Natural Selection

Financial Services Forum

21-22 May 2018 • Hilton Sydney

Actuaries Institute

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Advances in genetics and their impact on life insurance

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Purpose

Will **advances in genetic research** have an impact on the life insurance industry?

Will they lead to **adverse selection**?

Overview

1. Current **regulations** for the use of predictive genetic information in life insurance

2. A **framework** for assessing genetic adverse selection

3. Latest **genetics research** and its potential **impact**

4. Potential **responses** by the life insurance industry

1. Regulations

Australian regulatory proposal (Mar 2018)

Recommendations

1. Life insurers to be **prohibited the use of predictive genetic tests**, at least in the medium term, as a matter of urgency.

2. An **exception**: genetic information that demonstrates an individual is **not at risk** of developing an **inherited condition**.

3. Moratorium to be **reviewed five years** after being imposed, to take into account the **impacts to customers**.

(Key recommendations from an Australian parliamentary joint committee)

Rationale

1. Protecting customers against **genetic discrimination.**

2. Acknowledged existence of **adverse selection**, but judged that the **evidence is not strong enough** that life industry will be unstainable as a result of the prohibition.

3. Genetic information asymmetry may result in **increased premiums**, but believed the **benefits to customers is greater** on the balance.

Commonwealth of Australia (2018)

Regulations in other countries

Prohibitions for all policies

1. Australia*
2. Austria
3. Belgium
4. Canada
5. Denmark
5. France
6. Ireland
7. Poland
8. Portugal
9. Singapore

*(not yet enacted)

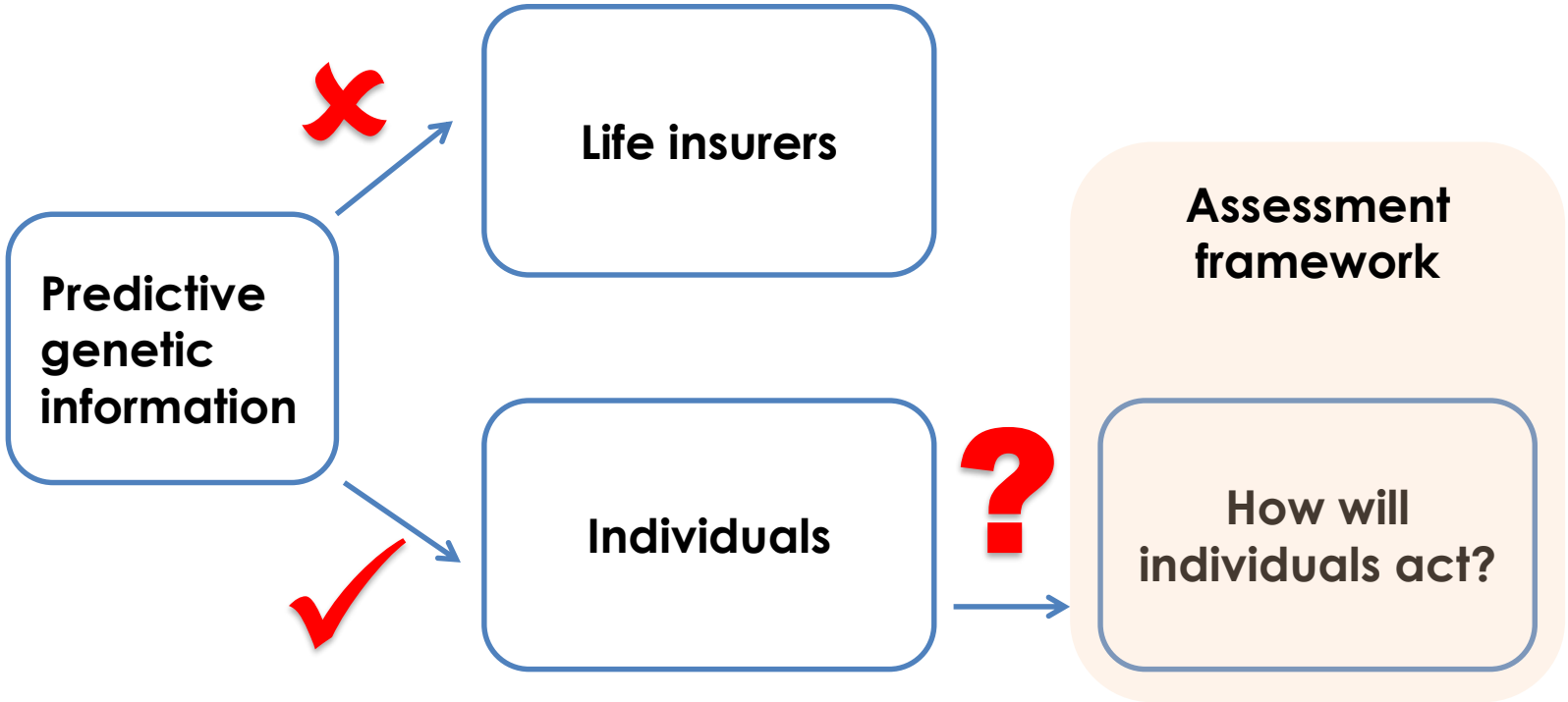
Prohibitions for policies below certain limits

1. Germany
2. Netherlands
3. Switzerland
4. United Kingdom

Increasingly more prohibitions around the world

Klein (2017)

Information asymmetry



2. Framework for assessing genetic adverse selection

Framework for assessing genetic adverse selection

Factors influencing individuals' actions

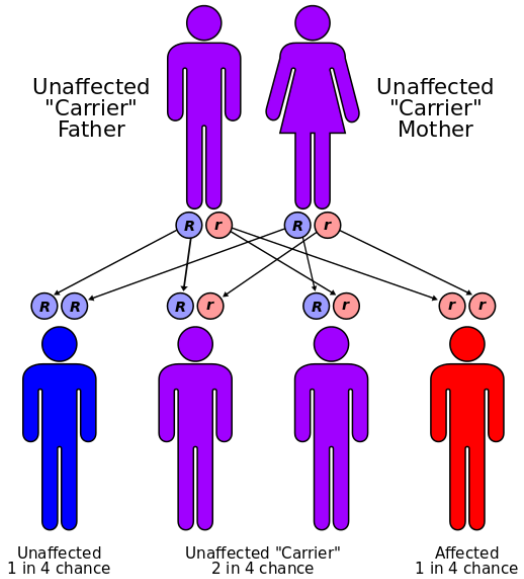
1. **Types** of genetic tests available
2. **Strength** of prediction
3. **Coverage** of diseases
4. **Availability** of tests
5. **Cost** of tests
6. Societal **perceptions** and attitudes
7. Likelihood to **change lifestyle**
8. Likelihood to make **insurance decisions**

Ability for the life insurance industry to respond

1. Use of **family history** as a proxy for genetics
2. Ability to influence **lifestyle**
3. **Product** changes to offset impacts
4. **Structural** changes to the whole industry

3. Genetic research and its potential impact

Monogenic tests (single genetic variants)



Availability

By medical referral

Cost

$100 – $1000

Disease coverage

Typically rare diseases (e.g. Huntington's) which affect relatively few individuals

Predictive strength

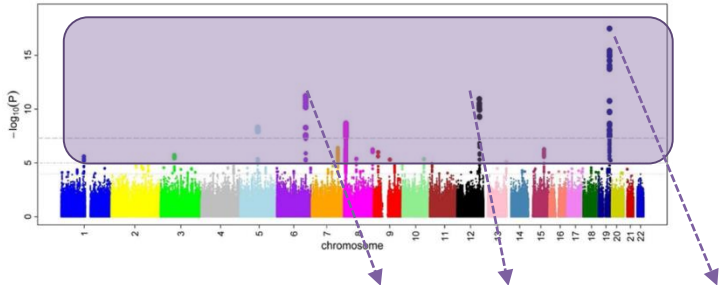
Typically highly predictive

Uses

Confirm medical diagnoses

Determining carrier status (e.g. for family planning)

Polygenic tests (multiple genetic variants)



Polygenic risk score (PRS) $= \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k$

Availability

Not currently available, but expected in the future

Cost

$100 – $1000 (current lab costs)

Disease coverage

All diseases, but especially useful for common diseases (e.g. heart disease)

Predictive strength

Low to medium (developing rapidly)

Uses (potential)

Targeted medical screening

Personalised medicine

Progress in genetic risk prediction

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Risk ratio when stratifying by a polygenic risk score (PRS)*

Disease	Reported last year	Newer studies (2017–8)
Coronary artery disease (Top 20% vs bottom 20%)	~2	~4.2
Breast cancer (Top 1% vs population average)	3.4	3.5
Prostate cancer (Top 1% vs population average)	4.2	5.7
Stroke (Top 10% vs bottom 20%)	1.2 – 2.0	*No recent studies found*
Depression (Top 10% vs bottom 10%)	*No studies found*	2.4

Question:

How should **updates** to the **interpretation** of previous test results be treated?

*X-fold increase in disease risk when comparing individuals in the top percentage of risk (as judged by the PRS) with those in the bottom percentage of risk or the population average (as indicated for each disease)

Potential increase in claim costs

Illustrative modelling for trauma (critical illness) insurance

Key assumptions

Modelling of 3 diseases:

Top 3 diseases	Prop. high risk	Increase in risk relative to the 'low risk' group*	Prop. trauma claims due to condition (ages 35 to 65)**
CAD	20%	45%	12%
Breast cancer	20%	71%	12%
Prostate cancer	1%	61%	10%
Total	**28%**	**31%**	**34%**

8% of population already insured

All individuals that receive a 'high risk' test result will obtain insurance

Key results

Genetic test **uptake** is a key driver of claim costs

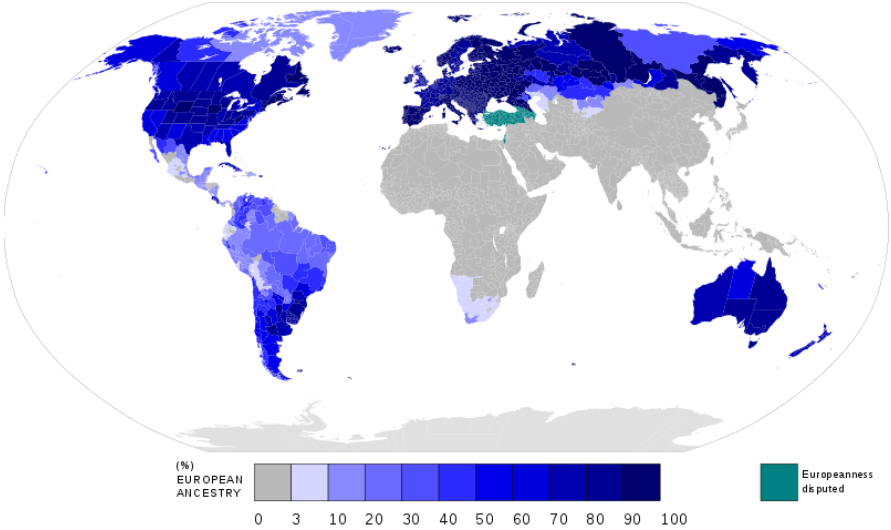
If **2–5%** of the **population** undertook polygenic tests, **claims** to **increase 7–17%**

Vukcevic & Chen (2017)

Caveat on current predictive strength

Europeans only

- Most research only done with individuals of European ancestry
- Predictive power likely to vary for other populations



Assessment of individual actions

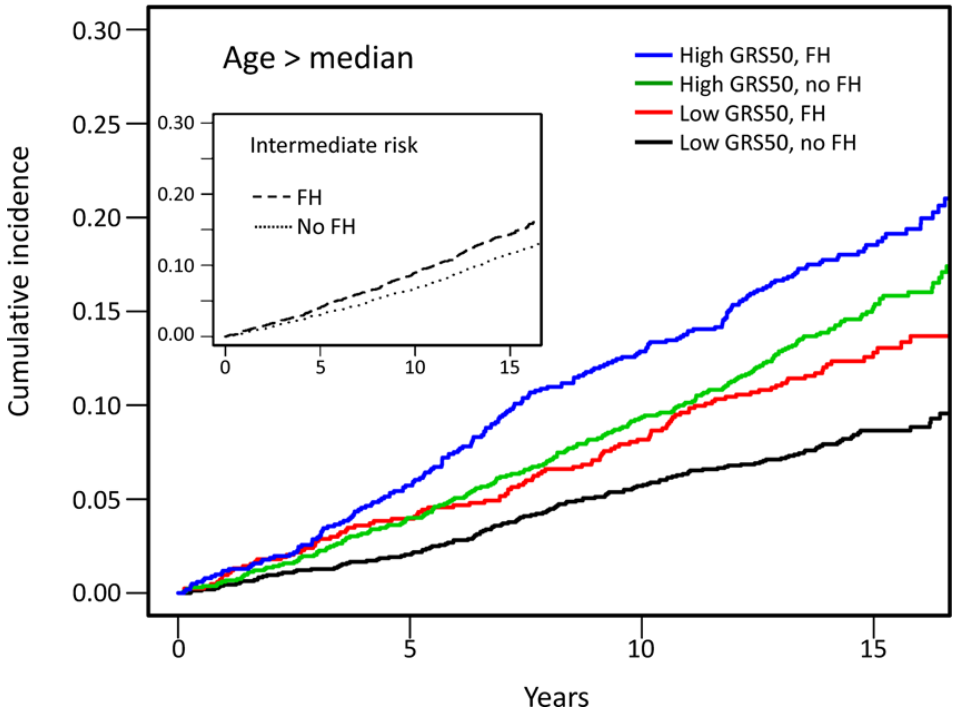
Overall assessment	Predictive genetic tests	
	Monogenic	Polygenic *Once available and in a mature state*
Likelihood to act	High	Medium
Impact on insurers	Low	Medium – High

4. Potential life insurance responses

Response 1: No action – family history as a substitute for genetics

Known family history **provides additional information** to the inferred genetic risk

Useful to know both and combine them together



Tada et al. (2015), adapted from Fig. 1

Response 1: No action – family history as a substitute for genetics

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	Predictive genetic tests	Family history
Measured genetic variation*	Yes	Yes (imprecise)
Unmeasured genetic variation	No	Yes (imprecise)
Shared environment	No	Yes

*Genetic variants included in the genetic test

Response 2: Actively influence lifestyle

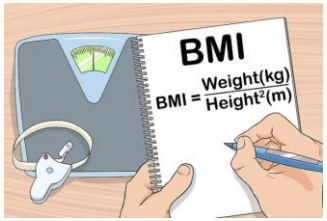
Mortality

Behavioural factors can improve life expectancy (e.g. Li et al. 2018)

+2 years

+2 years

+2 years



+2 years

+2 years

Morbidity

Impact of lifestyle changes varies by disease

Response 2: Actively influence lifestyle

Illustrative model for coronary artery disease

(a) Incidence rate by genetic & lifestyle risk

10-year cumulate incidence rate (%)		Lifestyle		
		Healthy	Intermediate	Unhealthy
Genetic risk	Low	3.1	4.3	5.8
	Medium	4.8	5.0	7.3
	High	5.1	7.3	10.7

(b) Distribution of people by genetic & lifestyle risk

		Lifestyle			
		Healthy	Intermediate	Unhealthy	
Genetic risk	Low	6%	8%	6%	**20%**
	Medium	19%	24%	17%	**60%**
	High	6%	8%	6%	**20%**
		32%	**40%**	**28%**	**100%**

Step 1: Expected incidence

= (a) x (b) = **5.7**

Data: Khera et al. (2016)

Response 2: Actively influence lifestyle

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	High	5.1	7.3	10.7

Step 1: Expected incidence
= (a) x (b) = **5.7**

Step 2: Adverse selection: 5% shift to high genetic risk
= (a) x (c) = **5.9**

(c) 5% low genetic risk move to high genetic risk

		Lifestyle			
		Healthy	Intermediate	Unhealthy	
Genetic risk	Low	5%	6%	4%	**15%**
	Medium	19%	24%	17%	**60%**
	High	8%	10%	7%	**25%**
		32%	**40%**	**28%**	**100%**

Response 2: Actively influence lifestyle

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	High	5.1	7.3	10.7

(d) then, 5% unhealthy move to healthy

		Lifestyle			
		Healthy	Intermediate	Unhealthy	
Genetic risk	Low	6%	6%	3%	**15%**
	Medium	22%	24%	14%	**60%**
	High	9%	6%	6%	**25%**
		37%	**40%**	**23%**	100%

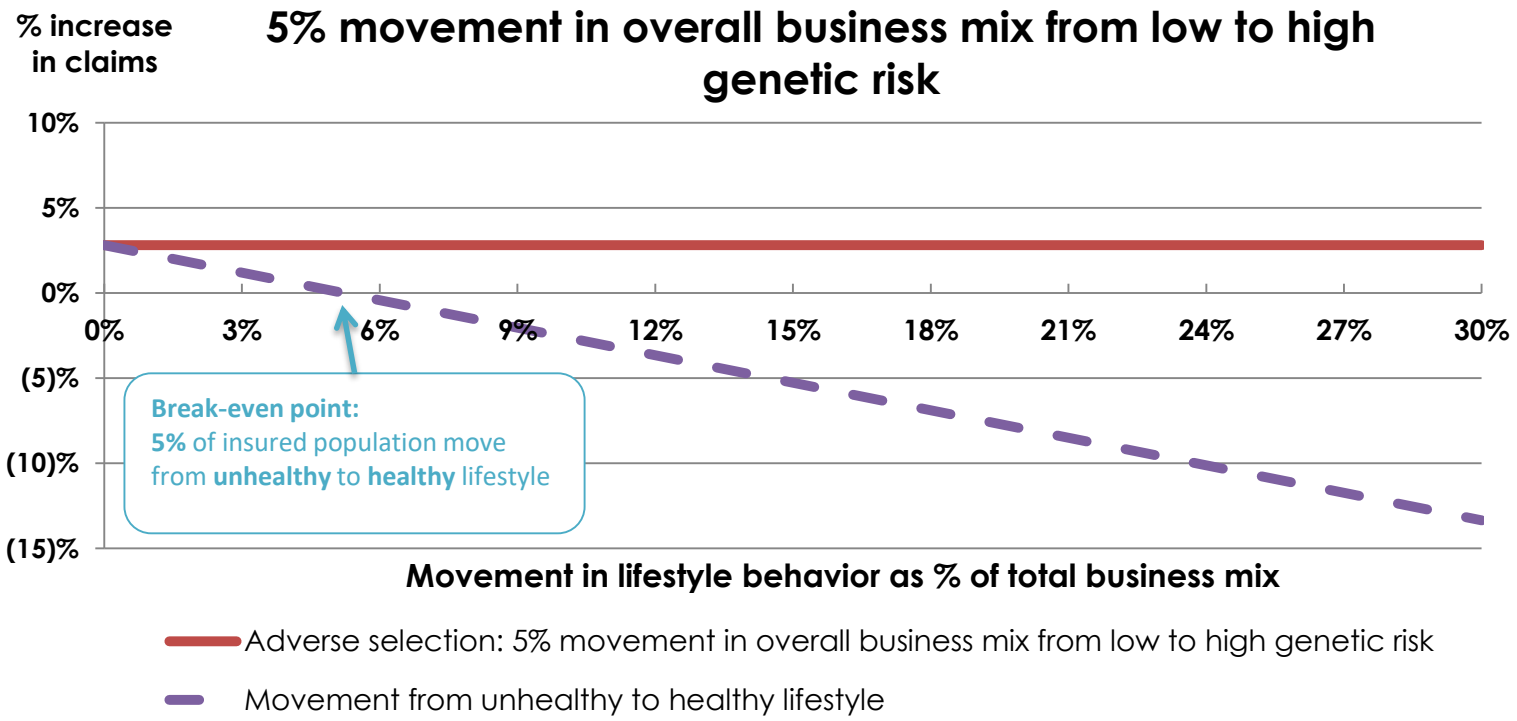
Step 1: Expected incidence
= (a) x (b) = **5.7**

Step 2: Adverse selection: 5% shift to high genetic risk
= (a) x (c) = **5.9**

Step 3: Lifestyle change: 5% shift to healthier lifestyle
= (a) x (d) = **5.7**

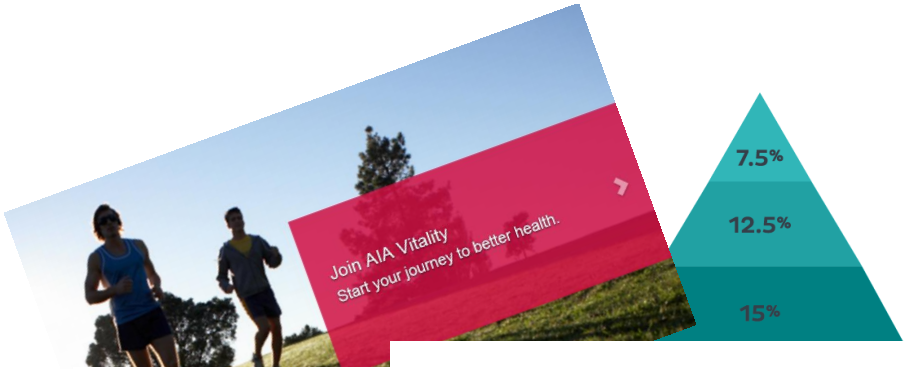
Response 2: Actively influence lifestyle

Illustrative model for coronary artery disease



Can we create lasting lifestyle changes?

Recent product trends



MLC On Track

We want our customers to be rewarded for being active. Tha
life insurance premiums in the first year.

TAL's Health Sense discount

'Wellness' programs **not** designed specifically to address **genetic adverse selection**

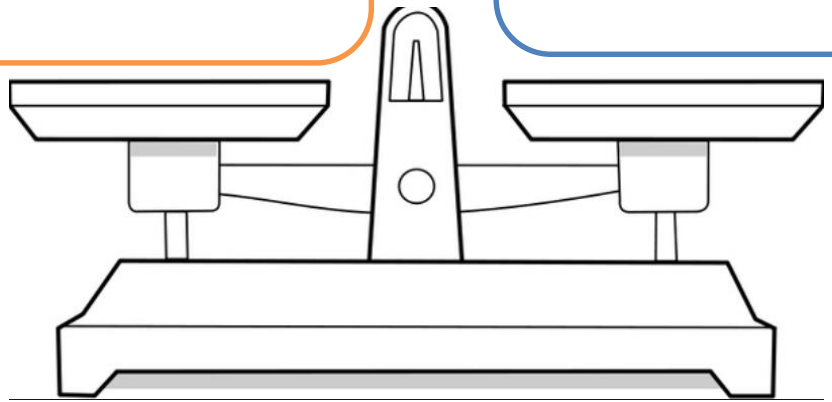
Lifestyle changes are **difficult** for individuals

Insurers may only have **limited influence** to create lasting changes

Response 3: Price and/or cover changes

Industry sustainability
- Increase prices?
- Limit cover?

Customer needs
- Affordability
- Effectiveness



The **scale** of social impact will depend on the **magnitude** of any adverse selection

Response 4: Structural changes

Change how we pool risk?

Some ideas:

- **Smaller risk pools**, more tailored premiums
- **Pooled industry fund** for diseases high in genetic risk
- Move towards a **community rating** structure
- Government **subsidy**, to account for any adverse selection

Shaping the agenda

How can we shape our desired long-term state?

- Set clear industry **principles and frameworks**

  Example: Should everyone be able to access a basic level of cover?

- **Monitor** customer and industry impacts as genetic testing becomes widespread

- Get involved in **policy and governance** discussions

Summary

International trend: **moratoria** for use in life insurance, governance will be a global issue

Genetic research is progressing at a **rapid** pace. **Polygenic** tests useful for assessing risk for **common diseases**, unlike current monogenic tests

Need to **monitor** impact and advocate policies that account for **current and expected future advances** and their likely applications

Discussion

Any questions?

Read our paper:
https://goo.gl/nduCpt

Acknowledgements

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