PartnerReviews

The Rising Tide of Genetic Data–New Challenges for Life & Health Insurance

The understanding and application of genetic data is redefining medical diagnosis, treatment and prognosis. As this area continues to advance, it's set to adjust, maybe even to reshape, the Life and Health insurance business model within the next 20 years.

We present an overview of the three general types of genetic testing, consider their implications and relevant timings for Life and Health insurance, and suggest how insurers could begin to tackle some of the associated challenges.

Genetics and genomics

In contrast to a simple blood test, a 'genetic test' analyzes the composition and functioning of a single gene. These tests identify a susceptibility to a particular disease that may manifest decades later in an individual's life (a predictive genetic test), or confirm that a disease is already present (a diagnostic genetic test).

In contrast, 'genomics' analyzes all of the genes in the human body and their interrelationships in order to identify their combined influence on the development and health of the individual. The result, totally new possibilities for precise diagnosis, targeted treatments, disease prediction and prevention.

Regulation of genetic data

In contrast to traditional diagnostics, such as simple blood checks, the sensitive nature of genetic data has the potential to cause anxiety and discrimination. As regards insurance, many countries have implemented regulations that ban any duty on individuals to disclose the results of a genetic test[1] when applying for Life and Health insurance[2]. Specifics vary: for example, Singapore has a moratorium on insurers asking for the results of genetic tests; in the UK, an insurer cannot request test results unless the test is on the approved list and for sums insured above a defined amount depending on the coverage type; in Switzerland, there is no duty of disclosure for Life insurance policies with sums insured under CHF 400,000; in the US, the 2008 Federal Genetic Information Nondiscrimination Act (GINA) bans the use of genetic information in Health insurance, while its mainly anti-discriminatory use in Life insurance varies in detail by insurance type and State[3].

These regulations in general introduce the risk of adverse selection against insurers, as positive results could prompt individuals to take out relevant insurances. Health insurers in markets with obligatory healthcare schemes are naturally less impacted by this risk.

Genetic tests and their impact on Life and Health insurance

Genetic testing has grown from a niche specialty for rare disorders, to a broad scope of applications for complex diseases (including diabetes, stroke and cancer) and personal use. It is now possible to distinguish between three general types of genetic testing:

- Single gene analysis
- Whole genome sequencing
- Direct-to-consumer genetic tests

[1] Regulations also act to prevent individuals from being forced or motivated to conduct a genetic test.
[2] 'Genetics and Life Insurance: A View into the Microscope of Regulation', The Geneva Association, 2017.
[3] For example: www.genome.gov/policyethics/legdatabase/pubsearch.cfm

The Human Genome Project (HGP)
This project operated from 1990 to 2003, ushering in a new phase of biology and bio-medical research. It provided information about the sequences of the three billion nucleotides (subunits of DNA) that make up the human genomic DNA that lies in every human cell, it identified the location of many genes and provided information about their structure and organization, and it chartered variations across human genomes, enabling a deeper understanding of disease including diagnostic and treatment options. This was just the start. The technologies and knowledge to read and analyze the human genome continue to advance at rapid speed.

Single gene analysis

These tests detect mutations in a single gene that is responsible for a particular disease ('single gene diseases'). Single gene diseases are mostly rare, inherited disorders.

To a high level of detail and quality, these tests identify the presence of an existing disease or predisposition to a disease which may manifest later in life. The tests are the most tangible result of the HGP (see above) and are already applied in clinical practice, mainly performed through specialized healthcare providers such as genetic counsellors.

There are currently more than 5,000 different single gene tests available, such as for cystic fibrosis, hereditary breast cancer (BRCA) and Huntington's disease. The lifetime risk of suffering from one of these diseases is low, in the 1–2% range.[4]

Where does this leave Life and Health insurers?

In many Health insurance markets, these tests, if submitted to insurers[5], are reimbursed, with an average price of a few hundred USD depending on the size and complexity of the analyzed gene. Additional treatment costs, which can be substantial, are usually also covered if the identified disease can be treated.

Single gene analysis: Low adverse selection risk
The associated adverse selection risk to insurers from single gene analysis tests is, and can be expected to remain, limited due to the low population prevalence of these rare diseases.

Whole genome sequencing

In contrast to single gene analysis, whole genome sequencing (WGS) includes the analysis of the entire genome, i.e. the approximately 25,000 genes of the human cell. It simultaneously identifies millions of genetic variants and leads to a better understanding of the mechanisms behind many common diseases. In the medium term, the expectation is for this to lead to more accurate and early diagnoses, even decades before a disease's first manifestation. Furthermore, this type of testing could enable early, more effective treatments and the prevention of many diseases.

The technologies needed to analyze and interpret genomic sequences have continued to improve and costs have plummeted. At the beginning of this century, the cost of sequencing an individual's genome was close to USD 100 million[6]. Within the next few years, the cost is expected to fall as low as USD 1,000. Lower pricing will inevitably lead to more testing and more data.

Because of its all-embracing nature, incidental findings unrelated to the original reason for sequencing can result. To date, WGS has been performed for tens of thousands of individuals in developed markets, including the US and the UK. Common diseases were incidentally found[7] in around 1% of cases. However, the full clinical interpretation of the genetic variants remains inadequate since these have to be assessed in conjunction with an individual's medical history and clinical symptoms/findings; this involves an extraordinary amount of data processing and analysis.

Formerly constrained to the field of medical research, WGS is now being used in some specialist hospitals and clinics to analyze the cancer tumors of selected patients to determine the most precise, targeted treatment ('personalized medicine'). It is therefore beginning to become relevant to Health insurance. The framework for reimbursement of the analysis cost and consequential expensive treatment is an ongoing issue.

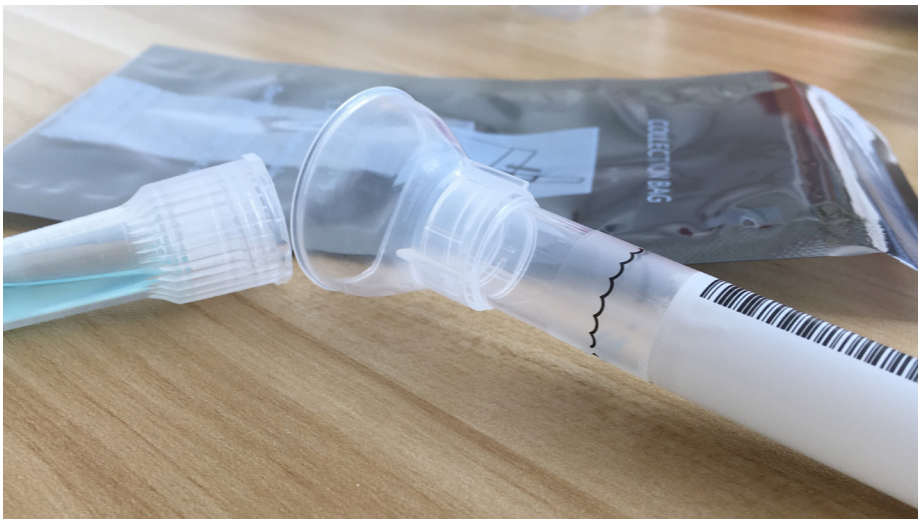
Despite the falling cost of WGS, substantial medical costs may result from performing consequential medical tests (e.g. imaging and endoscopies) and from the downstream actions that their results trigger. How these extra costs compare to cost savings from the prevention of disease manifestation is not clear and will require many more years' worth of experience.[8]

On the brink of a genomics revolution

Together with falling costs, Big Data technologies and advancing computing power and analytical capabilities are providing the catalyst for a genomics data revolution[9], paving the way to more prevalent personalized medicine and a new era of Life and Health insurance.

Numerous large-population based projects are already tapping the potential of genomic data for new diagnostic possibilities, treatments and healthcare strategies. For instance, in the UK a national program has been launched to sequence up to 100,000 genomes from patients and to combine this with clinical data from the UK's National Health Service. The UK strives to become the first country to introduce WGS as a mainstream component of a precise diagnosis and direct targeted treatment for many common diseases, particularly cancer[10]. Many other countries, including China, the US, Estonia, India and South Korea, are conducting similar projects, often collaborating with universities, pharmaceutical companies or private genomic companies.

[4] www.ncbi.nlm.nih.gov/pmc/articles/PMC4878778/
[5] Not everyone will choose to do this.
[6] www.genome.gov/27565109/the-cost-of-sequencing-a-human-genome/
[7] JAMA May 9, 2017 Volume 317, Number 18
[8] As an example of potential savings, 'Whole-genome sequencing aids NICU diagnoses', GenomeWeb Daily News, 2017. "[Genetic] Diagnoses, which on average took about a week, resulted in changes in medical care for 13 patients and researchers estimated that sequencing saved more than $1.8 million in health costs."
[9] Subject to compliance with data protection laws (beyond the scope of this publication).
[10] www.cmft.nhs.uk/saint-marys/our-services/manchester-centre-for-genomic-medicine/the-100000-genomes-project



Disease predisposition results from direct-to-consumer genetic tests remain unreliable, but with advances, the medium-term outlook is one of increasing (adverse selection) relevance for Life and Health insurance.

In addition, last but not least, Google, Apple and Amazon have entered this space and are amassing mega-databases of genomic information[11].

Where does this leave Life and Health insurers?

Compared to single gene analysis, WGS has far greater implications for insurers because it includes the predisposition to most common diseases.

Whole genome sequencing: High medium-term adverse selection risk

As soon as the abovementioned WGS projects are further advanced and integrated into the medical sector, individuals will potentially possess enhanced prognostic personal risk information. At the same time, anti-disclosure regulation is expected to prevail. The result, Life insurers and Health insurers (apart from those in markets with an obligatory healthcare scheme), will face a substantially increased exposure to adverse selection.

Direct-to-consumer genetic tests

These tests (also known as 'at-home genetic testing') are marketed directly to consumers. The test typically involves collecting a DNA sample at home, often by spitting into a tube, and then posting the sample back to a laboratory (usually overseas, introducing regulatory issues, see section 'Regulation of genetic data'). Consumers are notified of the result, frequently combined with a message to consult an online expert. Prices are low, generally in the USD 200 range.

Direct-to-consumer (DTC) tests are often offered by private companies for results relating to predisposition to obesity, nicotine or internet addiction, athletic ability, inborn talent, food preferences, genealogy and disease predisposition (e.g. to multiple sclerosis and prostate cancer). Marketing tends to focus on the fact that the results can influence individuals to make important, positive lifestyle changes.

In terms of disease predisposition, the tests analyze only a small proportion of the human genome, focusing on the hundreds of thousands of 'single nucleotide polymorphisms' (SNPs) that are suspected to be associated with common diseases. Research, however, has shown that risk prediction based on SNPs is still unreliable[12], has limited clinical value and limited impact on lifestyle improvement.

No healthcare professionals need to be involved in the tests and they are not documented in the healthcare system.

Where does this leave Life and Health insurers?

Irrespective of the validity of the tests, if such tests indicate predisposition to a particular disease, otherwise healthy individuals may submit costs to Health insurers for follow-up medical investigations to allay their fears. This impact is compounded by the fact that in April 2017, the US Food & Drug Administration permitted the marketing of DTC tests for predisposition to ten diseases/conditions[13], including Alzheimer's and Parkinson's, two common diseases that impact the need for care later in life.

DTC tests are amounting in volume and diseases covered (the largest DTC company has already genotyped over two million customers) and the accuracy of the tests may improve over time. Add to this increasing pressure on accessing traditional medical care and the ease with which such tests can be done, and the outlook is one of 'increasing relevance'.

Direct-to-consumer genetic tests: Low risk of adverse selection, increasing in the medium term

With increasing knowledge of genomics, improving test accuracy, accessibility, low cost and persisting anti-disclosure regulation, these tests may represent a growing, medium-term challenge to insurers in terms of adverse selection.

Shaping the new era of Life and Health insurance

For insurers, genetic data and its application represents the potential for change in multiple areas of the business model. However, on reading this article you will have seen a lot of 'coulds' and 'mays'. Only time will tell, but for insurers several clear considerations are already emerging.

Mortality and morbidity improvement

Genetics has the ability to positively impact the morbidity and mortality of numerous diseases in the medium-term, meaning that Life insurance coverage could become more affordable and less often declined.

[11] www.technologyreview.com/s/537081/apple-has-plans-for-your-dna/; www.theconversation.com/google-may-get-access-to-genomic-patient-data-heres-why-we-should-be-concerned-80417

[12] Uptodate Personalized medicine July 2017 www.uptodate.com/contents/personalized-medicine?source=machineLearning&search=direct%20consumer%20test&selectedTitle=1~16&sectionRank=1&anchor=H2097388#H487603359

[13] Parkinson's disease, late-onset Alzheimer's disease, celiac disease, alpha-1 antitrypsin deficiency (more than 100 different genetic variations of the gene have been identified and only some are linked with deficiency), early-onset primary dystonia, factor XI deficiency, Gaucher disease type 1, glucose-6-phosphate dehydrogenase deficiency, hereditary hemochromatosis, and hereditary thrombophilia.

Genetic test	Description	Quality	Main providers and owners of the data	Approximate cost of a test	Risk of adverse selection
Single gene analysis	Identifies mutations in a single gene responsible for a particular disease (single gene diseases)	High	Specialized healthcare providers	USD 100	**Now: Low,** as single gene diseases on average affect approx. 1-2% of population **Medium term: Low**
Whole genome sequencing	Analysis of the entire human genome and genetic variants associated with diseases	High potential	Now moving from the research sector to hospitals and clinics, primarily to analyze and better target treatments for cancers	USD 1,000 within the next few years	**Now: Low,** data processing requirement to incorporate patient's medical history and clinical symptoms not yet available **Medium term: High,** processing capabilities rapidly advancing
Direct-to-consumer genetic tests	Investigates a small proportion of the genome, i.e. SNPs suspected to be associated with diseases	Low	Private companies; no healthcare professionals need be involved	USD 200	**Now: Low** **Medium term: Medium**, accuracy of tests will improve

Table 1: Summary of the three main types of genetic testing and their impact (adverse selection risk) on Life and Health insurance. The 'low' and 'high' categories are presented as a simplification and for comparison purposes only. Source: PartnerRe.

For longevity business, sustained mortality improvements will affect pricing in the medium-term.

Health insurers stand to be positively impacted by genetics leading to earlier diagnosis or even efficient preventative measures that delay, mitigate or even totally prevent chronic diseases.

Underwriting new business with restricted access to data

It is anticipated that the majority of national legislators will not allow insurers to take genetic test results into their initial risk assessments. Over time, as medical records incorporate more and more genetic data, this could lead to progressively less medical information being shared with Life and Health insurers.

Monitoring adverse selection

The Life and Health (apart from for obligatory healthcare schemes) insurance industry will increasingly be confronted with adverse selection: If tests identify predisposition to a disease, an individual may be more likely to take out Life, Critical Illness, Disability, Health and Long-term Care insurances, with living benefit insurance products likely to be the worst affected.

DTC tests empower consumers. With better informed patients and low-threshold tests which can easily be purchased without participation of any healthcare stakeholder, these tests will become more common. WGS, once it has progressed to the next level, could significantly increase adverse selection. Monitoring the impact will be critical and the Life and Health insurance industry will have to find new ways to overcome this challenge.

Monitoring medical and genetic advances

Against the background of rapid growth in genomic knowledge due to the enabling powers of Big Data technologies and advancing analytical capabilities, the pace of change and advancement in genetic and traditional medicine will undoubtedly accelerate. It will be essential for underwriters and medical experts to work together to monitor this progress, and to assess the impact of the changes on underwriting and risk management.

Additional claims

Health insurance may have to reimburse not only extra medical costs to collect and analyze genetic data, but also additional clinical check-ups and examinations prompted by incidental findings of uncertain significance.

Whether such tests are reimbursed would depend on the carrier, market and regulations; in the US, for example, most Health policies require tests to be medically necessary. With this issue on the horizon and especially if there is no government mandate, the establishment of guidelines for the reimbursement of costs to collect and analyze genetic data would be a good starting point.

It is also not clear as to whether these costs, and the costs associated with preventing diseases from manifesting if a genetic predisposition is identified, will be offset by the future cost savings of early intervention/prevention.

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