Medical Genetic Counseling for Breast Cancer in Primary Care: A Synthesis of Major Determinants of Physicians' Practices in Primary Care Settings

Jalila Jbilou^{a,b} Norrin Halilem^c Jolyane Blouin-Bougie^c Nabil Amara^c
Réjean Landry^c Jacques Simard^d

^aCentre de formation médicale du Nouveau-Brunswick, ^bSchool of Psychology, Université de Moncton, Moncton, N.B., and ^cDepartment of Management and ^dCancer Genomics Laboratory, Department of Molecular Medicine, Laval University, Quebec, Qué., Canada

Key Words

Breast cancer · Genetic risk communication · Genetic risk prediction · Medical behavior · Medical genetic counseling · Primary care · Scoping review

Abstract

Objectives: This paper aims to identify relevant potential predictors of medical genetic counseling for breast cancer (MGC-BC) in primary care and to develop a comprehensive questionnaire to study MGC-BC. **Methods:** A scoping review was conducted to identify the predictors of MGC-BC among primary care physicians. Relevant articles were identified in selected databases (PubMed, Embase, CINAHL, ISI Web of Science, PsycINFO, and Cochrane CENTRAL) and 4 selected relevant electronic journals. **Results:** An inductive analysis of the 193 quantitatively tested variables, conducted by 3 researchers, showed that 6 conceptual categories of determinants, namely (1) demographic, (2) organizational, (3) experiential, (4) professional, (5) psychological, and (6) cognitive, influence MGC-BC practices. **Conclusion:** There is a scarcity of literature addressing the medical behavior determinants of MGC-BC. Future research is needed to identify effective strategies put into action to support the integration of MGC-

BC in primary care medical practices and routines. However, our results shed light on 2 levels of actions that could improve genetic counseling services in primary care: (1) medical training and educational efforts emphasizing family history collection (individual level), and (2) clarification of roles and responsibilities in ordering and referral practices in genetic counseling and genetic testing for better healthcare management (organizational level).

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Introduction

Breast cancer is the most frequently diagnosed cancer among women (23% of all cancers) and the leading cause of cancer mortality among women worldwide [1]. A woman in the developed world has a lifetime risk of developing breast cancer of approximately 9–11% [2]. The estimated global economic burden of new breast cancer cases in 2009 was USD 28 billion, representing associated medical costs as the largest fraction (46%), followed by productivity losses (27%), and non-medical service costs (27%) [3]. Genetic research identified pathogenic mutations in *BRCA1* and *BRCA2* genes in 5–10% of hereditary

breast cancer, and recent genetic discoveries showed more susceptible genes including *TP53* mutations in Li-Fraumeni syndrome, *STK11* mutations in Peutz-Jeghers syndrome, and *PTEN* mutations in Cowden syndrome [4]. Thus, an important proportion of the social and economic burden arising from breast cancer can be reduced and limited by implementing effective evidence-based strategies such as genetic counseling, risk management and surveillance, and early-stage tumor detection and management targeting women at moderate or high risk for breast cancer [5–7].

However, despite major advances in understanding the familial and hereditary risk factors for breast cancer development [8–10] and their translation into more accurate screening as well as preventive and therapeutic health interventions [11], there is still a need for integrating genetic services into medical practices [12], and more generally, into any context where the genetic counseling process is a critical component [13–15]. Indeed, the genetic counseling process includes effective assessment and communication of individual genetic risks as well as surveillance of at-risk patients. Thus, genetic counseling not only favors the detection of breast cancer at early stages, thus improving prognosis and survival and reducing mortality as well as the economic and social burden associated with breast cancer [6], but also fosters optimal treatment, surgery, and clinical follow-up for newly diagnosed breast cancer patients [16].

According to O'Daniel [17], genetic counseling for breast cancer is a combination of 2 clinical approaches: the risk prediction (RP) [18, 19] and the risk communication (RC) [20, 21]. This paper will consider genetic counseling for breast cancer exclusively from the point of view of medical doctors, thus referring to it as medical genetic counseling for breast cancer (MGC-BC) to differentiate it from genetic counseling provided by genetic counselors. We support that for an effective genetic counseling both healthcare providers (medical doctors and genetic counselors) have to be involved in an interdisciplinary collaboration. However, for the purpose of this paper, we will explore exclusively studies related to medical doctors. The MGC-BC process can be defined as a complex process [14, 22] that includes collecting and interpreting the familial and individual medical history to identify subjects at risk for hereditary breast cancer [13], ordering cancer susceptibility genetic tests or referring patients to other providers of these tests [23], providing risk information and risk management options [11], and facilitating informed decisions and adaptation to personal risk by increasing personal control and minimizing psychological distress [24].

Systematic reviews on genetic counseling have extensively studied the patient's perspective and have shown the impact of the physician's clinical behaviors on patient outcomes such as cognitive aspects (risk understanding and interpretation) and clinical decisions (testing, genetic service utilization, and treatment compliance) [11, 14, 25–27]. However, fewer studies have explored the MGC-BC process from the medical point of view. Therefore, knowledge about effective strategies for physicians to improve the effectiveness of the MGC-BC process is rather limited. Thus, we have performed a scoping review to identify factors (facilitators and barriers), shown as having a significant impact on MGC-BC performance among medical doctors, in order to derive evidence-based recommendations that may help research and decision making to support more effective MGC-BC practices in primary care and to develop a comprehensive framework and a questionnaire to be used in future research on MGC-BC.

Methods

Data Collection

A scoping review of counselor-based literature on RP and RC in breast cancer genetic counseling was conducted to identify major steps of these processes as well as their determinants.

Our approach followed established methods for a scoping literature review [28] and was based upon 5 stages: identifying the research question, identifying relevant studies, selecting studies, charting the data, and collecting, summarizing, and reporting the results. Our research question was: Which are the factors that impact on the use of RP models and RC strategies among medical doctors? To answer this question, we built a selection strategy for identifying relevant studies. Only papers using a quantitative design and published in health sciences were considered. We did not include qualitative studies, since they may affect the generalizability of our results.

Our search strategy involved 4 separate search activities, namely (1) a search for the most relevant keywords, (2) a search for reference lists from literature reviews and systematic reviews on the topic to assess the amount of relevant publications on the topic and evaluate the relevance of our study, (3) an electronic database search, and (4) a hand search in selected electronic journals. A specialist librarian developed a search strategy and was given a list of keywords proposed by the researchers. Relevant databases (table 1) were searched for published articles using MeSH and free text keywords in various combinations using the Boolean operators 'AND' and 'OR' (online suppl. table 1; for online suppl. material, see www.karger.com/doi/10.1159/000362358).

Next, we performed a systematic hand search of all issues of selected electronic relevant journals in the domain of genetic counseling, namely *Medical Genetics*, *Journal of Genetic Counseling*, *American Journal of Preventive Medicine*, *Preventive Medicine*, and *American Journal of Medical Genetics Part A*, *Part B*, and *Part C*. We also performed a systematic hand search in the reference list

Fig. 1. Flow diagram.

Table 1. List of electronic databases used in this study

Database	URL
PubMed	http://www.ncbi.nlm.nih.gov/pubmed/
Embase	http://www.embase.com
CINAHL	http://web.ebscohost.com
PsycINFO	http://psycnet.apa.org
Cochrane CENTRAL	http://www3.interscience.wiley.com/cgi-bin/mrwhome/106568753/HOME
Web of Knowledge (SCI/SSCI)	http://apps.isiknowledge.com

of each selected article to identify additional relevant articles that had not been identified via the electronic search strategy.

Because of the scarcity of literature on familial breast cancer, we extended our research to other cancers and other genetic diseases to capture all predictors and propose recommendations for practice and research. No time period restriction had been imposed for identifying relevant articles. We invited an advisory committee of researchers and clinicians for a 1-day meeting. Based on the research objective, they had to identify eligibility (inclusion and exclusion) criteria to be applied to determine which studies should be considered for inclusion within the review. Indeed, they are fundamental to collecting a rigorous set of data. Thus, for the scoping review, articles were selected based on the inclusion and exclusion criteria presented in table 2.

The articles retrieved were exported to the EndNote X2 program. We built an Excel information extraction form to (1) compile concepts and measures used to study determinants of RP and RC among physicians and (2) present descriptive statistics on studies retrieved for the scoping review.

Table 2. Inclusion and exclusion criteria

Inclusion criteria	Method: empirical work using a quantitative design (randomized clinical trials, cohort studies, and cross-sectional studies) Topic: description of genetic risk prediction model(s) and communication strategies Variables: factors facilitating or inhibiting genetic risk prediction or communication Population under study: health professional(s), medical doctor(s) Language: English
Exclusion criteria	Type of publication: grey literature (book, thesis, book review, editorial, comment, expert opinion, etc.) Method: qualitative design Topic: comparison of efficacy of predictive tools, approaches or practices; environmental risk(s); population risk(s) (public health, environmental health, etc.) Population: patients or general population

Data Analysis

Data from all extracted papers were read and analyzed at each step by 2 independent researchers, and the results were validated by the research team coordinator (fig. 1). An inter-coder reliability score was calculated at each step. The most often used approach is to randomly select 10% of the articles and have them analyzed separately by 2 independent researchers, followed by evaluation of the consistency index [29, 30]. As pointed out by some authors, Cohen's kappa is the measure of choice for intercoder agreement [30–33]. As widely used in this type of study, data interpretation was carried out using Landis and Koch's categorization and refer-

ence kappa statistic strength of agreement as follows: <0% as poor, 0.1–20% as slight, 21–40% as fair, 41–60% as moderate, 61–80% as substantial, and 81–100% as almost perfect [34]. We established the acceptable score at 70% which has been shown to be the most appropriate in exploratory studies [35].

The information extracted included the population under study (medical doctors), study design (objectives, methodology, data collection, and analysis), health topic(s) (breast cancer, other cancers, and other genetic diseases), dependent variables (RP, RC, or both) and independent variables (facilitators and barriers), including their conceptual and operational definitions. Quantitative descriptive analysis and qualitative content analysis were then performed. Content analysis was employed to examine the determinants of medical behaviors. This method of analysis was selected as a helpful means through which our large data set could be systematically scrutinized and categorized according to the theoretical articulation based on the social cognitive theories [36] and the value creation framework as applied to knowledge [37]. This theoretical articulation was used to code the findings and to structure the classification and the abstraction of the identified physician-associated factors in a 2-step conceptual analysis: (1) a conceptual categorization and (2) a conceptual abstraction. At first, we established the existence and frequency of variables (determinants) used in the econometric models of each included study. Thus, we were able to determine how many times each determinant was included in an econometric model and to categorize the effect it had on the dependent variable RP/RC (the direction of the effect). Secondly, we grouped the identified determinants in conceptual categories according to the theoretical articulation to propose recommendations for practice and research.

Results

This scoping review aimed to identify predictors of MGC-BC that may help provide recommendations for practice and research. Of the 147 retrieved articles, 31 studies, focused on health professional clinical behavior and using a quantitative methodology design, were selected.

Descriptive Analysis Results

The 31 selected studies were published between 1992 and 2010, with a median in 2006 (table 3). Studies were predominantly conducted in the United States (61%), the United Kingdom (10%), and the Netherlands (10%). Other countries represented were Australia, Canada, France, Mexico, and Switzerland. The populations were studied according to 2 perspectives: a unique specialty perspective [29% of the studies adopted a specific health professional (e.g. general practitioner) perspective], and a multi-specialty perspective (61% adopted a comprehensive perspective, exploring multiple categories of health professionals). The number of participants ranged

from 75 [18] to 1,795 [38], with a mean of 588 participants. Authors explored genetic RP through 2 perspectives: (a) ordering for a genetic test and (b) referral for genetic testing with/without genetic counseling. However, genetic risk assessment based on family and individual history was always included as part of the initial assessment of patient risk level categorization. In general, studies did not provide any information on the prediction model used by the medical doctor to assess the patient's level of risk [e.g. Manchester Scoring System, Breast and Ovarian Analysis of Disease Incidence and Carrier Estimation Algorithm (BOADICEA) model, Gail model]. Indeed, we extracted information on factors that might impact on the referral or prescription of genetic testing with the underlying assumption that medical doctors always collect and interpret family history to clinically assess the genetic risk before deciding on the relevance of ordering genetic tests.

Our findings showed that only 6 among the 31 selected articles (19%) explored MGC-BC as a specific target, and 10 of the 31 articles (31%) integrated MGC-BC with other health topics, i.e. ovarian cancer, prostate cancer, etc. About 50% of the selected articles explored other types of cancers (e.g. colorectal cancer) or diseases (e.g. Huntington disease).

Studies explored genetic RP and RC as a comprehensive process in only 30% of the articles. Most articles analyzed the RC process to study the skills and abilities of medical doctors to communicate with their patients. The major interest behind most of these studies was to further investigate the patient-oriented approach and the shared decision-making process. Articles that analyzed RP mostly focused on the compliance of medical doctors with guidelines from genetic counseling professionals and the actual relevance of genetic referrals. The categories of health professionals were addressed as follows: 11 articles (38%) explored the clinical behaviors of primary care physicians exclusively, 15 articles considered multiple clinical specialties, and 4 articles included only specialists. However, it must be pointed out that there is no widely accepted definition of primary care physicians among the different studies, especially in the US where this term may include family physicians, internists, obstetricians, and pediatricians. European studies define primary care physicians more consistently as including family doctors and general practitioners (GPs) only.

Table 3. Characteristics of the studies included in this review

Study	Principal aim	Country	Dependent variable			Health topic	Participants, n (specialties)	Response rate, %
			RC	RP	Ordering			
[18]	To identify reasons for referring for reproductive genetic counseling during pregnancy	Netherlands				X	75 (general practitioners)	87
[19]	To investigate physicians' experience ordering or referring patients for genetic tests and the utilization of available genetic tests for minority patients	United States		X		X	945 (primary specialty of internal medicine, family practice, or general practice)	62.3
[20]	To assess facilitators and barriers of prostate cancer screening	United States	X	X		X	99 (primary care physicians)	47
[21]	To investigate attitudes of general practitioners related to prenatal genetic services	United Kingdom	X				397 (general practitioners)	62
[22]	To determine the use of cancer susceptibility testing and physician characteristics associated with it	United States	X	X			1,251 (family practitioners, general practitioners, obstetricians/gynecologists, internists, gastroenterologists, general surgeons, oncologists, urologists)	71
[38]	To explore the opinions of physicians regarding the offering of cystic fibrosis carrier testing under different circumstances; to identify factors that distinguished those who favored testing from those who opposed it for each set of circumstances	United States	X				1,795 (primary care physicians and medical geneticists, and genetic counselors)	85
[43]	To assess factors related to the performance of breast cancer risk reduction practices and barriers to practices	United States	X	X			822 (primary care physicians such as family medicine, internal medicine, and obstetrics/gynecology)	50
[44]	To investigate attitudes of general practitioners and community health services workers related to routinely offering preconceptional cystic fibrosis carrier screening	Netherlands				X	215 (primary care providers, such as general practitioners and community health services)	65
[45]	To investigate knowledge, attitudes, personal role in pre- and post-DNA testing for Huntington disease	Netherlands		X			626 (general practitioners)	62
[46]	To explore general practitioners' attitudes and perceived ability to deliver genetics services for common disorders in routine primary care	United Kingdom	X	X			797 (general practitioners for disorders such as cancer, cardiovascular disease, diabetes, renal disease, and osteoporosis)	24.8
[47]	To determine whether self-reported motivations for ordering a Factor V Leiden genetic test differed among groups of primary care physicians	United States		X			170 (primary care physicians: internal medicine, family medicine, and obstetrics/gynecology and gerontology/geriatrics)	67
[49]	To gather information about cancer screening beliefs and behaviors among primary care physicians	United States		X			89 (physicians in internal medicine, family medicine, occupational medicine, and obstetrics/gynecology)	65
[50]	To identify barriers of breast cancer screening for women with disabilities	France		X		X	600 (general practitioners)	55.8
[51]	To assess the influence of attitude, personal screening behavior of female physicians, and other factors on screening	Switzerland	X	X			767 (general practitioners, internists and obstetricians/gynecologists)	58 for women, 46 for men
[52]	To determine physicians' awareness, use, and satisfaction with the Ministry of Health and Long-Term Care	Canada				X	1,427 (family physicians, gynecologists, oncologists (radiation, surgical, and medical), gastroenterologists and general surgeons)	49

Table 3 (continued)

Study	Principal aim	Country	Dependent variable			Health topic	Participants, n (specialties)	Response rate, %
			RC	RP	Refer- ring			
[53]	To identify colorectal cancer screening practices of the primary care provider; to identify determinants of colorectal cancer screening test that could increase screening rates	United States		X		Colorectal cancer	840 (primary care physicians)	67
[54]	To identify characteristics of patients least likely to have their family history recorded	Australia			X	Colorectal cancer	(geneticists, genetic counselors, gastroenterologists and surgeons: records of 113 patients)	not reported
[55]	To identify characteristics of physicians, patients, and visits associated with obtaining family history information	United States	X			Inherited health problems	138 (family physicians, community family physicians)	89
[56]	To identify patterns of links between communication and social factors	Mexico	X			Chronic diseases	371 (clinical specialties such as oncology, internal medicine, rheumatology, infectious diseases, gynecology, pediatrics, hematology, cardiology, intensive care, gastroenterology, neurology, and surgical specialties such as general surgeons, neurosurgeons, and clinicians enrolled in graduate programs, such as master's or doctoral degrees in biomedical sciences)	not reported
[57]	To explore general practitioners' understanding of genetic risk and decision to refer	United Kingdom		X		Genetic disorder	541 (general practitioners)	50.5
[58]	To determine physicians' standard-of-care for discussing colon cancer screening	United States	X			Colorectal cancer	270 (primary care physicians)	57.9
[59]	To develop an improved measure of tolerance for ambiguity; to determine its psychometric properties; to assess its relationship to physicians' demographic characteristics, their training, and several behavioral correlates of ambiguity tolerance including religiosity and medical specialty	United States	X			Cystic fibrosis	1,140 (primary care physicians such as family physicians, internists, obstetricians, pediatricians, and psychiatrists and medical geneticists)	65 (primary care physicians), 79 (medical geneticists)
[61]	To explore physicians' attitudes toward genetic testing for cancer susceptibility	United States	X	X		Numerous cancer susceptibilities	1,251 (primary care physician specialties of family practice, general practice, general internal medicine, and obstetrics/gynecology and the specialties of oncology, general surgery, or gastroenterology)	71
[62]	To understand how physicians implement genetic testing and see recommendations when dealing with positive results	United States	X			BRCA1/2 genetic testing	611 (medical oncologists, surgeons, geneticists, gynecologists/obstetricians, primary care physicians and physicians of other specialties)	58.2
[63]	To identify physicians' attitudes and practice patterns regarding family history, genetic testing, and counseling	United States	X		X	Genetic testing for cancer susceptibility	254 (general practitioners, internists, and obstetricians – gynecologists)	22.1
[64]	To understand how physicians tailor their recommendations for breast cancer prevention and risk reduction to the characteristics of individual women	United States	X			Breast cancer	822 (family medicine, internal medicine, and obstetrics/gynecology)	49.9
[65]	To explore cancer risk assessment in a primary care setting	United States	X			Common cancers	(family physicians: 734 charts audited)	not applied

Table 3 (continued)

Study	Principal aim	Country	Dependent variable			Health topic	Participants, n (specialties)	Response rate, %
			RC	RP	Ordering			
[66]	To assess factors associated with cancer susceptibility testing in primary care physicians	United States	X	X		Common cancer	475 (primary care physicians)	65
[67]	To gather information about practices and attitudes to presymptomatic and predictive genetic testing in minors	European countries	X	X		Alzheimer's disease (<i>ApoE4</i>), breast cancer (<i>BRCA 1/2</i>), or Charcot-Marie-Tooth disease	177 (clinical geneticists)	63
[70]	To describe the cancer genetic risk assessment and referral practices of primary care physicians	United States			X	Common cancers	860 (primary care physicians, such as family medicine, internal medicine, and obstetrics/gynecology)	3.5
[71]	To identify variables associated with physicians' compliance with screening guidelines for women aged 50–75 years	United States		X		Breast cancer	116 (primary care internists, family or general practitioners, and gynecologists)	61
[77]	To identify interurban variations in colorectal cancer screening practices among primary care physicians	United States		X		Colorectal cancer	264 (primary care physicians)	48.6

MGC-BC Predictors

Due to the small number of studies on breast cancer, we decided to integrate the results generated from all 31 selected articles in our analysis. Thus, an inductive analysis of the 193 variables that were quantitatively tested to predict clinical behaviors in medical genetic counseling led to the identification of 6 major conceptual categories of determinants (table 4, fig. 2) having an impact on the performance of medical genetic counseling: (1) demographic, (2) organizational (3) experiential, (4) professional, (5) psychological, and (6) cognitive. The literature shows that medical genetic counseling based on family history is usually considered as equivalent to genetic RC. Genetic RP is mostly associated with genetic testing where, according to the country of practice, the clinician can order the genetic test (either as a public or private service) or must refer the patient to a genetic counseling and testing center to provide genetic counseling services and perform the test.

Table 5 shows a synthesis of the barriers and facilitators after quantitative testing and classification into the 6 categories of factors mentioned above that are related to the 3 variables studied, namely: (1) RC, (2) RP via ordering a test, and (3) RP via referring a patient. We used a vote-counting method [39] which consists of the count of the significant effect directions by considering the same operational definition of the dependent variable. This method has been previously used in systematic reviews in medicine [40–42]. Our review shows that 60% of the categories of variables were considered in studies that integrated RP and RC in a comprehensive process.

RP Predictors

Ethnicity/Race. Self-identification as a member of an ethnic group was found to be a barrier to engage in a RP process [19, 43]. Physicians who identified themselves as Asians, Asian Pacific Islanders, and Latino/African Americans were less likely to refer patients to a genetic center for genetic testing or to a genetic counselor. Because these doctors practiced in minority groups, some factors like paucity of resources and low health literacy (patient-related factors) may be considered as confusion bias. Thus, the evidences are not strong enough for this variable.

Religion. Self-identification as non-religious was found to be a facilitator for routinely offering DNA testing, notably with respect to pre-conceptional cystic fibrosis screening [44]. Another study found that religious affiliation was an inhibitor of ordering a genetic test [45]. It seems that there is not enough evidence to support the effect of this factor.

Fig. 2. Major predictors of MGC-BC.

Healthcare Services Management. Some studies have identified that the availability of professional society guidelines [46] that favor genetic counseling [47] were positively associated with referrals for genetic testing. In addition, the accessibility of genetic testing services influenced medical doctors' provision of such services. Indeed, genetic counseling services that are poorly integrated with the daily routine of physicians' practice were one of the barriers discussed by Hindorff et al. [47] regarding RP. There is enough evidence that supports the effect of these types of predictors.

Diversity of Work Time-Sharing. The type of work time-sharing (work as a full-time faculty or in teaching/research) was also found to be a facilitator for RP. Being a medical doctor with a full-time appointment and working in teaching or research facilities was positively correlated with referring for genetic tests regarding various cancers (especially breast cancer) [19, 43]. However, this category of factors has to be interpreted according to context, since genetic services and referral procedures may differ from one country to another. For example, in Australia, professional guidelines for GPs/family doctors are available and present clear information on the appropriate referral of patients to specialized familial cancer services where MGC-BC is offered [48]. The evidence for supporting these effects on RP is sufficient.

Openness to Innovation. Shields et al. [19] also found that acceptance of innovative practices and self-identification as an early adopter of new diagnostic tests had a

positive impact on RP, including either referral for genetic counseling or ordering genetic tests. There is satisfying evidence to support the effect of this predictor on RP.

Clinical Skills. Clasen et al. [49] showed a positive association between the outcome expectancies by medical doctors and genetic test-ordering practices. Indeed, genetic testing practices were influenced by the fact that the performance of tests by medical doctors was recognized to decrease mortality or to detect the disease earlier effectively [49]. However, physicians' practices may reflect caution in ordering tests or a lack of knowledge of the appropriate indications for genetic testing (e.g. paucity of clinical guidelines, best practices or recommendations) [49]. There is significantly sufficient amount of evidence that supports the relation of this predictor with RP.

Self-Confidence: Emotional Comfort. The feeling of comfort related to patients and the feeling of comfort as related with the type of patient and the situation have both been shown to have an impact on RP. Verger et al. [50] conducted a study on genetic services for women with physical and mental impairments. The results revealed that feelings of discomfort in GPs when providing care to women with disabilities were strongly associated with providing less frequent breast cancer screenings to this specific group. Moreover, Clasen et al. [49] showed that physicians felt discomfort in performing cancer screening tests during patient visits for clinical complaints that were not related to cancer. The evidence regarding this predictor is enough to support its relation with RP.

Table 4. Taxonomy of barriers and facilitators and their definitions

Independent variable	Dependent variable		Definition	Articles	
	RC	RP			
	Ordering	Referring			
<i>Demographic factors</i>					
Age	X	X	X	MD's age, principally defined as groups of age	[19, 52, 53, 55, 61]
Gender	X	X	X	MD's gender (male/female)	[43, 52, 53, 56, 57, 59, 67, 70]
Race/ethnicity			X	MD's ethnic group, defined as limited ethnic group choices (White/Non-White, Asian, Afro-American, Latino American)	[19, 43]
Religion	X	X	X	MD's religious or non-religious affiliation defined as dichotomic variables	[44, 45, 59]
<i>Organizational factors</i>					
Organization affiliation	X	X	X	MD's organizational affiliation (e.g. HMO, IPA, integrated health system, etc.)	[43, 53, 66, 71]
Healthcare services management		X	X	Professional guidelines presenting referral criteria or in favor of genetic testing, genetic services integration, or availability into routine practice	[46, 47]
Geographic location	X	X	X	MD's region of practice characteristics [socio-economic status, language, type of the region (rural, urban, sub-urban), size (number of inhabitants)]	[19, 22, 51, 52, 59, 67, 77]
Work time diversification			X	Proportion of time devoted by MD to clinical consultation, research, and/or teaching	[19, 43]
<i>Experiential factors</i>					
Number of years practicing/seniority	X	X	X	Number of years of practice defined either by the number of years since graduation or number of years of practice	[46, 55, 57–59, 63, 71]
Past experiences with cancer and patients	X	X	X	MD's personal experiences with cancer defined by a past experience of personal, relative's, or close friend's disease and past experiences with patients	[43, 50, 61, 67, 68]
<i>Professional factors</i>					
Openness to innovation		X	X	MD's openness to innovative practices and self-identification as an early adopter	[19]
Model of practice	X	X		Defined as a preference for a more prevention-oriented practice or more curative-oriented practice	[46, 53, 66]
Clinical skills		X		MD's ability to manage the clinical encounter and to adapt to the patients' needs and health condition	[49]
<i>Psychological factors</i>					
Self-confidence					
Emotional comfort		X		Feeling of comfort with patients with physical or mental impairments to order RP during an unrelated cancer visit and to propose a genetic test to a patient	[49,50]
Knowledge skills	X		X	MD's self-confidence in genetic-related knowledge (knowledge of referral criteria and genetic test recommendation); MD's self-evaluation of core competencies in genetics (subjective measures)	[19, 22, 52, 59, 61]
Communication skills	X	X		MD's perceived skills in terms of health education for patient, health communication skills, etc.	[50, 59]
Attitudes	X	X	X	MD's attitudes toward genetic testing or counseling (optimistic that genetics will improve treatment, positive attitude toward testing, positive attitude toward communicating risk, etc.)	[18, 19, 51, 56, 60, 61]
Perceived role	X		X	MD's perceived role and responsibilities in terms of genetic counseling services delivery (is genetic counseling a medical responsibility?)	[43, 60]
<i>Cognitive factors</i>					
Medical knowledge					
Country of graduation	X	X		MD's medical school localization, defined as a dichotomy: national or international graduation	[22, 61, 64]
Medical specialty	X	X	X	Holding a specialty defined as a list of specialties that are related to genetics or not (i.e. medical geneticist, etc.)	[19, 20, 38, 43, 51, 59, 61–64, 70]
Training	X	X	X	MD's holding a certification in genetics or genetic counseling training from a medical school	[19, 21, 46, 56, 65]
Clinical competencies	X	X	X	MD's level of knowledge on genetic risk and genetic testing and core competencies in genetics (objective measures)	[18, 38, 46, 51, 59, 66, 71]
Health system knowledge		X	X	MD's level of knowledge on ethical and legal issues or awareness of services and where to refer to	[19, 22, 52]
Sources of information	X	X	X	Advertising materials; access to informational resources (journals, databases, etc.); access to medical expertise (colleagues, etc.)	[22, 46, 50, 54, 62, 64]

Table 5. Number of quantitative significant barriers and facilitators of genetic counseling

	RC		Ordering a genetic test		Referring for a genetic test	
	Barrier	Facilitator	Barrier	Facilitator	Barrier	Facilitator
<i>Demographic factors</i>						
Age (years)	2 (>50)	1 (<50)	2 (>45; >65, increasing age)	1 (male)	8 (>45; >65; >50)	1 (>40)
Gender		1 (female); 2 (male)	1 (male)			3 (female)
Race					4 (ethnic minority affiliation)	
Religion		1 (non-religious)	1 (religious affiliation)	1 (non-religious)		
<i>Organizational factors</i>						
Organizational affiliation	2 (HMO; academic)			2 (IPA or HMO; integrated health system)	2 (IPA)	
Healthcare services management			2 (guidelines do not encourage genetic testing; genetic counseling services not well integrated into routine)	1 (local guidelines available)		
Geographic location		1 (rural region)	3 (upper-socioeconomic status communities; group of countries)	4 (higher-socioeconomic status communities, language region; group of countries; Northeast US region)		5 (urban region, Northeast and Midwest US region)
Diversity of work time						3 (full-time faculty and work in teaching or research)
<i>Experiential factors</i>						
Number of years practicing/seniority	1 (less years of practice)	3 (10 years or less; more years of practice; medical training since 1971)	1 (graduation before 1976 for individual practice)	2 (less time since qualification; graduation before 1976 for group practice)		2 (10 years or less; more years since qualification)
Past experiences with cancer and patients		1 (BC diagnose per year)	2 (work in institution with elderly; personal experience with patient)	3 (provided counseling, ever ordered/referred; family member with cancer)		1 (BC diagnoses per year)
<i>Professional factors</i>						
Model of practice		2 (prevention-oriented: diet and medical information frequency)	2 (higher priority to other health concerns)	1 (high priority to screening)		1 (early adopter of new diagnostic tests)
Openness to innovation						
Clinical skills				2 (early adopter of new diagnostic tests)		
				6 (screening test decreased mortality, detects cancer or is justified under a certain age)		
<i>Psychological factors</i>						
Self-confidence; emotional comfort			4 (uncomfortable performing during unrelated visits; feelings of discomfort for women with physical and mental impairment)			
Self-confidence: knowledge skills		7 (feels qualified or prepared to counsel or to recommend genetic tests)				
Self-confidence: communication skills		2 (high confidence; tolerance to ambiguity)	2 (communication difficulties with women with physical and mental impairment)			5 (high confidence in knowledge of referral criteria, and in core competencies in genetics)

Table 5 (continued)

	RC		Ordering a genetic test		Referring for a genetic test	
	Barrier	Facilitator	Barrier	Facilitator	Barrier	Facilitator
Attitudes		4 (paternalistic attitude, acceptance toward death, positive attitude toward genetic advantage to health, etc.)		5 (positive attitude toward genetic advantage to health, etc.)		1 (objections to abortion)
Perceived role	1 (training/role factors scale)	1 (preliminary stage before performing the test belongs to them)			1 (training/role factors scale)	
<i>Cognitive factors</i>						
Medical knowledge: country of graduation	1 (national graduate)		1 (international graduate)	2 (international graduate)		
Medical knowledge: specialty	2 (surgeon and geneticist)	10 (tertiary care physicians; obstetrics/gynecology; oncology; family practice; internists)	2 (family practice; tertiary care physicians)	3 (obstetrics/gynecology)		9 (family practice; obstetrics/gynecology)
Medical knowledge: training		3 (received training in clinical genetics or bioethics; faculty physician)	1 (lack of training)	9 (received training in medical school or in CME courses)		7 (received training in medical school or in CME courses)
Medical knowledge: clinical competencies		2 (knowledge on risk communication; of disease)	1 (lack of knowledge)	4 (level of knowledge on benefits of mammography, or on risk prediction tests)		1 (knowledge of genetics)
Health system knowledge			1 (uncertainty of services availability)			8 (accurate knowledge of current legal protections, of services, of where to refer)
Sources of information	1 (lack of specialist services)	2 (consulted with a university-affiliated physician; assistance from a geneticist)	2 (lack of assistance during counseling)	1 (advertising materials)		1 (attended specialist)

BC = Breast cancer; HMO = health maintenance organization; IPA = independent professional association.

Attitudes. A positive attitude towards the benefits of genetics on treatment of breast or colorectal cancer [19], towards genetic counseling and its implications on clinical decision making [18], and towards the accuracy of the tests [51] had a positive impact on RP practices. The evidence which supports these effects on RP seems sufficient.

Geographic Location. Literature has shown differences among geographic areas within the same country [51, 52]. Practicing in communities of higher-socioeconomic status was found to be a facilitator for RP. Moreover, the regions of practice as defined by the language spoken were also found to have a significant effect on the ordering process (e.g. the French- and Italian- as opposed to the German-speaking regions in Switzerland) [51]. These differences could be explained by social factors such as cultural differences between ethnic groups, organizational factors such as a lower access to healthcare services among linguistic minority groups, or geographical factors such as living in an urban or rural/remote area. The evidence to support the effect of these predictors is adequate.

Organizational Affiliation. Dulai et al. [53] have found that physicians with independent practice association are less likely to recommend cancer screening compared with those affiliated with an integrated medical group. Because this study has been about colorectal cancer, it cannot be considered as a strong evidence for this effect regarding breast cancer.

Source of Information. Verger et al. [50] have reported a negative association between RP and assistance during consultation. Also, Foo et al. [54] reported an association between RP and the presence of attending specialists with respect to colorectal cancer patients. The evidence about these relations is not sufficient.

Self-Confidence: Perceived Knowledge Skills. Shields et al. [19] have found that feeling prepared and confident with genetic skills was positively associated with ordering a genetic test. The supporting evidence seems rather insufficient for this predictor.

Medical Knowledge: Training. A lack of training in genetic medicine is a barrier with respect to RP. Shields et al. [19] found this relationship between medical schools (and/or continuing medical education) training in clinical genetics and RP, for either ordering tests or referral practices. It seems that the evidence in this field is not strong enough to support these relations with respect to breast cancer.

RC Predictors

Age. Being a physician older than either 50 or 65 years of age was found to be a barrier to genetic counseling

taken as a comprehensive process [55]. The study was about genetic counseling in general and not breast cancer specifically. Thus, the evidence seems pretty insufficient related to breast cancer.

Gender. Female physicians were more likely to communicate genetic risk including its assessment. One study found that male physicians were more likely to provide explicit information on genetic risks to cancer patients [56]. However, other studies found that male gender could be either a barrier or a facilitator on the RC or RP processes [53, 57]. There is adequate evidence regarding female but not male physicians (gender of the medical practitioners as a predictor for RC).

Organizational Affiliation. Kaplan et al. [43] also found a negative association between the initiation of counseling and working in a Health Maintenance Organization. Their study has been about breast cancer, and the findings could be considered as a strong evidence for this type of predictor.

Geographic Location. Keller et al. [51] found that clinical geneticists from Northern and Western European countries had a better experience with counseling and RC than those from Southern and Eastern countries of the continent. This result cannot be considered as a strong evidence for this predictor.

Number of Years of Practice/Seniority. A positive association between RC and the number of practicing years was found in Wolf et al. [58]. More studies about breast cancer should be accomplished to consider the results as a strong enough support for this effect.

Self-Confidence: Perceived Communication Skills. Geller et al. [59] found that a high level of confidence and tolerance to ambiguity were positively associated with RC. Their study was about cystic fibrosis, and this finding cannot be assumed strong enough as an evident.

Attitude. Adopting a paternalistic attitude was positively associated with RC [56]. The literature also showed that RC is positively associated with a positive attitude towards genetic susceptibility testing [60], the benefits of good communication [56], and death (i.e. the acceptance of death) [56]. However, negative attitudes toward health insurance issues (i.e. loss of insurance) related to genetic testing for cancer susceptibility [61] were found to be barriers to RC. These studies were about general chronic diseases and cancers, so their findings are not strong evidences for breast cancer genetic counseling.

Perceived Roles. The perceived role of the professional had been identified as a predictor of RC. Escher and Sapi- no [60] found that physicians who felt that they have an active role in the pre-test procedure, the disclosure of re-

sults, and long-term follow-up were better in RC. Though, Kaplan et al. [43] found that the perceived role of physicians is negatively associated with the initiation of counseling. The evidence is strong enough.

Medical Knowledge: Medical Specialty. There are many studies that have explored the relation between the specialty of the doctors and RC or RP. Keating et al. [62] found that surgeons and geneticists were less likely than medical oncologists to always/usually report covering all aspects of RC, such as the benefits and limitations of close surveillance, the possibility of a psychological reaction, or sharing test results with family members. However, geneticists reported the highest rates of counseling [62]. Moreover, there was evidence that physicians in other specialties are more likely to engage in RC, namely oncologists [61], obstetricians/gynecologists [20, 63, 64], and obstetricians [38]. The evidence in this regard seems strong enough.

Medical Knowledge: Training. Physicians who had taken one course or more in genetics were more likely to engage in RC [21, 56]. Also, Lazcano-Ponce et al. [56] found that when physicians had received training in bioethics, their RC was characterized by providing more detailed information to cancer patients. Finally, Tyler and Snyder [65] found a similar association for the documentation of family history when comparing faculty physicians and residents. Generally, evidence for this predictor is strong enough.

Source of Information. McCahon et al. [46] found that a lack of specialized service availability was a barrier to RC. Moreover, consultation with a university-affiliated physician [64] or assistance from genetic counselors, nurse geneticists, or other physician extenders to assist with counseling [62] was a facilitator of RC. The evidence seems sufficient to support the effects of this predictor on RC.

Predictors for both RP and RC

Age. Being a physician older than either 50 or 65 years of age was found to be a barrier to genetic counseling taken as a comprehensive process and for both RP and RC when considered separately [19, 53, 61]. Moreover, 45 years of age appeared to be a critical threshold. There is sufficient evidence about the effect of this predictor.

Gender. Female physicians were more active in communicating genetic risk and to start a RP process, including estimation of the genetic risks, ordering a genetic test, or referring a patient for genetic testing [43, 52, 57]. However, the results on the involvement of male physicians in RP were inconclusive, as the studies found that male gender could be either a barrier or a facilitator on the RC or

RP processes [53, 57]. There is enough evidence for female but not for the male physicians (gender of the doctors as a predictor for RP and RC).

Organizational Affiliation. In one study [66], clinicians working in a clinical setting that is affiliated with an integrated health system were shown to be more likely to use cancer susceptibility testing than in unaffiliated practices. Kaplan et al. [43] established a positive association between referral for genetic testing with a physician's affiliation with a university. They also found a negative association between the initiation of counseling and working in a Health Maintenance Organization [43]. Thus, the assumption was that physicians who are affiliated to a genetic center were more compliant with the referral of patients for genetic testing. It seems that there is sufficient evidence to support these correlations.

Geographic Location. Literature has shown differences among countries (Southern, Eastern, Northern and Western European countries) [67]. Practicing in an urban region [52] or in some rural regions as defined by their localization (North-eastern and Midwestern US regions [19]) was also found to be a facilitator especially for RP. The evidence to support the effect of these predictors is adequate.

Number of Years of Practice/Seniority. One study found that higher rates of RP practice, such as recording family history for inherited health problems, were associated with fewer years in practice [55]. McCahon et al. [46] found that recently certified clinicians were more likely to deliver RP genetics services for common disorders. Moreover, one study showed that a post-qualification period ≤ 10 years was positively associated with referral practices [63], while another showed a positive linear association between the number of years since certification and RP [57]. These results showed a trend in knowledge, with a difference between older and more recent studies. Studies published before 2000 showed a negative association between the number of years since qualification and RC or RP; while on the contrary, more recent studies showed a positive association between the same parameters. Our assumption is that with the growing knowledge about genetics and the development of new testing technologies, physicians are more comfortable with RC and RP. There is adequate evidence to support the effects of this type of variables.

Past Experiences with Cancer and Patients. Professional and personal experience was found to be a facilitator of RC and RP either on the ordering or the referral practices. The items used by authors to measure past experiences were, for example, exposure to cancer diagnoses [43],

personal experience with patients [50], past experience of RC [67] or RP [61], as well as a personal history of cancer [43] or history of a relative with cancer [68]. Besides, one study reported that having a family member with breast cancer, in addition to its association with a greater knowledge of breast cancer risk factors, was associated with the utilization of software for breast cancer risk assessment [68]. Past experiences seemed to influence MGC-BC; however, more investigations are needed to better understand the association between past experiences with breast cancer and MGC-BC in order to develop specific strategies to increase the awareness of physicians, especially through their exposure to patients with breast cancer during their clinical training or continuing medical education programs. The evidence for supporting the effects of this variable seems insufficient.

Model of Practice. The literature showed that the profile of practice has an impact on MGC-BC. Indeed, clinicians may choose to adopt a practice profile that is prevention-oriented. Thus, physicians who frequently collected and recorded their patient medical history, diet information and are engaged in prevention counseling were more likely to report ordering genetic testing [66]. However, an assignment of higher priority to other health concerns was found to be a barrier to RP in the case of colorectal cancer screening [53] and has also been found to be related to a negative attitude toward routine provision of primary care genetic services by GPs [46]. It sounds that there is enough evidence regarding the effect of 'model of practice' as a predictor of RC and RP.

Self-Confidence: Perceived Knowledge Skills. Freedman et al. [61] and Wideroff et al. [22] found that feeling qualified or prepared to recommend or advise patients for cancer susceptibility testing was positively associated with RC and RP. Furthermore, Carroll et al. [52] showed that high confidence in the knowledge of referral criteria and in core competences in genetics (e.g. family history recording, risk assessment for hereditary breast and colorectal cancers) were facilitators of referral practices. The evidence to support the effect of these predictors is adequate.

Self-Confidence: Perceived Communication Skills. Verger et al. [50] showed that difficulties in communication were barriers to breast cancer screening, as they can impair the process of obtaining cooperation and/or consent from patients. There is enough evidence to support these correlations.

Attitudes. The literature also showed that RC is positively associated with a positive attitude towards genetic susceptibility testing [60]. However, negative attitudes to-

ward health insurance issues (i.e. loss of insurance) related to genetic testing for cancer susceptibility [61] were found to be barriers to RC. There is sufficient evidence about the effect of this predictor.

Perceived Roles. The perceived role of the professional has been identified as a predictor of RC. Escher and Sapino [60] found that physicians who felt that they have an active role in the pre-test procedure, the disclosure of results, and long-term follow-up were better in RC. Though, Kaplan et al. [43] found that the perceived role of physicians was negatively associated with the initiation of counseling as well as referral for genetic evaluation. The evidence for supporting the effects of this variable seems insufficient.

Medical Knowledge: Country of Graduation. Freedman et al. [61] found that US physicians having graduated from international medical schools (vs. US schools) were more likely to report feeling competent to recommend genetic testing to their patients. However, the latter were more likely to have a negative attitude towards the clinical utility of genetic tests for cancer susceptibility with respect to risk analysis, cost-effectiveness, and accuracy. Wideroff et al. [22] studied RP (ordering and referral) and found that being a foreign medical school graduate is inversely related to the use of cancer susceptibility testing among tertiary care physicians in the USA. International medical graduates were more likely to discuss the genetic risk but less likely to order or refer for genetic testing [22]. The evidence is not enough to strongly support the relation of this predictor to RP and/or RC.

Medical Knowledge: Medical Specialty. Many studies have explored the link between medical specialty and RC or RP. However, geneticists indicated a higher tolerance for ambiguity in their reported practices regarding genetic testing [69]. With regard to RP ordering practices, physicians in some specialties were less likely to order a genetic test, such as family practitioners [19], while others were more likely to order such tests, such as tertiary care physicians [61], obstetricians/gynecologists [51, 68], and oncologists [61]. In the case of referral practices, the specialties that were more likely to refer were family practice [19] and obstetrics/gynecology [43, 63, 68, 70]. There is enough evidence that advocates the effects of this variable.

Medical Knowledge: Training. Finally, another important predictor of the RP and RC processes is the training which the doctors received in medical school or in continuing medical education courses. McCahon et al. [46] found that a lack of training in genetic medicine was a barrier with respect to RC and RP. The supporting evidence for this factor is sufficient.

Medical Knowledge: Clinical Competences. With respect to competences, investigators have shown that knowledge of the characteristics and probabilities of cancers were positively associated with RC [38, 59], RP ordering [51, 66, 71], and RP referral [18]. The latter findings were supported by the study of McCahon et al. [46] which reported that a negative knowledge score influences GP abilities to provide genetic services. There is strong enough evidence to support these effects.

Health System Knowledge. Knowledge about macro- and micro-level health system components had been found to be critical for RP and RC. Awareness of important specific aspects of the health system such as protective legislations (e.g. confidentiality, equity) was associated with RC and RP [19]. Moreover, when clinicians were aware of the location of genetic services [52] or local service availability [22], they were more likely ready to provide RC and RP. Carroll et al. [52] pointed out that differences that may exist among medical genetic counseling practices were partly related to the level of awareness of the services which were available for different diseases. For example, the latter investigators noticed that in the particular population studied, clinicians were less aware of services for hereditary colorectal cancer than for hereditary breast/ovarian cancer. The supporting evidence regarding this type of variables seems sufficient.

Source of Information. Advertising materials on cancer susceptibility testing, received during the previous year, was also a facilitator of RP [22]. Overall, the diversity of sources of information appeared to be a good predictor of RC and RP. The evidence to support this predictor's effect on RP and RC is adequate.

Discussion

According to the 2011 National Comprehensive Cancer Network (NCCN) Guidelines entitled 'Genetic/Familial High-Risk Assessment: Breast and Ovarian', women diagnosed with breast cancer prior to the age of 50 years should be referred for further risk assessment, genetic counseling, and possible genetic testing [72]. NCCN more recently published more detailed criteria for consideration of *BRCA1/2* genetic testing [73]. This scoping review aimed to identify behavioral predictors of MGC-BC among medical doctors. Anticipating the paucity of evidence describing determinants of medical doctors' MGC-BC behavior, we also sought indirect evidence from other genetic diseases. The inductive analysis of 31 retrieved articles was performed and allowed the extrac-

tion of 193 predictors that were classified into 6 categories: (1) demographic, (2) organizational, (3) experiential, (4) professional, (5) psychological, and (6) cognitive.

With regard to those variables, studies have shown that practices vary across individuals, disciplines, and contexts [19, 53, 61]. However, we have identified relevant evidence. Indeed, determinants consistently associated with RC notably included seniority, prevention-oriented practices, and feeling qualified or prepared to counsel or recommend genetic tests. Determinants consistently associated with RP included positive attitudes toward genetic testing, knowledge about benefits, and affiliation to an integrated health care system. Some categories of factors, such as past experiences with the disease, were found to be facilitators of the whole process, either RC or RP, in the case of breast cancer [68], while some others were found to be barriers, such as the lack of genetic training [21, 56].

Literature revealed contradictory results for religion/spirituality factors. Indeed, cancer is often linked to death and fatal diagnosis where religion/spirituality may play a major role. A proportion of breast cancer is hereditary and may involve aspects of victimization or a feeling of guilt that can have a religious or spiritual substratum. Medical doctors may not be comfortable with these aspects. Further research is needed to study physicians' religious affiliation and its impact on MGC-BC (performance and efficacy) and to develop breast cancer genetic risk communication tools that are sensitive to religion/spirituality.

The perceived inadequacy of undergraduate and postgraduate genetic education was emphasized in some studies [19, 21, 54] and suggested that development and presentation of cancer-related genetic courses should be favored in medical schools. Recent studies confirmed that genetic training and specific guidelines have a high influence on a physician's decision to undertake genetic testing [74]. However, as noted by McCahon et al. [46], some medical doctors may not offer MGC-BC even with previous appropriate training. Resistance to change can be related to perceptions of one's roles and responsibilities.

Battista et al. [12] reviewed the literature to explore major conditions for the implementation of genetic services in healthcare systems and found that the reconfiguration of professional roles and responsibilities is among the most important challenges in the reorganization of genetic services and clinical practice changes. Our results showed that medical doctors, who are affiliated to a genetic center, were more compliant with the referral of patients for genetic testing. Therefore, a thorough study of

organizational factors may contribute to understand how genetic center services should ideally be linked to primary care clinical settings as well as the distinctive qualities that these services should have regarding the risk assessment and the themes of communication.

A major limitation that we had in the development of specific recommendations was the lack of homogenous evidence and the occurrence of conflicting evidence. The selected studies were heterogeneous in terms of targeted population (GPs and doctors with different specialties), inconsistency of concepts definition (e.g. family history collection was part of the RC), study designs used (randomized clinical trials, cohorts, and cross-sectional surveys), or organizational context (i.e. healthcare system). Moreover, the studies considered in this scoping review were not only related to breast cancer (56%) but also addressed other genetic diseases or disorders such as colorectal cancer [49] or cystic fibrosis [38]. Among the 9 studies identified regarding predictors for RC, only 2 had investigated genetic risk communication in a context of breast cancer [69, 70]. The heterogeneity of studies selected prevents sound specific recommendations from being drawn. However, generic recommendations are provided.

Another inherent limitation of this scoping review was that the recommendations were based on quantitative studies only. However, qualitative data are context sensitive with weak external validity and were thus excluded from this review. Therefore, future conceptual and theoretical research should synthesize qualitative data to build a comprehensive theoretical framework that may advise quantitative studies

On the other hand, we found a paucity of articles that explored genetic counseling (specific genetic risk prediction and communication) from the perspective of medical doctors (authors usually explore patients' perspective, needs, and expectations). Thus, there is an urgent need to organize research activities to better understand not only the actual clinical practices but also the needed skills, trainings, competencies, attitudes, perceptions, and receptiveness of MDs (especially those in primary care clinical settings) in terms of RP and RC in a context of MGC-BC. In the future, we should focus our research on the areas that can be changed over time with considering some specific training courses and educative activities to increase the willingness and professional ability and skills of the physicians regarding genetic counseling. In addition, future research should identify the important elements involved in the effective training of young doctors in medical schools and medical specialty (residency) programs.

Practical and Research Implications

As the patients become more informed on genetic aspects of many diseases (www.breastcancer.org), primary care physicians at the front-line of health care access will be more and more called to deliver genetic counseling/testing and to talk about genetic risk prediction/surveillance with their patients. This will be increasingly true as the field of public health genomics and personalized prevention through risk stratification at a population level will expand [9, 10]. However, few strategies have been put into action to support clinical practices. In this review, we have found emerging evidence to support MGC-BC in primary care. These results offer relevant information that can be used to support MGC-BC performance among primary care physicians.

Based on our results, we recommend actions which can be considered for 2 sections: medical competences and healthcare management.

Strategies targeting medical competences include training and educational efforts emphasizing family history collection, genetic counseling for individuals at risk for inherited cancer, harms and benefits of genetic testing, and risk surveillance/management options. Strategies targeting healthcare management should include clarification of genetic testing referral procedures, clarification and standardization of roles and responsibilities in genetic counseling, referrals for testing and ordering genetic tests, and creation of effective channels of communication between genetic centers and primary care clinical settings, especially for those in solo practices. However, with limited data to discern evidence on patients' outcomes, it is difficult to provide clear guidance to clinicians and managers regarding advice on the specific strategies to be implemented in this area.

Given the gap in research in the area of MGC-BC, there should be a strategic investment in building research capacity to address relevant questions related to MGC-BC in primary care [75, 76]. We suggest that future studies need to explore MGC-BC predictors through randomized controlled trials and observational studies with larger samples to explore the effect of these determinants in a real clinical context. Most studies were conducted in clinical settings but did not include patients; prospective trials should collect data and undertake dualistic analysis of MGC-BC as a shared decision-making process; the decision making that both the doctor and the patient are involved in it. Indeed, MGC-BC is a social interaction where multiple factors may interfere (e.g. interpersonal, cognitive, and spiritual dimensions). Thus, randomized

clinical trials should focus on meaningful clinical outcomes and provide precise determinants of clinical effectiveness and patients' satisfaction. In an era of personalized medicine, this evidence is a cornerstone for targeting shared decision-making support tools and personalized services for MGC-BC in primary care.

In Canada, we need more studies, especially the ones that include real clinical environments and settings. By having more statistic data, we can organize our healthcare systems better to serve the people. Particularly, at the family practice level we need more comprehensive study results to be able to develop guidelines for genetic risk prediction and communication and to help the primary

care physicians making decisions more easily and reliably regarding when and where to refer patients for genetic counseling or to discuss the risks with them.

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