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LETTER TO THE EDITOR

The evolution of personalized cancer genetic counseling in the era of personalized medicine

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Abstract Practice changes in cancer genetic counseling have occurred to meet the demand for cancer genetic services. As cancer genetics continues to impact not only prevention strategies but also treatment decisions, current cancer genetic counseling models will need to be tailored to accommodate emerging clinical indications. These clinical indications include: surgical prophylactic bilateral mastectomy candidates, PARP-inhibitor candidates, patients with abnormal tumor screening results for Lynch syndrome, and post-test counseling patients (after genetic testing is ordered by another healthcare provider). A more personalized, multidisciplinary approach to selecting the best framework, for a given clinical indication, may become increasingly necessary in this era of personalized medicine.

Keywords Cancer genetics · Personalized medicine · Treatment based genetic counseling · Genetic counseling models

The traditional model for cancer genetic services has been set forth by the National Society of Genetic Counselors [1, 2]. Essential elements of an initial cancer genetics consultation include: personal and family medical history, psychosocial assessment, risk assessment, pretest counseling, and informed consent for genetic testing. The traditional multistep process, also known as the three visit model, includes the initial cancer risk assessment, predisclosure and blood draw, and a results disclosure.

There is evidence, however, that the traditional model of cancer genetic counseling is evolving [3, 4]. Practice changes have occurred to better adapt to patient medical needs. For example, Wham et al. [4] surveyed cancer genetic counselor practices through the NSGC Familial Cancer Risk Counseling Special Interest Group and reported results on parameters including the number of sessions, the mode of delivery, documentation, and results disclosure. A total of 161 members of the National Society of Genetic Counselors Cancer Special Interest Group responded to the survey, yielding an overall response rate of 29.4 %. Survey results demonstrated that although professional guidelines currently propose a 3 visit model, 29.3 % of respondents use a 1 visit model. In the 1 visit model, the sample is drawn in the first visit and phone disclosure replaces the third visit, which requires two fewer in-person visits for the patient. This study revealed that 56 % of genetic counselors felt that 30–60 min is sufficient to cover the material needed as opposed to the traditional 90 min for the initial session.

These practice changes may be due to market forces such as direct-to-consumer/physician marketing, the information age, and shift in medicine toward patient autonomy [5, 6]. Patients are presenting to their cancer genetic counseling appointment with a higher baseline level of knowledge and increased desire to seek genetic information [7]. Therefore, genetic counselors may need to spend less time on educating with patient with factual information, which may enable them to see a larger volume of patients. In addition, a recent study highlighted that non-genetic health care providers may not offer appropriate

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testing strategies increasing the cost of genetic testing and subsequent management of these patients [8]. Therefore, there is an immediate need to increase visibility and access to genetic providers to ensure appropriate testing and contain costs in the current healthcare system.

Alternate service delivery models have also been employed to accommodate increased demand to services and more convenient access to genetic counselors. An Alternative Service Delivery Taskforce through National Society of Genetic Counselors is working toward defining and characterizing current service delivery models, including telegenetic and telephone genetic counseling. In particular, they are increasingly being employed as a means to accommodate patients who live a sizable distance from their respective providers. For example, both telephone counseling as well as video teleconferencing (telemedicine) have been shown to be a feasible alternative to face to face counseling [9, 10]. Data from telephone genetic counseling studies show similar effects to in person counseling including accurate risk perception and patient satisfaction [11, 12]. Studies examining the use of telegenetics for cancer genetic counseling have been shown to be feasible both in a satellite office as well as in a patients' home [13–16].

Based on the evidenced presented, it is readily apparent that cancer genetic counseling has begun to adapt to the current needs of patients. Previously, cancer susceptibility testing was predictive in nature and used to educate patients about future cancers. [17]. Genetic testing is only expected to increase as new genomic advances are designed to enhance personalized cancer treatment and prevention [18]. Consequently, cancer genetic counseling may need to evolve even further in this age of personalized medicine to accommodate timely decision-making impacting patient's ongoing medical care.

Personalized medicine is by definition a form of medicine that uses information about a person's genes, proteins, and environment to prevent, diagnose, and treat disease (NCI). Similar to how personalized medicine uses the patient's unique genetic make-up to deliver the right therapy to the right patient, genetic counseling in cancer may need to be tailored according to indications for referral, thereby delivering the appropriate form of genetic counseling to the right patient at the right time.

An example of using BRCA test results to guide management is in the setting of newly diagnosed breast cancer patients who have the opportunity to receive genetic information prior to making a definitive surgical decision. Also, treating oncologists may use cancer genetic test results to guide treatment decisions for targeted therapy such as PARP-inhibitors. Such advances in breast cancer treatment and prevention have paved the way for treatment based genetic counseling [19]. Effectively, this shift in the use of cancer genetic information may necessitate genetic counseling sessions to become more context-focused to more effectively meet patient's medical management needs.

The goal of this paper is to re-examine the existing framework and counseling delivery methods to accommodate the needs of patients and providers. To illustrate, a sampling of emerging clinical indications are presented and critically evaluated including: treatment based genetic counseling (i.e., surgical decision making and targeted therapy in BRCA carriers) as well as other emerging clinical indications (i.e., population level tumor screening for Lynch syndrome and post-test counseling wherein genetic testing results have already been received.

Treatment based genetic counseling

Surgical Decision Making: This emerging clinical indication is most prevalent in the BRCA setting in which recently diagnosed breast cancer patients are being offered BRCA testing to decide whether or not to pursue prophylactic bilateral mastectomy (PBM). Data from a recent study shows approximately 48 % of patients who carry a *BRCA1/2* mutation chose bilateral mastectomy as their definitive surgery. In contrast, 24 % of patients with no mutation detected opted for bilateral mastectomy [20].

From a logistical standpoint, timing of genetic counseling may need to be adjusted for patients that are making medical decisions that impact surgical management. These patients will need expedited genetic counseling appointments. Genetic counselors can accommodate these timely decisions. Data from a recent study show that 41.8 % of cancer genetic counselors can see patients within a week [4]. Further, if pre-test and post-test genetic counseling is performed, patients are not adversely affected by this information, given the vulnerability of patient at the time of diagnosis [20]. However, it is clear from studies regarding surgical decision-making that more psychological support is often necessary. In one study, the majority of women who had undergone or considering prophylactic mastectomy felt that psychotherapeutic consultation would be valuable in both decision-making and post-surgical adaptation [21]. Therefore, inclusion of a clinical psychologist or trained social worker need to be considered as part of the genetic counseling process. Also, it may be useful for the genetic counselor to have more intensive training in identifying red flags that would constitute the need for more immediate referral to these services before genetic testing is made available. The red flags can include but not limited to depression, anxiety, misunderstanding of risk reduction attributed to prophylactic mastectomy such as the difference between local and systemic control [22].

Certain institutions have established protocols for those who plan to undergo prophylactic mastectomy based on genetic test results or significant family history of breast cancer. However, no standardized protocols have been established. Ideally, the genetic counselor would work in collaboration with the psychologist as well as the breast surgeon (who is often the referring physician). Inclusion of the breast surgeon's perspective prior to the appointment can be an integral part of the genetic counseling process and clarify medical management issues before adding genetic test results to the decision making process. Decision points need to be addressed in addition to traditional counseling such as timing of genetic testing and its possible impact on surgical management as well as radiation therapy decisions [23–25]. The surgical community has offered algorithms that include the benefits of bilateral mastectomy in patients with and without a *BRCA* mutation [23]. These algorithms include genetic counseling after a new diagnosis of breast cancer regarding how genetic testing can impact surgical management but also recognizing that deviations can occur based on an individual's distress surrounding the diagnosis. Involvement of the breast surgeon either by phone or in person depending on surgeon availability can be useful to determine the need for intensive psychological support during the actual genetic counseling session. As Silva outlines in his proposed algorithm, a multidisciplinary, collaborative form of genetic counseling will need to be adopted. Other healthcare providers including surgeons, primary care specialists, and medical oncologists are also increasingly involved with some aspect of genetic counseling or testing, as supported by their professional guidelines [26, 27]. However, the genetics community will need to incorporate data from multicenter randomized clinical trials regarding psychosocial and behavioral outcomes of rapid genetic testing before formal implementation of these proposed algorithms [28].

Incorporation of decision aids have demonstrated utility as an adjunct to genetic counseling in the setting of surgical decision making [29–31]. Wakefield and colleagues conducted a randomized trial using in depth booklet 40 page booklet that discussed the psychological implications of genetic testing for *BRCA1/2* that could be reviewed at home prior to the genetic counseling appointment. Patients who had the decision aid felt more informed about genetic testing, had clearer values, and had higher knowledge levels compared to women who received the control pamphlet [31]. Web-based decision aids have also been developed specifically for BRCA carriers to help them make timely surgical decisions [32]. Collectively, these data highlight the importance of a multidisciplinary approach to PBM indications for cancer genetic counseling and the value of psychological support, involvement of the breast surgeon, and the use of adjunct decision aids. The list of clinical indications for treatment based genetic counseling and the corresponding tailored genetic counseling approach are described in Table 1.

Targeted Therapy: Another form of treatment based genetic counseling is the use of Poly (adenosine diphosphate-ribose) polymerase (PARP) inhibitors for targeted therapy for breast cancer [33, 34]. PARP inhibitors can be used in patients with germ-line *BRCA* mutations as targeted therapy [35]. The mechanism of PARP inhibitors relies on the fact that, in *BRCA* germ-line mutation carriers, when the second allele is lost, it inhibits the cancer cell's ability to repair double stranded breaks through homologous recombination. Therefore, by default, it relies on the base excision repair requiring PARP. By inhibiting PARP, *BRCA*-associated cancer cells only are targeted during therapy for breast and ovarian cancer [36]. PARP inhibitors have been promising based on data from phase I,II trials with a 40 % objective response rate as single agents in *BRCA*-associated breast and ovarian cancers with acceptable toxicity [35, 37]. Recent data from phase III trials in the setting of triple negative breast cancer have not been as promising [38]. Therefore, future studies are needed to address the use of PARP inhibitors for treatment of BRCA-associated cancers.

Triple negative phenotype (estrogen receptor negative (ER-)/progesterone receptor negative (PR-)/Her2neu-) for breast cancer has been associated with *BRCA* mutation status, especially with *BRCA1* mutations [39, 40]. Since a significant proportion of triple negative breast cancers have been shown to be caused by a *BRCA* mutation, the current NCCN guidelines (v.2011) now list triple negative breast cancer less than age 60 as an indication for genetic testing for *BRCA1/2*.

Therefore, a tailored counseling approach to triple negative breast cancer is now a necessity for cancer genetic practice as it is a frequent reason for referral. A possible approach could be an abbreviated initial counseling session and the genetic counselor serves as a liaison between the treating oncologist and patient to provide a more thorough post-test counseling. More correspondence with the treating physician is necessary than in the typical referral situation. Use of alternative service delivery models, such as phone or web-based counseling, may be a feasible approach for triple negative breast cancer/PARP inhibitor candidates. This approach can bring together the multidisciplinary team of professionals as well as the patient (Table 1).

Emerging clinical indications

Population Screening for Colon and Endometrial Cancers for Lynch Syndrome: Microsatellite instability (MSI) and

Table 1 Treatment focused genetic counseling indications

Clinical Indication	Factor(s) necessitating change	GC role/HCP role	GC Method	GC Service delivery
Prophylactic mastectomy	Personalized medicine and targeted therapy	GC liaison between patient and treating med oncologist	Targeted pre-test counseling session and thorough post test counseling (with medical oncologist input)	In person, phone, web-based
PARP-Inhibitor/ Triple negative breast cancer	Patient awareness and advocacy; Direct to physician marketing of genetic based tests	GC liaison between patient and breast surgeon	Extensive pre-test counseling (ideally with psychologist/social work consultation) and post test counseling	In person with decision aid adjuncts

immunohistochemistry (IHC) testing for all colon and endometrial cancer has emerged to better identify families at risk for Lynch syndrome [41–44]. Hampel et al. [45] proposed routine screening of all colorectal cancers due to inability of current clinical criteria to capture all potential Lynch syndrome cases and at risk family members. It has been implemented in many academic and community hospitals. This MSI/IHC screening test is being done without formal pre-test genetic counseling similar to first and second trimester prenatal screening and newborn screening. Therefore, this model is not new in the realm of genetic counseling. If there is an abnormal result, then a formal genetic consultation is advisable.

MSI/IHC screening is increasingly ordered by a colorectal surgeon or medical oncologist and automatically performed through an in-house or contracted laboratory. Studies have also suggested MSI/IHC be performed on all colorectal tumors to determine prognosis and response to fluorouracil based therapy [46]. As treatment decisions may be impacted, this testing may become more routine in clinical practice. The current process could benefit from utilizing alternative media adjuncts to supplement clinical encounters, such as standardized written materials, websites, or interactive CD ROM to replace formal pre-test counseling and enhance post-test counseling. CD-ROM's has been successfully used in clinical trials compared to usual care and has been shown to be effective at increasing knowledge as well as decreasing anxiety when used to help educate patients for MSI/IHC testing [47]. These non-traditional means may become more important as serving as adjuncts to clinical care so patients have some context with which to provide informed consent for MSI/IHC testing as outlined in Table 2. These tools can also help prepare the patient for the implications of an abnormal screening result and follow-up genetic counseling.

Post-test Counseling Using a Collaborative Triage Method: The final clinical indication which is becoming more common is post test counseling for hereditary breast ovarian cancer and Lynch syndromes, which has also been termed "rescue" counseling. These referrals are, in part, due to direct to consumer web based testing and physicians performing testing independently [48–50]. Therefore, a collaborative approach may be more fitting in these cases such that physicians who are doing their own testing still maintain a relationship with a genetic counselor. This approach allows for more effective triage of difficult cases that are more well suited for a genetics professional [51] (Table 2).

Using a collaborative approach to triaging is critical so that patients are not arriving to their post- test or rescue genetic counseling appointment with undue distress, which requires more intensive psychological intervention [51]. This triaging would require more careful evaluation of the needs of different providers, especially primary care providers, who will be the likely gatekeepers of genetic information. Studies have shown that risk assessment and

Table 2 Other emerging genetic counseling indications

Clinical Indication	Factor(s) necessitating change	GC role/HCP role	GC Method	GC Service delivery
Abnormal MSI/IHC results	Population screening efforts Prognostic information/ treatment decisions	Ordering MD: surgeon/med oncologist; GC referred only abnormal results and/or suggestive family history	Similar to abnormal prenatal screening results with initial counseling by MD/ staff followed by extensive post-test counseling/follow-up by GC	In person or phone (alternate media strategies for pre-test counseling)
Post-test BRCA and Lynch syndrome testing	Patient awareness and advocacy; Direct to physician marketing of genetic based tests	GC establishing collaborative approach for triaging difficult cases	Extensive post-test counseling largely dependent on test result and interpretation (psychologist/social work consultation as needed)	In person

referral patterns providers may be different depending of the comfort level of the testing provider [52]. Therefore this variations need to be accounted for to make for an effective collaborative triaging approach.

The collaborative approach to post test counseling cases, may involve more emphasis on psychological measures by the genetic counselor, depending upon the context with which the genetic test results were disclosed. Hence, use of a psychological professional may be required to address psychosocial issues in addition to medical implications for the patient and family members. In addition, these sessions will tend to focus on clarification of the patient's risk level based on the genetic test result so patients are making medical decisions that are reflective of their true level of risk, thereby containing healthcare costs [8]. At the present time, data from Plon et al. reveal that physicians recommended more intensive screening for women with a variant of uncertain significance compared to a similar family without testing, which could increase healthcare costs unnecessarily. It will be increasingly important in this era of healthcare reform to utilize the collaborative approach to cancer genetic testing to better accommodate the demand for cancer genetic services in a more systematic, cost-effective manner.

In summary, it is evident that one size does not fit all. Cancer genetic counseling models may have to change to a more personalized, context specific approach, utilizing alternate service delivery models as needed. Although it may be unrealistic to characterize every situation, a library of key paradigms may be a useful reference for genetic counselors, as well as other health care providers, that may be involved in counseling. Once these paradigms are established, successful ways of triaging these indications to an appropriate, evidence-based genetic counseling service delivery model becomes ever more important. In the same light that oncology nurses can serve as patient navigators guiding the patient through their cancer journey, there may be a critical need for research in genetic counseling "navigation" to assess which genetic counseling delivery model is most appropriate for a given clinical situation, and which providers need to be involved in the counseling process as genetic permeates into mainstream medicine. At that end, a more personalized approach to cancer genetic counseling may emerge that has increasing application in this era of personalized medicine.

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