Strategic Development of

genomic MEDICINE IN HONG KONG

ANNEX

Steering Committee on Genomic Medicine

Strategic Development of

genomic MEDICINE IN HONG KONG

ANNEX

Steering Committee on Genomic Medicine

ANNEX A

MEMBERSHIP AND TERMS OF REFERENCE OF STEERING COMMITTEE ON GENOMIC MEDICINE AND ITS WORKING GROUP

STEERING COMMITTEE ON GENOMIC MEDICINE MEMBERSHIP AND TERMS OF REFERENCE

MEMBERSHIP

Chairman

Professor Raymond LIANG Hin-suen

Expert Members

Dr Derrick AU Kit-sing

Dr Joseph AU Siu-kie

Professor Stephen LAM Tak-sum

Professor LAM Tak-wah

Professor LAU Yu-lung

Professor LEUNG Tak-yeung

Professor Dennis LO Yuk-ming

Professor SHAM Pak-chung

Dr Mary TANG Hoi-yin

Dr WONG Kit-fai

Institutional Members

Dr CHUNG Kin-lai,
Hospital Authority *(from February 2018)*

Dr Libby LEE Ha-yun,
Hospital Authority *(from December 2018)*

Dr Rebecca LAM Kit-yi,
Hospital Authority *(until February 2018)*

Professor Martin WONG Chi-sang,
Hong Kong Academy of Medicine

Professor TO Ka-fai,
The Chinese University of Hong Kong

Professor Nancy IP Yuk-yu,
The Hong Kong University of Science and Technology

Professor LEUNG Suet-yi,
The University of Hong Kong

Ex-officio Members

Under Secretary for Food and Health or representative

Commissioner for Innovation and Technology or representative

Director of Health or representative

TERMS OF REFERENCE

(a) To take stock of the current provision and application of genetic and genomic services in Hong Kong for healthcare services

(b) To recommend to the Secretary for Food and Health strategies for developing genomic medicine for healthcare, with a focus on the following areas –

(i). Screening: enhancing disease-based screening in specific subgroups and prenatal screening utilising genomics with proven efficacy and cost-effectiveness

(ii). Disease management: facilitating early diagnosis, personalised treatment and secondary prevention

(iii). Capacity building: building effective laboratory network and assuring the quality of laboratory services; as well as identifying manpower gaps and enriching training to healthcare professionals

(iv). Education: stepping up public education on genetics and genomic medicine

(c) To review the experience of other economies in and propose broad directions for addressing regulatory and ethical issues surrounding genomic applications, including genetic discrimination, direct-to-consumer genetic testing, privacy of genomic information, etc.

WORKING GROUP ON LABORATORY NETWORK FOR GENETIC TESTING

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Members

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Professor LEUNG Suet-yi

Dr Mary TANG Hoi-yin

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Dr WONG Kit-fai

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Food and Health Bureau

Consultant Clinical Geneticist,
Department of Health

WORKING GROUP ON BIOBANK

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Professor LEUNG Wai-keung

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Biotechnology Director,
Innovation and Technology Commission

Principal Medical and Health Officer (Health Technology and Advisory),
Department of Health

Senior Medical and Health Officer (Clinical Genetic Service) 1,
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WORKING GROUP ON HONG KONG GENOME PROJECT

MEMBERSHIP

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Deputy Convenor
Under Secretary for Food and Health

Members

Dr Josephine CHONG Shuk-ching

Dr Brian CHUNG Hon-yin

Dr CHUNG Kin-lai

Professor Nancy IP Yuk-yu

Dr LAM Ka-on

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ANNEX B

GENOME PROJECTS IN OTHER JURISDICTIONS

GENOME PROJECTS IN OTHER JURISDICTIONS

UNITED KINGDOM (UK) - THE 100 000 GENOME PROJECT[1]

Background

In December 2012, the UK Prime Minister announced a programme of whole genome sequencing (WGS), i.e. the 100 000 Genomes Project, as part of the Government's Life Sciences Strategy. The principal objective of the 100 000 Genomes Project was to sequence **100 000 genomes** from patients with cancer, and rare disorders, etc., and to link the sequence data to a database with standardised, extensible medical information of diagnosis, treatment, and outcomes. The Project was designed to produce new capability and capacity for genomic medicine that would transform the National Health Service (NHS). It also aimed to produce new capability for clinical genomics research. As part of the proposal, a secure infrastructure was established for the protection and analysis of clinical and genomic data. This was made available for approved academic and industrial research purposes, including those of the contributing clinical organisations from the NHS.

Implementation

2. The UK Department of Health established Genomics England as a wholly owned, limited company to deliver the project. Genomics England worked with NHS England (NHSE), Health Education England (HEE), NHS Trusts, the Northern Ireland Department of Health (DoH NI), and a number of other stakeholders. The project created NHS Genomic Medicine Centres (GMCs) to identify and enrol participants, which harnessed the existing capability and capacity of the NHS across England to contribute to the Project.

3. Genomics England also worked with research groups, to ensure that the new research capability would be fit for purpose and that the data was acquired and managed to appropriate standards. To maximise the value of the programme, Genomics England created the Genomics England Clinical Interpretation Partnership (GeCIP) which brought researchers, NHS teams, trainees and potentially industrial partners together to enhance the value of this dataset for healthcare benefit.

1 *Genomics England. 100 000 Genomes Project. Available from* ***https://www.genomicsengland.co.uk/***

Aims of project

4. The aims of the 100 000 Genomes Project were:

(a) **Patient benefit:** providing clinical diagnosis and in time, new or more effective treatments for NHS patients;

(b) **Scientific insights and discovery:** with the consent of patients, creating a database of 100 000 whole genome sequences linked to continually updated long-term patient health and personal information for analysis by researchers;

(c) **Accelerating the uptake of genomic medicine in the NHS:** working with NHS and other partners to deliver a scalable WGS and informatics platform to enable these services to be made widely available for NHS patients, and creating through the GeCIP a mechanism to both continually improve the accuracy and reliability of information fed back to patients and add to knowledge of the genetic basis of disease;

(d) **Stimulating and enhancing UK industry and investment:** by providing access to this unique data resource by industry for the purpose of developing new knowledge, methods of analysis, medicines, diagnostics and devices; and

(e) **Increasing public knowledge and support for genomic medicine:** delivering a transparent programme which has public trust and confidence and working with a range of partners to increase knowledge of genomics.

Scope covered by the project

5. Rare diseases and cancer were selected as the focus for the 100 000 Genomes Project as they present high potential for significant health gain from this Project. Focus on these diseases offered the strongest prospect of patient and scientific benefits and the ability to drive the transformation of the NHS in terms of application of genomic medicine. Furthermore, given the current state of knowledge regarding the genetic architecture of these diseases, the application of WGS might enable major new biological insights that would enable new diagnostics and therapeutic innovation.

Outcomes of the project and way forward

6. 100 000 Genomes Project was announced in 2012 with a cost of about **GBP 300 million**. There were 13 GMCs, 85 NHS Trusts and 1 500 NHS staff (doctors, nurses, laboratory staff, pathologists, genetic counsellors) involved. 100 000 genomes were completely sequenced in **December 2018, taking a total of around six years.** NHS is now equipped with enhanced genomic medicine service. With the established infrastructure, UK Department of Health has set out another vision for genomic medicine in the NHS, and **plans to sequence five million genomes over the next five years**.

SINGAPORE: NATIONAL PRECISION MEDICINE STRATEGY[2,3]

Background

7. The Singapore Ministry of Health is coordinating a multi-agency effort to develop an integrated national strategy for precision medicine (NPMS) and its subsequent implementation. An overarching Precision Medicine Steering Committee was established to lead the NPMS, with six working groups overseeing different issues including regulation and ethics, public and community trust, enabling platforms, clinical adoption, industry development and workforce development.

Implementation

8. The Genomic Institute of Singapore (GIS) was set up under the Ministry of Trade and Industry in 2000 to develop genomic sciences in Singapore with a focus on driving economic development ultimately. **The Singapore 10K Genome Project (SG10K)** led by the GIS **was introduced in 2016** and included as one of the initiatives under the NPMS. The primary purpose was to establish an at-scale infrastructure and to map out the genomic profile of Singaporeans according to their three main ethnicities (namely, Chinese, Malay and Indian), in view of the constraint that current genomic profiles for clinical and research purposes are predominantly from Western countries.

Scope covered

9. By design, the SG10K was a pilot research project **utilising existing cohort data, including healthy cohorts free of major diseases and patient cohorts.**

Outcomes of the project and way forward

10. The goal was to sequence 10 000 genome for further analysis. The initial findings of about 4 800 genomes showed that the genomic profiles of Asians are different from those of Caucasians and there are differences between Chinese, Malays and Indians too. Some common deleterious mutations (with Minor Allele Frequency > 0.01) which were absent in the existing public databases were found, highlighting the importance of local population reference for genetic diagnosis. The current reliance only on Caucasian data might reduce the clinical effectiveness of genomic medicine. The data could be used to improve genotype imputation not only for Singapore populations, but also for population across Asia and Oceania.

2 *Wu D et al. Large-scale whole-genome sequencing of three diverse Asian populations in Singapore. Cell. 2019; 179(3): P736-749 E15.*

3 *Singapore Ministry of Health. Speech by Dr Lam Pin Min, Senior Minister of State for Health, at the MOH Committee of Supply Debate 2018. 7 March 2018. Available from* ***https://www.moh.gov.sg/news-highlights/details/speech-by-dr-lam-pin-min-senior-minister-of-state -for-health-at-the-moh-committee-of-supply-debate-2018***

UNITED STATES: ALL OF US[4]

Background

11. The All of Us Research Program is a historic effort to gather data from one million or more people living in the United States to accelerate research and improve health. By taking into account individual differences in lifestyle, environment, and biology, researchers aim to uncover paths towards delivering precision medicine. The mission of the All of Us Research Program is to accelerate health research and medical breakthroughs, enabling individualised prevention, treatment, and care for the whole population.

Implementation

12. The All of Us Research Program is a key element of the Precision Medicine Initiative (PMI). Through advances in research, technology, and policies that empower patients, the PMI will enable a new era of medicine in which researchers, health care providers, and patients work together to develop individualised care. PMI was launched in fiscal year 2016 when **USD 130 million** was allocated to National Institutes of Health (NIH) to build a cohort with national, large-scale research participant group, and **USD 70 million** was allocated to the National Cancer Institute to lead efforts in cancer genomics as part of PMI for Oncology. The All of Us Research Program seeks to extend precision medicine to all diseases by building a national research cohort of **one million or more participants.** Enrollment of participants started in mid-2018.

13. Participants of All of Us will share different kinds of information over time. The programme will ask questions about their health, family, home, and work. The programme may also ask for access to their electronic health records. Physical examination will be conducted at clinics and the participants will be asked to give samples, such as blood or urine at the appointment..

Scope covered

14. This large-scale cohort does not focus on a specific disease, and instead will be a broad resource for researchers working on a variety of important health questions including precision medicine approaches in treating cancers and other diseases. The Program will also look into ways to increase an individual's chances of remaining healthy throughout their life.

Outcomes and way forward

15. Precision medicine is an approach to disease prevention and treatment that takes into account individual variability in genes, environment and lifestyle to aid in the development of personalised care. It can take many years to understand the contribution of a single unique variable on a given disease or treatment. It will take even more time to develop new treatments and methods of disease prevention. By launching a study of the size and scope of the All of Us Research Program, the NIH hopes to accelerate the understanding of disease onset and progression, treatment response, and health outcomes.

ICELAND: deCODE GENETICS[5]

Background

16. Genome sequencing of Iceland population is led by deCODE, a genome sequencing and analysis company based in Iceland. Using Iceland's uniquely comprehensive genealogical records, deCODE has also put together a genealogy database covering the entire present day population and stretching back to the founding of the country. The database has been very useful in research purpose including to detect *de novo* mutations (new mutations which are not known before).

Implementation

17. Since the establishment of the company in 1996, deCODE has gathered genotypic and medical data from more than **160 000 volunteer** participants, comprising well over half of the adult population. DeCODE has been identifying disease-related variants since it started, by correlating their genetic database with medical data from Iceland. The company has also discovered significant number of people with a special kind of genetic mutation that completely disables a gene (knocked-out genes). Finding individuals with knocked-out genes is made possible by the low background noise in Iceland.

Outcomes and way forward

18. Some results have already been published in renowned journals including *Nature Genetics*, including the identification of a new Alzheimer's-associated gene. The findings will help to guide medical research and the understanding of human evolution, through understanding of sequence diversity.

4 *US NIH. All of Us Research Programme. Available from* ***https://allofus.nih.gov/***

5 *deCODE genetics. Available from* ***https://www.decode.com/****; and Jónsson H et al. Whole genome characterization of sequence diversity of 15,220 Icelanders. Nature Scientific Data. 4:170115. 2017. Available from* ***https://www.nature.com/articles/sdata2017115***

DENMARK: DANISH REFERENCE GENOME PROJECT[6]

Background

19. GenomeDenmark is a national platform for sequencing and bioinformatics, which includes universities, hospitals and private firms. The main objective of GenomeDenmark is to establish a platform with research infrastructure to develop know-how, advance national coordination and create synergy within the field of genomics through broad cooperation across research fields and sectors. Genomic references are important and fundamental tools because they facilitate analyses of individual patients and their genes, including how hereditary disorders arise.

Implementation

20. One of the key projects by GenomeDemark is to establish a high quality Danish reference genome, in order to generate knowledge that can support the development of personalised treatment, based on genomic information, in the healthcare system. The project also generates knowledge that can be applied to the Danish pharmaceutical and food industries.

21. The project maps the genomes of 150 healthy Danes selected to represent the normal citizens in order to examine which variations can be observed in the Danish genetic material. The joint genomic information from all donors constitutes a Danish reference genome of high quality. The reference helps determine the structure and development history of the Danish genome and serve as a tool for research and development of genomics and public health.

Outcomes and way forward

22. In the future, it is expected that it will be possible to exploit genomic information generally in the healthcare system via large genomic data collected from many individuals. Establishing a Danish reference genome is an important step in the development of a far more individualised diagnosing and treatment process.

6 *GenomeDenmark. The Danish Reference Genome Project. Available from* ***http://www.genomedenmark.dk/english/about/referencegenome/***

ISRAEL: NATIONAL GENOMIC AND PERSONALISED MEDICINE INITIATIVE[7,8]

Background

23. Israel Government started in 2018 a national initiative to develop a genomic and clinical data research platform aiming to improve digital health technology and infrastructure to benefit the Israeli population.

Implementation

24. The Government plans to spend about **NIS 1 billion** (about **HKD 2.1 billion**) to support the National Genomic and Personalised Medicine Initiative, which aims to sequence over **100 000 patients' genomes by 2023** in order to improve targeted patient healthcare services. The multi-disciplinary program also aims to begin collaborating with Israeli health medical organisations (HMOs) and collecting patient samples. The project team will establish a national database for health researchers working in genetics and medical information, which will show long-term disease and illness trends of Israeli citizens. Researchers wishing to inquire about the participants' genomic data can apply for access to the database.

Outcomes and way forward

25. The Israel Ministry of Health is directing the national initiative in cooperation with other national organisations. It is envisaged that **samples collection from over 100 000 participants will be completed by 2023**.

7 *Gilmore J. Israel to Sequence 100K People, Create Genomic Database to Support 'Digital Health'. Genomeweb. 13 December 2018. Available from* ***https://www.genom eweb.com/ sequencing/israel-sequence-100k-people-create-genomic-database-support-digital-health#.XC7LZFwzY2w***

8 *Israel Ministry of Health. The Psifas Initiative for Precision Medicine. Available from* ***https://www.health.gov.il/English/About/projects/psifas/Pages/default.aspx***

MAINLAND CHINA: 100 000 CHINESE PEOPLE GENOME PROJECT[9]

Background

26. The 100 000 Chinese people genome project is a precision medicine research project under the national key research and development plan. The project is led by the Harbin Institute of Technology and was launched in December 2017.

Implementation

27. The project involves sequencing of 100 000 healthy subjects from different ethnic backgrounds and regions across China (the Han and nine selected minorities including the Zhuang and the Hui) and collection of their phenotype and environmental exposure data in four years.

Outcomes and way forward

28. The goal is to establish a reference database of genomic variation and health map for Chinese population to facilitate development of personalised medicine.

9 *Harbin Institute of Technology. 100,000 Chinese people genome project, a precision medicine research project led by HIT, is beginning. 5 January 2018. Available* ***from http://encs.hit.edu.cn/2018/0611/c5396a210190/page.htm***

ANNEX C

SUMMARY OF KEY DISCUSSION OF THE WORKING GROUP ON HONG KONG GENOME PROJECT

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The Working Group deliberated on a number of key principles regarding the overall project framework and principles for the Hong Kong Genome Project (HKGP). The gist of discussion is summarised below–

Project scope

2. The HKGP aims to perform 20 000 cases (or 40 000 to 50 000 whole genome sequencing (WGS)) in two phases for a period of six years. The pilot phase (2 000 cases or about 5 000 genomes) will cover patients with undiagnosed disorders, and cancers with clinical clues linked to possible hereditary / genetic components. The definitions and recruitment criteria for each disease category are elaborated below –

UNDIAGNOSED DISORDERS

(a) Definition

Disorders without a specific diagnosis after thorough evaluation through clinical assessment and routine investigations.

(b) Recruitment Criteria

(i) The patient is with a medical condition which meets the definition in (a); and

(ii) Consent of the patient is obtained for providing and sharing his medical information and samples; and

(iii) The patient (or legal guardian) agrees to trio testing, i.e. blood sample to be taken from patient and both parents. In case trio testing is not possible, inclusion or not depends on the relevant specialists' assessment.

HEREDITARY CANCER AND GENETIC PREDISPOSITION TO CANCER

(a) Definition

Meeting any of the following situations –

(i) having more than one first- or second-degree relatives[Note] with confirmed cancer;

(ii) developing cancer at younger age than expected for that cancer type;

(iii) paediatric cancer patients; or

(iv) having more than one types of cancer in the same person

Note: First-degree relatives: parents, children, and full siblings
Second-degree relatives: grandparents, aunts/uncles, nieces/ nephews, grandchildren, and half-siblings

(b) Recruitment Criteria

(i) The patient is pathologically confirmed with cancer which meets the definition in (a); and

(ii) Consent of the patient is obtained for providing and sharing his medical information and samples.

3. The coverage of the main phase (18 000 cases or 45 000 genomes) can be expanded to include other diseases and research cohorts which would benefit from WGS. The feasibility of recruiting private patients in HKGP should also be explored.

Principles of participation by patients

4. Participation in HKGP should be based on **three fundamental principles** –

(a) Participation in HKGP is entirely voluntary;

(b) The clinical care of participants will not be affected even if they decide not to take part in the HKGP; and

(c) Participants can withdraw from the HKGP without reason anytime.

5. Patients should not be charged for nor receive financial benefits from joining the HKGP.

Informed consent

6. Informed consent is critical to the implementation of the HKGP. Informed consent will be obtained for –

(a) Donation of DNA sample for repository and WGS;

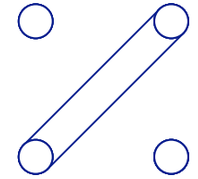
(b) Access, collection and analysis of participant's medical information and records; and

(c) Sharing of de-identified clinical and genomic data for approved research purposes.

7. Since participation in HKGP will not affect the existing clinical care of patients received at the Hospital Authority (HA), and the essence of HKGP is to build up a large database to facilitate research, consent to share de-identified data for approved research purposes should be a pre-requisite for joining the HKGP to ensure the completeness of the database.

Clinical data to be collected

8. HKGP should focus on disease analysis and thereby the types of data to be collected should be oriented towards the primary disease indications of participants.



Feedback of WGS results to participants

9. Participants will be provided feedback of WGS findings related to their primary indications within a reasonable time. While there is no obligation on the clinician to initiate re-analysis of WGS data, re-analysis may be conducted on a need basis such as the emergence of new evidence and technology. Clinicians should inform the participants if new clinical findings related to the primary indication are discovered.

10. Apart from the findings related to their primary indications, participants should be given an option whether to receive additional findings not directly related to their primary indication. There should be a specified list of additional findings, with reference to international guidelines (e.g. ACMG recommendations) and subject to regular review and update.

11. Unless there are significant medical implications, WGS results with suggestive findings on kinship should not be reported back to the participants as it is not the aim of the HKGP.

12. In general, the current local practice of allowing patients to decide whether to disclose genetic risks to their family members should be followed. The Food and Health Bureau and the Hong Kong Genome Institute (HKGI) should keep in view the development of relevant court cases overseas concerning the duty to disclose actionable genetic risks to patient's relatives when mapping out the way forward.

13. All the above arrangement should be clearly stated in the consent form and explained to the participant in the consent process.

Right of withdrawal from HKGP

14. Participants should be allowed to withdraw from the project without reason anytime. Data of withdrawn participants should be archived and sealed off from database, so that they are no longer available for new access requests. That said, the data should still be available for supporting completed and ongoing research, with access before the time of withdrawal.

Data security and privacy protection

15. Data security and privacy protection policies and protocols should be formulated in compliance with the local law requirements and with reference to the international practices.

16. Data should be kept in a secure, centralised information technology (IT) platform for access by clinicians and approved researchers. Security measures such as data encryption, user authentication, fine-grain access control, audit log, password policy, etc. should be employed to protect the data.

17. Only the authorised staff of Partnering Centres should be granted access to the identifiable information of participants under their care, while approved researchers should only be granted access to de-identified data.

18. All staff and researchers who need to access the data should be subject to strict contractual confidentiality obligations. Clauses such as prohibition of re-identifying study participants by researchers granted access to de-identified data and penalty for unauthorised use of data could be imposed.

Data access mechanism and use of data

19. In general, data should only be accessed and analysed within the secure, controlled IT platform managed by the HKGI. A tiered data access system should be adopted according to the data sensitivity and the purpose of using the data. A three-tier data access system as below should be considered –

(a) Tier 1 (identifiable, individual-level genomic and clinical data): clinicians of Partnering Centres should be given access to the data of their patients for patient care purpose. Identifiable data should in general be restricted for use in patient care only and not in research unless under special circumstances such as publishing case study reports where individual patient's permission has been obtained.

(b) Tier 2 (de-identified, individual-level, linked genomic and clinical data): access should be granted to researchers on a project-by-project basis and only dataset necessary for conducting the approved research project could be accessed.

(c) Tier 3 (anonymous, aggregate data): aggregate data can be accessed by researchers after registration.

20. In general, data for patient care should be provided to the Partnering Centres as soon as practicable. De-identified data could be released by HKGI in batches. Priority access to research data should be given to Partnering Centres and others who have substantial input to the HKGP as an incentive for and recognition of their contribution.

ANNEX D

EVALUATION OF GENETIC AND GENOMIC TESTS

EVALUATION OF GENETIC AND GENOMIC TESTS

Evaluation Framework

Given the rapid development of genetic/genomic tests, an assessment of their benefits, risks, and limitations is crucial for clinical use. There are a number of evaluation frameworks. A review identified that over 20 frameworks have been adopted in various countries[10]. Nonetheless, the majority are based on the ACCE Framework (whose name derives from the evaluation components used: analytic validity, clinical validity, clinical utility, and ethical, legal and social implications (ELSI)) which are defined as follows –

(a) Analytic validity is the ability of the test to accurately and reliably measure the genotype of interest and it is most frequently addressed in terms of sensitivity and specificity;

(b) Clinical validity is the ability of the test to accurately and reliably detect or predict a clinical condition;

(c) Clinical utility compares the risks and benefits of testing and provides evidence of clinical usefulness for the integrated package of care in terms of measurable health outcomes; and

(d) The ELSI evaluation component is concerned with the moral value that society confers on the proposed interventions, the specific related legal norms and the impact on the social life of the patient and his or her family.

2. The ACCE framework has been adopted by institutions/organisations like US Office of Public Health Genomics under the Centres for Disease Control and Prevention (CDCOPHG), UK Genetic Testing Network (UKGTN), EuroGentest, etc.

10 *Pitini E et al. How is genetic testing evaluated? A systematic review of the literature. European Journal of Human Genetics. 2018. 26:605–615.*

EVALUATION OF GENETIC TESTING BY SELECTED OVERSEAS INSTITUTIONS

UKGTN

3. The UKGTN evaluates new genetic tests that member laboratories would like to offer to NHS patients for rare disorders that usually affect fewer than 1 in 2000 as described in the UK Rare Disease Strategy. Laboratories complete a form called a "Gene Dossier" which is submitted to the UKGTN Genetic Test Evaluation Working Group. The Genetic Test Evaluation Working Group consists of over 20 members from different institutions of the field and include molecular scientists, genetic counsellors, bioinformaticians, clinical geneticists, public health experts, etc.

4. New genetic tests that are approved for service by the working group are recommended initially to the UKGTN Clinical and Scientific Advisory Group for ratification and subsequently to commissioners of NHS genetic services. Information about the test, disease epidemiology, clinical requirements, etc are listed in the dossier. A genetic test under UKGTN is described as a test for a specified population, for a particular disease and defined genetic variants and for a specific purpose. The UKGTN evaluation of a test considers each of the following elements –

(a) The analytical sensitivity and specificity are determined by the technologies and methodologies used in the laboratory;

(b) The test evaluation process also considers how the technologies and methodologies have been validated in the providing laboratory;

(c) The clinical sensitivity and specificity are calculated for the target population where the target population is described by clinical features or family history of clinical features; and

(d) The utility of the test describes how the management of the patient will be affected by testing.

5. All approved tests are listed on the online database of genetic testing services and also added to the NHS Directory of Genetic Disorders/Genes for Diagnostic Testing. This process assures commissioners and healthcare professionals that the new tests are appropriate for use. The recommendation to fund and provide new tests that have passed the UKGTN test evaluation process is for the relevant health authorities in the United Kingdom. In England, services which require additional NHS investment will be recommended by UKGTN to the NHS England Clinical Priorities Advisory Group to review the resource implications for the commissioning process.

6. Due to the rapid development of new testing technology including next generation sequencing (NGS) and the emergence of whole exome sequencing and panels testing for a larger number of genes, some older genetic tests will be replaced in the long run[11]. NHS England has worked with Genomics England to publish a National Genomic Test Directory[12, 13], initially for rare and inherited disorders and cancer, specifying which genomic tests are commissioned by the NHS in England, the technology by which they are available, and the patients who will be eligible to access to a test. The Test Directory will include all genetic and genomic tests from single gene tests through to whole genome sequencing, delivered by the new Genomic Laboratory Hubs. Over time, as the evidence develops, it will also include other functional genomic tests, for example, RNA-based technologies and proteomics. Expert panels under NHS England will review relevant evidence including those of UKGTN.

US CDC (OFFICE OF PUBLIC HEALTH GENOMICS)

7. The CDCOPHG aims at providing timely and credible information for the effective and responsible translation of genomics research into population health benefits. It conducts horizon scanning (a systematic research method to find and follow novel technologies appearing in the literature) to identify and track the progress of genomic tests as they move from research into clinical and public health practice. CDCOPHG has developed a three-tiered framework for classifying genomic testing and family health history applications based on the availability of scientific evidence. The three-tier model is as follows –

(a) Tier 1/green applications are supported by a base of synthesised evidence for implementation in practice, e.g. BRCA-associated hereditary breast and ovarian cancer (U.S. Preventive Services Task Force recommendation).

(b) Tier 2/yellow applications may provide information for informed decision making based on existing evidence; however, synthesised evidence is insufficient to support routine implementation in practice, e.g. using whole genome sequencing for rare familial diseases.

(c) Tier 3/red applications are not ready for routine implementation in practice based on synthesised evidence culminating in recommendations against use, or no relevant synthesised evidence identified; however, they might be candidates for population or clinical research, e.g. direct-to-consumer personal genomic tests.

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11 *UKGTN. Evaluation of new genetic tests for NHS services. September 2017. Available from* ***https://ukgtn.nhs.uk/fileadmin/uploads/ukgtn/Documents/Resources/Library/Reports_Guidelines/Report_Gene_Test_Recommendations_CSAG_SEPT17_amend_353.pdf***

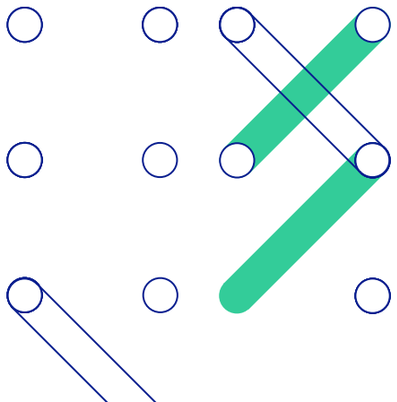
12 *Hill S. The genomic revolution – its future. 23 March 2018. Available from* ***https://www.england.nhs.uk/blog/genomic-revolution/***

13 *NHS National Genomic Test Directory 2019/2020. Available from* ***https://www.england.nhs.uk/publication/national-genomic-test-directories/***

8. The method of classification is designed to provide a high level overview rather than a detailed analysis of selected conclusions from available evidence sources. Therefore, CDCOPHG also states that the classifications should not be construed as an endorsement or official position of CDC. The process is not intended to capture all of the information necessary to inform clinical or public health practice or policymaking. Nonetheless, the findings can be useful as a starting point for people interested in identifying relevant evidence sources, in order to accurately and effectively interpret and employ the recommendations. As such, more effort would be put on implementation of Tier 1 applications which have significant potential for positive impact on public health based on available evidence.

EUROGENTEST

9. EuroGentest is a project funded by the European Commission to harmonise the process of genetic testing, with the ultimate goal to ensure that all aspects of genetic testing are of high quality thereby providing accurate and reliable results for the benefit of the patients. EuroGentest provides annual update of the clinical utility gene cards (CUGCs) which are disease-specific guidelines regarding the clinical utility of genetic testing, and assess the ability of a genetic test to significantly affect the clinical setting and patient outcome. CUGCs cover all elements relevant for assessing risks and benefits of genetic test application, enabling quick guidance to all stakeholders. ACCE framework is being used in CUGCs as the main component. Each CUGC is authored by an international expert team. Subsequent to peer-review, the documents are published in the European Journal of Human Genetics.



ANNEX E

EXECUTIVE SUMMARY OF THE STRATEGIC SERVICE FRAMEWORK FOR GENETIC AND GENOMIC SERVICES OF HOSPITAL AUTHORITY

EXECUTIVE SUMMARY

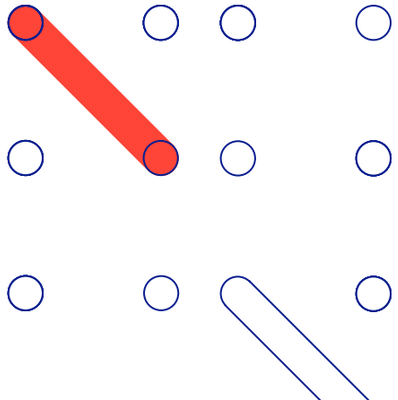
INTRODUCTION

The Hospital Authority (HA) Strategic Service Framework for Genetic and Genomic Services (The Framework) is the overarching blueprint for guiding the planning and development of human genetic and genomic services in HA over the next five to ten years. It outlines the directions and strategies for building up the service model to address the existing issues and improve the service quality.

According to the World Health Organisation, genetics is the study of heredity and the mechanism by which genetic factors are transmitted from one generation to the next; while genomics is the study of the structure and action of the genome (which is the complete set of genes), including how the different genes interact with each other and with the environment. The global trend of healthcare systems is moving towards integrating genetics and genomics (G/G) into mainstream clinical practices to facilitate personalised and precision medicine.

In view of rapid advances in the field of G/G worldwide that have transformed medical care, it is important for HA to enhance its G/G services and harness the potential of the relevant technologies for improving patients' health outcomes. In this regard, concerted efforts are required from frontline clinical and laboratory staff, as well as executives from the hospitals, Clusters and HA Head Office to work together towards achieving the following vision:

> **HA aims to provide structured and coordinated G/G services that are evidence-based and keeping pace with advances in G/G development, through professional staff with the relevant skills and expertise to meet patients' healthcare needs in a timely and equitable manner.**

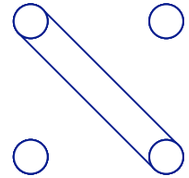


PLANNING PROCESS

Formulation of the Framework commenced in late 2017. Under the policy direction and guidance of the Medical Services Development Committee (MSDC) and the Directors' Meeting, a Taskforce was established to oversee the formulation process. Working Groups were also set up to advise on the future governance and service development, as well as the specific areas of cancer G/G services, and prenatal and paediatric G/G services. Overall, a highly participative and broad engagement approach was adopted, with involvement of frontline healthcare staff and representatives from relevant Coordinating Committees (COC) and Central Committees (CC), as well as HA executives. In addition, as key providers of G/G services in Hong Kong, representatives from the Department of Health Clinical Genetic Service (DH CGS), the University of Hong Kong (HKU), and the Chinese University of Hong Kong (CUHK) also participated.

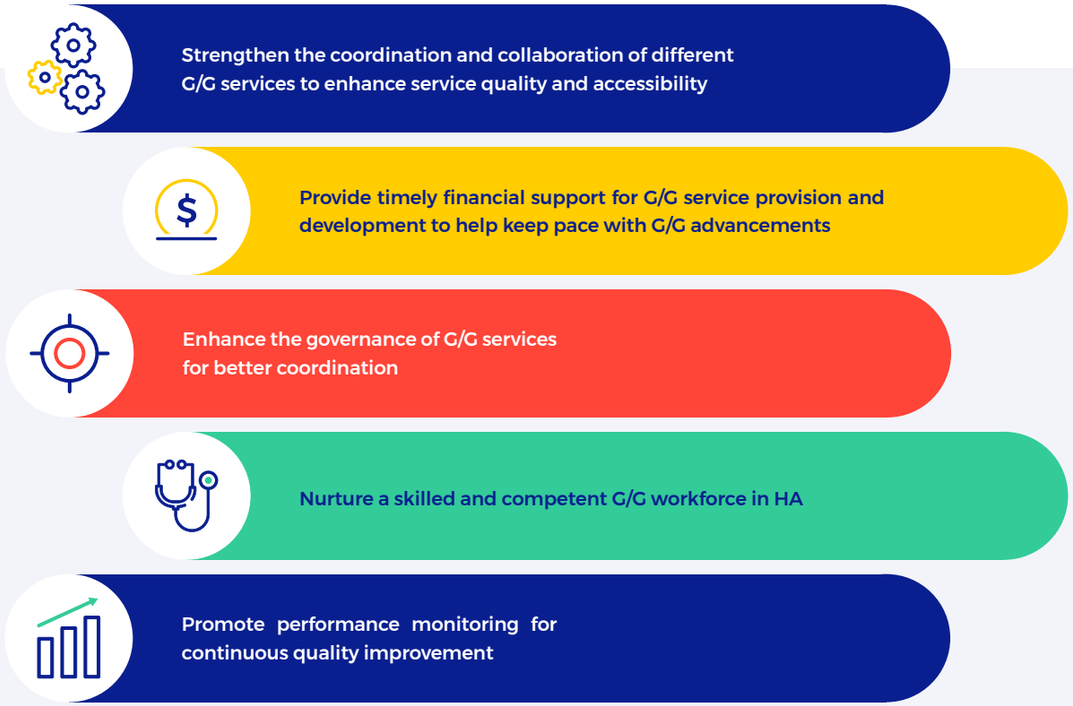
The formulation process included literature review to gather information about overseas experience and developments, as well as situation analysis of the local service landscape, particularly with regard to HA's existing G/G services. In addition, a comprehensive consultation exercise was carried out to identify the key issues and draw up the strategies for addressing them. This comprised a workshop carried out by an overseas expert, questionnaire survey of key specialties on G/G services in HA, hospital and site visits, and meetings with relevant COC/CCs and survey respondents.

The findings and proposed strategies were put forward to the Taskforce for formulating the Framework, and regular reports were made to the Directors' Meeting and MSDC for policy direction. Consultation on the draft Framework was conducted in June 2019. The responses and comments received were carefully considered and deliberated by the Taskforce. The refined Framework was subsequently submitted to the Directors' Meeting for endorsement, and then to MSDC for final approval.



FRAMEWORK STRATEGIES FOR HA'S GENETIC AND GENOMIC SERVICES

The Framework comprises five strategic directions for HA to improve its G/G services, covering service organisation, financial support, governance, talent and expertise, and performance monitoring, as follows:



Under each strategic direction, strategies have been formulated with reference to the identified key issues or opportunities for improvement in HA's G/G services.

1. STRENGTHEN THE COORDINATION AND COLLABORATION OF DIFFERENT G/G SERVICES TO ENHANCE SERVICE QUALITY AND ACCESSIBILITY

Opportunities for Improvement

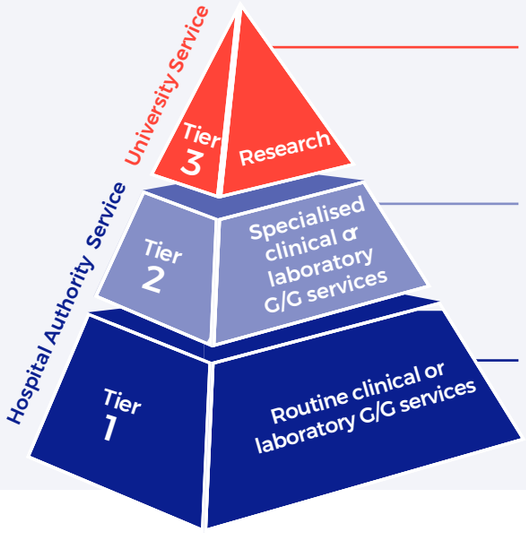
Due to the historical development of public clinical genetic service in Hong Kong, there is currently no dedicated clinical department providing G/G services in HA, while DH is the main service provider although it does not offer treatment for G/G disorders. In general, HA's G/G services have mostly developed at the local level and on an independent basis by individual clinicians or hospitals according to the interest and expertise of the respective staff and local needs, and have largely been driven through laboratory initiatives. The absence of a structured clinical genetic service in HA has resulted in significant service gaps, along with a mismatch between clinical needs and laboratory support. Moreover, there are very few standard protocols or test criteria for G/G services in HA and referral practices vary considerably, often relying on the informal links between individuals or departments, which give rise to inequitable access to the services.

Strategies

In order for HA's G/G services to develop and move forward, it is crucial to improve the service organisation by strengthening their coordination and collaboration so that the services are more structured and systematic. Strategies include:

- Developing structured and coordinated G/G services by organising different services based on a tiered approach. The services will be organised into three tiers according to service complexity and expertise requirement, as shown in the following diagram. Tier 1 consists of routine services provided in local hospitals through a Cluster-based approach. Tier 2 comprises specialised services which will be provided at designated centres to concentrate the caseloads and expertise. Tier 3 involves innovative services that will be provided mainly in the teaching hospitals by the universities as part of research.

Structured Genetic and Genomic Services based on a Tiered Approach



Universities

Innovative clinical and laboratory G/G services conducted as part of research (e.g. pilots or clinical trials)

Designated Centres

Low volume and high complexity G/G services, which would benefit from concentration of caseloads and expertise

Localised (Cluster-based) Provision

High volume and low complexity G/G services, often requiring short turnaround time

- Establishing collaborative G/G service networks according to a programme-based hub-andspoke service model. The "hubs" are Tier 2 designated centres providing specialised services, while the "spokes" are Tier 1 routine services provided locally. The different networks could be grouped under the following three themes: (i) Paediatric Programmes that cover networks for prenatal, newborn and paediatric G/G services; (ii) Disease / Condition-based Programmes, such as networks for cancer G/G services; and (iii) Organ-specific Programmes, such as cardiac G/G service networks.
- Developing a G/G Service Directory to facilitate standardised service provision and information sharing. The electronic Directory will provide up-to-date reference on where HA funded G/G clinical services and laboratory tests are available, as well as the access criteria.

2. PROVIDE TIMELY FINANCIAL SUPPORT FOR G/G SERVICE PROVISION AND DEVELOPMENT TO HELP KEEP PACE WITH G/G ADVANCEMENTS

Opportunities for Improvement

Largely due to the independent development of G/G tests across HA, as well as unavailability of certain tests as standard service, there are variable funding arrangements for G/G tests received by patients. The funding mechanism can include HA funding, self-financed items (SFI), funding by universities, and sponsorship by pharmaceutical companies, which is complicating how tests are provided and their accessibility. In addition, some HA laboratories may cross-charge other HA hospitals and departments for tests that have been referred to them, mainly because they are developing and providing the tests using their baseline budgets without additional resources. An underlying reason is the long lead time in the annual planning cycle for getting the resources, which cannot keep up with the rapid G/G development.

Strategies

The development of structured and accessible G/G services in HA requires appropriate planning and allocation of financial resources. To tie in with the fast pace of G/G development and the reengineered service model, the strategies include:

- Establishing a designated fund to help expedite the introduction of new G/G tests into HA. The funding will be allocated to the relevant departments on a time-limited basis to pilot and evaluate new tests. Recurrent funding, if needed, could subsequently be sought through the annual planning process.
- Developing programme-based funding to support the collaborative G/G service model. The funding will be distributed among the clinical departments and laboratory services involved in a specific G/G programme for meeting their operational needs, including to designated centres for providing specialised services across HA. Steps will also be taken to provide and fund the relevant biomarker tests for drugs in the HA Drug Formulary.

3 ENHANCE THE GOVERNANCE OF G/G SERVICES FOR BETTER COORDINATION

Opportunities for Improvement

Over the years, CC(Genetic Services) has been the only platform for coordinating HA's G/G services. Despite its cross-specialty membership, coordination of the specialties and hospitals providing G/G services as well as between the clinical and laboratory services is suboptimal. As a result, the G/G tests and technologies are not introduced into HA in a systematic or coherent manner, and they are often not in sync with the overall clinical need. At the same time, there is no mechanism for evaluating when to transpose research-based services into HA. This means well-evidenced services or tests from the academic sector are not transferred into mainstream clinical practice in a timely manner, which could otherwise have benefitted a wider number of patients. All these have contributed to HA's G/G services falling behind international developments.

Strategies

Robust governance is essential for HA's G/G services to ensure the service provision and development is carried out in an effective manner with transparency and accountability. This includes the governance in determining which innovations or new technologies should be introduced and how to introduce them. Strategies include:

- Strengthening the governance structure and process for overseeing G/G service provision and development. A newly established Steering Group on Genetic and Genomic Services in HA, chaired by the Chief Executive, will steer the overall development with regard to the strategies laid out in this Framework. Under the guidance of the Steering Group, CC(Genetic Services) will oversee the service development and coordination. In addition, various Expert Panels for clinical and laboratory work streams as well as for the different programmes in the new service model will be set up under CC(Genetic Services) to provide advice, and will include representatives from the universities and DH CGS as appropriate.
- Establishing a central mechanism for assessing and prioritising the introduction of new G/G services in a timely and systematic manner. To be developed under the revamped governance structure, the mechanism will cover all G/G services that are proposed to be included as HA standard service and which require additional resources. It will also cover the transfer of G/G services across the different service tiers, including the translation of research-based services into HA service.

4 NURTURE A SKILLED AND COMPETENT G/G WORKFORCE IN HA

Opportunities for Improvement

As far as specialised G/G expertise is concerned, there is at present no "Clinical Geneticist", "Genetic Counsellor", or "Bioinformatician" establishment in HA. Most of the expertise is vested in HKU, CUHK and DH CGS. Besides, the role and duties of staff involved in HA's G/G services are not well defined and there are different interpretations among departments on what they should involve. It is also unclear who should perform certain tasks, such as genetic counselling or the ordering of tests. As a result, there is variability across HA on what staff are involved in G/G services and to what extent. In addition, there is inadequate genetic literacy among healthcare staff. Many of them may not be able to recognise conditions with a genetic basis.

Strategies

Fundamental to the provision of HA's G/G services in alignment with the reengineered service model is a workforce with the right mix of skills and competencies. The priority is to strengthen the workforce for delivering the different tiers of G/G services. Strategies include:

- Setting out the competency requirements and building up relevant expertise for the delivery of advanced G/G services. This includes defining the qualifications, professional competencies and associated training for specialised roles.
- Taking steps to raise the G/G literacy of healthcare staff for enhanced awareness and capabilities. The aim is to facilitate the healthcare staff in managing common G/G cases and knowing when to appropriately refer to specialised G/G services.

5 PROMOTE PERFORMANCE MONITORING FOR CONTINUOUS QUALITY IMPROVEMENT

Opportunities for Improvement

At present there is no systematic monitoring of HA's G/G services in terms of quality and performance. Service monitoring is mostly performed at the department level in the absence of standardised HA-wide indicators.

Strategies

Systematic monitoring of clinical and laboratory G/G services is important to help drive improvements. Strategies include:

- Identifying key domains and developing indicators for evaluating and monitoring patient outcomes.
- Enhancing data collection, including standardisation of data capture and alignment of measuring tools.

KEY ENABLERS

Implementing the strategies will require key enablers, in particular Information Technology (IT), to support the service development. For instance, IT system infrastructure will be crucial in enabling the workflow, communication and coordination of different clinical specialties and pathology disciplines. Specifically, IT will be deployed in the establishment of the electronic G/G Service Directory, and in providing system support for the collection, storage, analysis and sharing of high volumes of G/G data in HA.

IMPLEMENTATION AND MONITORING

Successful implementation of the Framework requires the concerted efforts of various stakeholders and input of different resources. It will be led by the Steering Group on Genetic and Genomic Services in HA, which will report to the Directors' Meeting and MSDC, as appropriate, on the development of G/G services in HA. While the overall directions and strategies are laid out in this Framework, the operational details for the implementation will be worked out by the key stakeholders under the guidance of the Steering Group. Some of the strategies do not require additional resources, while others will incur resources, which could be sought through the annual planning process.

The implementation will be monitored at different levels, including the existing mechanism of Annual Plan programme monitoring; progress review of the operational plan for the Framework to be conducted by CC(Genetic Services), with guidance from the Steering Group on Genetic and Genomic Services in HA; and the development of HA-wide quality indicators on clinical and laboratory G/G services.

CONCLUSION

Rapid advances in the field of G/G internationally have transformed our understanding of the role our genes play in health and disease. Keeping in pace with the development and adopting the relevant technologies to guide healthcare decisions and treatment is the way forward for healthcare systems worldwide. As the blueprint for HA's G/G services, the Framework sets out the directions for HA to work towards in this regard, thereby contributing to the overall development of G/G in Hong Kong. The strategies will not only help address the service needs of today, but also lay the foundations for HA to leverage on the huge potential of G/G innovations and advancements to benefit patient care in the years to come.

ANNEX F

SUMMARY OF PROGRAMMES ON GENETICS AND GENOMICS OFFERED BY LOCAL UNIVERSITIES

SUMMARY OF PROGRAMMES ON GENETICS AND GENOMICS OFFERED BY LOCAL UNIVERSITIES

MEDICAL GENETICS

The CUHK has offered the Master of Science in Medical Genetics programme from 2014 onwards. The program is tailor-made for clinical professionals (such as obstetricians, paediatricians, physicians, nurses and midwives) who are managing patients and families with genetic diseases in their daily practice, laboratorial professionals who are working on genetic and genomic testing, and others working in related fields who would like to develop their career as genetic counsellors.

GENETIC COUNSELLORS

2. CUHK has been offering a part-time programme "Professional Diploma in Genetic Counselling" since 2018, with target participants being nurses, laboratory technologists and psychologists, etc.

BIOINFORMATICIANS

3. The School of Biomedical Sciences of CUHK has been offering the Master of Science in Genomics and Bioinformatics programme since 2011, which aims at training personnel who are interested in joining the industry in genomics, bioinformatics and personalised medicine.

4. HKU Master of Science in Computer Science also runs a module on computational methods and data structures for analysing biological data (e.g. DNA, RNA and protein sequences).

5. HKUST has recently launched an initiative to develop data analytics for biological and physical sciences, which will enable the university to recruit data analytics experts and to enhance its strength in genome analysis and mining, bioinformatics, and health informatics.

BIOMEDICAL SCIENTISTS / LABORATORY SCIENTISTS

6. The Division of Life Science of HKUST offers a variety of courses on biomedical sciences and developmental biology, as well as training for genetic laboratory scientists.

7. CUHK offers the Bachelor of Science in Biomedical Sciences programme covering molecular techniques for genetics and medicine, as well as the Master of Medical Laboratory Science programme at postgraduate level.

8. HKU offers the Bachelor of Biomedical Science programme covering subjects including molecular diagnostics laboratory and genomic science, as well as training at postgraduate level for genetic laboratory scientists.

9. The Hong Kong Polytechnic University offers both undergraduate and postgraduate degree programmes in Medical Laboratory Science, which covers human genetics among other subjects.

ANNEX G

INTERNATIONAL PRACTICES IN QUALIFICATIONS FOR GENETIC COUNSELLORS

INTERNATIONAL PRACTICES IN QUALIFICATIONS FOR GENETIC COUNSELLORS

UNITED KINGDOM (UK)

Genetic counsellors in UK are registered under Genetic Counsellor Registration Board (GCRB)[14]. The board was accredited by Professional Standard Authority, an independent body, accountable to the UK Parliament.

2. To register as a genetic counsellor, the applicants must hold a GCRB accredited master degree in genetic counselling; or be an experienced registered nurse or midwife holding an undergraduate or master degree with accredited training on counselling and human genetics. Applicants also need to have experience related to genetic counselling.

AUSTRALIA

3. Genetic counsellors in Australia are certified by The Human Genetics Society of Australasia (HGSA)[15] Board of Censors for Genetic Counselling.

4. Graduates of a two-year clinical Master in Genetic Counselling programme who are employed as associate genetic counsellor could apply to the HGSA to be a board eligible genetic counsellor.

5. Board eligible genetic counsellors can choose to complete the training required for HGSA Board Certification which assesses the knowledge, skills and competency of the individual in a clinical role over two years and certified as Genetic Counsellor.

UNITED STATES (US)

6. Genetic counsellors in the US are certified by The American Board of Genetic Counselling (ABGC)[16].

7. ABGC certification is granted to individuals who pass the ABGC certification examination. The primary qualification to sit for the examination is a Master degree in Genetic Counselling from a program accredited by the Accreditation Council for Genetic Counseling (ACGC)[17].

14 *Genetic Counsellor Registration Board. Available from* ***https://www.gcrb.org.uk/registrants/***

15 *The Human Genetics Society of Australasia. Genetic Counselling Certification. Available from* ***https://www.hgsa.org.au/about/genetic-counselling-certification***

16 *The American Board of Genetic Counselling. Certification Process. Available from* ***https://www.abgc.net/becoming-certified/certification-process/***

17 *Accreditation Council for Genetic Counselling. Available from* ***https://www.gceducation. org/mission/***

CANADA

8. Genetic counsellors in Canada are certified by the Canadian Association of Genetic Counsellors (CAGC)[18] and/or the ABGC in the US.

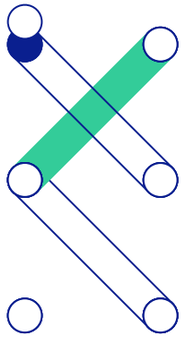
9. The CAGC certification process consists of a certification examination. The CAGC grants certification that could be accessed by one of four pathways. Generally all pathways require an applicant to hold a master degree in genetic counselling. Addition requirements are requested for those holding a degree not accredited by ABGC/ACGC.

EUROPEAN UNION

10. Genetic counsellors in the EU are registered under the Genetic Nurse and Genetic Counsellor Branch Board (GNGC board)[19] of the European Board of Medical Genetics (EBMG). The GCGN board is also responsible for the assessment of MSc in Genetic Counselling curricula provided in the EU.

11. It is an educational standard that all registered genetic counsellors and registered genetic nurses should be educated at Master level (Master degree in genetic counselling for genetic counsellors and Master degree in genetic nursing for genetic nurses).

12. As a new graduate does not have the competence to work autonomously as a genetic counsellor or genetic nurse within the multi-disciplinary team, a period of two years (or equivalent if the practitioner works part-time) of practice within a genetic healthcare environment should precede registration. This practice could be undertaken in one or more departments, as long as the practitioner is involved in the provision of genetic counselling.



18 *Canadian Association of Genetic Counsellors. Available from* ***https://www.cagc-accg. ca/?page=111***

19 *European Board of Medical Genetics. Genetic Nurse and Genetic Counsellor Branch Board. Available from* ***https://www.ebmg.eu/408.0.html***

ANNEX H

A SUMMARY TABLE OF EXAMPLES OF OVERSEAS BIOBANKS

A SUMMARY TABLE OF EXAMPLES OF OVERSEAS BIOBANKS

Name	Operator	Scope
UK Biobank[20]	Wellcome Trust (Registered as charity); supported by National Health Service (NHS), Medical Research Council (MRC), Department of Health (DH), etc.	**Population-based biobank** **Participants:** 500 000 people recruited, aged 40-69, in 2006- 2010, followed for 30 years **Samples:** blood, urine and saliva **Records:** health parameters measured; link to the centralised UK NHS system
Danish National Biobank[21]	Statens Serum Institut (SSI) under the Ministry of Health	**Population-based biobank** **Samples:** blood, urine, spinal fluid **Records:** link to other registers e.g. National Patient Register, Pathology register
Singapore Biobank (2002- 2011)[22]	Agency for Science, Technology and Research of Ministry of Trade and Industry	**Population-based biobank** **Samples:** mainly blood
Australian Breast Cancer Tissue Bank (ABCTB)[23]	University of Sydney	**Disease-based biobank** **Participants:** patients with breast cancer **Samples:** breast cancer tissues, normal tissues, blood **Records:** breast cancer treatment information
Finland FinBioBank (FINBB)[24]	FINBB Biobank Cooperative (Publicly owned)	**Centralised gateway for six Finnish biobanks** **Participants and samples:** depend on the biobanks **Records:** owned by the Finnish biobanks and accessible through FINBB

20 *UK Biobank. Available from* ***http://www.ukbiobank.ac.uk/***

21 *Danish National Biobank. Available from* ***http://www.biobankdenmark.dk/about.html***

22 *Singapore had established a National Biobank in 2002 which was closed in 2011 partly because of funding problem and under-utilisation of the biobank samples.*

23 *Australian Breast Cancer Tissue Bank. Available from* ***https://www.abctb.org.au/abctbNew2/default.aspx***

24 *FinBioBank. Available from* ***https://finbb.fi/***

ANNEX I

RELEVANT REGULATIONS ON PROCESSING OF GENETIC DATA IN HONG KONG

RELEVANT REGULATIONS ON PROCESSING OF GENETIC DATA IN HONG KONG

DISABILITY DISCRIMINATION ORDINANCE (DDO) (CAP. 487)

Genetic and congenital predisposition is considered "disability that may exist in the future", and hence falls under the definition of "disability" under section 2(1) of DDO, extracted below for ease of reference (emphasis added).

Section 2(1)

Disability (殘疾), in relation to a person, ...
includes a disability that— (a).....(g)....
And includes a disability that –
presently exists;
previously existed but no longer exists;
***may exist in the future**; or*
is imputed to a person.

2. Sections 26, 27, 42 and 52 of the DDO are relevant to genetic discrimination in the insurance context. The relevant extracts are as follows – (emphasis added)

Section 26

*(1) Subject to subsection (2), **it is unlawful for a person who, whether for payment or not, provides goods, services or facilities, to discriminate against another person with a disability** –*

(a) by refusing to provide that other person with those goods, services or facilities;

(b) in the terms or conditions on which the first-mentioned person provides that other person with those goods, services or facilities; or

(c) in the manner in which the first-mentioned person provides that other person with those goods, services or facilities.

(2) Subsection (1) shall not apply to a person who discriminates against another person with a disability if –

(a) the provision of the goods, services or facilities would impose unjustifiable hardship on the person who would have to provide those goods, services or facilities; and

(b) in the case of the facilities described in paragraphs (c), (d), (e) or (f) of section 27 (or facilities of a like nature to the facilities so described) and to the extent that those facilities are physical in nature, those facilities are so designed or constructed as to be inaccessible to a person with a disability.

Section 27

The following are examples of the services and facilities referred to in section 26 –

(a) access to and use of any place which members of the public or a section of the public are permitted to enter;

(b) accommodation in a hotel, guesthouse or other similar establishment;

(c) facilities by way of banking or insurance or for grants, loans, credit or finance;

(d) facilities for education, including the conduct of public examinations;

(e) facilities for entertainment, recreation or refreshment;

(f) facilities for transport or travel;

(g) the services relating to transport or travel;

(h) the services relating to telecommunications;

(i) the services of any profession or trade;

(j) the services of –

(i)-(ii) (Repealed 78 of 1999 s. 7)

(iii) any department of the Government; or

(iv) any undertaking by or of the Government.

Section 42 Requests for information

(1) If, because of another provision of Part 3 or 4, it would be unlawful, in particular circumstances, for a person to discriminate against another person, in doing a particular act, it is unlawful for the first-mentioned person to request or require that other person to provide, in connection with or for the purposes of the doing of the act, information (whether by completing a form or otherwise) that persons who do not have a disability would not, in circumstances that are the same or are not materially different, be requested or required to provide.

*(2) Subject to subsection (3), if, because of section 11(1), it would be unlawful, in particular circumstances, for a person to discriminate against another person, in doing a particular act, it is unlawful for the first-mentioned person to request or require that other person to provide **information of a medical nature** (whether by completing a form or otherwise) in connection with or for the purposes of the doing of the act.*

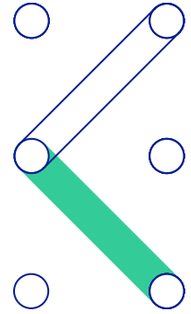
(3) Nothing in subsection (2) shall render it unlawful for a person to request or require another person to provide information of a medical nature that is necessary to determine if that other person would be unable to carry out the inherent requirements of the job or would require services or facilities that are not required by persons without a disability.

Section 52

Nothing in Part 3, 4 or 5 shall render unlawful the treatment of a person in relation to any class of insurance business, or similar matter involving the assessment of risk, where the treatment –

*(a) **was effected by reference to actuarial or other data from a source on which it was reasonable to rely;** and*

(b) was reasonable having regard to the data and any other relevant factors.



3. In the employment context, it is not uncommon for an employer, either before or during employment, to request for certain health-related information, such as family health history, or require a body check of a prospective or existing employee. Such medical information can be collected for various reasons and the collection of medical information is not in itself discrimination. However, if such information is collected and used in connection with doing an act of discrimination against a prospective or existing employee, it may constitute discrimination under DDO. Accordingly, an employer should only request information related to genetic tests where it relates to determining whether a person can perform the inherent requirements of the job, or would require services or facilities not required by persons without a disability.

4. The Equal Opportunities Commission (EOC) is a statutory body to implement the DDO in Hong Kong. The roles of EOC on execution of DDO include resolving disputes between parties through conciliation, and providing legal assistance to cases not conciliated.

PERSONAL DATA (PRIVACY) ORDINANCE (PD(P)O) (CAP. 486)

5. According to Section 64 of PD(P)O, it is an offence if the person discloses any personal data of a data subject which was obtained from a data user without the data user's consent, with an intent –

(a) to obtain gain in money or other property, whether for the benefit of the person or another person; or

(b) to cause loss in money or other property to the data subject.

The maximum penalty is a fine of HK$1,000,000 and imprisonment for 5 years.

6. Furthermore, a data user who, without reasonable excuse, contravenes any requirement under the PD(P)O commits an offence and is liable on conviction to a fine at level 3.

7. According to the PD(P)O, genetic information of a living individual is classified as personal data. Processing of genetic data is regulated by the six data protection principles in Schedule 1 of the Ordinance.

8. The six data protection principles of PD(P)O, in general, are as follows –

Principle 1 - Data Collection Principle

- *Personal data must be collected in a lawful and fair way, for a purpose directly related to a function /activity of the data user.*
- *Data subjects must be notified of the purpose and the classes of persons to whom the data may be transferred.*
- *Data collected should be necessary but not excessive.*

Principle 2 - Accuracy and Retention Principle

- *Practicable steps shall be taken to ensure personal data is accurate and not kept longer than is necessary to fulfil the purpose for which it is used.*

Principle 3 - Data Use Principle

- *Personal data must be used for the purpose for which the data is collected or for a directly related purpose, unless voluntary and explicit consent with a new purpose is obtained from the data subject.*

Principle 4 - Data Security Principle

- *A data user needs to take practicable steps to safeguard personal data from unauthorized or accidental access, processing, erasure, loss or use.*

Principle 5 - Openness Principle

- *A data user must take practicable steps to make personal data policies and practices known to the public regarding the types of personal data it holds and how the data is used.*

Principle 6 - Data Access and Correction Principle

- *A data subject must be given access to his/her personal data and allowed to make corrections if it is inaccurate.*

9. Generally speaking, an employer may only collect minimum information relating to the health condition of employee for a purpose directly related to: (i) the assessment of suitability of his continuance in employment; or (ii) the employer's administration of medical or other benefits or compensation provided to him. In general, it is not necessary for an employer to use a person's genetic data when making decisions about hiring, promotion or other terms of employment.

10. The Office of the Privacy Commissioner for Personal Data (PCPD) is an independent statutory body set up to oversee the enforcement of the PD(P)O in Hong Kong. The role of PCPD is to secure the protection of privacy of individuals with respect to personal data through promotion, monitoring and supervision of compliance with the Ordinance..

ANNEX J

INTERNATIONAL PRACTICES ON REGULATION OF USE OF GENETIC DATA FOR INSURANCE PURPOSE

INTERNATIONAL PRACTICES ON REGULATION OF USE OF GENETIC DATA FOR INSURANCE PURPOSE

UNITED NATIONS (UN)

The Recommendation on the protection and use of health-related data (the Recommendation)[25] was reported by the UN Special Rapporteur on the right to privacy to UN General Assembly on 29 October 2019.

2. The Recommendation suggests that health-related data and genetic data obtained for scientific research purposes cannot be used for insurance-related purposes in respect of the data subjects or their family members. Existing predictive data derived from genetic tests may not be processed for insurance purpose unless specifically authorised by law. Where authorised, the requisite data processing is allowed only after independent assessment of conformity with a set of criteria (e.g. high positive predictive value) by type of test used and with regard to a particular risk to be insured.

EUROPE

3. The Council of Europe adopted the Recommendation CM/Rec (2016)8[26] on 26 October 2016, which covers the use of predictive health information for insurance purposes and introduces high level principles based on the Council of Europe's Conventions on data processing and on human rights and biomedicine. In gist –

(a) predictive genetic tests must not be carried out for insurance purposes;

(b) existing predictive data resulting from genetic tests should not be processed for insurance purposes unless specifically authorised by law. If so, their processing should only be allowed after independent assessment of conformity with specific criteria (e.g. the relevance of the data has been duly justified, high positive predictive value) by type of test used and with regard to a particular risk to be insured;

(c) existing data from genetic tests from family members of the insured person should not be processed for insurance purposes;

(d) health-related personal data obtained in a research context involving the insured person should not be permitted; and

(e) questions posed by the insurer should be clear, intelligible, direct, objective and precise.

25 *United Nations Special Rapporteur on the Right to Privacy. Recommendation on the protection and use of health-related data. Available from https://undocs.org/A/74/277. Explanatory Memorandum to the Recommendation is available from* ***https://www.ohchr.org/_layouts/15/WopiFrame.aspx?sourcedoc=/Documents/Issues/Privacy/SR_Privacy/MediTASFINALExplanatoryMemoradum1.pdf&action=default&DefaultItemOpen=1***

26 *Committee of Ministers, Council of Europe. Recommendation CM/Rec (2016)8 of the Committee of Ministers to the member States on the processing of personal health-related data for insurance purposes, including data resulting from genetic tests. Available from* ***https://search.coe.int/cm/Pages/result_details.aspx?ObjectId=09000016806b2c5f***

UNITED KINGDOM (UK)

4. The UK adopted a flexible, voluntary regulatory structure. In 2001, a moratorium was agreed between the UK Government and the Association of British Insurers (ABI), under which a person will not be required to disclose the result of a predictive genetic test unless the test has been approved by a designated committee, and is for coverage of insurance above a certain financial limit.

5. In 2018, the Code on Genetic Testing and Insurance (the Code)[27] was published to replace the moratorium. The Code covers life insurance, critical illness insurance and income protection above a certain financial limit. Private health insurance is not covered by the Code as under current practice, insurers do not ask for results of predictive genetic tests for private health insurance[28].

6. The Code recognises that insurers are lawfully permitted to seek access to appropriate family medical history and medical information relevant to applications for health-related policies, provided that it is in compliance with data protection requirements and consent from the applicant is obtained. Results of a diagnostic genetic test[29] previously taken can form part of relevant medical information and insurers will be able to access the results of a diagnostic genetic test and may use these results to inform their decision about an application.

7. Meanwhile, the Code imposes the following restrictions on insurers –

(a) an insurer will not require or put pressure on an applicant to undertake any genetic test, whether predictive[30] or diagnostic, as a condition of obtaining insurance;

(b) the results of a predictive genetic test will not be considered in an application for insurance except in the scenario where both of the following conditions are met:

(i) it is in the approved list of predictive genetic test mentioned in the Code (only Huntington's disease is covered at present); and

(ii) the sum assured exceeds a financial limit as set out in the Code (currently set at £500,000 for life insurance); and

(c) insurers will not ask an applicant to disclose the results of predictive tests obtained exclusively in the context of scientific research, regardless of the test or the level of cover.

8. To ensure compliance with the Code, insurers are required to report annually on their compliance and complaints received related to the Code.

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27 UK Government and the Association of British Insurers. Code on Genetic Testing and Insurance. October 2018. Available from ***https://www.abi.org.uk/globalassets/files/ publications/public/genetics/code-on-genetic-testing-and-insurance-final.pdf***

28 In the UK, the existence of National Health Service means that unlike many developed economies, there is little concern about private health insurance. Under current practice, insurers do not ask for results of predictive genetic tests for private health insurance.

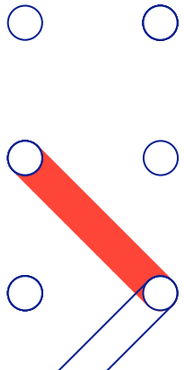
29 As defined under the Code, diagnostic genetic tests confirm or rule out a diagnosis based on existing symptoms, signs or abnormal non-genetic test results which indicate that the condition in question may be present.

30 As defined under the Code, predictive genetic tests predict a future risk of disease in individuals without symptoms of a genetic disorder.

UNITED STATES (US)

9. The US adopted a legislative approach on regulation of genetic discrimination. In 2008, the Genetic Information Non-discrimination Act (GINA) was enacted at federal level to prohibit the use of any genetic information in health insurance. Some state laws go beyond the scope of GINA and prohibits genetic discrimination for other insurances including life insurance, disability insurance and long-term care insurance.

10. Under GINA, insurers are prohibited from requiring an individual to undergo a genetic test. Insurers are also prohibited from requesting, requiring or purchasing genetic information for underwriting purposes or prior to enrolment. As for claim handling, insurers can ask for a minimum amount of genetic information for assessing whether a requested test, treatment or procedure is medically necessary. The genetic information so collected must not be used to discriminate against the insured.



CANADA

11. Canada adopted the legislative approach on regulation of genetic discrimination. In 2017, the Genetic Non-Discrimination Act (GNA)[31] was enacted to prohibit the use of all genetic test result, including use by the insurance industry.

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31 Canada Genetic Non-Discrimination Act (GNA). Available from ***https://laws-lois. justice.gc.ca/eng/acts/G-2.5/index.html***

AUSTRALIA

12. The Australia adopted a hybrid approach in terms of regulation of genetic discrimination. A self-regulatory moratorium and Private Health Insurance Act (2007) were adopted for life and health insurance respectively.

13. The Financial Services Council (FSC) adopted the FSC Standard No. 11: Moratorium on Genetic Tests in Life Insurance (the Standard[32]) in July 2019. The Standard covers life insurance, critical illness insurance and income protection. The Standard is in place until at least 30 June 2024 and FSC would review the Standard in 2022 to extending the end date, the financial limits and any other required changes.

14. The Standard has similar approach as the Code in the UK on access of family medical history and medical information relevant to applications, use of results of a diagnostic genetic test and no requirement to undertake any genetic test as a condition of obtaining insurance. In gist –

(a) for all levels of coverage, insurance providers will not ask or otherwise encourage applicants to –

  (i) take a genetic test as part of their application and underwriting process; and

  (ii) disclose the result of a genetic test that was taken as part of a medical research study conducted by an accredited university or medical research institution, where the result is not known to the applicant.

(b) for coverage level higher than the threshold limit (e.g. AUD500,000 for death and AUD200,000 for critical illness), insurance providers may ask for results of a previously taken or planned genetic test provided that an evidence base shows that the test has relevance to the insurance cover applied for in accordance with the Disability Discrimination Act. Privacy law must be complied with.

(c) When assessing claims, insurance providers will not treat the insured person as having breached their duty of disclosure for not disclosing the results of a genetic test that the Life Insurance Provider was not entitled to ask for or use in accordance with the Moratorium.

15. The Private Health Insurance Act (2007) (the Act) is not a legislation directly prohibiting the use of genetic test in health insurance of Australia. However, the Act regulates the health insurance available to public must be community-rated, that is, made available in a way that does not discriminate between people. The applicant would not be treated in different loading or condition whether a positive genetic test result is available.

32 *The Financial Services Council. FSC Standard No. 11: Moratorium on Genetic Tests in Life Insurance. July 2019. Available from* ***https://www.fsc.org.au/resources-category/standard/1779-standard-11-moratorium-on-genetic-tests-in-life-insurance/file***

JAPAN

16. According to the Life Insurance Association of Japan (LIAJ), its member firms do not use genetic information to make underwriting decisions[33]. A guide on collection and usage on genetic testing data would be developed by LIAJ to ban life and health insurers from collecting or using genetic information for decisions regarding cover and premiums.

33 *Insurance Asia News. Japan to ban use of genetic information. 8 April 2019. Available from* ***https://insuranceasianews.com/japan-to-regulate-genetic-information/***

ANNEX K

OVERSEAS REGULATION OF DIRECT-TO-CONSUMER GENETIC TESTS

OVERSEAS REGULATION OF DIRECT-TO-CONSUMER GENETIC TESTS

The Steering Committee reviewed international practices in regulating direct-to-consumer genetic tests (DTCGTs). Key findings are summarised below.

UNITED STATES (US)

2. In the US, the Food and Drug Administration (FDA) is responsible for regulating genetic tests. FDA considers genetic tests to be a special type of medical device, and therefore these diagnostic tools fall under FDA's regulatory purview. A test may be marketed and sold as a commercial test "kit", a package that contains reagents used in the processing of genetic samples. Manufacturers must obtain approval from FDA before selling these test kits in the market.

3. More commonly, a test is introduced to the market as a laboratory-developed test (LDT), in which case the test is developed by a single laboratory, and specimen samples are sent to the same laboratory to be tested. In the past, FDA applied enforcement discretion on LDTs, i.e. not enforcing pre-market review and other applicable FDA requirements, because clinical genetic tests were not very widespread in the past. However, due to the rapid advances in sequencing technology, next-generation sequencing (NGS) in particular, the pervasiveness of clinical genetic testing and the growth of DTCGT, FDA is increasingly concerned that unregulated tests might pose a public health threat, and is now enhancing regulation of LDTs..

EUROPE

4. Currently there are laws regulating genetic testing in Europe. There are countries (e.g. France and Germany) where DTCGT is essentially banned, while in others (e.g. Luxembourg and Poland) DTCGT may only be restricted by general laws, usually under healthcare services and patients' rights. Requirements on areas such as medical supervision, counselling and informed consent also differ from one country to another. The United Kingdom (UK) also has no specific legislation that relates to genetic testing or DTCGT in general. There are however provisions in the UK Human Tissue Act 2004 that criminalise genetic analysis of human tissue without the consent of the donor.

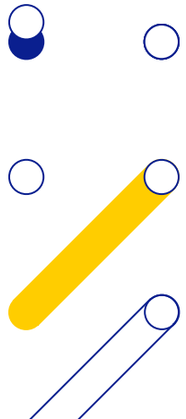
5. The Regulation (EU) 2017/746 on in vitro diagnostic medical devices (the Regulation) entered into force in May 2017. The regulation covers diagnostic (including Internet-based) services, genetic testing and other tests that provide information about a patient's predisposition to a specific disease or susceptibility for a medical treatment, and put in place more stringent requirements on clinical evidence, post-market surveillance and several other aspects. Manufacturers of currently approved in vitro diagnostic medical devices will have a transition time of five years, up to May 2022 to meet the requirements of the Regulation.

AUSTRALIA

6. Australia puts in place a strict regulatory regime governing the registration and provision of human genetic tests offered by Australian companies through the Therapeutic Goods Act 1989 and the Therapeutic Goods (Medical Devices) Regulations 2002 (the Regulations). Laboratories which carry out genetic testing must be accredited for technical competencies by the National Association of Testing Authorities. These standards mandate a level of quality control for genetic testing services in Australia. However, offshore companies which can access Australian consumers via the Internet are not subject to any Australian regulation. Consumers are also allowed to access non-accredited overseas tests through a self-importation exemption. In addition to regulations, the National Pathology Accreditation Advisory Council (NPAAC) issues guidance for DTCGT providers to ensure the quality of services and the safety of clients. The latest version in 2014 listed out 17 recommendations for the providers, e.g. the provider should not overstate the value or the significance of the result of DTCGT; the provider should not offer DTCGT (such as whole genome sequencing) unless there is appropriate medical infrastructure to deal with consequences arising from its result, etc.

SINGAPORE

7. The Singapore Ministry of Health issued in July 2018 the Code of Practice on Standards for the Provision of Clinical Genetic / Genomic (CGT) Testing Services (the Code). It is stated in the Code that CGT services shall only be provided to consumers by licensed healthcare institutions and prescribed by qualified medical professionals. CGT services therefore shall not be offered or provided by manufacturers or suppliers of genetic tests directly to consumers. On the other hand, nutrigenomics, lifestyle and ancestry genetic tests, which are not used for clinical applications, do not fall under the scope of the Code.



INTERNATIONAL GENETIC AND GENOMIC ORGANISATIONS

American College of Medical Genetics and Genomics (ACMG)

8. ACMG published the first statement on DTCGT in 2008 and a revised version in 2015. The statement stressed on the following–

(a) The consumer should be fully informed that the test may not give a definitive result or may have incidental findings and impacts on family members;

(b) Service provider should clearly state the scientific evidence base describing the validity and utility of a genetic test by easy-to-understand wordings; and

(c) For the sake of personal data privacy protection,

(i) the consumer should be informed of:

a. the persons who will have access to test results;

b. what data security process is implemented;

c. the handling of the DNA sample after testing is completed; and

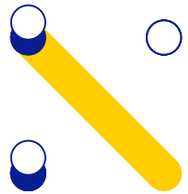
d. the implication of the test results on personal or family-related for life, long-term care, or disability insurance before the test.

(ii) service provider should disclose whether data generated from testing will be sold to or shared with third parties; and

(iii) service provider should state clearly the ownership of the sample and generated data.

European Society of Human Genetics (ESHG)

9. ESHG published a position statement in 2010 on the provision and advertising of DTCGTs, which highlighted important principles including respect for the right of individuals to health and genetic information (but with due regard to protecting them from inappropriate genetic information and testing); quality of tests performed; clinical usefulness of tests provided; the need for individualised medical supervision; the need for provision of pre-test information and genetic counselling, follow-up and support in the interpretation of results and their psychosocial impact; informed consent; protection of persons not able to consent such as minors; respect for privacy and confidentiality; and respect for ethical principles in research.



Strategic Development of

genomic MEDICINE IN HONG KONG

ANNEX