Actuaries Summit

Think Differently

Actuaries Institute

21-23 May 2017 • Grand Hyatt Melbourne

Actuaries Summit
Think Differently

21-23 May 2017 • Grand Hyatt Melbourne

Actuaries Institute

Thinking about life insurance through a genetics lens

Jessica Chen & Damjan Vukcevic

Purpose

Should we think differently about genetics?

Overview

The presentation will discuss:

1. Current views of the life insurance industry on genetics
2. The latest in genetics research
3. Analysis of potential impacts
4. Thoughts on future considerations

1. CURRENT VIEWS

Industry's current guidance & practice

Guidance

FSC genetic disclosure guidelines (key items)

1. Make available the results genetic tests **upon request**.
2. Will **take account** of the benefits of special medical monitoring, early medical treatment, compliance with treatment and the likelihood of successful medical treatment when assessing overall risk.
3. Will **provide reasons** for any adjustment to premiums or policy conditions after application assessment.

Practice

1. While the results of any genetic test are required to be disclosed if requested, life insurers currently **do not regularly make** genetic disclosure **requests**.
2. They are **rarely used to assess the outcome** or change a person's premium.
3. This also seems to be largely the case in the USA as well (Green et al. 2015).

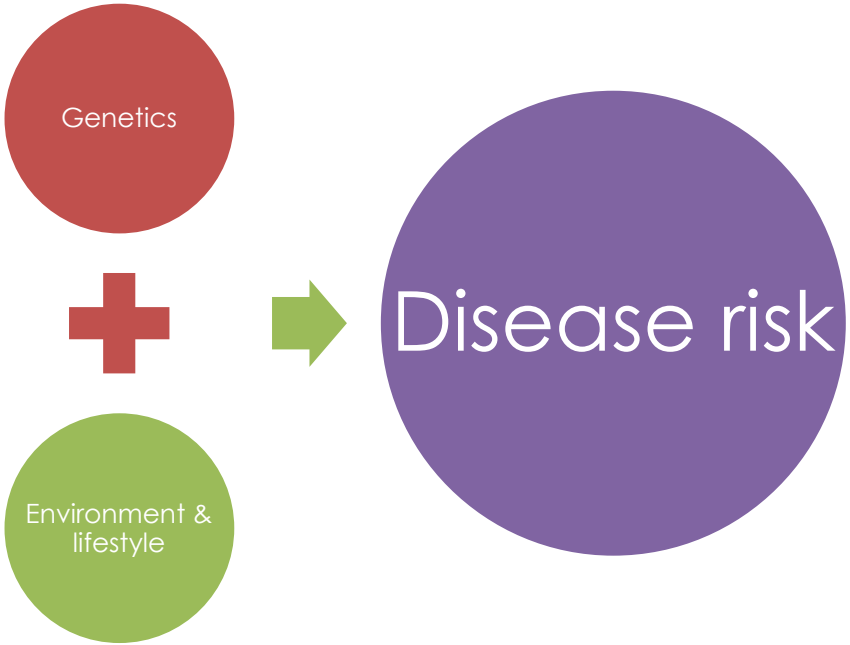
Industry's current views

Questions	Current common views
1. How much deterministic information does a genetic test provide?	1. There are a limited number of life-debilitating diseases that will definitely occur, but that only manifest in later life
2. Do genetic tests give more information compared to existing assessments methods? (e.g. family history, blood test, etc)	2. Not necessarily
3. Can predictive genetic test results be used in underwriting to reject or vary premium rates?	3. As the results are non-definitive, underwriting outcomes may be challenged in court
4. Have there been cases of declined claims due to non-genetic disclosure?	4. Very few

Current view: not immediate threat, but a potential emerging risk

2. GENETICS RESEARCH

‘Nature vs nurture’



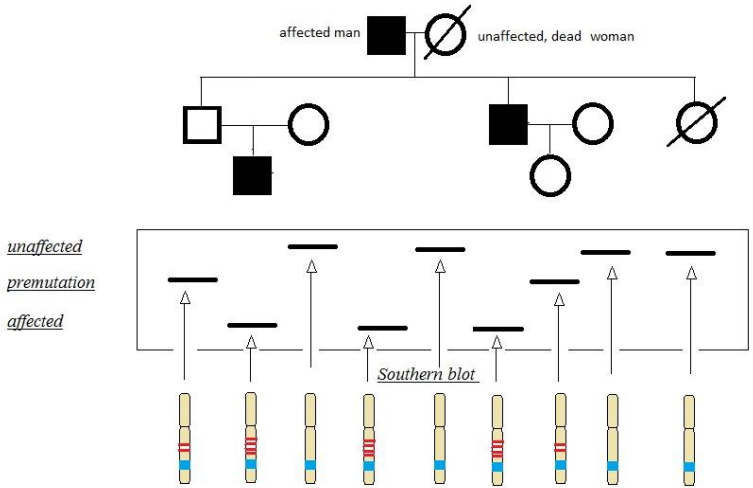
Disease	Heritability (approx.) *Variance explained by genetic factors*
Type 1 diabetes	85%
Alzheimer’s disease	80%
Coronary artery disease	50%
Prostate cancer	40%
Parkinson’s disease	25%
Breast cancer	25%
Stroke	15%

Data: Do et al. (2012), rounded to nearest 5%

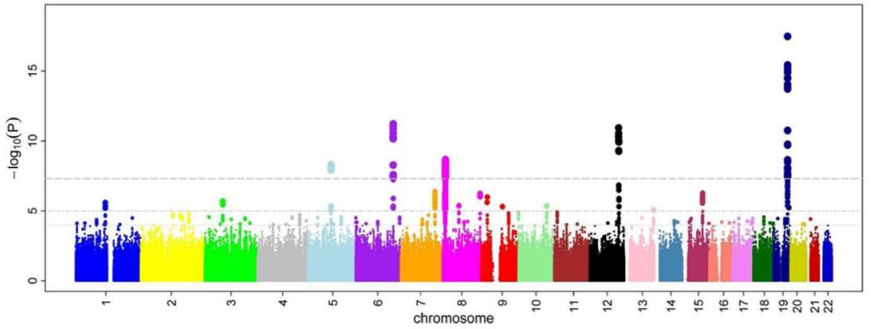
Genetic epidemiology

1980 — **2005**

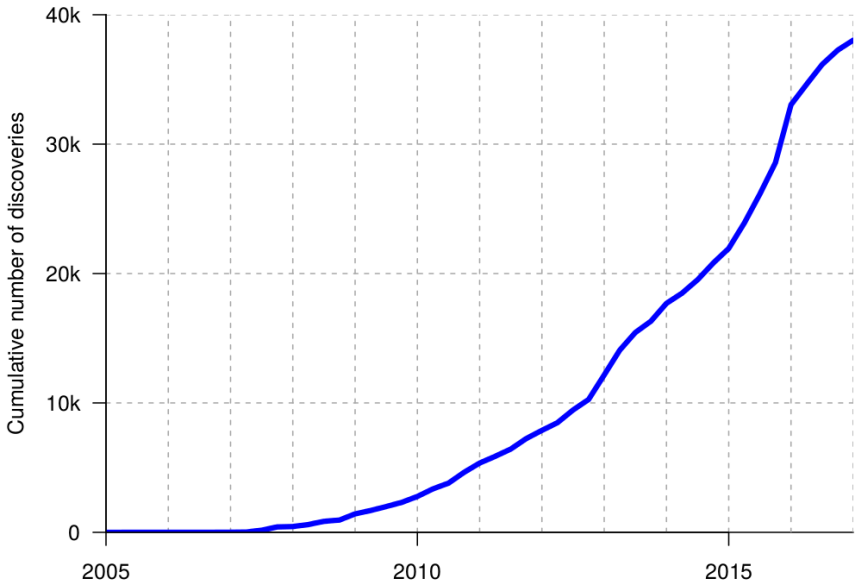
Linkage analysis — **Genome-wide association studies (GWAS)**



Pedigree with genetic linkage



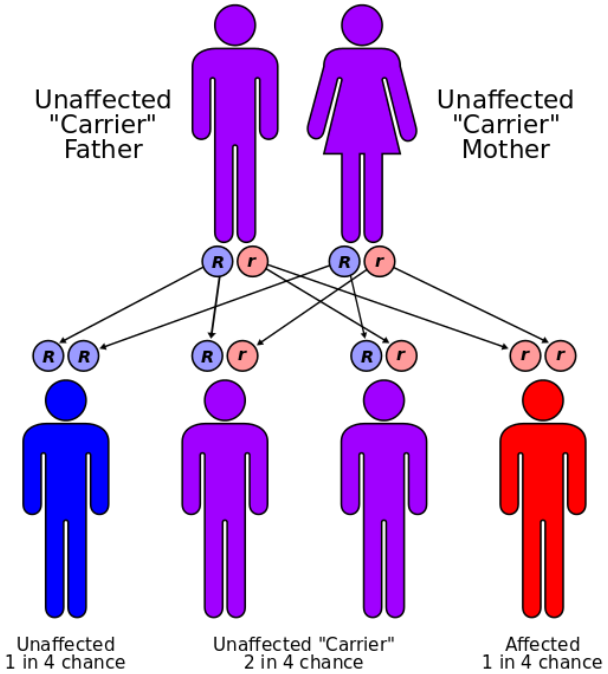
The GWAS 'boom'



Life insurance & genetics

Data: NHGRI GWAS Catalog

Genetic risk prediction – monogenic



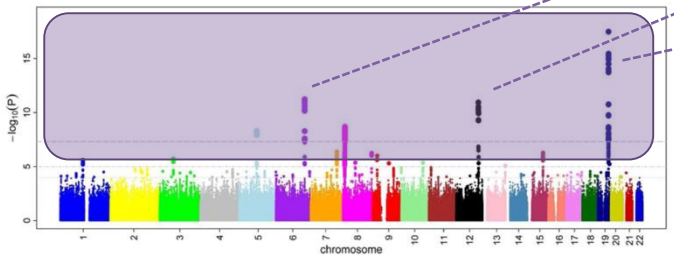
Disease caused by a single gene

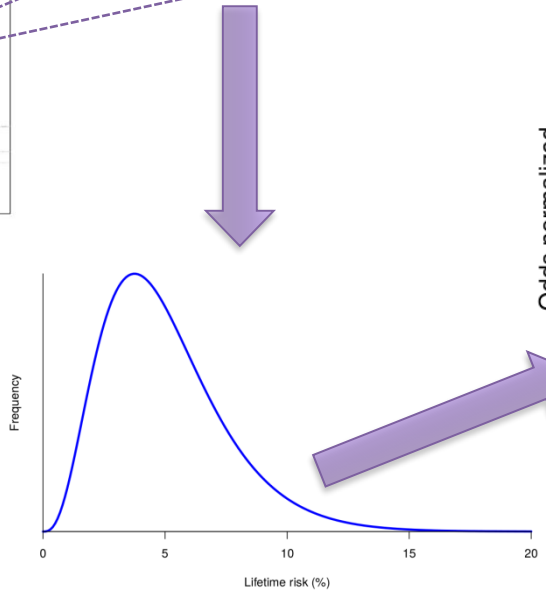
Example uses:

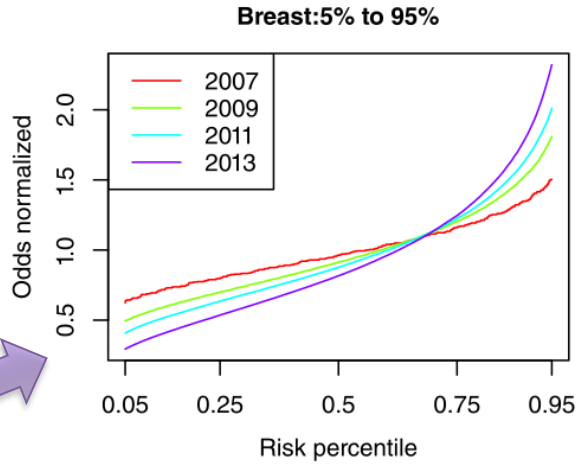
- Confirm medical diagnoses
- Determining carrier status (e.g. for family planning)

Genetic risk prediction – polygenic

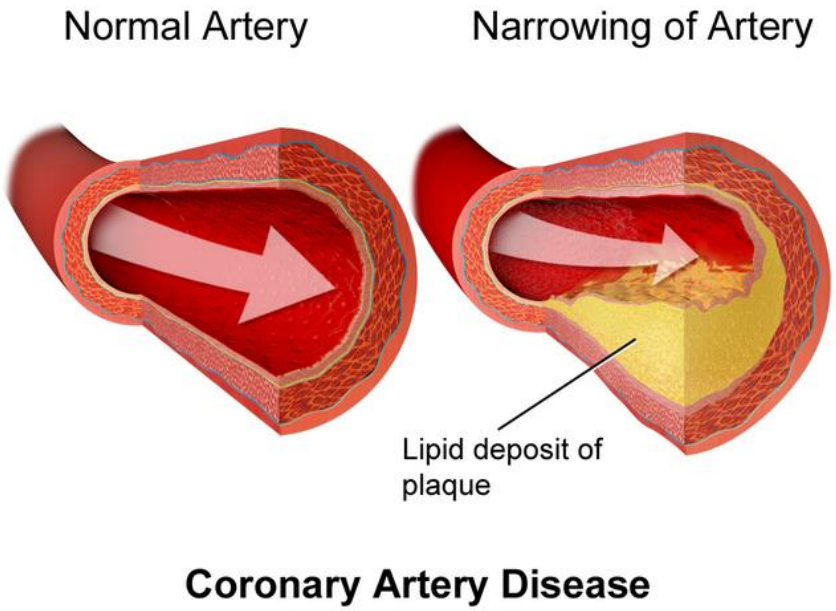
Polygenic risk score (PRS) $= \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k$





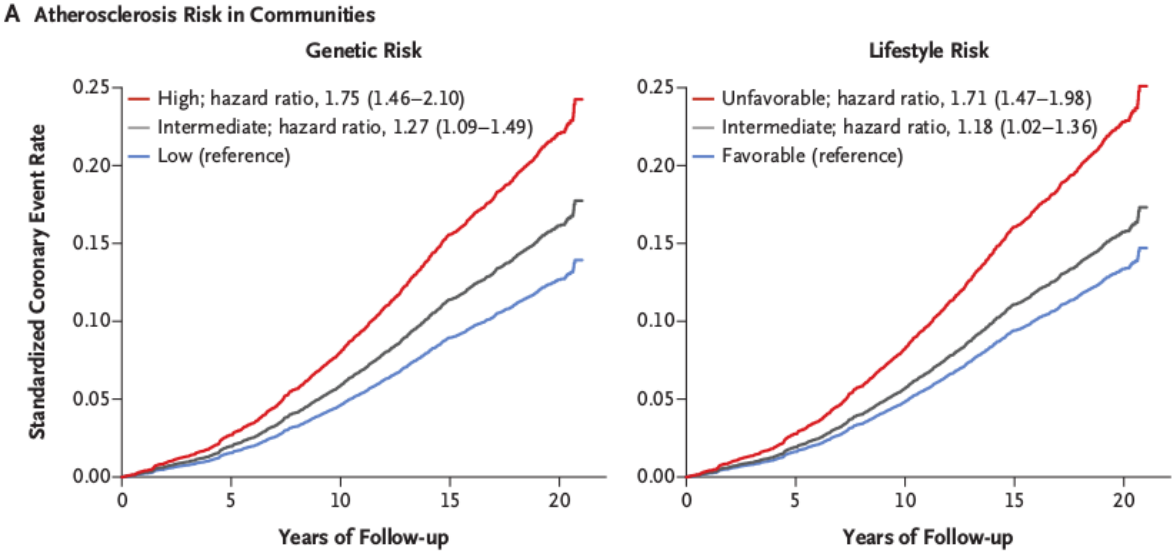


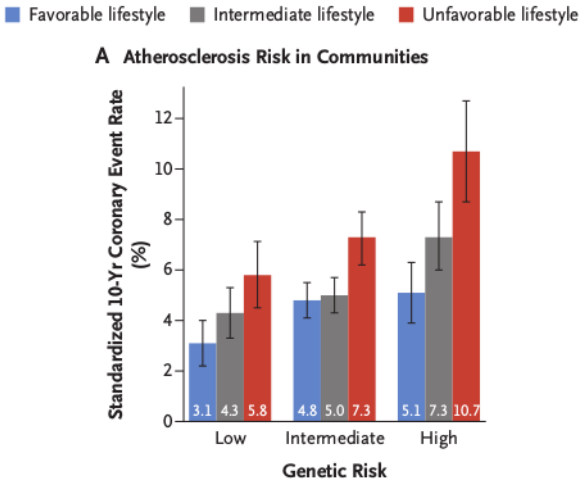
Coronary artery disease



- Leading global cause of death
- Prominent cause of life insurance claims

Predicting coronary artery disease



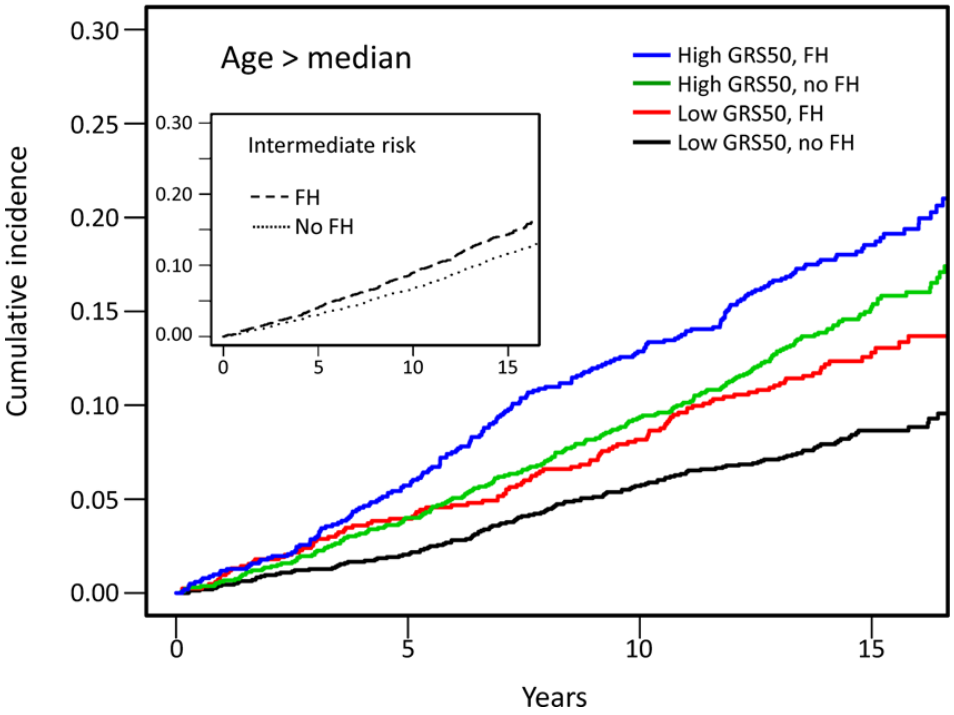


Khera et al. (2016), adapted from Figures 1 and 3

What about family history?

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

Useful to know both, and combine, to predict risk

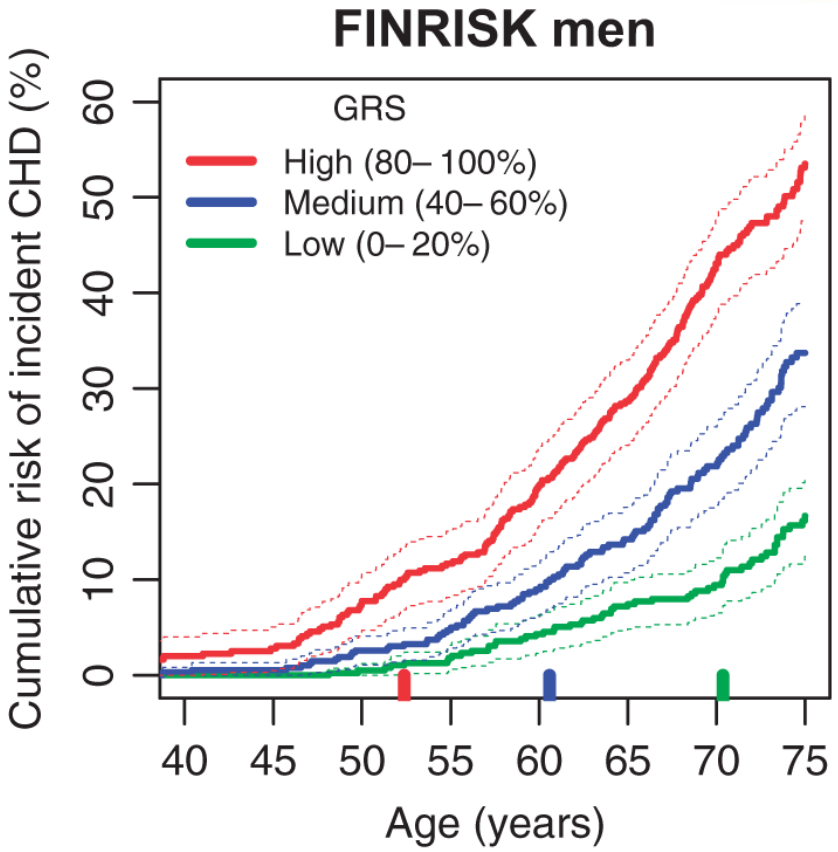


Tada et al. (2015), adopted from Figure 1

How might a predictive test be used?

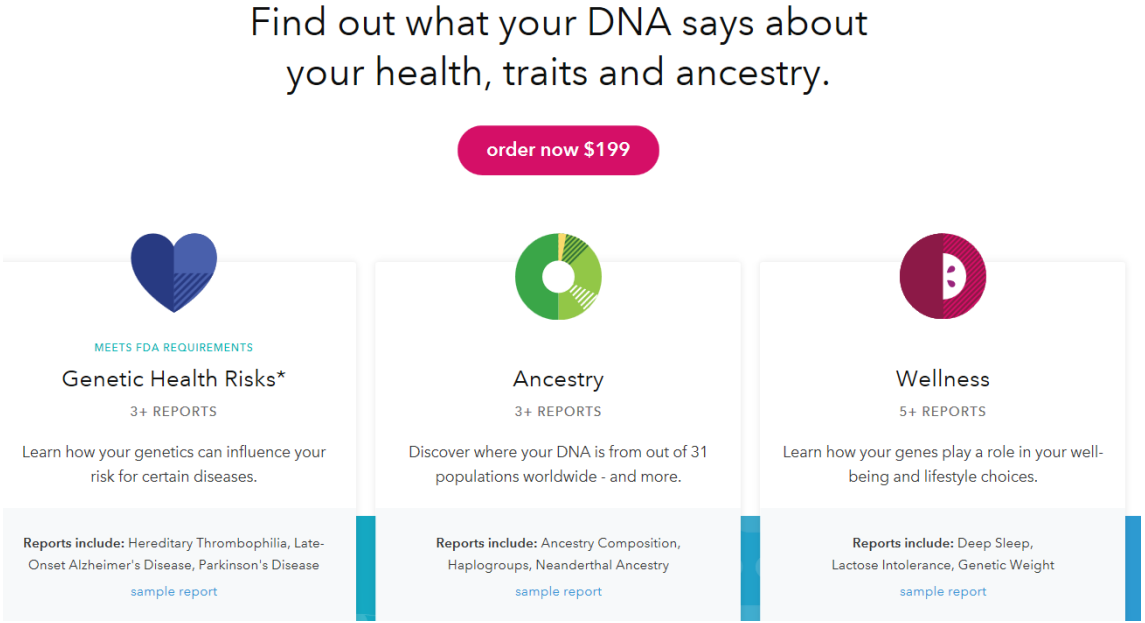
Medical screening stratified by genetic risk

Preventative interventions targeting high-risk individuals



Abraham et al. (2016), adapted from Figure 3

Are predictive tests available?



https://www.23andme.com/dna-health-ancestry/

3. ANALYSIS OF IMPACT

Predicting the impact of predictive tests

Would people make insurance decisions based on a test result?
Yes (Green et al. 2015)

How would this affect insurance companies?
We did an…

- illustrative model of **trauma insurance anti-selection**
- using the **latest genetic knowledge**
- to estimate **claim costs** and **lapse rates**.

Modelling: genetic assumptions

Disease	Proportion with high genetic risk	Increase in risk, relative to those not in high risk group	Proportion of trauma claims due to disease(s) (ages 35–65)
Coronary artery disease	20%	45%	12%
Breast cancer	20%	71%	12%
Prostate cancer	1%	61%	10%
Total	**28%**	**31%**	**34%**

Diseases considered but omitted:

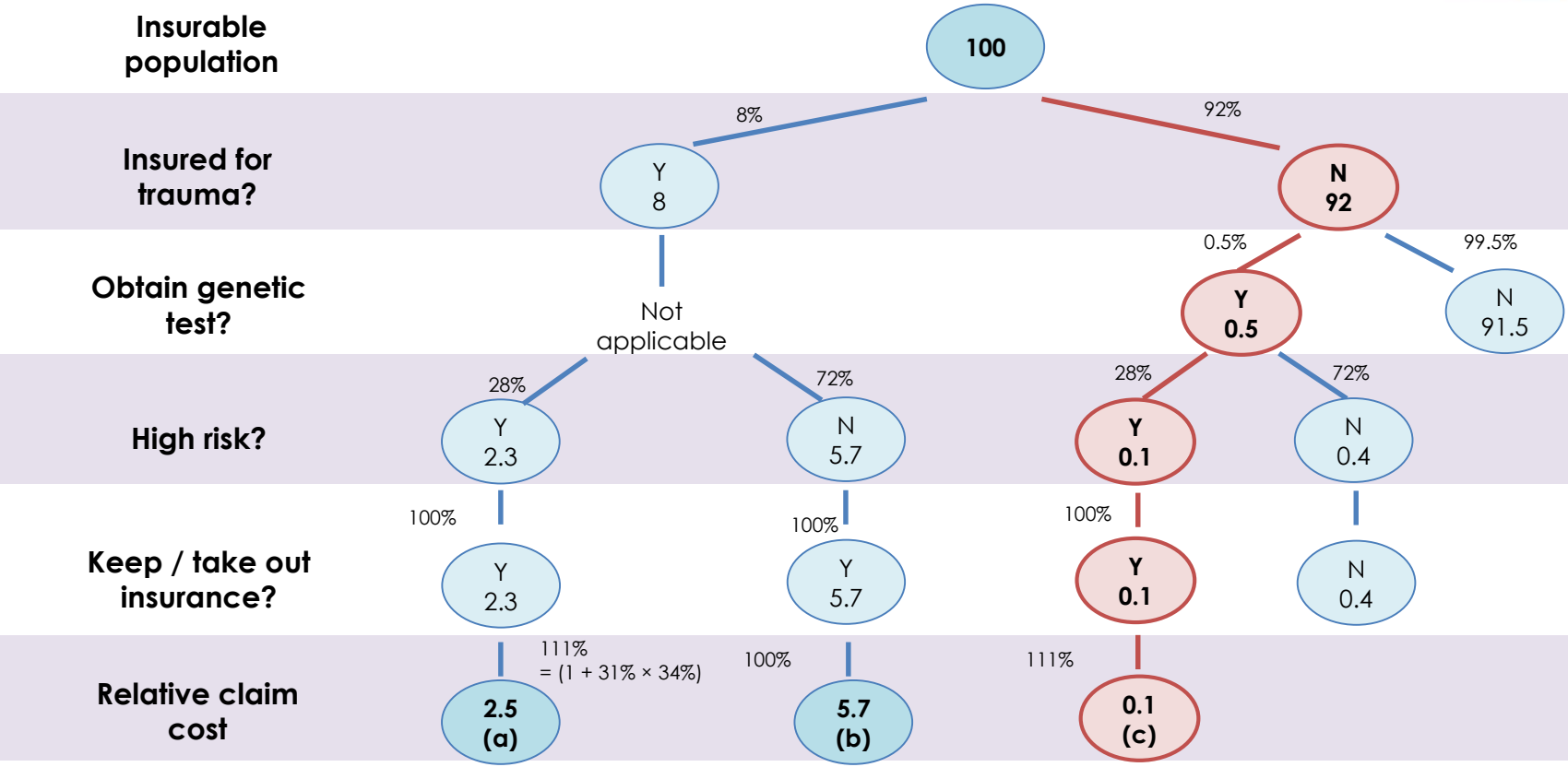
- Stroke
- Depression

Data: (see our paper for sources)

Modelling: other assumptions

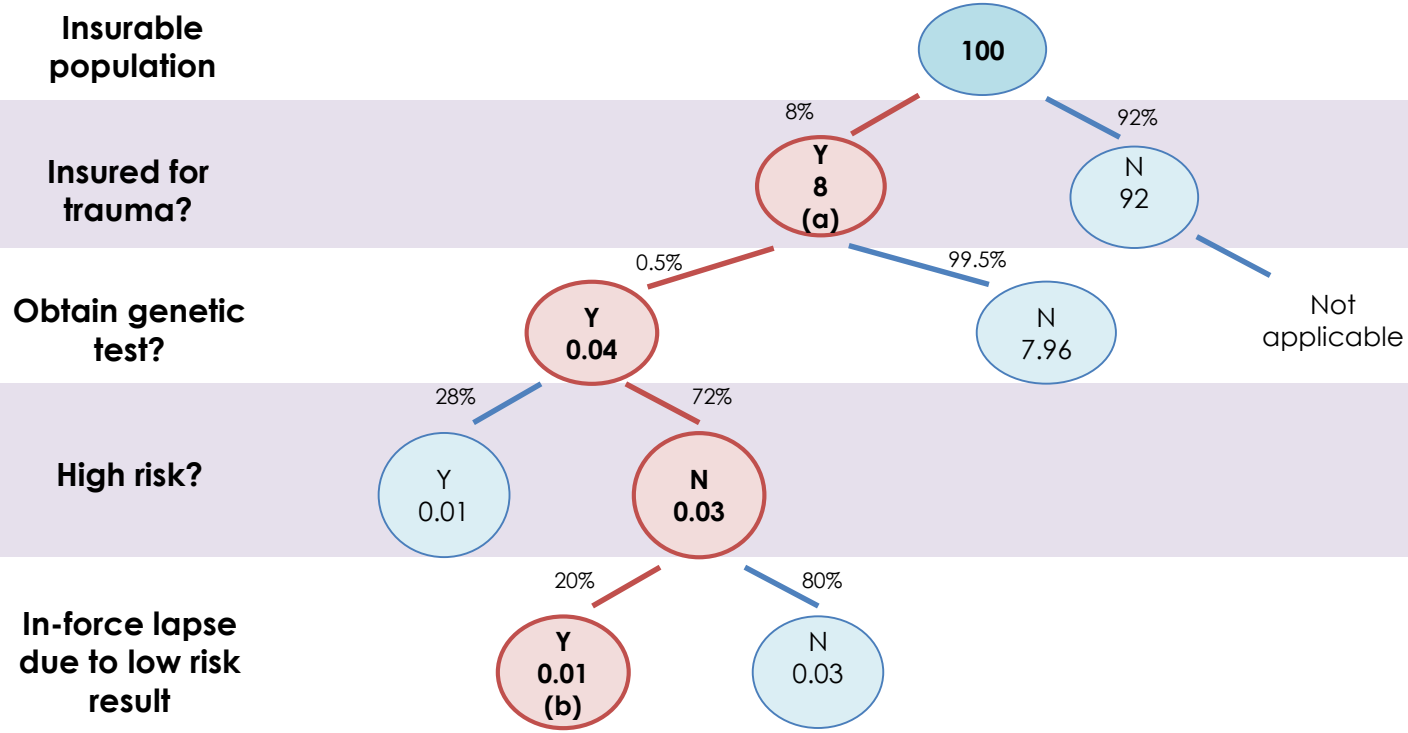
Variable	Value
Proportion of people that get a genetic test	0.5%
Proportion of people insured for trauma	8%
In-force lapse rate if known to be at low risk (c.f. BE 15%)	20%
Non-insured who obtain insurance before obtaining a genetic test	100%

Modelling: claims



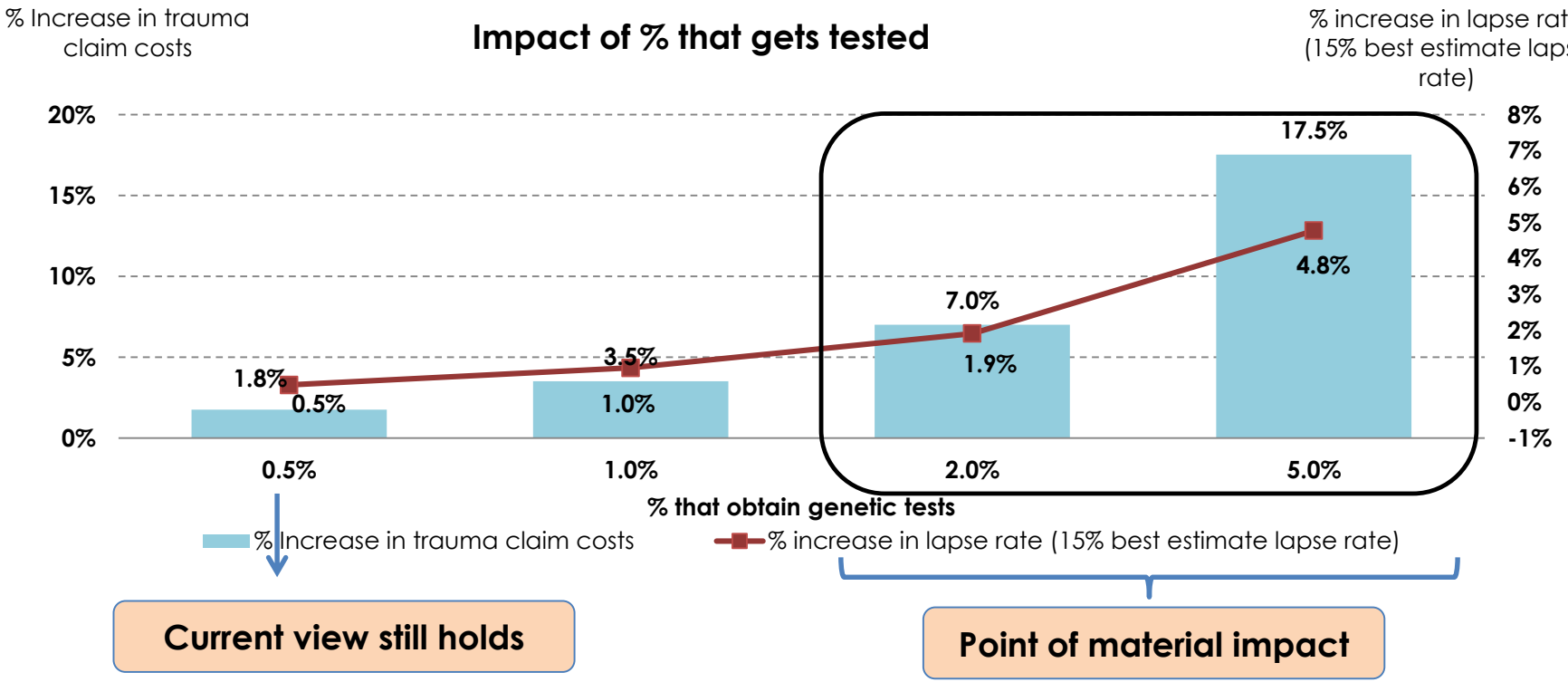
Increase in claim costs = 0.2%
[c / (a + b)]

Modelling: in-force lapse



% of in-force lapsed from knowledge of low risk result = 0.1% [b / a]
or
% increase in lapse rate (15% best estimate lapse rate) = 0.5% [0.1% / 15%]

Modelling: variation of factors



4. WHAT DOES THIS MEAN?

Reassessment of current views

Questions	Reassessment of views
1. How much deterministic information does a genetic test provide?	**1. Recent advances now provide a useful estimate of disease risk for a number of common diseases, comparable to the effect of lifestyle risk factors**
2. Do genetic tests give more information compared to existing assessments methods ? (e.g. family history, blood test, etc)	**2. Yes, for a number of diseases, and they do so in a way that is complementary to existing methods**
3. Can predictive genetic test results be used in underwriting to reject or vary premium rates?	**3. If tests are widely performed, people may view this similar to a blood test and may find it more acceptable**
4. Have there been cases of declined claims due to non-genetic disclosure?	**4. Very few, and may be difficult to prove due to direct-to-customer business models**

Longer terms considerations

- **Ethical tension:** desire to be inclusive and not discriminate based on genetics, and a desire to have a sustainable insurance industry
- **Long term states:**

  (1) more tailored premiums

  (2) much larger risk pools and restrictions on 'tailorability'

  (3) some restrictions, especially with respect to genetic tests

  How can we shape our desired long-term state?
- **Group insurance opt-in vs opt-out:** impact of genetic testing should be considered

In summary

Predictive genetic testing is an area that is fast developing and if such testing were to become **widely adopted** it is likely to impact the life insurance industry.

Insurance would need to **evolve and adapt** to these technological changes, perhaps at a **faster rate** than in the past.

Discussion

Any questions?

Read our paper:
https://goo.gl/XF4UVK

Acknowledgements

Martin Mulcare (peer-reviewer)
Iain Bulcraig (chair)

References

Abraham G, Havulinna AS, Bhalala OG, et al. (2016). Genomic prediction of coronary heart disease. *European Heart Journal*, 37 (43), 3267–3278.

Blausen.com staff (2014). Medical gallery of Blausen Medical 2014. *WikiJournal of Medicine* 1 (2).

Do CB, Hinds DA, Francke U & Eriksson N (2012). Comparison of Family History and SNPs for Predicting Risk of Complex Disease. *PLOS Genetics* 8 (10), e1002973.

Green R, Lautenbach D & McGuire A (2015). GINA, genetic discrimination, and genomic medicine. *New England Journal of Medicine*, 372, 397–399.

Khera AV, Emdin CA, Drake I, et al. (2016). Genetic Risk Adherence to a Healthy Lifestyle, and Coronary Disease. *New England Journal of Medicine*, 375 (24), 2349–2358.

Krier J, Barfield R, Green RC & Kraft P (2016). Reclassification of Genetic-Based Risk Predictions as GWAS Data Accumulate. *Genome Medicine* 8, 20.

Tada H, Melander O, Louie JZ, et al. (2015). Risk prediction by genetic risk scores for coronary heart disease is independent of self-reported family history. *European Heart Journal*, 37 (6), 561–567.

Creative Commons attributions

Pedigree linkage by Garasone is licensed under CC BY 3.0 CZ
Manhattan Plot by M. Kamran Ikram et al. is under CC BY 2.5
Autorecessive by Cburnett is licensed under CC BY-SA 3.0
Figure 3 from Krier et al. (2016) is licensed under CC BY 4.0
Coronary Artery Disease by BruceBlaus is licensed under CC BY 3.0
Figure 1 from Tada et al. (2015) is licensed under CC BY-NC 4.0
Figure 3 from Abraham et al. (2016) is licensed under CC BY-NC 4.0