Siaw-Teng Liaw

Genetics and genomics in general practice

Background

The translation of molecular medicine into clinical practice has implications for general practice and personalised medicine.

Objective

This article outlines requirements for general practice to make optimal use of genomics.

Discussion

Genomics identifies variations in many genes, enhancing knowledge of gene-gene and gene-environment interactions. Unlike personal information, genomic information raises issues of privacy, potential family trauma and discrimination by employers and insurers. To embed genomics safely and effectively into practice, general practitioners need information, competencies and support through regulation, policy, information management, professional decision support, patient self management, community engagement and educational activities.

Keywords: genetics; general practice; genomics

Genomics can enhance the professional role of the general practitioner. A GP can provide ongoing, personalised, coordinated and comprehensive care to patients[1] as a custodian of confidential information in an environment of trust, and as a professional assisting the patient to make important decisions for their health.

Unlike personal clinical information, genomic information is 'shared' with blood relatives (ie. can be common to members of family) – in a genealogical network. The implications of this for individual consent, and authorisation of access to personal data, has led to an amendment of the Commonwealth Government *Privacy Act (s95AA)*, supporting guidelines for the disclosure of a patient's genetic information to at risk relatives without consent.[2]

Many patients want to know their genetic/genomic information – regardless of available treatment. The aggressive direct-to-consumer marketing of increasingly cheaper DNA tests has led to increasing numbers of tests, often carried out by online offshore laboratories, without any health professional involvement.[3] Inevitably, these consumers will consult their GP for assistance with choice of tests and interpreting results. However, research suggests that GPs are poorly prepared to deal with genomics issues.[4]

To date, much of what GPs understand about human genetics involves cytogenetics and germ line mutations in single genes identifying disease (eg. genetic carrier status for cystic fibrosis) and familial predisposition (eg. hereditary haemochromatosis). Genomics based DNA tests detect variations in many genes in germ line and somatic cells, eg. the MammaPrint® tests biopsy specimens for 70 different genes implicated in breast cancer. Such tests can more clearly define the level of risk for many common conditions, which can increase understanding of gene-gene and gene-environment interactions which form the basis of personalised medicine.[5]

Personalised medicine[5] comprises:

- predictive medicine (eg. assessing risks of developing cardiovascular disease[6])
- pharmacogenomics to identify patients at increased risk of adverse reactions (eg. to warfarin) or variation in responsiveness to particular therapies (eg. herceptin in breast cancer).

Genomic tests can also aid in the identification of individuals and biological relationships among individuals through common genomic markers (eg. paternity/ethnicity testing and forensic medicine).

How good is genomic information?

Does current genomic information enhance or improve on a detailed family history or genogram in the assessment of genetic risks? Tests results

are difficult to interpret because of:

- the high false-positive rates on tests for low prevalence genetic diseases
- the limited generalisability of existing (mostly European) genomic databases
- the current limited understanding of the complex interaction, over time, between the various factors in genome-wide association studies (GWAS).

Many genomic tests are promoted without any assessment against the Analytical validity; Clinical validity; Clinical utility; and Ethical, legal, and social implications (ACCE) framework,[7] which recommends that all tests have analytical validity, clinical validity and clinical utility; and be ethically, legally and socially acceptable. Clinical utility addresses whether earlier screening will benefit patients with higher risk. In Australia, the clinical utility and economic benefits of DNA tests are assessed by the Commonwealth Medical Services Advisory Committee. Regulatory, licensing and quality assurance programs have not kept up with the increasing availability of predictive DNA tests, leading the College of Pathologists to comment that DNA testing and counselling services are 'uncoordinated, inequitable and inefficient', and should be better resourced and coordinated nationally.[8]

How secure is genomic information?

Electronic information from GWAS is often shared, usually commercially, among many genomic laboratories. This creates a situation in which there can be potentially harmful leaks of genomic data among insurers, employers, data brokers and pharmaceutical companies hoping to profit. For instance, 23andMe, a popular retail DNA testing service, has a partnership deal with the Swiss firm, Mondobiotech.[9] Genomic privacy is so hard to protect that the Personal Genome Project[10] has warned volunteers that anyone submitting DNA for tests or use by the project, or other biobanks, should have 'the expectation of full public data release'.[10] Loss of genomic privacy can lead to family trauma, or genetic discrimination by employers or life insurance companies.[11] Although Australia has universal public health cover, predictive genetic testing could raise issues in relation to private health insurance in Australia.

Genomics in community discourse

Consumer education about genomics is vital and should be nationally coordinated and supported, using all information and communication technologies and media available. HealthInsite (see *Resources*) and the NSW Health Centre for Genetics Education (see *Resources*) are existing reputable online information resources. However, local reinforcement and interpretation of genomic information requires the active participation of well informed GPs, practice nurses, community health professionals, pharmacists, and other health professionals and educators. The highly personal nature of genomic information and the implications it can have for blood relatives, may facilitate greater appreciation of the complexity of genes, how they are expressed within larger somatic networks, and gene-environment interactions. Community education will enable better understanding of genes as independent risk enhancing or limiting factors and that genomic information is 'shared' information across our genealogical network.

Uses of genetic information

Open and matter-of-fact discussion is essential to debunking the concept of genetic determinism – the notion that there is a gene for everything from addiction to intelligence. Many consumer genomic testing companies maintain that their focus is patient education and not medical decision making, while others believe that information about genetic risks or gene based responses to prescription drugs will influence the practice of medicine.[12] By making DNA tests accessible, and democratising the field, 23andMe claims to be the 'Google of human genetics'. However, 'opening the field' does not mean there is no need for protection of information in the form of ACCE assessment, privacy preserving databases, accurate identification and authentication, and well developed standard operating procedures to manage personal information.[13]

GPs in the genomic age

General practitioners must increase their understanding of genomics, acquire relevant clinical competencies, improve collection of family histories, and manage ethical, legal and social issues. Undergraduate education, training and support of GPs are being considered by the National Health and Medical Research Council Human Genetics Advisory Committee (HGAC),[14] established in 2006 in response to the Australian Law Reform Commission report.[15] The HGAC is also currently funding a hardcopy edition of *Genetics in family medicine: the Australian handbook for general practitioners*.[16] However, sustained transformation to the genomic age will require strategies for regulation, policy, service delivery, information management, professional decision support, patient self management, and community engagement and education.[17] A coherent national regulatory framework covering evidence based genomic tests and services based on the international ACCE framework and the work of the United Kingdom Human Genetics Commission,[18] is necessary to underpin these strategies in Australia.

General practice – as a computerised healthcare home[19] for patients and their families – is well placed to manage the added complexity of the inclusion of genomic information in clinical practice. A well organised practice with secure information systems and decision support tools for patients and clinicians, in which continuity of information and care is maintained in a trusted and confidential environment within an ongoing patient-doctor relationship, can improve genomic diagnosis and management.[1] The GP will need the clinical and communication skills to be able to assist the patient to understand tests and their implications. The professional and organisational requirements of a healthcare home are developing as the multiple professional organisations consolidate their e-health policies and programs within the current health reform environment.[20,21]

Genomics services and training could be underpinned by a telegenomics network that includes professional and consumer information portals, DNA test delivery systems, interactive videoconferencing to support pretest and post-test counselling for patients, as well as providing genomics advice to GPs. The use of the *Genetics in family medicine* handbook[16] should be reinforced by training workshops and complemented by a support and advisory program. The utility and effectiveness of all programs that implement and support the use of genomics information should also be tested. Ongoing clinical practice can be supported by well tested

instruments to collect family history[22] and clinical decision support applications and programs.[23]

Conclusion

The GP is integral in the provision of appropriate genomics services, and in improving access and embedding scientific understanding of genomics in the community. However, there is great need to develop genomics knowledge and competencies and to adopt an integrated and multidisciplinary approach to the professional practice of human genomics in general and family practice.

Resources

- HealthInsite: www.healthinsite.gov.au/topics/Genetic_Diseases_and_Disorders
- NSW Health Centre for Genetics Education: www.genetics.com.au.

Author

Siaw-Teng Liaw PhD, FRACGP, FACHI, is Professor of General Practice, University of New South Wales, and Director, Sydney South West Area Health Service General Practice Unit, Sydney, New South Wales. siaw@unsw.edu.au.

Conflict of interest: none declared.

Acknowledgments

The author would like to acknowledge fellow members on the foundation National Health and Medical Research Council (NHMRC) Human Genetics Advisory Committee (2006–9).

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correspondence **afp@racgp.org.au**