Genomic medicine in primary care: barriers and assets

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Sequencing the human genome created the tantalising promise of more personalised medicine. Futurists envisage a time when each individual undergoes genome sequencing at birth, stores the data on a chip or in an electronic health record (EHR), and allows healthcare providers to query it throughout one's life. Genomic medicine, the use of one's genotype in medical decision-making, may improve health outcomes, but the clinical translation of this vast body of scientific information is in its infancy. Nonetheless, some patients are eager to use genomic information to shape their healthcare now. Primary care providers (PCPs), however, may not share their patients' enthusiasm for this new technology. Prioritising actions supported by an evidence base of efficacy, safety and cost-effectiveness, PCPs identify many barriers to the use of genomic medicine.[1]

THE GENOMIC MEDICINE EVIDENCE BASE

The potential benefits of genomic medicine include improved disease risk assessment, selection of therapy and drug dosing. Its potential adverse effects include patient anxiety and the unnecessary and expensive tests and procedures that might follow from a genomic result.[2] Despite rapid advances in understanding the genetic architectures of many diseases, translational research into the outcomes of their clinical applications has lagged. The full risk-benefit ratio is thus unknown for almost all genomic tests, particularly for long-term outcomes. Primary care has a culture of evidence-based medicine that seeks to maximise health benefits and minimise unnecessary harms to patients. Consequently, PCPs may be reluctant to integrate genomics into clinical practice. Certain genomic tests have been better studied than others. Variants in the *BRCA1/2* genes have proven implications for the risk assessment and management of hereditary breast and ovarian cancer. In the USA, the Food and Drug Administration has included pharmacogenomic considerations for efficacy and safety on the labels of more than 100 medications including clopidogrel, warfarin and citalopram.[3] However, developing an evidence base for most genomic tests comparable to what is known about *BRCA* testing, for example, will require decades of research. Pending such research, however, PCPs can take comfort in a situation familiar to primary care: having to make clinical decisions despite an absence of sufficient evidence. PCPs are experts at combining the available evidence with professional judgement and open communication to make medical decisions with the individual patients in front of them. At the same time, their call for clinical and patient-centred outcomes will be a critical contribution to shaping the genomics research agenda moving forward.

PHYSICIAN KNOWLEDGE

The last decade has seen unprecedented genomic discovery and also major clinical advances in the management of common diseases including cardiovascular disease and cancer. In an environment with limited time for reading new medical literature, PCPs may not prioritise learning about genomic medicine. Moreover, many PCPs profess low confidence in their ability to use genetic information to make clinical decisions.[4] This challenge is not new to primary care; medical discovery always outpaces an individual's ability to master it. However, PCPs have several resources to help them adapt to new medical knowledge, including genomic medicine. The first is the emphasis on generalism that originally attracts many to primary care. The value of having a broad knowledge base spurs PCPs to read the medical literature widely while prioritising what is important to their patients' health. They often rely on clinical guidelines and resources from expert panels (table 1). They also cultivate networks of trusted colleagues through both informal 'curbside' and formal consultations. With the rise of genomic medicine, these networks will increasingly include genetics professionals, although their supply may be insufficient to meet growing demand. Knowledge learned through such interactions around one patient may apply to future similar patients. Generalists are also innovators in designing systems to help manage complex medical information. Clinical decision support is increasingly being introduced into EHRs across North America to alert prescribers about adverse drug interactions or to remind physicians about overdue health maintenance. Efforts are already underway to incorporate genomic data into the EHR and create systems to help manage large quantities of rapidly changing genetic information.[5] Moving forward, primary care residencies may also increasingly include genomics education.[6 7]

PATIENT PREFERENCES

Evidence gaps and lack of physician knowledge will not deter some patients from seeking genomic testing. Even without demonstrated clinical utility (defined here narrowly as a favourable balance of benefits and risks for health and disease outcomes[8]), patients in certain parts of the world may still request whole genome sequencing or seek direct-to-consumer genetic testing out of a belief that it will equip them to improve their health. A misalignment of patient and physician values may result. But while PCPs may believe that the clinical utility of such genetic testing does not merit its incorporation into their practices, patients' perceptions of its personal utility might. This concept incorporates a respect for each patient's health attitudes and preferences and is a central tenet of primary care. If providers do not meaningfully engage with patients in the health information they value, they may risk undermining the therapeutic relationship. Effective PCPs already use these episodes of patient engagement with their health as teachable moments to discuss medical evidence and explore the underlying health beliefs and values and personal preferences. These conversations can use existing models of shared decision-making that present options, discuss their risks and benefits and elicit patient preferences.[9] In the case of genomic medicine, PCPs should educate patients about its limits and the potential harms of uncertain and unwanted information while listening to patients' beliefs and preferences for engaging with their genetic make-up.

PCPs have a real opportunity to lead the discussion on the role of genomic medicine in patient care. The concepts of

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Table 1 Barriers to incorporating genomic medicine into primary care and existing assets to overcome them

	Scientific evidence	Physician knowledge	Patient preferences
Barriers to incorporating genomic medicine into primary care	Dynamic evidence base being continually updated Insufficient evidence on the relationship between genomics and clinical outcomes	Unprecedented scale of scientific discovery Limited time to spend reviewing scientific literature Low genetic literacy among primary care providers Limited supply of medical geneticists and other genetics professionals	Direct-to-consumer genomic services outside of clinical setting Patient interest in genomic information where there is questionable clinical utility Potential for patient anxiety around test results
Primary care assets to overcome these barriers	Critical appraisal of scientific literature Familiarity with medical decision-making under uncertainty Research agenda focused on patient-centred outcomes	Emphasis on generalism and broad knowledge base Networks with professional colleagues for consultation Incorporation of EHR-based clinical decision support into practice Use of clinical guidelines from professional organisations and expert panels Primary care genomics education	Environment of open communication and trust Effective use of teachable moments Shared decision-making based on evidence and patient preferences Clinical care in the context of families and familial risk

Selected genomic medicine resources available to physicians:
GeneReviews (http://www.ncbi.nlm.nih.gov/sites/GeneTests/review?db=GeneTests): a searchable compendium of diseases and their associated genetic variants including information about disease manifestation, the appropriate use of genetic testing, and recommendations for clinical management. Links to support groups and resources for patients and families are also provided.
Center for Disease Control and Prevention Office of Public Health Genomics (http://www.cdc.gov/genomics/gtesting/tier.htm): a list of genetic tests organised by the level of evidence supporting their use in specific clinical contexts.
Evaluation of Genomic Applications in Practice and Prevention (EGAPP) (http://www.egappreviews.org/): thorough evidence reports summarising the analytical validity, clinical validity and clinical utility of specific genetic/genomic tests. Evidence reports are commissioned on topics chosen from a prioritised list.

EHR, electronic health record.

shared decision-making and patient-centred care comprise the bedrock of primary care. These ideals have grown out of both a respect for patient autonomy in healthcare and also the pragmatic recognition that health can only be achieved if the patient is a partner in the medical process. In listening to their patients' values regarding genomic medicine, PCPs have the opportunity to harness those values for health.

Contributors All three authors made substantial contributions to the conception, writing and revision of the manuscript.

Funding This work was supported by National Institutes of Health grants U01-HG006500, R01-HG005092, K24-AG027841 and L30-DK089597.

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

To cite Vassy JL, Green RC, Soleymani Lehmann L. *Postgrad Med J* 2013;**89**:615–616.

Received 2 May 2013
Revised 21 September 2013
Accepted 24 September 2013

Postgrad Med J 2013;**89**:615–616.
doi:10.1136/postgradmedj-2013-132093

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