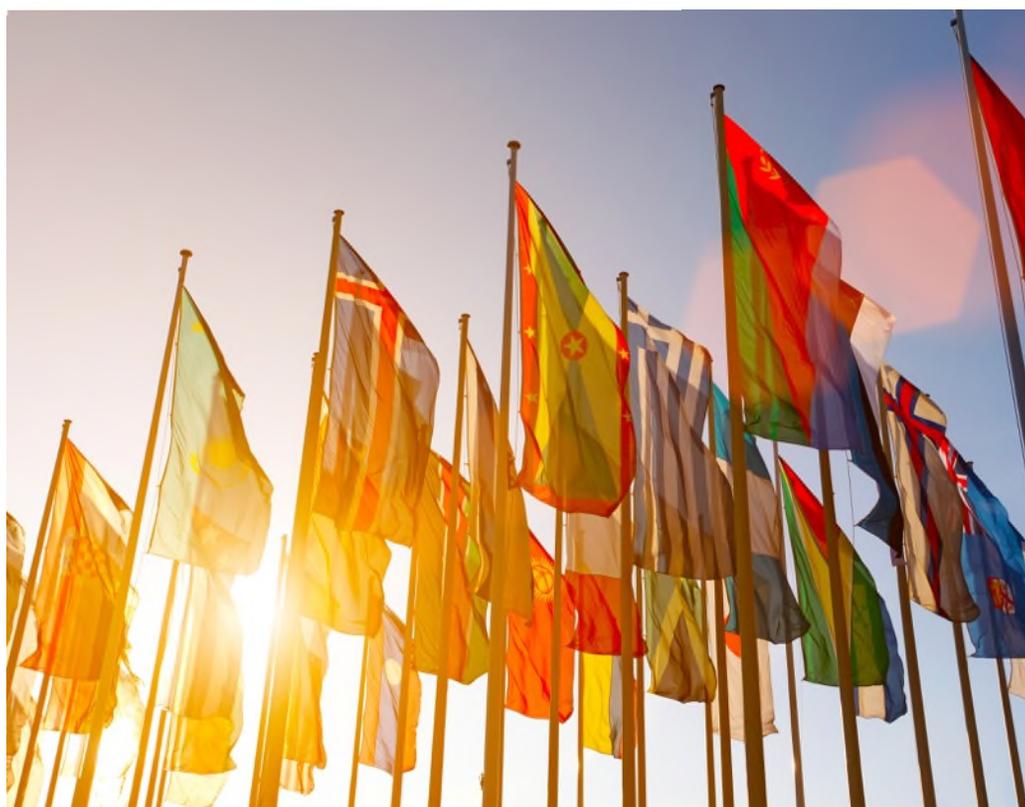




International Actuarial Association  
Association Actuarielle Internationale



# The Shape of Water, Genetics, E-cigarettes, and Diabetes

IAA Life Section and Mortality Working  
Group Webinar

Sally Hawkins, Al Klein, Sam Gutterman, Ian  
Duncan

27 March 2019



## Presenters



### **The Shape of Water**

Sally Hawkins  
(Actress)



### **The Shape of Genetics**

Al Klein, FSA, MAAA  
(Principal and  
Consulting Actuary,  
Milliman)  
Co-Vice Chair, Mortality  
Working Group



### **The Shape of E- cigarettes**

Sam Gutterman, FSA,  
MAAA, FCAS, FCA,  
HONFIA, CERA, CPCU  
(Retired)

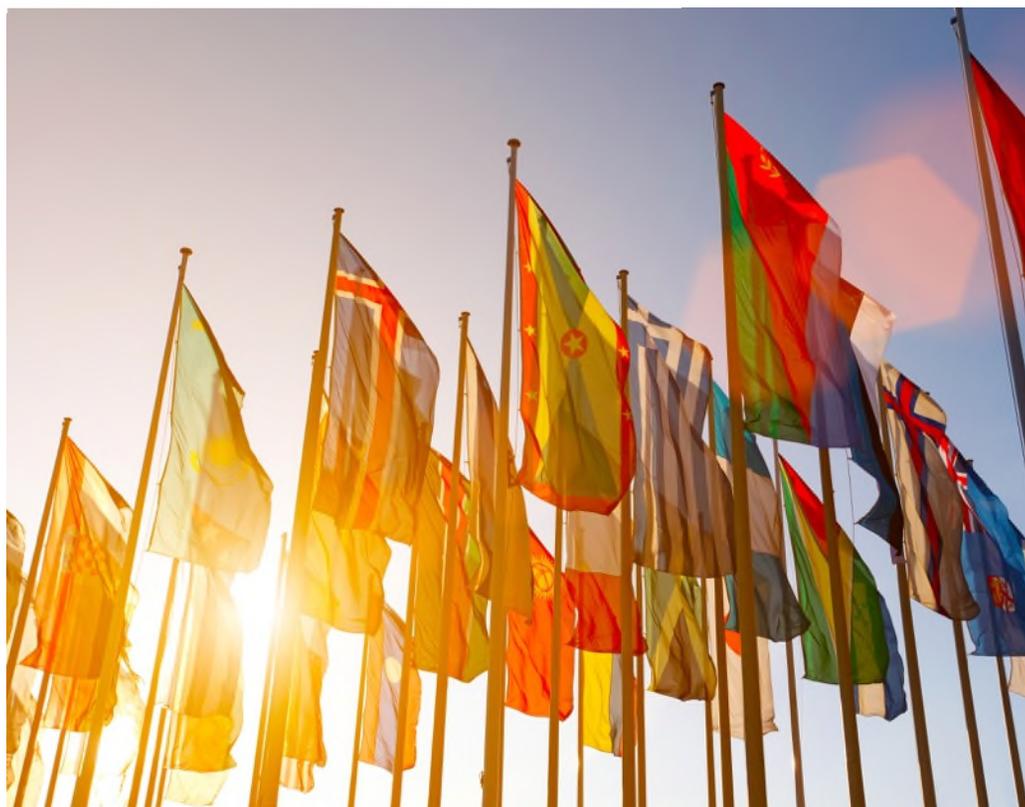


### **The Shape of Diabetes**

Ian Duncan, FSA,  
FCIA, MAAA, FCA  
(Professor, University  
of California, Santa  
Barbara)



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# The Shape of Genetics

IAA Life Section and Mortality Working Group  
Webinar

Al Klein

27 March 2019



## The Shape of Genetics - Agenda

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### Genetics

Understanding the basics

04

### Direct to Consumer Testing

Should we be concerned?

02

### Genetic Test

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What does it hold?

# Genetics

The Basics



# Genetics – The Basics

## Cell

- Basic building block of all living things
- Our body has trillions of cells
- Cells have many components – I will focus on the nucleus, the cell's command center
- Every cell contains about 3 billion DNA pairs (in the nucleus)

## DNA

- Stands for deoxyribonucleic acid
- DNA makes up the genes, which are the cell's hereditary material
- The hereditary information is stored as a code, using four chemical bases: adenine (A), cytosine (C), guanine (G), and thymine (T)
- DNA bases pair with each other, forming a spiral called a double helix
- Of the 3 billion base pairs in human DNA, about 99% are the same in all humans





## Genetics – The Basics (cont'd)

### Chromosome

- In the nucleus, this is a thread-like structure made up of DNA tightly wound around proteins
- Each person has 23 pairs of chromosomes or 46 in total
- Chromosomes contain the genes

### Gene

- Physical and functional unit of heredity
- Every person has two copies of each gene, one from each parent (except for sex-linked traits)
- It is estimated, from the Human Genome Project, that each person has 20,000-25,000 genes
- These genes comprise only 1-2% of the 3 billion DNA base pairs
- Purpose of genes is to code for proteins
- Rest of genome (98-99%) has purpose of other than coding for genes



## Genetics – The Basics (cont'd)

### The ENCODE Project

- **ENCyclopedia Of DNA Elements**
- Project started in 2003, initial results published in 2007, work still ongoing
- Public research consortium
- Goal is to identify all functional elements in the human genome sequence



## Genetics – The Basics (cont'd)

### Genetic mutations

- Permanent alteration to the DNA sequence
- Can come from inheritance, acquired mutation (e.g., from ultraviolet rays from the sun), or CRISPR (new technology that can edit genes)
- Mutations can occur in a single cell or multiple cells (more common)
- Some mutations can be disease-causing (rare) or have no impact (most)

### Other considerations regarding genetic mutations

- Just because a person has a genetic mutation that pre-disposes them to a disease, doesn't mean they will get it because virtually all genetic mutations have an environmental component
- Similarly, just because a person doesn't have a genetic mutation that pre-disposes them to a disease, doesn't mean that they won't get it
- There are a few genetic mutations, typically single gene mutations, where there is not an environmental component, e.g., Huntington's disease

# Genetic Testing

What is it?



# Genetic Testing

## What is it?

- Type of medical test that identifies changes in chromosomes, genes, or proteins
- Can confirm or rule out certain genetic conditions or help determine chance of developing or passing on genetic condition

## How is it done?

- By analyzing a sample from blood, saliva, hair, skin, other tissue or fluids

## What do the results show?

- Hair and eye color, where in the world your genes came from, percent Neanderthal
- Susceptibility to certain diseases, including environmental component
- Medicines that will work (more quickly metabolize) or not work for person



## Genetic Testing (cont'd)

### Concerns

- Interpretation of results are not always straightforward
- Much learning about impact of many genetic mutations still ongoing

### What can you do about the results?

- Modify behavior to reduce risk of getting disease
- Seek advice from genetic counselor

# Regulations

on genetic testing



## Regulations from a number of countries

### Prohibited

- Canada, Ireland, Mexico, Norway, Spain
- Ireland particularly restrictive – From Disability Act 2005, requirement to inform GP when sending other info, not to include any genetic info. If genetic info gets in file, must be ignored and deleted. If it can't be deleted, a note must be included in file indicating it was ignored.

### Prohibited unless the applicant provides:

- Israel, Italy, South Africa

### Cannot require genetic test, but if applicant has taken one it can be requested:

- Australia (unless genetic test done for research purposes and applicant doesn't know results)
- Sweden and Switzerland (only above certain face amount limits)
- UK (only above certain face amount limits or if Huntington's disease found)

### Not used but not prohibited:

- China, Japan, Latin America/Caribbean, Russia, US

Source: Underwriting Around the World, <https://www.actuaries.org/mortality>



## Regulations in US

### Primary regulation – GINA (Genetic Information Nondiscrimination Act)

- Federal law
- Prohibits genetic discrimination in health insurance, but not in other forms of insurance

### State laws

- Considerable variation, regulations could include items, such as:
  - Definition of genetic test or analysis
  - Whether or not a test can be required
  - Disclosure
  - Consent, exceptions (e.g., for education, research, diagnosis)
  - Whether genetic testing and DNA samples are considered personal property, private, confidential, privileged
- Penalties for privacy violations

# Direct-to-Consumer Genetic Testing

Should we be concerned?



## Direct-to-Consumer Genetic Testing – Should we be concerned with respect to life insurance?

### Report by the SOA on the impact of genetic testing on life insurance mortality

- Attempt to quantify the impact through a model
- Many assumptions needed for model, impact of results driven by these assumptions

### Considerations of model

- Diseases potentially not asked about in underwriting process or that cannot be identified by insurance company in some other manner (e.g., BRCA1 or 2, early onset Alzheimer's disease)
- Prevalence of disease



## Direct-to-Consumer Genetic Testing – Should we be concerned with respect to life insurance? (cont'd)

### My opinion

- Consider what a person is more susceptible to
- What is the environmental component?
- What is the genetic situation regarding the drugs that can treat the condition?
- Can we be selected against? Today vs. the future

# Epigenetics

The Basics



# Epigenetics – The Basics

## What is it?

- The study of gene expression
- Alterations in gene expression that don't involve changes to the base pairs

## What causes these alterations?

- Diet, exercise
- Chemicals, toxins, pollution in the environment
- Smoking, drinking
- Medications
- Stress, depression
- Disease, infections



## Epigenetics – The Basics (cont'd)

### What is the process for determining epigenetics?

- Similar as done with genetics, i.e., test blood, saliva, tissue
- Methylation process at biochemical level to look at modifications to DNA, genes, proteins
- Alterations in genes that don't involve changes to the base pairs

### Biological vs. Chronological age

- Epigenetics predictive of all cause mortality
- Can determine biological age as well as rate at which a person is aging

### Other important notes:

- Genetic code does not change over time
- Epigenetics can change over time, particularly with lifestyle changes
- However, epigenetic rate of aging appears to be fairly constant over time
- Initial work done on this by Steven Horvath, UCLA, but many now studying

# The Future

of genetic and epigenetic testing



## The Future

### **Further identification of meaning of specific genetic combinations**

- Research being done by many of the genetic testing companies

### **Precision medicine**

- Using genetic information to prescribe appropriate medicines and dosage

### **CRSPR**

- Edit known birth defects before they have an impact
- Reduce chance of developing disease

### **Epigenetics in underwriting**

- Can provide overall life expectancy
- Can also determine smoking, alcohol use more accurately

### **Use genetic information to help our customers**

- Inforce management



## The Future (cont'd)

### Will our genetic code become public?

- Will it be used for research and learning purposes or will we (as individuals or insurance companies) be discriminated against in some manner we are not even thinking about today?

### Risks

- Potential for misunderstanding of genetic test information
- Potential for misuse of genetic test information
- Regulation that negatively impacts consumers and/or insurance companies

### Benefits

- Increased understanding and better treatment of disease
- Potential for reduction in and elimination of disease leading to gains in healthy longevity
- Consider use of epigenetics in underwriting process

### Should we be concerned in the life insurance industry?

- Not today, but possibly in the future
- We should work closely with regulators to formulate the best solution for all parties
- We should work to make genetic testing valuable to all

# Resources

On Genetics and Epigenetics



## Sources

### Genetics

- <https://ghr.nlm.nih.gov/>
- <http://sitn.hms.harvard.edu/flash/2012/issue127a/>
- <https://www.genome.gov/10005107/>

### Epigenetics

- <https://www.whatisepigenetics.com/what-is-epigenetics/>
- <https://learn.genetics.utah.edu/content/epigenetics/>

### SOA Study

- <https://www.soa.org/resources/research-reports/2018/impact-genetic-testing/>

Thank you



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