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Barriers to the provision of genetic services by primary care physicians: A systematic review of the literature

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Purpose: The purpose of this literature review is to report primary care physicians' perceived barriers concerning the provision of genetic services. **Methods:** Sixty-eight papers were identified in six electronic databases. Only publications classified as empirical studies (N = 18) were included in this review. **Results:** Barriers identified most frequently in reviewed studies were inadequate knowledge of basic genetics, lack of detailed or updated family histories, lack of confidence, and lack of referral guidelines. **Conclusion:** Although many primary care physicians perceive genetics as a low practice priority, they do report a need for educational programs in genetics, informational resources, and referral guidelines. ***Genet Med*** **2003:5(2):70–76.**

Key Words: *genetics, primary care, genetic services, literature review*

The achievements of the Human Genome Project have enabled researchers to identify errors in genes that may either cause or contribute to disease. As a result of the expansion of genomics into human health applications, an increasing number of gene tests are becoming available commercially.[1] These tests will play an important role in the diagnosis, monitoring, and treatment of diseases.

According to the director of the National Human Genome Research Institute, Francis Collins, MD, PhD, "This 'next revolution in medicine' will fall on the shoulders of physicians who provide primary care."[2(p1)] While many primary care providers (PCPs) already incorporate genetic screening into their routine services, it is reasonable to assume that the demands on family physicians will increase substantially as they are required to provide information on new genetic tests to their patients, to help interpret test results, and to consider prescribing new genetic therapies as they become available. One fundamental challenge that PCPs will encounter is becoming familiar with an ever increasing number of technologies for both screening and treatment of genetic disorders.

If Collins' prediction is true, questions regarding PCPs' willingness, capacity, and resources to provide genetic services inevitably arise. The review of literature presented here represents an attempt to address some of these questions.

This review systematically examines and organizes findings from available studies of PCPs' views regarding the provision of genetic services. The specific research question guiding this review is, What are PCPs' perceived barriers that hinder the routine provision of genetic services? For the purposes of this review, genetic services are defined as patient-oriented tasks that include (but are not limited to) screening for treatment and prevention, counseling regarding genetic testing results, referring patients with genetic risks, and comprehensive family history-taking. In addition to answering the proposed question, recommendations from the literature regarding knowledge, skills, and resources needed to overcome these barriers also are examined. In the context of this review, PCPs include family or general practitioners, internists, obstetricians and gynecologists, as well as pediatricians.

METHODS

A search of six electronic databases from the decade after the beginning of the Human Genome Project, 1991 to 2001, revealed 68 papers that investigated or discussed the provision of genetic services by primary care physicians. The databases searched were Medline, ERIC, PsycINFO, Healthstar, Cancerlit, and Annual Reviews. Key terms combined with "genetics," "genetic testing," or "genetic screening" through the Boolean term "and" included "primary care," "primary care providers," "primary care physicians," "family practice," and "general practitioners." Reference lists from retrieved papers were also examined.

Eighteen of the 68 papers examined were classified as research studies. The 50 excluded papers were commentaries, theoretical, or otherwise nonempirical examinations of the issue. The 18 included studies were written in the English language and published in peer-reviewed journals. Their focus, methods, and outcomes varied. Studies that focused on proposed solutions to previously identified barriers were also included. The studies were carried out in the United States (9), United Kingdom (6), Scotland (1), the Netherlands (1), and

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Switzerland (1). A review matrix was created to structure information abstracted from each study.[3] Table 1 is an adaptation of that original matrix.

Studies also were rated according to their methodological quality. The rating was determined by using the set of criteria and codes developed by Bernstein and Freeman[4] and described by Patton.[5] The design of these criteria is based on assumptions that value quantitative, controlled studies, over qualitative efforts. The criteria cover the dimensions of sampling, data analysis, statistical procedures, and design. For each of these, a numbered score was given to the reviewed study if it contained the specific elements defined for each dimension. For instance, if the sampling procedure involved systematic random sampling, the study received a score of 1; if the sample was nonrandom, cluster, or nonsystematic, it received a score of 0. The maximum score a study could obtain when all criteria were used was 10. A score of 10 indicates that the study utilized a systematic random sample, it was quantitative in nature, it utilized multivariate statistical analyses, and its design consisted of experimental or quasi-experimental randomization with control groups.

RESULTS

Table 2 summarizes the barriers encountered in the reviewed studies. In the text below, only barriers identified in three or more studies are discussed.

Lack of genetic knowledge

Twelve of the 18 studies identified inadequate knowledge of genetics, genetic testing, or genetic counseling as a barrier to providing genetic information or services (Table 2). From a national survey of family practitioners, obstetricians, gynecologists, internists, and psychiatrists, Hofman and colleagues[6] found recent medical school graduates appeared to have a higher level of genetic knowledge. This suggests medical schools are incorporating more genetic education into the curriculum. Teague and colleagues[7] tested a medical education module on medical students to assess their pretest and posttest knowledge of and attitudes toward cancer and predictive genetic testing. After hearing discussions led by genetic specialists of case examples, medical students seemed more favorable toward genetic testing and genetic counseling.

Kolb and colleagues[8] estimated that the majority of underutilization of genetic services by PCPs was due to lack of adequate genetics information and knowledge. They found a significant increase in knowledge and attitudes of PCPs in a Texas community toward the provision of prenatal and children's genetic services after a 16-hour basic genetic educational program. A 150-page course manual, several pamphlets on specific genetic conditions, and a videotape that was developed by the Texas Department of Health accompanied the program. As an aid to the knowledge barrier, a Texas survey of physicians' attitudes and practices of cancer genetics revealed physicians would like to see a variety of continuing education programs and educational materials on DNA testing for cancer susceptibility.[9]

In a qualitative study, Kumar and Gantley[10] reported general practitioners in Britain view "new genetics" as a series of additional tasks requiring new knowledge and skills, rather than an extension of current practice. Focus groups with 26 general practitioners in Britain[11] also revealed lack of genetic knowledge and referral skills as a barrier to providing genetic services, although these physicians perceived genetics as an important and increasingly relevant topic for primary care.

Positive attitudes toward genetic testing for breast and ovarian cancer were found in Escher and Sappino's[12] study but, again, knowledge deficits underlined a need for genetic education. Watson et al.[13] found many general practitioners were unsure about their decisions to refer patients with a high risk for breast cancer and were uncertain about how to manage lower-risk patients who were not referred.

Mountcastle-Shah and Holtzman[14] believe skepticism about the impact of genetic discoveries on primary care practice could be a barrier in the provision of genetic services. Because of this skepticism, genetic training is a low priority for many primary care physicians.[15,16] Six percent of physicians in Hayflick and colleagues'[16] study reported no need for additional genetic services. Some of the general practitioners in Kumar and Gantley's qualitative study felt genetic advances had little relevance for their practice: "Genetic conditions are not our bread and butter; the new genetics has little impact on my day-to-day clinical work."[10(p1411)]

Mountcastle-Shah and Holtzman[14] proposed encouraging primary care physicians to participate in clinical studies to assess the safety and effectiveness of genetic testing. They believe participation in research may serve as an effective medium for physician education in genetics.

A pretested survey to measure hereditary breast cancer knowledge and practice behavior was mailed to a random sample of 400 family practitioners in Denver, Colorado. Mouchawar et al.[17] reported a low knowledge level relating to genetic principles in general and hereditary breast cancer in particular, even though 100% of the surveyed physicians took family cancer histories as part of routine clinical practice.

Lack of detailed or updated family history

Limited time to obtain a detailed family history was a barrier in 4 of the 18 studies reviewed.[11,15,18,19] Use of family histories has been erratic for most primary care practices. An accurate family history is useful to make a diagnosis of a genetic disease, to determine a person's risk of developing a genetic disease, or to determine the risk of having a child with a genetic disease. Despite its utility, time availability limits the extent of history-taking by PCPs. As one physician pointed out, ". . .I've no idea how long a genetic history would take but if you were to add that on to the day I don't know how that would be resourced. . .."[11(p422)]

In a survey of Alabama primary care physicians, 71% of respondents obtained family histories from new patients, but nearly half did not update them at annual examinations.[18] In

Table 1
Characteristics of reviewed studies

Authors	Methods	Barriers	Results	Conclusions	Location	Methodological quality
Hofman et al., 1993[6]	Questionnaires regarding genetic knowledge and awareness of availability of tests were mailed to PCPs. *N* = 1795 Response rate = 64.8%	•Lack of genetic knowledge	Recent graduation from medical school and exposure to genetic specialists predicted higher knowledge scores. CME, medical journals, and pharmaceutical contacts were most frequent resources for genetic knowledge.	Most physicians will not increase their role in genetics until a greater emphasis is placed on genetics in medical education.	CA, IL, ME, NE, NY, OR, PA, SC, TX, UT (US)	8
Teague et al., 1996[7]	A genetics education module for medical students. *N* = 173 Response rate = 35.8% pretest, 57.8% posttest	•Lack of basic genetic testing and counseling knowledge	After module, knowledge scores increased and there were significant changes in students' attitudes toward genetic testing and counseling.	Small-group discussions of relevant case examples increase knowledge and awareness of issues regarding genetic testing for breast cancer.	Virginia	5
Friedman et al., 1997[9]	One-page survey mailed to PCPs. *N* = 350 Response rate = 30%	•Lack of referral guidelines •Lack of genetic knowledge •High cost of services •Insurance problems	PCPs would consider genetic screening but there is a need for CE programs on genetic testing for cancer susceptibility.	There is a need for educational modules on genetics to be incorporated into medical schools.	Texas	7
Hayflick et al., 1998[16]	Three-page survey mailed to primary care physicians. *N* = 1642 Response rate = 34%	•Perception of limited or no benefit from genetic services •Lack of knowledge	One in four did not know if genetic consults were available and reported no need for additional services.	New educational programs must go beyond imparting knowledge. Changes needed in perceptions and utilization of genetic services.	US Pacific NW (AK, ID, OR, WA)	7
Kolb et al., 1999[8]	A 16-hour genetics education program for PCPs in community health settings. *N* = 121	•Lack of genetic knowledge •Funding resources	Pretest: inadequate knowledge of basic genetics. Posttest: significant improvement in knowledge/attitudes for genetic services.	There is a need for genetic education and to address funding for genetic services. Added knowledge should assist PCPs in referral of patients to genetic services.	Texas	6
Fry et al., 1999[15]	Cross-sectional survey of GPs, pilot-tested on 50 then revised. *N* = 670 Response rate = 59.3%	•Lack of confidence assessing cancer risk based on family history •Low levels of confidence for delivering genetic services •Lack of time •Need for referral guidelines	Positive attitude for detailed family histories, referrals, emotional support for patients. Less support for counseling, calculating patient's cancer risk. Low confidence and limited time.	Cancer risk based on family history not seen as a reliable model; referral guidelines needed. GPs do not see training for themselves as a priority. Need effective model for effective involvement without increasing GPs' workload.	SE Scotland	6
de Bock et al., 1999[20]	Simplified GP guidelines were tested on patients whose pedigrees were already assessed using the expert guidelines of the "Clause Table." *N* = 67	•Use of complex referral guidelines •No information on how to manage moderate risk for genetics-related disease	The total number of misclassified patients was lowest when using the more simplified guidelines that offer dichotomous strategies (to refer or not to refer for genetic counseling).	More testing and refining are needed to increase their sensitivity regarding a referral to a family cancer clinic.	The Netherlands	4
Emery et al., 1999[23]	Qualitative analysis of semistructured interviews/video recordings of simulated consultations. *N* = 15	•Lack of confidence in assessing genetic risk •Lack of comfort in assessing genetic risk •Lack of knowledge regarding genetics and resources •Lack of appropriate office tools (such as computer software) to implement guidelines	The program was viewed as an appropriate, easy-to-use application of information technology but often affected their control of the consultation.	The program could provide the necessary support to assist assessment of genetic risk of cancer in primary care.	Britain	1
Kumar and Gantley, 1999[10]	Semistructured interviews with GPs and a further theorectical sample of 14. *N* = 44	•Lack of genetic knowledge	GPs view the "new genetics" as a series of additional tasks requiring new knowledge and skills. Most do not think genetics will have an impact on their present practice.	Tensions exist between policymakers and GPs in implementing the new genetics into primary care.	Britain	1
Watson et al., 1999[11]	Focus groups and individual interviews with GPs. Audiotaped transcripts/field notes were analyzed by three researchers. *N* = 26	•Lack of genetic knowledge •Limited time •Insurance problems •Lack of detailed family history	GPs comfortable with role of referral but not counseling. Only routine family histories used. Concerns: limited time, ethics, raising patient anxiety, insurance problems, and lack of knowledge.	Major educational efforts, local resource information, and referral guidelines are needed. GPs do not see genetic training as a priority.	UK	1

Table 1
Continued

Authors	Methods	Barriers	Results	Conclusions	Location	Methodological quality
Escher and Sappino, 2000[12]	A mailed survey sent to all GPs in Geneva, Switzerland. *N* = 400 Response rate = 65%	•Lack of genetic testing and counseling knowledge	The majority approved of genetic susceptibility testing. Objections were due to absence of approved strategies for prevention and detection of early breast cancer.	There is a favorable attitude toward genetic counseling and testing for breast/ovarian cancer, but defective knowledge scores underline need for education.	Switzerland	7
Mountcastle-Shah and Holtzman, 2000[14]	Qualitative analysis of interviews with PCPs. *N* = 60 Also a questionnaire was mailed. *N* = 752 Response rate = 13.3%	•Skepticism about validity/utility of genetic testing •Lack of clearly demonstrated clinical utility of knowing a test result •Concerns with costs	Uncertainty of clinical utility or validity of predictive genetics. Majority would participate in clinical studies but do not see genetics as important in their practice.	Large-scale, collaborative, practice-based evaluation of genetic technology is feasible. Participation in research may serve as an effective medium for genetic education.	MD, VA, DC (US)	6
Acheson et al., 2000[19]	Observation of PCPs by research nurses, review of medical records, billing data, exit questionnaires, physician questionnaires, and field notes. *N* = 138	•Lack of updated family history •Lack of time	Family history was discussed during 51% of the visits by new patients and 22% of visits by established patients. Family history was discussed more during well visits and lasted less than 2.5 minutes.	The data can form the basis for realistic interventions to increase the use of family history in primary care.	Ohio	7
Acton et al., 2000[18]	Questionnaire mailed to a random sample of PCPs. *N* = 1148 Response rate = 22.1%	•Lack of updated family history •Lack of time for genetic counseling •Lack of knowledge	A majority obtained a family history from patients, but they were not updated regularly. Lack of time hindered efforts to do genetic counseling.	There are gaps in PC practices in obtaining family histories of cancer, lack of confidence in explaining genetic test results, and making recommendations.	Alabama	7
Lucassen et al., 2001[21]	Referral guidelines were developed and sent to GPs. Referral letters were analyzed. *N* = 103, pre-guideline *N* = 110, posttest guideline	•Lack of referral guidelines tailored to general practitioners	Post-guidelines showed fewer "lower risk" referrals and genetic clinic risks agreed with GP letters.	The use of referral guidelines can help GPs to act as gatekeepers for referrals to secondary care.	England	3
Watson et al., 2001[22]	Cluster randomized control-Group A received education session + info pack, Group B received info pack alone, Group C received neither. (Questionnaires) *N* = 225, Group A Response rate = 62% *N* = 233, Group B Response rate = 53% *N* = 250, Group C Response rate = 70%	•Lack of confidence in counseling about risk and management	40% improvement in correct referral on five out of six cases in Group A (79%) compared with control Group C (39%), and 42% improvement in Group B (81%).	Providing general practitioners with an information pack significantly improved referral decisions. Adding in-house education session produced no additional improvements except increased confidence.	England	9
Mouchawar et al., 2001[17]	A survey was mailed to a random sample of family practitioners. *N* = 400 Response rate = 94%	•Lack of genetic knowledge	Overall knowledge of hereditary breast cancer was inadequate.	Family practitioners recognize their deficit in cancer genetics. Future cancer genetic outreach for PCPs is necessary.	Colorado	7
Watson et al., 2001[13]	Postreferral questionnaire mailed to referring physicians. *N* = 50 Response rate = 94%	•Lack of genetic knowledge	Many general practitioners did not know which patients warranted a referral to the genetic service.	GPs require further education if they are to become gatekeepers in the delivery of genetic services.	UK	6

PCP, primary care provider; CME, continuing medical education; CE, continuing education; GP, general practitioner.

Table 2
Barriers to the provision of genetic services identified in reviewed studies

Barriers	Authors
Lack of genetic knowledge	Hofman et al., 1993[6] Teague et al., 1996[7] Friedman et al., 1997[9] Hayflick et al., 1998[16] Kolb et al., 1999[8] Emery et al., 1999[23] Kumar and Gantley, 1999[10] Watson et al., 1999[11] Escher and Sappino, 2000[12] Acton et al., 2000[18] Mouchawar et al., 2001[17] Watson et al., 2001[13]
Lack of detailed or updated family history	Watson et al., 1999[11] Acton et al., 2000[18] Acheson et al., 2000[19] Fry et al., 1999[15]
Lack of referral guidelines or tools to facilitate their use	Friedman et al., 1997[9] Fry et al., 1999[15] Lucassen et al., 2001[21] de Bock et al., 1999[20] Emery et al., 1999[23]
Lack of confidence for delivering genetic services, assessing, and managing risk	Fry et al., 1999[15] Emery et al., 1999[23] Watson et al., 2001[13]
High cost of services	Friedman et al., 1997[9] Mountcastle-Shah and Holtzman, 2000[14]
Funding resources	Kolb et al., 1999[8]
Insurance problems	Friedman et al., 1997[9] Watson et al., 1999[11]
Perception of limited or no benefit from genetic services	Hayflick et al., 1998[16]
Skepticism about validity/utility of genetic testing	Mountcastle-Shah and Holtzman, 2000[14]
No information on how to manage moderate risk for genetics-related disease	de Bock et al., 1999[20]

this study, the information obtained about family cancer history was less than optimal for genetic risk assessment, screening, and prevention. Acheson and colleagues[19] also found family histories were updated less than half the time during an established patient's visit.

Lack of referral guidelines

Lack of guidelines was identified as a barrier in three of the reviewed studies.[15,20,21] Fry and colleagues affirmed that estimation of genetic cancer risk based on family history "is an unreliable method by which to expect general practitioners to make appropriate referrals to regional services."[15(p473)] These authors felt guidelines supportive of general practitioners' referral decisions need to be provided. De Bock and colleagues[20] attempted to develop a set of simple, practical guidelines for primary care physicians to use for referring and counseling women with a family history of breast cancer. While the simple guidelines lowered the number of misclassified patients, the researchers felt more testing and refining was needed to increase the guideline's sensitivity for referral to a family cancer clinic.

After discussion with local general practitioners, surgeons, radiologists, gynecologists, public health physicians, and geneticists, Lucassen and colleagues[21] found PCPs have difficulty with genetic referral decisions unless the risk is either very low or very high. These researchers established guidelines for referral of patients to a family cancer clinic and found that by using their practical guidelines, fewer "lower risk" patients were referred. In addition, analysis of general practitioners' letters of referral showed agreement with the genetic clinic's risk assessment.

Lack of confidence

Assessing and counseling about genetic risks requires knowing which choices are available. Watson and colleagues[22] found general practitioners lacked information about genetic services and options available to patients which, in turn, decreased their confidence to refer patients to services offered by genetic clinics. Authors of that study sought to determine whether provision of printed materials alone was effective to disseminate new knowledge and implement guidelines successfully. In their study, one group of physicians was issued a tailored information pack while another group received an education session and an information pack. No additional improvements in referral decisions were seen when general practitioners received an educational session along with the information pack. However, both groups fared better, with regard to appropriate referrals, than the control group that did not receive either aid.

Emery and colleagues[23] tested a computer program for assessing genetic risk of cancer in primary care. Before exposure to the computer program, general practitioners stated that while they felt it was their role to assess and refer patients with genetic risks, most felt uncomfortable with the task, even after attending courses on cancer genetics. According to the authors, "The doctors managed this discomfort in a variety of ways: some referred all patients concerned about their family history of cancer, some assessed risk using a heuristic approach, reflecting an incomplete memory of referral guidelines, and others attempted to reassure patients in the face of uncertainty."[23(p34)]

Fry and colleagues[15] assessed the views of 397 general practitioners in Scotland, regarding their role in cancer genetics services and their confidence in carrying out that role. The study's findings revealed low levels of confidence, even for genetic services tasks thought to be part of general practitioners' role. For instance, only 27% of respondents felt "confident, or very confident" "deciding which patients should be referred to a regional cancer genetics clinic."[15(p471)]

Methodological quality

Table 1 displays each study's methodological quality score, out of the possible maximum score of 10. Given the bias inherent in the criteria, the lowest-ranking studies were those that used a qualitative methodology. Nevertheless, qualitative studies were carried out with rigor and concern for validity and reliability. Of interest, one of the qualitative studies[14] achieved—even when compared to quantitative criteria—a score of 6. This study had a randomly selected sample and used both qualitative and quantitative analyses.

The methodological quality scores for the quantitative studies ranged from 3 to 9, with an average overall quality rating of 5.47. Only three of the studies[6,8,18] mentioned any validation of their survey instrument, or assessment of the scores' reliability.[24] Ten of the studies used descriptive statistics exclusively,[7–9,11–13,15–18] while only two studies used multivariate statistical analyses.[6,19]

DISCUSSION

According to this review, the majority of studies found that many health care providers are uncertain whether genetic discoveries will impact the daily practice of medicine in their primary care setting. For those PCPs who are willing to meet the rising demand for genetic health care, however, additional education and training in basic genetics will become an important need. According to Greendale and Pyeritz,[25] most of currently practicing physicians were exposed to only 29 hours of genetics in medical school and most of that knowledge is outdated. Williams complained that despite the "explosion of genetic knowledge in the past ten years," time devoted to genetics in medical school curricula remains the same.[26(p434)]

Although exposure to formal training in genetics within medical school curricula may affect only recently trained students, interventions are being designed to reach practicing providers. Evaluations of information resources designed to aid practicing physicians with the provision of genetic services are also beginning to emerge within the literature. These evaluations are finding that most physicians obtain genetic information from medical journals, continuing medical education courses, other practitioners, professional meetings, or pharmaceutical contacts.[6] Regarding the diffusion of genetic knowledge in primary care, a physician in Mountcastle-Shah and Holtzman's study stated, "Well it's going to be analogous to dumping the Encyclopedia Britannica on a ten-year-old. We're going to be able to read it, we're going to have a lot of information there.. . . The largest part of the challenge is going to be making sense out of it and deciding how we use it—making sense of its utility if you will."[14O(p413)]

Although lack of knowledge was the most often cited barrier among the reviewed publications, studies that identified lack of knowledge as a barrier operated under a basic and, perhaps, problematic assumption: that PCPs' lack of knowledge and/or skepticism is undesirable. Instead, studies of PCPs' knowledge levels would do well to examine the *meaning* of this void, and consider whether ignorance about genetic developments may signify, instead, uncertainty about the clinical utility of specific technologies. Such valid uncertainty or skepticism is not unique to PCPs, and it is equally shared by geneticists, practitioners, and public health professionals. As Burke and colleagues affirm, "When a [genetic] test has poor ability to predict clinical outcome and there is no associated treatment, testing is difficult to justify on either medical or social grounds."[27(p238)] Interventions designed to increase PCPs' genetic knowledge, therefore, should incorporate debate about genetic tests' clinical validity and treatment effectiveness.[27]

Findings from this review also suggest that—along with knowledge acquisition—PCPs will require training for the refinement of specific skills such as family history-taking and use of referral guidelines. Undoubtedly, family history represents a strong risk factor in many diseases[28]; it remains unclear, however, what types of family history and which elements of family history-taking are most appropriate in a primary care setting. Further investigation into these issues is essential.

Along with appropriate family history-taking, the availability of and appropriate training in the use of referral guidelines also warrant attention. A referral to a genetic clinic is expensive[20] and can cause undue stress and anxiety[21] for the patient and his/her family. As referral guidelines are being developed to assess and refer high-risk cases to genetic services, more care should be placed upon the development of guidelines for the management of low- and moderate-risk patients in a primary care setting.

The mere availability of appropriate and simple guidelines, however, does not guarantee that providers will feel comfortable using them routinely. Self-efficacy, or a level of confidence that one has the skills, resources, and persistence to competently perform screening and referral tasks, will also influence the decision to incorporate these services into practice. As seen in this review's findings, lack of confidence may represent an important barrier that must be addressed along with knowledge and specialized skills. Further examination of these two barriers (lack of referral guidelines and low perceived self-effi-

cacy to perform genetics-related tasks) should consider the compounded effect of one barrier on the other, in place of examining each of them in isolation: to what extent, for instance, is lack of confidence (self-efficacy) related to the absence of clearly outlined guidelines and, conversely, to what extent is the absence of guidelines due to assumptions about physicians' self-efficacy to screen for genetic risks?

While this study's main strength lies in organizing the available empirical evidence concerning PCPs' perceptions of barriers to the provision of genetic services, its main weakness is found precisely in the data being organized. None of the studies reviewed here (with one exception[14]) were designed to primarily assess providers' perceived barriers; such barriers were usually captured in the course of measuring other factors such as physicians' knowledge, attitudes, perceptions of role vis-à-vis genetic technology, referral behavior, and levels of confidence with specific genetic-services practices. Given that 7 of the 18 reviewed studies were designed to assess PCPs' knowledge, it is not unexpected to find that knowledge-related factors were the most often cited barriers limiting a more extensive inclusion of genetic technologies into primary care practice.

Another important limitation of this review is the methodological quality of the studies summarized. Examination of these studies' quality scores reveals that this body of literature is composed, mainly, of noninferential analyses of convenience samples with infrequent reporting of validity of measures and reliability of findings. Ten of the reviewed studies, for instance, had nonrandom, cluster, or nonsystematic samples. Despite the clear bias in favor of quantitative methods inherent in the evaluation criteria used in this review, some of the most useful information was provided by four qualitative studies.[10,11,14,23] Qualitative data provided richer descriptions of respondents' views and identified issues that were relevant to respondents' professional groups. Findings from this study suggest it is paramount that future research on PCPs' incorporation of genetic technologies pay attention to the quality of a study's design and measures, as well as strive to use valid methods and collect reliable data utilizing quantitative, qualitative, or mixed-methods approaches.

In addition to the need for methodological rigor, this review's findings suggest that further studies are needed to fill two important gaps. The first gap relates to the need for validation of these studies' findings and for establishment of their generalizability to various populations of PCPs, especially in nations other than Britain and the United States. The second gap consists of the need for evaluation studies of targeted interventions that address the barriers identified thus far. If lack of knowledge, for instance, remains an important barrier (after further validation studies), evaluation research is needed to determine which interventions are best suited to overcome this barrier: are continuing education credits better than conference presentations, for instance? Along with evaluation studies, further examination of which factors are perceived as facilitators of providers' behaviors are also needed. The identification and evaluation of factors amenable to intervention for supporting PCPs in their future genetics-related tasks may provide useful tools to promote the integration of genetics and primary care.

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