient?" Oncologist **13**(3): 232-238.

In the genetic counseling setting, the health care provider can be challenged by opposing duties to members of the same family: protecting the privacy of the patient identified with a gene mutation and the ethical obligation to warn at-risk relatives. In a situation of nondisclosure between members of a family with a known disease-predisposing mutation, this type of dilemma can present in acute form for the provider who cares for different members of the family. This can hinder effective medical decision making. To minimize this effect, we recommend detailed pretest genetic counseling steps to empower the patient to communicate with their at-risk relatives their intent to pursue testing and willingness to share information. In addition, post-test counseling should reiterate the implications of a positive result for at-risk relatives and conclude with a written summary that patients can share with their family.

Chieng, W. S. and S. C. Lee (2012). "Discrepancy between initial high expression of interest in clinical cancer genetic testing and actual low uptake in an Asian population." Genet Test Mol Biomarkers **16**(7): 785-793.

AIMS: Little is known about the acceptance of clinical cancer genetic testing in Asians. We surveyed the attitudes and perceived motivators and barriers to genetic testing immediately after genetic counseling in at-risk patients for hereditary cancer in a cancer genetics clinic in Singapore, and compared the responses of actual test acceptors and decliners. RESULTS: Three hundred seventeen patients participated, including 199 cancer-affected and 118 cancer-free probands or family members. Overall, 70% of patients expressed an initial willingness to be tested, and most did not perceive major barriers. However, only 69/199 (35%) of cancer-affected probands were actually tested. There was no significant difference in age, education, marital status, or initial expression of negative feelings toward genetic information between the test acceptors and decliners, although the decliners were more likely to have indicated a wish not to be tested (22% vs. 4%, $p<0.001$) and cited cost as a barrier (32% vs. 12%, $p=0.002$). The most common actual reasons against testing were cost (60%), not wanting to bear the emotional burden of genetic information (16%), and the perception that the medical

management will not change (16%). CONCLUSION: A significant discrepancy exists between an initial high interest in testing and actual low uptake. Health programs that address cost issues and education to correct misperceptions may improve genetic information utilization.

Cowley, L. (2016). "What can we Learn from Patients' Ethical Thinking about the right 'not to know' in Genomics? Lessons from Cancer Genetic Testing for Genetic Counselling." Bioethics **30**(8): 628-635.

This article is based on a qualitative empirical project about a distinct kinship group who were among the first identified internationally as having a genetic susceptibility to cancer (Lynch Syndrome). 50 were invited to participate (42 were tested; eight declined genetic testing). 15, who had all accepted testing, were interviewed. They form a unique case study. This study aimed to explore interviewees' experiences of genetic testing and how these influenced their family relationships. A key finding was that participants framed the decision to be tested as 'common sense'; the idea of choice around the decision was negated and replaced by a moral imperative to be tested. Those who did not follow 'common sense' were judged to be imprudent. Family members who declined testing were discussed negatively by participants. The article addresses what is ethically problematic about how test decliners were discussed and whether these ethical concerns extend to others who are offered genetic testing. Discussions showed that genetic testing was viewed as both an autonomous choice and a responsibility. Yet the apparent conflict between the right to autonomy and the moral imperative of responsibility allowed participants to defend test decliners' decisions by expressing a preference for or defending choice over responsibility. The 'right not to know' seemed an important moral construct to help ethically manage unpopular decisions made by close family who declined testing. In light of this research, the erosion of the 'right not to know' in the genomic age could have subtle yet profound consequences for family relationships.

Cox, S. L., et al. (2012). "Patterns of cancer genetic testing: a randomized survey of Oregon clinicians." J Cancer Epidemiol **2012**: 294730.

Introduction. Appropriate use of genetic tests for population-based cancer screening, diagnosis of inherited cancers, and guidance of cancer treatment can improve health outcomes. We investigated clinicians' use and knowledge of eight breast, ovarian, and colorectal cancer genetic tests. Methods. We conducted a randomized survey of 2,191 Oregon providers, asking about their experience with fecal DNA, OncoVue, BRCA, MMR, CYP2D6, tumor gene expression profiling, UGT1A1, and KRAS. Results. Clinicians reported low confidence in their knowledge of medical genetics; most confident were OB-GYNs and specialists. Clinicians were more likely to have ordered/recommended BRCA and MMR than the other tests, and OB-GYNs were twice as likely to have ordered/recommended BRCA testing than primary care providers. Less than 10% of providers ordered/recommended OncoVue, fecal DNA, CYP2D6, or UGT1A1; less than 30% ordered/recommended tumor gene expression profiles or KRAS. The most common reason for not ordering/recommending these tests was lack of familiarity. Conclusions. Use of appropriate, evidence-based testing can help reduce incidence and mortality of certain cancers, but these tests need to be better integrated into clinical practice. Continued evaluation of emerging technologies, dissemination of findings, and an increase in provider confidence and knowledge are necessary to achieve this end.

Hamilton, J. G., et al. (2017). "Primary care providers' cancer genetic testing-related knowledge, attitudes, and communication behaviors: A systematic review and research agenda." J Gen Intern Med **32**(3): 315-324.

BACKGROUND: Primary care providers (PCPs) can play a critical role in helping patients receive the preventive health benefits of cancer genetic risk information. Thus, the objective of this systematic review was to identify studies of US PCPs' knowledge, attitudes, and communication-related behaviors regarding genetic tests that could inform risk-stratification approaches for breast, colorectal, and prostate cancer screening in order to describe current findings and research gaps. METHODS: We conducted a systematic search of six electronic databases to identify peer-reviewed empirical articles relating to US PCPs and genetic testing for breast, colorectal, or prostate cancer published in English from 2008 to 2016. We reviewed these data and used narrative synthesis methods to integrate findings into a descriptive summary and identify research needs. RESULTS: We identified 27 relevant articles. Most focused on genetic testing for breast cancer (23/27) and colorectal cancer risk (12/27); only one study examined testing for prostate cancer risk. Most articles addressed descriptive research questions (24/27). Many studies (24/27) documented PCPs' knowledge, often concluding that providers' knowledge was incomplete. Studies commonly (11/27) examined PCPs' attitudes. Across studies, PCPs expressed some concerns about ethical, legal, and social implications of testing. Attitudes about the utility of clinical genetic testing, including for targeted cancer screening, were generally favorable; PCPs were more skeptical of

direct-to-consumer testing. Relatively fewer studies (9/27) examined PCPs' communication practices regarding cancer genetic testing. DISCUSSION: This review indicates a need for investigators to move beyond descriptive research questions related to PCPs' knowledge and attitudes about cancer genetic testing. Research is needed to address important gaps regarding the development, testing, and implementation of innovative interventions and educational programs that can improve PCPs' genetic testing knowledge, assuage concerns about the appropriateness of cancer genetic testing, and promote open and effective patient-provider communication about genetic risk and genetic testing.

Hay, J. L., et al. (2017). "Implementing an Internet-Delivered Skin Cancer Genetic Testing Intervention to Improve Sun Protection Behavior in a Diverse Population: Protocol for a Randomized Controlled Trial." JMIR Res Protoc **6**(4): e52.

BACKGROUND: Limited translational genomic research currently exists to guide the availability, comprehension, and appropriate use of personalized genomics in diverse general population subgroups. Melanoma skin cancers are preventable, curable, common in the general population, and disproportionately increasing in Hispanics. OBJECTIVE: Variants in the melanocortin-1 receptor (MC1R) gene are present in approximately 50% of the population, are major factors in determining sun sensitivity, and confer a 2-to-3-fold increase in melanoma risk in the general population, even in populations with darker skin. Therefore, feedback regarding MC1R risk status may raise risk awareness and protective behavior in the general population. METHODS: We are conducting a randomized controlled trial examining Internet presentation of the risks and benefits of personalized genomic testing for MC1R gene variants that are associated with increased melanoma risk. We will enroll a total of 885 participants (462 participants are currently enrolled), who will be randomized 6:1 to personalized genomic testing for melanoma risk versus waiting list control. Control participants will be offered testing after outcome assessments. Participants will be balanced across self-reported Hispanic versus non-Hispanic ethnicity (n=750 in personalized genomic testing for melanoma risk arm; n=135 in control arm), and will be recruited from a general population cohort in Albuquerque, New Mexico, which is subject to year-round sun exposure. Baseline surveys will be completed in-person with study staff and follow-up measures will be completed via telephone. RESULTS: Aim 1 of the trial will examine the personal utility of personalized genomic testing for melanoma risk in terms of short-term (3-month) sun protection and skin screening behaviors, family and physician communication, and melanoma threat and control beliefs (ie, putative mediators of behavior change). We will also examine potential unintended consequences of testing among those who receive average-risk personalized genomic testing for melanoma risk findings, and examine predictors of sun protection at 3 months as the outcome. These findings will be used to develop messages for groups that receive average-risk feedback. Aim 2 will compare rates of test consideration in Hispanics versus non-Hispanics, including consideration of testing pros and cons and registration of a decision to either accept or decline testing. Aim 3 will examine personalized genomic testing for melanoma risk feedback comprehension, recall, satisfaction, and cancer-related distress in those who undergo testing, and whether these outcomes differ by ethnicity (Hispanic vs non-Hispanic), or sociocultural or demographic factors. Final outcome data collection is anticipated to be complete by October 2017, at which point data analysis will commence. CONCLUSIONS: This study has important implications for personalized genomics in the context of melanoma risk, and may be broadly applicable as a model for delivery of personalized genomic feedback for other health conditions.

Hirschberg, A. M., et al. (2015). "Psychiatric implications of cancer genetic testing." Cancer **121**(3): 341-360.

As genetic testing for hereditary cancer syndromes has transitioned from research to clinical settings, research regarding its accompanying psychosocial effects has grown. Men and women being tested for hereditary cancer syndromes may experience some psychological distress while going through the process of testing or after carrier status is identified. Psychological distress appears to decrease over the course of the first year and it is typically not clinically significant. Longer term studies show mixed results with some mutation carriers continuing to experience elevated distress. Baseline distress is the greatest risk factor for both immediate (weeks-12 months) and long-term psychological distress (18 mo-8 years post genetic testing). In addition to baseline psychological distress, other risk factors can be identified to help identify individuals who may need psychosocial interventions during the genetic testing process. The challenges of providing clinical care to the growing population of individuals identified to be at increased risk for heritable cancers present opportunities for research and new models of care.

Ho, S. M., et al. (2010). "Hopefulness predicts resilience after hereditary colorectal cancer genetic

testing: a prospective outcome trajectories study." BMC Cancer **10**: 279.

BACKGROUND: Genetic testing for hereditary colorectal cancer (HCRC) had significant psychological consequences for test recipients. This prospective longitudinal study investigated the factors that predict psychological resilience in adults undergoing genetic testing for HCRC. METHODS: A longitudinal study was carried out from April 2003 to August 2006 on Hong Kong Chinese HCRC family members who were recruited and offered genetic testing by the Hereditary Gastrointestinal Cancer Registry to determine psychological outcomes after genetic testing. Self-completed questionnaires were administered immediately before (pre-disclosure baseline) and 2 weeks, 4 months and 1 year after result disclosure. Using validated psychological inventories, the cognitive style of hope was measured at baseline, and the psychological distress of depression and anxiety was measured at all time points. RESULTS: Of the 76 participating subjects, 71 individuals (43 men and 28 women; mean age 38.9 +/- 9.2 years) from nine FAP and 24 HNPCC families completed the study, including 39 mutated gene carriers. Four patterns of outcome trajectories were created using established norms for the specified outcome measures of depression and anxiety. These included chronic dysfunction (13% and 8.7%), recovery (0% and 4.3%), delayed dysfunction (13% and 15.9%) and resilience (76.8% and 66.7%). Two logistic regression analyses were conducted using hope at baseline to predict resilience, with depression and anxiety employed as outcome indicators. Because of the small number of participants, the chronic dysfunction and delayed dysfunction groups were combined into a non-resilient group for comparison with the resilient group in all subsequent analysis. Because of low frequencies, participants exhibiting a recovery trajectory (n = 3 for anxiety and n = 0 for depression) were excluded from further analysis. Both regression equations were significant. Baseline hope was a significant predictor of a resilience outcome trajectory for depression (B = -0.24, $p < 0.01$ for depression); and anxiety (B = -0.11, $p = 0.05$ for anxiety). CONCLUSIONS: The current findings suggest that hopefulness may predict resilience after HCRC genetic testing in Hong Kong Chinese. Interventions to increase the level of hope may be beneficial to the psychological adjustment of CRC genetic testing recipients.

Honrado, E., et al. (2005). "The molecular pathology of hereditary breast cancer: genetic testing and therapeutic implications." Mod Pathol **18**(10): 1305-1320.

Cancer arising in carriers of mutations in the BRCA1 and BRCA2 genes differs from sporadic breast cancer of age-matched controls and from non-BRCA1/2 familial breast carcinomas in its morphological, immunophenotypic and molecular characteristics. Most BRCA1 carcinomas have the basal cell phenotype, a subtype of high-grade, highly proliferating, estrogen receptor- and HER2-negative breast carcinomas, characterized by the expression of basal or myoepithelial markers such as basal keratins, P-cadherin, epidermal growth factor receptor, etc. This phenotype is rarely found in BRCA2 carcinomas, which are of higher grade than sporadic age-matched controls, but tend to be estrogen receptor- and progesterone receptor-positive. The expression of the cell-cycle proteins cyclins A, B1 and E and SKP2 is associated with a BRCA1 phenotype, whereas cyclin D1 and p27 expression is associated with BRCA2 carcinomas. Recent studies have shown that hereditary carcinomas that are not attributable to BRCA1/2 mutations have phenotypic similarities to BRCA2 tumors, but tend to be of lower grade and proliferation index. Somatic mutations in the BRCA genes are rarely found in hereditary tumors; by contrast, BRCA1 and BRCA2 loss of heterozygosity (LOH) is found in almost all BRCA1 and BRCA2 carcinomas, respectively. Furthermore, all types of hereditary breast carcinomas have a low frequency of HER2 expression. Finally, comparative genomic hybridization studies have revealed differences in chromosomal gains and losses between genotypes. The pathological and molecular features of hereditary breast cancer can drive specific treatments and influence the process of mutation screening. In addition, detecting molecular changes such as BRCA1/2 LOH in nonatypical cells obtained by random fine-needle aspiration, ductal lavage or nipple aspirate fluid may help to earlier identify carrier women who are at an even higher risk of developing breast carcinoma.

Julian-Reynier, C., et al. (2000). "Uptake of hereditary breast/ovarian cancer genetic testing in a French national sample of BRCA1 families. The French Cancer Genetic Network." Psychooncology **9**(6): 504-510.

Due to the technical difficulties involved in identifying BRCA1/2 genetic mutations, the affected patients have to be investigated before testing can be made available to all the relatives at risk. Here, we studied the attendance rates at cancer genetic clinics (CGC) and the uptake of genetic testing in first/second degree relatives after the first BRCA1 mutated woman with cancer had been informed in the family. We carried out a survey on French cancer geneticists involved in breast/ovarian CGC, asking them to select their first three BRCA1 family records. Data collection was carried out retrospectively by telephone interview

with a standardised closed item questionnaire. Considering only those families (n = 37) where the index case had been informed for at least 8 months at the time of the survey, the overall attendance at CGC of first/second degree relatives (n = 419) was 31.7% (n = 133) and the overall uptake of BRCA1 testing was 26.7% (n = 112). Among those who attended the CGC (n = 133), 84.2% (n = 112) requested genetic testing (95% confidence interval: 78-90.4%). Among the first degree relatives, the unaffected women who attended accounted for 59.8% and 51.2% requested testing after the index case had been informed. Women with cancer had a higher attendance rate (83.3%) than unaffected women (36.1%) (Odds Ratio (OR) = 8.86; $p < 0.001$) and first degree relatives (51.4%) than second degree relatives (17.9%) (OR = 2.87; $p < 0.001$); women (43%) also attended more frequently than men (16%) (OR = 3.97, $p < 0.001$). In French BRCA1 mutated families, female first degree relatives of the index patient show the most interest in genetic testing.

Koehly, L. M., et al. (2003). "A social network analysis of communication about hereditary nonpolyposis colorectal cancer genetic testing and family functioning." Cancer Epidemiol Biomarkers Prev **12**(4): 304-313.

Hereditary cancers are relational diseases. A primary focus of research in the past has been the biological relations that exist within the families and how genes are passed along family lines. However, hereditary cancers are relational in a psychosocial sense, as well. They can impact communication relationships within a family, as well as support relationships among family members. Furthermore, the familial culture can affect an individual's participation in genetic counseling and testing endeavors. Our aims are (a) to describe the composition of familial networks, (b) to characterize the patterns of family functioning within families, (c) to analyze how these patterns relate to communications about genetic counseling and testing among family members, and (d) to identify influential family members. Specifically, we asked how the relationship between mutation status, kinship ties, and family functioning constructs, e.g., communication, cohesion, affective involvement, leadership, and conflict, was associated with discussions about genetic counseling and testing. We used social network analysis and random graph techniques to examine 783 dyadic relationships in 36 members of 5 hereditary nonpolyposis colorectal cancer (HNPCC) families interviewed from 1999-2000. Results suggest that in these five HNPCC families, two family members are more likely to discuss genetic counseling and testing if either one carries the mutation, if either one is a spouse or a first-degree relative of the other, or if the relationship is defined by positive cohesion, leadership, or lack of conflict. Furthermore, the family functioning patterns suggest that mothers tend to be the most influential persons in the family network. Results of this study suggest encouraging family members who act in the mother role to take a "team approach" with the family proband when discussing HNPCC risks and management with family members.

Li, S. T., et al. (2017). "Impact of subsidies on cancer genetic testing uptake in Singapore." J Med Genet **54**(4): 254-259.

PURPOSE: Previous reports cite high costs of clinical cancer genetic testing as main barriers to patient's willingness to test. We report findings of a pilot study that evaluates how different subsidy schemes impact genetic testing uptake and total cost of cancer management. METHODS: We included all patients who attended the Cancer Genetics Service at the National Cancer Centre Singapore (January 2014-May 2016). Two subsidy schemes, the blanket scheme (100% subsidy to all eligible patients), and the varied scheme (patients received 50%-100% subsidy dependent on financial status) were compared. We estimated total spending on cancer management from government's perspective using a decision model. RESULTS: 445 patients were included. Contrasting against the blanket scheme, the varied scheme observed a higher attendance of patients (34 vs 8 patients per month), of which a higher proportion underwent genetic testing (5% vs 38%), while lowering subsidy spending per person (S$1098 vs S$1161). The varied scheme may potentially save cost by reducing unnecessary cancer surveillance when first-degree relatives uptake rate is above 36%. FINDINGS: Provision of subsidy leads to a considerable increase in genetic testing uptake rate. From the government's perspective, subsidising genetic testing may potentially reduce total costs on cancer management.

Lowery, J. T., et al. (2008). "The impact of direct-to-consumer marketing of cancer genetic testing on women according to their genetic risk." Genet Med **10**(12): 888-894.

PURPOSE: To assess the impact of direct-to-consumer marketing for genetic testing among women of varying genetic risk for breast and ovarian cancer. METHODS: Telephone surveys were conducted with 315 women in Denver, Colorado, one target audience for the Myriad BRACAnalysis ad campaign. Genetic risk was determined from personal and family history and grouped by probability of having a BRCA1/2 mutation (low <5%, moderate 5-<10%, high > or =10%). RESULTS: High-risk women were more knowledgeable about BRACAnalysis and more likely

to recall the media ads than were low-risk women (60 vs. 39%, P < 0.01). After seeing the ads, about 40% of women were more interested in testing and about 10% expressed increased worry about developing breast or ovarian cancer. Women across all risk groups overstated the benefits and appropriateness of testing. An equal percentage of high- and low-risk women (51 and 60%) felt that they would benefit from genetic testing. CONCLUSION: The campaign effectively reached a large audience. Concern about breast cancer was not appreciably increased. A large percentage of low-risk women (not candidates for testing) expressed interest in testing, suggesting the campaign was too broad. A campaign targeted at high-risk women, who may benefit from testing might be preferred.

Matloff, E. T., et al. (2014). "Changes in specialists' perspectives on cancer genetic testing, prophylactic surgery and insurance discrimination: then and now." J Genet Couns **23**(2): 164-171.

We surveyed cancer genetics specialists in 1998 to learn what they would do if at 50% risk to carry a BRCA or Lynch syndrome mutation. We chose to repeat our study 14 years later, to examine how perspectives have changed with the extensive data now available. In July 2012 we surveyed the National Society of Genetic Counselors (NSGC) Cancer Special Interest Group via an internet based survey. We found statistically significant increases in the percentage of specialists who: would undergo BRCA testing (p = 0.0006), opt for prophylactic bilateral mastectomy (p =0.0001), opt for prophylactic removal of their uterus and ovaries for Lynch syndrome (p =0.0057 and P = 0.0090, respectively), and bill testing to insurance (p >0.0001). There were also statistically significant decreases in the percentage of participants who would have their colon removed for Lynch syndrome (p = 0.0002) and use an alias when pursuing testing (p > 0.0001). Over the past 14 years there has been a major change in perspective amongst cancer genetic specialists regarding genetic testing, prophylactic surgery and insurance discrimination.

Matloff, E. T., et al. (2000). "What would you do? Specialists' perspectives on cancer genetic testing, prophylactic surgery, and insurance discrimination." J Clin Oncol **18**(12): 2484-2492.

PURPOSE: To examine what cancer genetics specialists predict they would do personally if they were at 50% risk of carrying a mutation that predisposes to hereditary breast/ovarian cancer (BRCA1/BRCA2) and hereditary nonpolyposis colon cancer (HNPCC). METHODS: Questionnaire survey of the membership of the National Society of Genetic Counselors (NSGC) Special Interest Group (SIG) in Cancer. RESULTS: Of the 296 active members of the NSGC Cancer-SIG surveyed, 163 (55%) responded. Eighty-five percent predicted that if they had a 50% risk of carrying a BRCA1/BRCA2 mutation, they would pursue genetic testing. If they tested positive for a mutation at age 35, 25% predicted they would pursue prophylactic bilateral mastectomies and 68%, prophylactic oophorectomy. Ninety-one percent of respondents believe they would pursue genetic testing for HNPCC, and 17% would elect prophylactic colectomy; 54%, prophylactic hysterectomy; and 52%, prophylactic oophorectomy if they tested positive for a mutation. The majority (68%) would not bill their insurance companies for genetic testing because of fear of discrimination, and 26% would use an alias when undergoing testing. Fifty-seven percent of counselors would seek professional psychologic support to help them cope with the results of testing. CONCLUSION: A large percentage of cancer genetic counseling providers predicted they would opt for prophylactic surgery at a young age if they carried a BRCA or HNPCC mutation, and most would seek professional psychologic assistance when undergoing testing. More than half of respondents would not bill their insurance companies for genetic testing, largely because of fear of genetic discrimination. The vast majority of those providers most familiar with cancer genetic testing and its associated medical, psychologic, and legal implications would still pursue genetic testing.

McVeigh, T. P., et al. (2014). "Familial breast cancer genetic testing in the West of Ireland." Ir J Med Sci **183**(2): 199-206.

AIMS: The majority of hereditary breast and ovarian cancers are associated with highly penetrant mutations in two genes: BRCA 1 and 2. Our aim was to investigate the prevalence and types of BRCA mutations in patients from the West of Ireland. METHODS: A retrospective cohort study was undertaken that included all patients from the counties, Mayo, Sligo, Galway, Roscommon, and Clare, who were referred to the National Centre for Medical Genetics (NCMG) for testing for mutations in BRCA 1 or 2 between 2000 and 2010. Data including age, symptoms, family history, Manchester score, and test results were recorded and analysed using SPSS. RESULTS: The NCMG received 380 referrals from the Western seaboard, including 148 for diagnostic testing and 232 for predictive evaluation. Sixty-five patients did not attend for assessment. Two hundred and fifty-six patients fulfilled criteria for genetic counselling, which was accepted by 184, of whom 127 proceeded to testing. Predictive tests were more often declined than diagnostic [41 (46 %) vs. 16 (17 %)]. Ten mutations in BRCA 1 were identified in 20 patients (15 families), including Exon 1-23del (3

families); Exon 14-20del (2 families) and E143X (2 families). Six mutations in BRCA 2 were identified in 15 patients (12 families) including 8525delC (n = 2 families) and 8205-1G>C (n = 3 families). Patients with positive results had significantly higher Manchester scores than those with negative tests [median 25.5 (12-48) vs. 20 (8-37), p = 0.042, Mann-Whitney U test]. CONCLUSION: To identify patients with highly penetrant variants, referrals should be made with strict adherence to guidelines. Counselling should be individualised to counteract intrinsic psychological barriers to testing.

Mouchawar, J., et al. (1999). "A study of the relationship between family history of breast cancer and knowledge of breast cancer genetic testing prerequisites." Cancer Detect Prev **23**(1): 22-30.

Awareness of hereditary breast cancer genetic testing, of breast cancer risk factors, and of increased level of risk based on family history are necessary before women can seek out genetic services. The aim of this paper is to describe the relationships between family history of breast cancer and awareness of genetic testing, knowledge of breast cancer risk factors, and perceived lifetime risk of breast cancer. An anonymous survey was administered by mail to a random sample of 600 women, 200 from each of three breast cancer family history groups (none, intermediate, and strong), drawn from a population-based registry of 240,000 women enrolled in a mammography screening program in the Denver Metropolitan area in Colorado. Awareness of genetic testing for breast cancer risk assessment was found to be significantly associated with family history of breast cancer, increasing from 35% in the lowest family history risk group to 67% in the group with the strongest familial risk (p = 0.002). In all family history groups, nearly 70% of respondents viewed high-fat diet and smoking as being important in relation to breast cancer risk, but alcohol was seen as being only somewhat important or not important by almost half of all respondents. Having a mother or sister with breast cancer was reported as being extremely or very important by nearly all respondents, regardless of family history. As expected, perceived lifetime risk for developing breast cancer was associated with family history (p = 0.001), but the perception of the lifetime risk for breast cancer was much higher among all of the family history groups than their true risk. In conclusion, educational interventions are needed to heighten women's awareness of genetic testing, to clarify women's knowledge of breast cancer risk factors, especially alcohol, and to reassure many women that their actual breast cancer risk is lower than they might perceive.

Offit, K., et al. (2006). "Cancer genetic testing and assisted reproduction." J Clin Oncol **24**(29): 4775-4782.

PURPOSE: Because of increasing uptake of cancer genetic testing and the improving survival of young patients with cancer, health care practitioners including oncologists will increasingly be asked about options for assisted reproduction by members of families affected by hereditary cancer syndromes. Among these reproductive options, preimplantation genetic diagnosis (PGD) offers the opportunity to select embryos without familial cancer-predisposing mutations. METHODS: A review of the published literature supplemented by a survey of PGD centers in the United States. RESULTS: Prenatal diagnosis and/or embryo selection after genetic testing has already been performed in the context of more than a dozen familial cancer syndromes, including the common syndromes of genetic predisposition to colon and breast cancer. CONCLUSION: While constituting new reproductive options for families affected by cancer, the medical indications and ethical acceptance of assisted reproductive technologies for adult-onset cancer predisposition syndromes remain to be defined. Continued discussion of the role of PGD in the reproductive setting is needed to inform the responsible use of these technologies to decrease the burden of heritable cancers.

Offit, K. and P. Thom (2007). "Ethical and legal aspects of cancer genetic testing." Semin Oncol **34**(5): 435-443.

As a result of the increasing effectiveness of cancer screening and preventive interventions, ethical issues, as well as legal liabilities, are increasingly associated with cancer genetic testing. These issues include the possible "duty to warn" relatives of inherited cancer risk, the appropriateness of testing of children and embryos, equity of access to genetics services, and potential harms of testing including the risk of genetic discrimination. An approach to these and other ethical challenges will be presented, drawing not only on recent case law but also on a broader bioethical framework.

Peshkin, B. N., et al. (2010). "On the development of a decision support intervention for mothers undergoing BRCA1/2 cancer genetic testing regarding communicating test results to their children." Fam Cancer **9**(1): 89-97.

Parent communication of BRCA1/2 test results to minor-age children is an important, yet understudied, clinical issue that is commonly raised in the management of familial cancer risk. Genetic counseling professionals and others who work with parents undergoing this form of testing often confront

questions about the risks/benefits and timing of such disclosures, as well as the psychosocial impact of disclosure and nondisclosure on children's health and development. This paper briefly reviews literature on the prevalence and outcome of parent-child communication surrounding maternal BRCA1/2 test results. It also describes a formative research process that was used to develop a decision support intervention for mothers participating in genetic counseling and testing for BRCA1/2 mutations to address this issue, and highlights the conceptual underpinnings that guided and informed the intervention's development. The intervention consists of a print-based decision aid to facilitate parent education and counseling regarding if, when, and potentially how to disclose hereditary cancer risk information to children. We conclude with a summary of the role of social, behavioral, and decision science research to support the efforts of providers of familial cancer care regarding this important decision, and to improve the outcomes of cancer genetic testing for tested parents and their nontested children.

Quillin, J. M. (2016). "Lifestyle Risk Factors Among People Who Have Had Cancer Genetic Testing." J Genet Couns **25**(5): 957-964.

Hereditary cancer genetic counseling often focuses on medically intensive risk-reduction strategies, like imaging and risk-reducing surgeries. Lifestyle factors also influence cancer risk, but health behavior counseling is not common in genetic counseling. Information about typical lifestyle risk factors among patients seeking hereditary cancer risk is sparse. The current study describes cancer risk-relevant lifestyle factors for people who have had cancer genetic testing. Data came from the Health Information National Trends Survey (HINTS 4) collected in 2013. Analytic variables represented American Cancer Society nutrition and physical activity guidelines. Lifestyle factors were assessed for people who had undergone testing for BRCA1, BRCA2, or Lynch Syndrome genes. Among 3016 HINTS respondents, 135 had cancer genetic testing. Of these, 58 % were overweight or obese. Eighteen percent reported no moderate-intensity physical activity. Average sedentary screen-time was 3.4 h (SE = 0.472) daily. Sixty-three percent drank non-diet soda, and 23 % of these people drank soda every day. Between 18 and 36 % consumed less than 2 (1/2) cups fruits/vegetables daily. Twenty-four percent were current smokers. Lifestyle risk factors were not different between people who had genetic testing and those who had not. In conclusion, most people who had genetic testing for cancer susceptibility have at least one modifiable risk factor. Genetic counselors have opportunities to impact a counselee's cancer risk not only through risk-tailored medical procedures, but also through lifestyle modification recommendations. Results of the current study may foster a broader discussion of genetic counselors' roles in healthy lifestyle education.

Quillin, J. M., et al. (2008). "Tolerance for ambiguity could influence awareness of breast cancer genetic testing and inform health education." Cancer Causes Control **19**(10): 1227-1232.

OBJECTIVE: This exploratory study assessed relationships among education, tolerance for ambiguity, and genetic testing awareness in light of implications for cancer genetics education. METHODS: Cross-sectional analyses were conducted from self-administered written survey data of a breast cancer risk communication trial, including 899 Women's Health patients recruited from 2003 to 2005. The modifying effect of tolerance for ambiguity on the relationship between educational background and breast cancer genetic testing awareness was assessed through logistic regression. RESULTS: There was a statistically significant main effect of education ($p < 0.05$), but not tolerance for ambiguity, on genetic testing awareness. However, the relationship between education and awareness was stronger among those with high tolerance for ambiguity (p for interaction <0.05), even when controlling for age, race, and breast cancer family history. Among persons with high (>1 SD above the mean) and medium tolerance for ambiguity, the relationship between education and awareness was positive and significant ($p = 0.048$ and 0.002, respectively). Among participants with low tolerance for ambiguity, the association was not significant. CONCLUSIONS: Educational background may predict awareness knowledge of breast cancer genetic testing only for those with higher tolerance for ambiguity. These findings could inform future intervention research concerning education about cancer genetic testing.

Ramirez, A. G., et al. (2015). "Attitudes Toward Breast Cancer Genetic Testing in Five Special Population Groups." J Health Dispar Res Pract **8**(4): 124-135.

PURPOSE: This study examined interest in and attitudes toward genetic testing in 5 different population groups. METHODS: The survey included African American, Asian American, Latina, Native American, and Appalachian women with varying familial histories of breast cancer. A total of 49 women were interviewed in person. Descriptive and nonparametric statistical techniques were used to assess ethnic group differences. RESULTS: Overall, interest in testing was high. All groups endorsed more benefits than risks. There were group differences

regarding endorsement of specific benefits and risks: testing to "follow doctor recommendations" (p=0.017), "concern for effects on family" (p=0.044), "distrust of modern medicine" (p=0.036), "cost" (p=0.025), and "concerns about communication of results to others" (p=0.032). There was a significant inverse relationship between interest and genetic testing cost (p<0.050), with the exception of Latinas, who showed the highest level of interest regardless of increasing cost. CONCLUSION: Cost may be an important barrier to obtaining genetic testing services, and participants would benefit by genetic counseling that incorporates the unique cultural values and beliefs of each group to create an individualized, culturally competent program. Further research about attitudes toward genetic testing is needed among Asian Americans, Native Americans, and Appalachians for whom data are severely lacking. Future study of the different Latina perceptions toward genetic testing are encouraged.

Ropka, M. E., et al. (2006). "Uptake rates for breast cancer genetic testing: a systematic review." Cancer Epidemiol Biomarkers Prev **15**(5): 840-855.

PURPOSE: Individuals and families dealing with the possibility of hereditary cancer risk face numerous decisions, including whether to obtain genetic testing. The purpose of this article is to determine what is known about the rate at which people obtain cancer genetic testing. METHODS: Using MEDLINE, CINAHL, and PSYCHINFO plus reviewing reference lists of relevant articles, we identified 40 studies in May 2002 that addressed breast cancer-related decisions, enrolled adult participants, were published in 1990 or more recently, were peer-reviewed primary clinical studies, addressed genetic testing either alone or in combination with genetic counseling, and reported rates at which participants showed interest in and/or underwent cancer genetic testing. Information regarding study design, participants, and genetic testing uptake rates was recorded. Each article was reviewed for methodologic quality using a flexible quality review system applicable to all study types. RESULTS: Of the 40 studies, 25 provided information about hypothetical genetic testing decisions, 14 about real decisions, and 1 about both. Mean hypothetical uptake was 66% (range, 20-96%) and real uptake was 59% (range, 25-96%). Multivariate logistic regression analyses found that decision type (real/hypothetical), personal and family history of breast cancer, and variability in sampling strategy, recruitment setting, and criteria for real and hypothetical uptake were independently associated with uptake. Our systematic review identified additional explanations for uptake variability (investigator influences, small sample sizes, variability in target populations, lack of clearly described sampling strategies, sampling methods open to bias, and variability in reporting associated risk factors). CONCLUSION: In addition to clinical characteristics, research methodologic issues are likely to be major determinants of variability in published breast cancer genetic testing uptake rates. An understanding of these issues will clarify to clinicians why their clinical experience may not be congruent with published rates and help guide future research.

Schroeder, D. and S. A. Conroy (2015). "Breast cancer genetic testing: more than a medical management tool." Clin J Oncol Nurs **19**(5): 603-607.

BACKGROUND: Knowing whether a harmful hereditary mutation exists in BRCA1 and BRCA2 can enable women to make informed decisions regarding surveillance and surgery options to manage risk. Given the attention in the media about BRCA genetic testing, nurses need to revisit how this knowledge may affect a woman's sense of self and the forces that may influence this decision. OBJECTIVES: This article aims to understand how complex the decision to undergo genetic testing may be for some women by exploring the impact of genetic knowledge on the self, changes to customary definitions for health and illness, and ethical issues and social forces that may influence genetic testing decisions. METHODS: A review of the literature was undertaken to understand how genetic knowledge may alter meanings attached to the breast and how health is defined, and to identify ethical concerns and social forces that may affect a woman's decision to undergo or decline an offer for genetic testing. FINDINGS: An understanding and awareness of the potential benefits and harms of BRCA1 and BRCA2 genetic testing, as well as the social forces that may influence a woman's decision to undergo or decline an offer for genetic testing and the commitment to remain open to the uniqueness of each woman's situation, may enhance the nurse-patient relationship and result in a decision that is ethically in the best interest of the patient.

Selkirk, C. G., et al. (2014). "Cancer genetic testing panels for inherited cancer susceptibility: the clinical experience of a large adult genetics practice." Fam Cancer **13**(4): 527-536.

Next-generation sequencing genetic testing panels for cancer susceptibility (cancer panels) have recently become clinically available. At present, clinical utility is unknown and there are no set criteria or guidelines established for whom to offer such testing. Although it may be a cost-effective method to test multiple cancer susceptibility genes concurrently, the rate of finding variants of unknown significance (VUS) may be high and testing may yield mutations in genes with no established management recommendations. We describe our Center's

experience over a 14-month period (April 2012-June 2013) for patient interest and uptake in cancer panel testing and whether there were predictors of pursuing testing or identifying mutations. Using a clinical ranking system, patients' family histories were ranked from 0 to 3 (low likelihood to high likelihood for underlying genetic susceptibility). The clinical ranking system was assessed to determine its predictability of finding mutations. Of the 689 patients who met inclusion criteria, the option of pursuing a cancer panel was discussed with 357 patients; 63 (17.6 %) patients pursued testing. Those who pursued testing were more likely to be older, male, affected with cancer, affected with multiple primary cancers, and had a higher clinical rank than non-pursuers. There were no significant predictors of finding a mutation on panel testing. Of the 61 patients who have received results, there was a 6.6 % mutation rate and 19.7 % VUS rate. The yield of cancer panels in clinical practice is low and the strength of family history alone may not predict likelihood of finding a mutation.

Shappell, H. L. and E. T. Matloff (2001). "Writing Effective Insurance Justification Letters for Cancer Genetic Testing: A Streamlined Approach." J Genet Couns **10**(4): 331-341.

The topic of insurance coverage and justification letters for cancer predisposition testing has been the subject of much discussion on the National Society of Genetic Counselors Cancer Special Interest Group (NSGC Cancer-SIG) listserv. Some counselors have stated that they have had difficulty in obtaining insurance coverage for their patients, while others have indicated that they would appreciate seeing examples of successful letters. The purpose of this paper is to provide practical guidance in writing successful letters of justification and to share insurance success stories in the area of cancer genetic testing.

Teng, I. and A. Spigelman (2014). "Attitudes and knowledge of medical practitioners to hereditary cancer clinics and cancer genetic testing." Fam Cancer **13**(2): 311-324.

Genetic testing for susceptibility for common cancers is widely available. Thus, doctors have a role in identifying and referring patients who would benefit from a consultation with a specialist in genetics. This study aims to assess doctors' referral rates, knowledge and attitudes towards cancer genetic testing, broken down by specialty (gastrointestinal, breast/ovarian, other specialties and General Practitioners-GPs). A 4-page questionnaire was mailed out to the GPs of all patients seen in 2012 in the Hereditary Cancer Clinic of St. Vincent's Hospital Sydney (n = 128) and all the specialists in St. Vincent's Hospital Sydney that might refer to the HCC (n = 33). 50 questionnaires were returned (31 %). Most doctors had referred a patient for cancer genetic testing (90 %). The average proportion of patients referred was 1 in 68.5 patients with breast/ovarian specialists referring the most, followed by gastrointestinal specialists and GPs. There was suboptimal knowledge of cancer genetic testing amongst doctors. Breast/ovarian specialists were most knowledgeable, followed by gastrointestinal specialists, other specialists and GPs. There were indications of inappropriate referral amongst doctors. Most (77.6 %) doctors were willing to receive further information on cancer genetics. Nearly all (94 %) doctors believe that it is their duty to inform an individual at high risk for hereditary cancer that cancer genetic counselling and testing is available. The majority of doctors have positive attitudes towards cancer genetic testing. Defective knowledge scores, however, indicate that doctors need further training or tools to enable them to refer patients appropriately for cancer genetic testing.

Wakefield, C. E., et al. (2008). "A randomized trial of a breast/ovarian cancer genetic testing decision aid used as a communication aid during genetic counseling." Psychooncology **17**(8): 844-854.

OBJECTIVES: To evaluate the impact of a decision aid for women considering genetic testing for breast/ovarian cancer risk given during genetic counseling. METHODS: One hundred and forty-eight women were randomized to receive the decision aid or a control pamphlet at the beginning of their first consultation with a genetic counselor. When the patient received the decision aid, it was used to complement consultation discussions about genetic testing. One hundred and ten (74.3%) women completed the first questionnaire designed to elicit information about women's levels of decisional conflict and knowledge about genetic testing. Of these, 105 (70.9%) completed a second questionnaire to assess longer-term outcomes, 6 months postconsultation. RESULTS: Results showed that women who received the decision aid felt more informed about genetic testing (chi (2) (1)=8.69; P=0.003), had clearer values (chi (2) (1)=6.90; P=0.009) and had higher knowledge levels (chi (2) (2)=6.49; P=0.039) than women who received the control pamphlet. CONCLUSIONS: The developed decision aid improved patient outcomes better than a control pamphlet when implemented during genetic counseling and given to the patient to take home.

The above contents are the collected information from Internet and public resources to offer to the people for the convenient reading and information disseminating and sharing.

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