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Longevity Catalysts

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Route-map

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- Which problems are we looking to solve?
- Delayed recognition
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- Potential uses: Overview
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- Examples of Indicators
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- Cancer diagnosis
- Back testing: Breast cancer death rates
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- Aims for 2014
- Q & A

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About us

- Longevity Catalysts Working Party
- Set up in 2012
- What problem are we looking to solve?
- We have a website! www.longevitycatalysts.com

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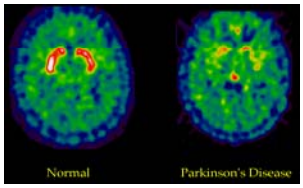
Longevity Catalysts

What future events are we aware of today whose occurrence will be coupled with a universal increase in expectations around mortality improvements?

Cardiovascular polypill

Universal Influenza vaccine

Bowel cancer screening



Stem cell therapy for Parkinson's

Genetic Screening

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What problems are we looking to solve?

- Uniqueness of the past
- Granularity
- Not making use of all available information
- Greater appreciation of “dormant risks”
- Philosophy: imperfect but less so than status quo
- Delayed recognition

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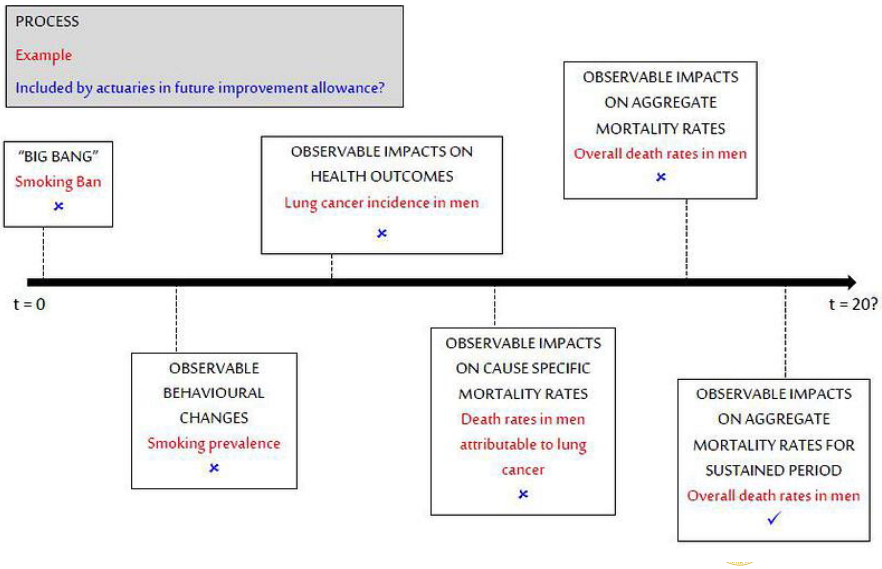
Delayed Recognition



Potential Indicators

Candidate

Population tobacco consumption →

Early cancer diagnosis rates →

Population cholesterol levels →

Desirable properties

1. Objective
2. Regular
3. Frequent
4. Reliable
5. Strong mortality link
6. Historic precursor?

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Potential Uses

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Example 1 – Economic Capital

- A stress and scenario testing framework linked to catalyst events could provide a more robust and less abstract way of calibrating, validating and communicating 1-in-200 year events

- A schedule of catalysts could help to answer the question:

"What could happen in the next year to significantly change our life expectancy estimates?"

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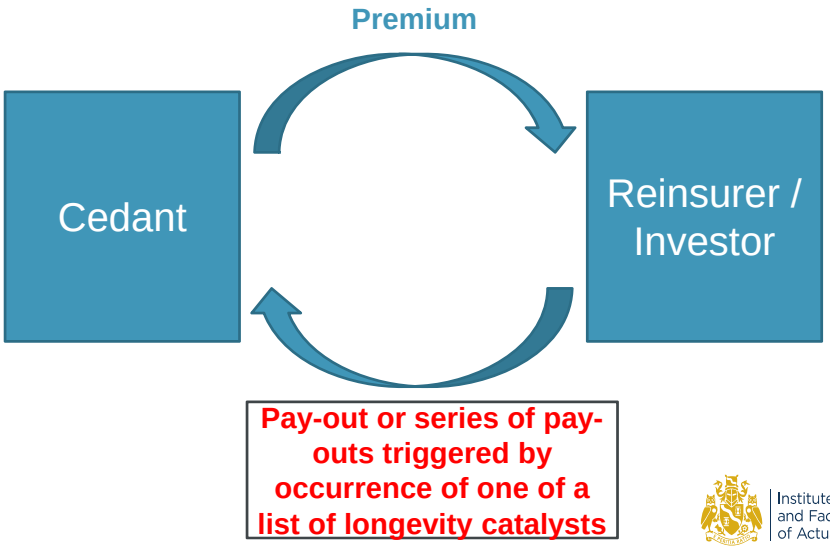
Example 2 – Targeted Reinsurance / Retrocession



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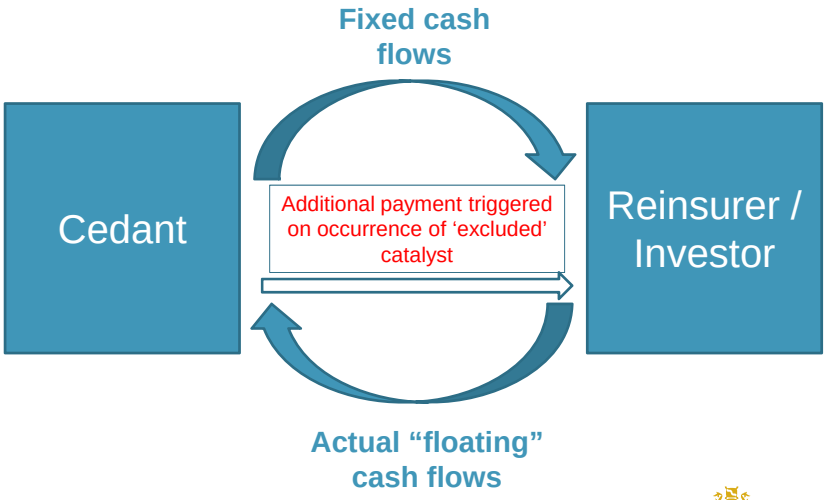
Example 3 – Longevity swap exclusions



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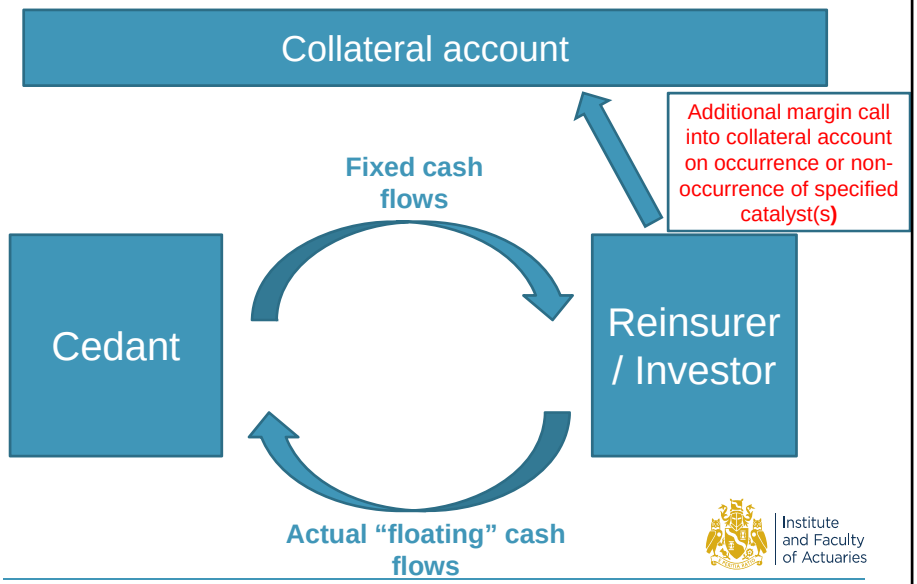
Example 4 – Longevity swap collateral call



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Potential Uses

- Economic Capital / Solvency II
- Risk appetite
- Best estimate approach – what future events are you already (knowingly or otherwise) allowing for?
- Hedging
- Greater appreciation of
  - Dormant risks
  - Existing exposure
- Other

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Monitoring of Key Indicators

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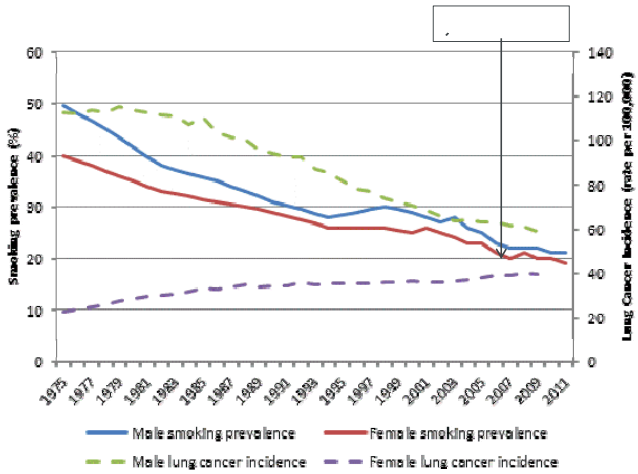
Example: Smoking prevalence



Source: Office for National Statistics and Cancer Research UK

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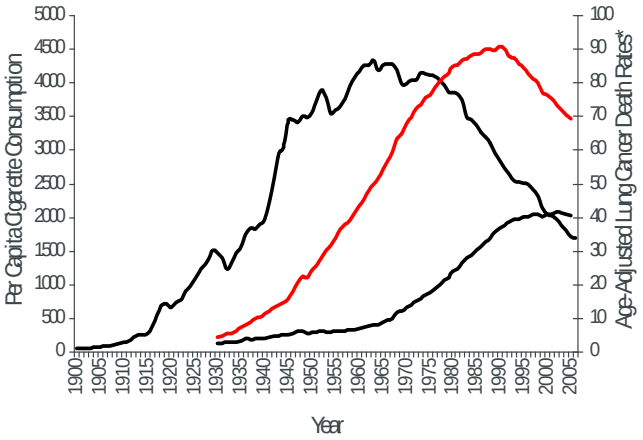
Tobacco Use in the US, 1900-2005



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Example – Stem Cell Treatments

Cell types	Stem cells experimental	Stem cells implantation
Skin	Yes	Yes
Cartilage	Yes	Yes
Arteries & veins	Yes	
Trachea	Yes	Yes
Eye (retinal cells)	Yes	Yes
Pancreas (insulin cells)	Yes	Yes
Brain (dopamine cells)	Yes	Yes
Red blood cells	Yes	Yes
Lung	Yes	
Heart	Yes	
Liver	Yes	
Small intestine	Yes	

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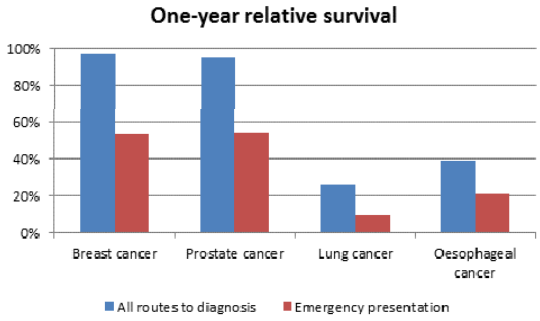
Example – Cancer Mortality by Diagnosis Route



Source: Improving Outcomes, A Strategy for Cancer

- In 2007, over 50,000 cancer patients in the UK were diagnosed on emergency presentation
- Earlier detection would clearly have a very significant impact on cancer rates

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Back testing past catalysts: Breast cancer screening and Tamoxifen

1. BIG BANG - BREAST SCREENING

NHS breast screening is launched in England & Wales — 1988

2. OBSERVABLE CHANGES

Increase in proportions diagnosed with breast cancer at early stages. Five year survival rates drop from 90% when diagnosed at stage I to only 13% when diagnosed at stage 4 (Source: Department of Health and Cancer Research UK) — 1990s

3. IMPACT ON HEALTH OUTCOMES

Increased survival rates owing to both (a) early diagnosis - see table below - and (b) treatment with Tamoxifen — 1990s and 2000s

4. IMPACT ON DEATH RATES

See below for breast cancer specific improvement rates — 1990s and 2000s

1. BIG BANG - TAMOXIFEN

Increased clinical acceptance of the use of tamoxifen to treat women with breast cancer — mid 1980s

2. OBSERVABLE CHANGES

Rapid increase in use amongst women with breast cancer. By 1990, in the Thames regions, over 90% of women over age 50 and over 50% of women under age 50 received tamoxifen for breast cancer treatment (Blanks at al, BMJ 2000) — 1990

3. IMPACT ON HEALTH OUTCOMES

Increased survival rates owing to both (a) early diagnosis - see table below - and (b) treatment with Tamoxifen — 1990s and 2000s

4. IMPACT ON DEATH RATES

See below for breast cancer specific improvement rates — 1990s and 2000s

19

Impact on past breast cancer death rates

There is a clear signal in observed mortality data that shows large reductions in breast cancer mortality in 1990's and 2000's following the introduction of a national breast screening programme and the increased use of the drug Tamoxifen in the mid to late 1980's

Hotter colours illustrate greater improvements from 1988 onwards

The study by Blanks et al (BMJ 2000) attempted to disaggregate the drivers for the decline in breast cancermortality over the 1990s. It suggests that changes in treatment accounted for around 70% whilst the remaining 30% were due to the introduction of screening.

Strong improvements continue to be observed in the recent past

Stage of Diagnosis	Five year survival rate (%)
Stage I	90
Stage II	70
Stage III	50
Stage IV	13

The above chart illustrates that earlier dagnosis has a significant impact on breast cancer survival rates

Data sourced from Department of Health 2010b; Cancer Research UK 2011c

Certain cohorts of lives were too old for the introduction of screening and / or use of tamoxifen to have an impact

This suggests a potential for similar improvements in the 2010's and 2020's for bowel cancer due to the recently launched bowel cancer screening programme.

Source: PIC calculations based upon ONS and causal data

Case study: the unfolding smoking story

Muller suggests link between smoking and cancer

1939

German Institute for Tobacco Hazards study confirms Muller's finding

1943

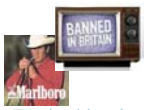
Doll & Hill identify link between smoking and lung disease

1950

60% of men smoke
40% of women smoke

Royal College of Physicians calls for tobacco controls

1962



TV advertising of cigarettes banned

1965

Health warnings on packaging

1971

Late 1980s and 1990s

Several states (including Alaska, Arizona, California, Maine, Massachusetts and New York) raise their tobacco excise taxes substantially, using the proceeds to launch statewide tobacco-control programs (Farrelly).

Class actions in US & increases in tobacco duties

1980s – 1990s

Unal et al show 54% of improvements in CHD mortality relate to smoking

2005

Smoking ban in public places, including pubs

2006

The First Nonsmoking Nation

Bhutan banned tobacco. Could the rest of the world follow?

Bhutan becomes first country to ban sale of tobacco products

2010

20% of men smoke
20% of women smoke

E-cigarettes to be regulated as medicines

Call for regulation of electronic cigarettes

2013

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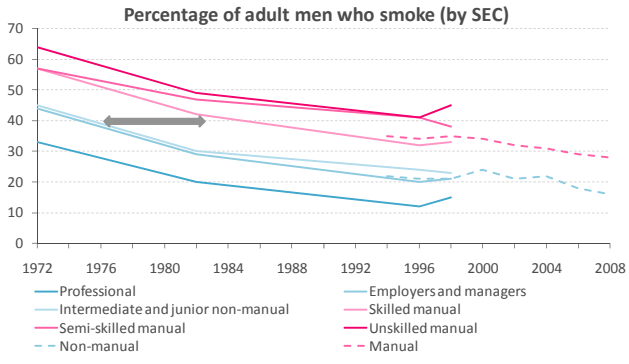
Why did it take so long?

- Groupthink
- Categorical proof of link
- Popularity amongst voters
- Personal habits of decision-makers
- Tough habit to break
- Tax revenues
- Lobbying
- People don't act rationally



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Questions

Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenters.

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