Institute and Faculty of Actuaries

Cause of Death Working Party update

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18 September 2014

Agenda

- Background to the working party
- Work to date
- Cause of Death Models
- Overview of model
- Cause of Cause of Death Models
- Conclusion

Background to working party

- October 2011 - Autumn Lecture by Sir Harry Burns
- Large differences in life expectancy within west central Scotland
- Theories about cause of “Glasgow Effect”
- Challenge issued to actuarial profession

Work to date

- Working party formed in late 2012
- Three strands to working party:
  1. Develop a cause of death model

     Particular focus on meeting needs of Sir Harry
  2. Draft paper on cause of death models
  3. Draft paper on cause of cause of death models
- Focus of second strand changed
- Paper now a more practical guide to cause of death models

Cause of death models

- Data
- Model Form
- Incorporation of expert opinion
- Example model results/output
- Benefits and limitations

Cause of death WP – Work Stream 2

Aim of the work stream:

- A practical entry point to Cause of death modelling
  - For practitioners
  - For users of CoD model results
- Provide overview on strengths and weakness of the approach

Cause of death WP – Work Stream 2

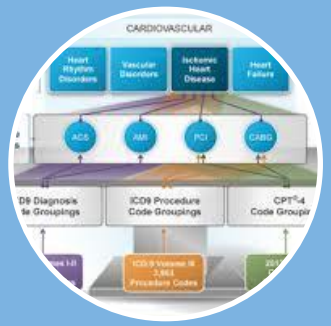
Cause of death model process

Data

Deaths

Exposure

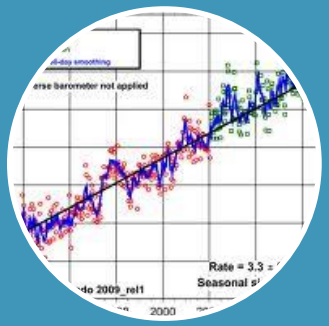
Process Data



ICD code mapping

Group conditions

Projection



Model Form

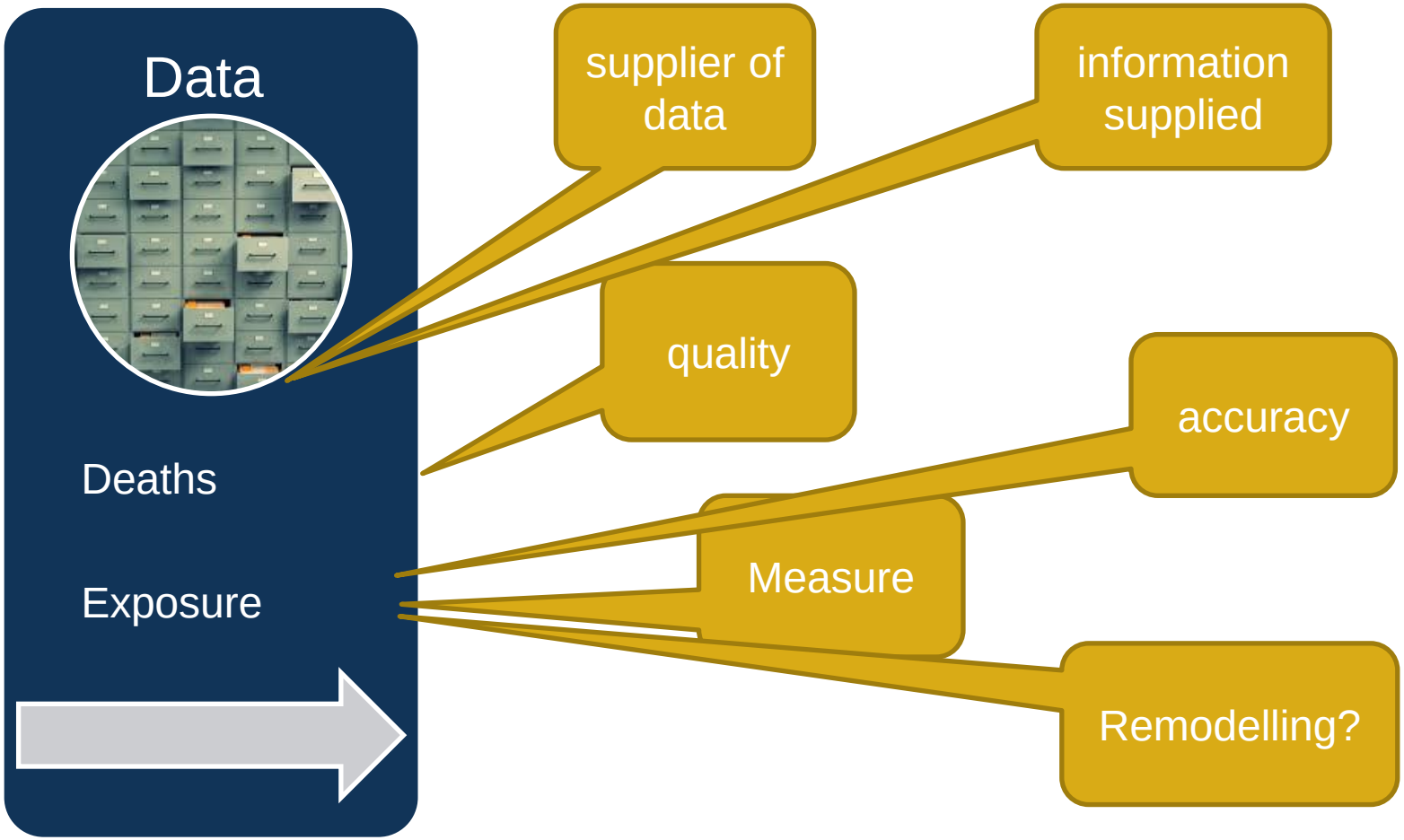
Allowance for expert opinion

Recombine

Recombine to aggregate

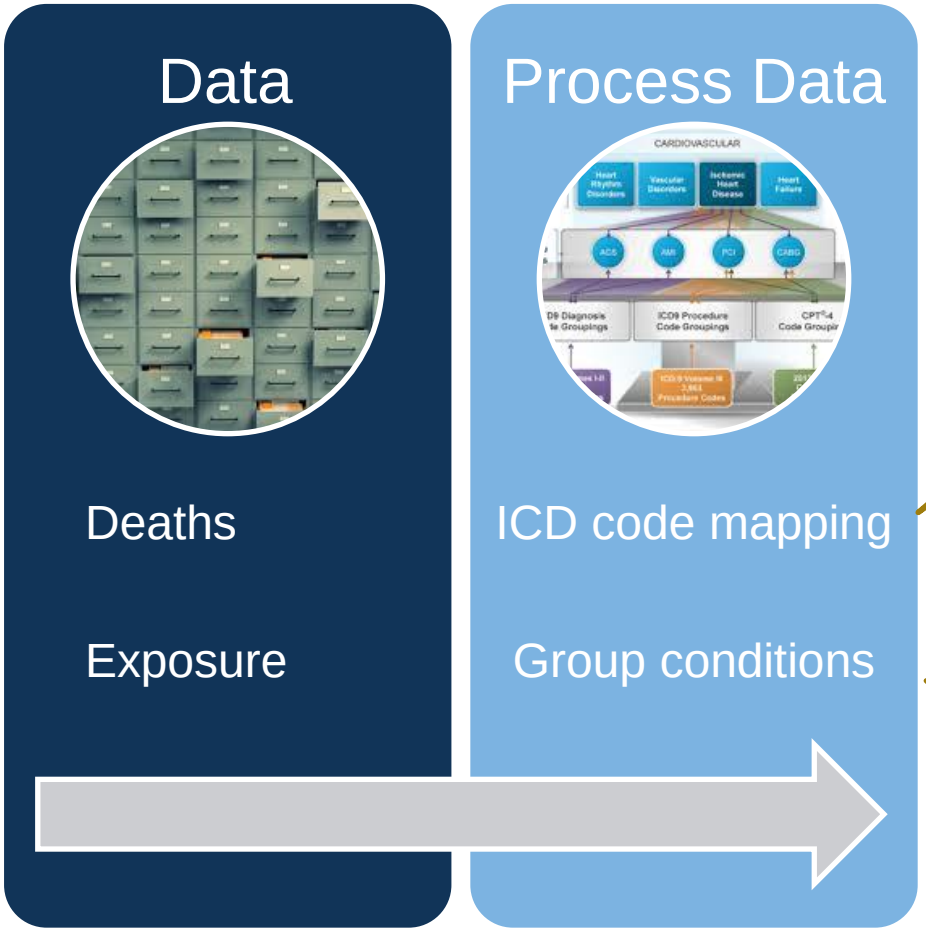
Cause of death WP – Work Stream 2

Cause of death model process



Cause of death WP – Work Stream 2

Cause of death model process



Cause of death WP – Work Stream 2

Cause of death m

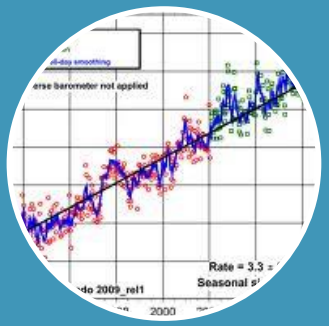
Data

Deaths

Exposure

ICD code mapping

Projection



Model Form

Allowance for expert opinion

Increased risk of discontinuities in historic data

Expected lifestyle changes, new medical treatments

Strength / weaknesses of different projection models

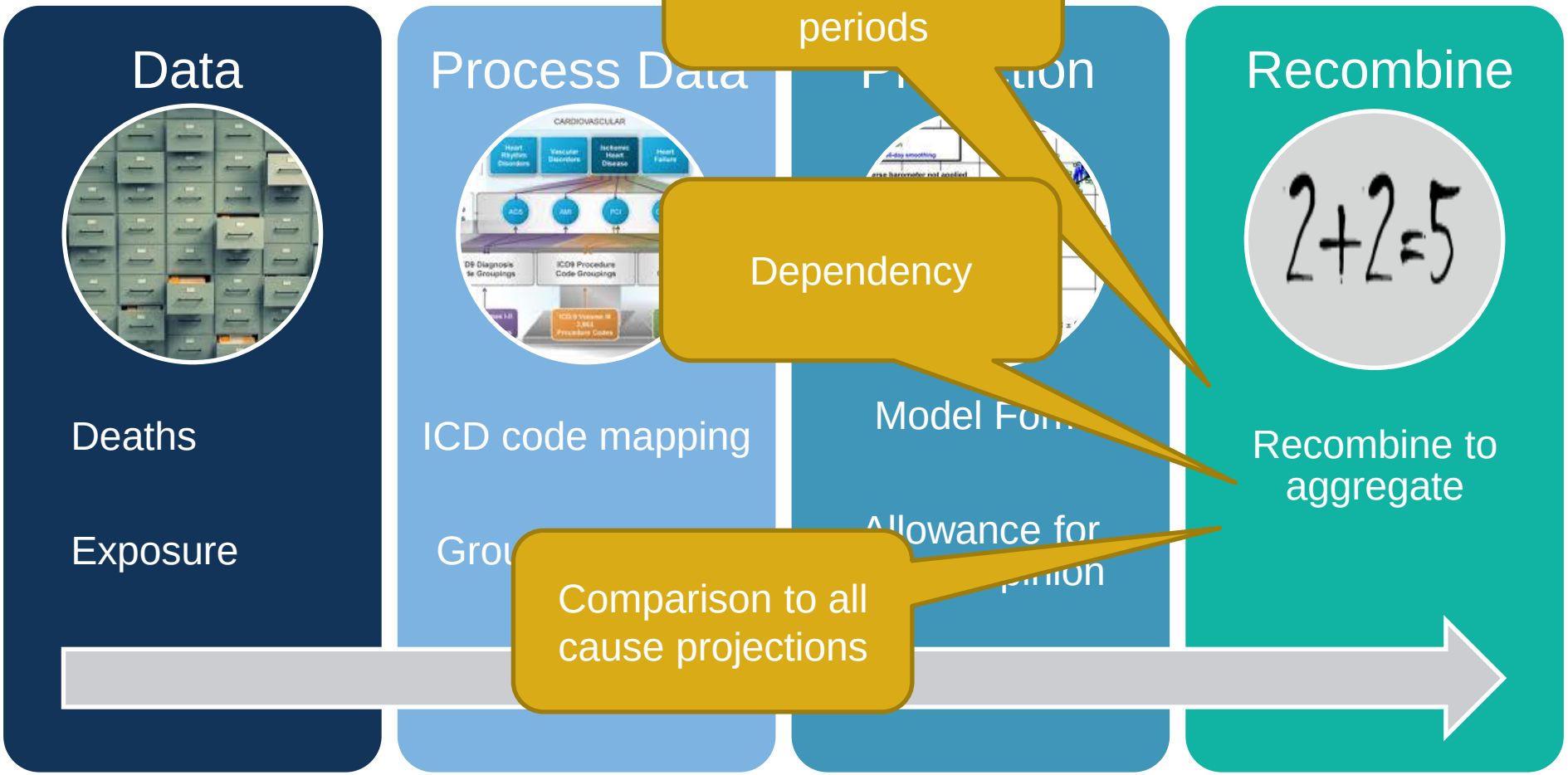
Allowance for strong “cohort” patterns

Medical and other expert opinion

Introduces subjectivity, increases complexity

Cause of death WP – Work Stream 2

Cause of death model process



Cause of death WP – Work Stream 2

Overview of benefits & limitations

- Key insights CoD models provide
- Awareness of limitations of the approach
- Where CoD models fit in with the family of projection models

Key Insights CoD models can provide	Limitations
Drivers of mortality trends at the cause of death level	Not appropriate for longer term trend estimation due to dependencies between causes of death
Indicate likely direction of trends in the short to medium term.	Need to contend with limitations of death by cause data
Can “unpick” apparent patterns in trends providing clues to reasons for improvements but will not provide the underlying causes	Underlying causes of mortality trends will work across multiple causes of death
Can incorporate expert opinion at the cause level but this brings increased subjectivity and complexity	Co-morbidity, especially at older ages.

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Working Party Cause of Death Modelling so far

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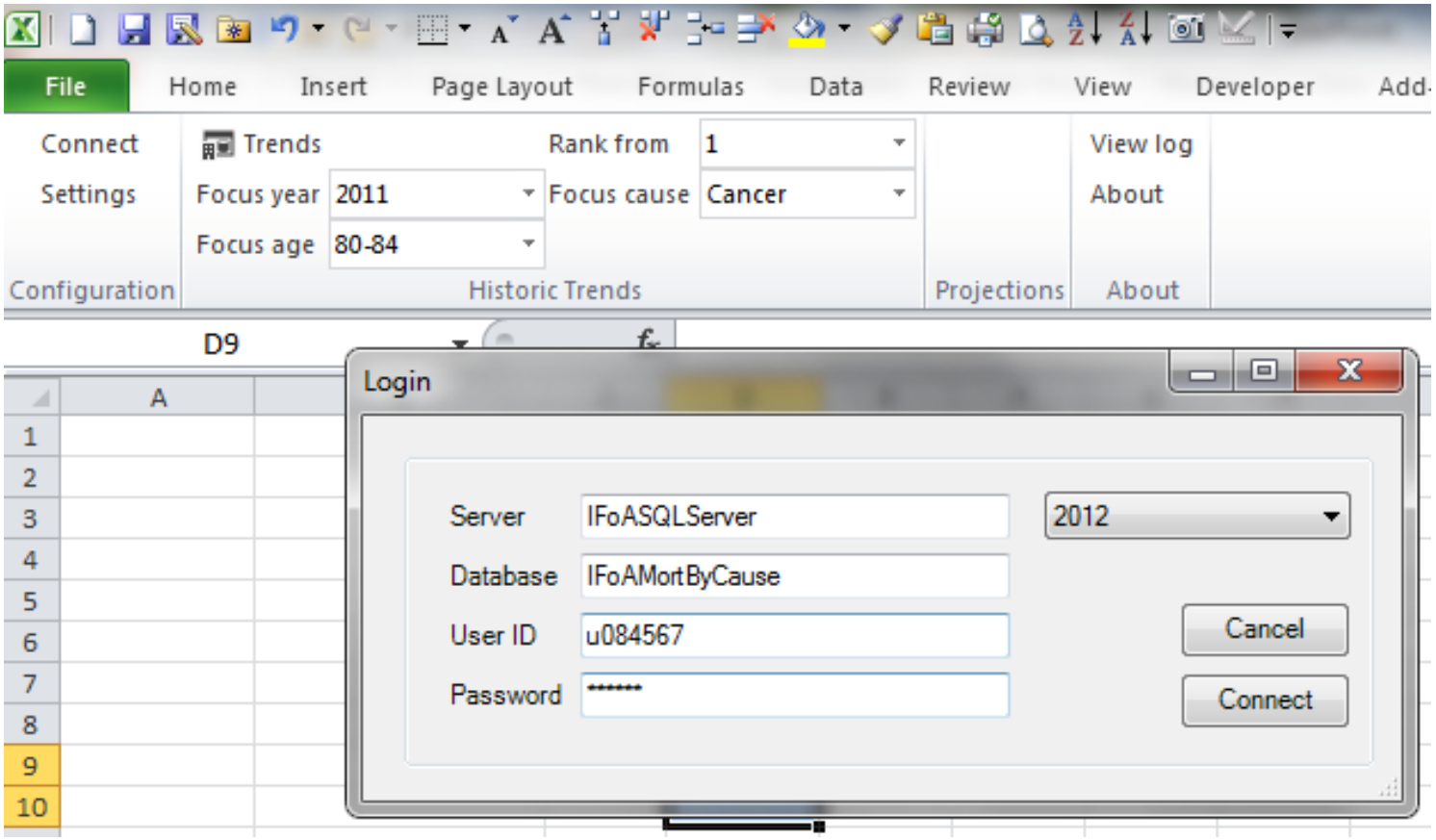
Overview of model (intentions)

- Technical description of model
- Can be used retrospectively or prospectively
- Presents historic death rates
- Can project forward death rates
- Can use various criteria to assess data (e.g. causes of death, gender, age,...)
- Requires a degree of experience for projection
- Can be used to compare death rates across populations

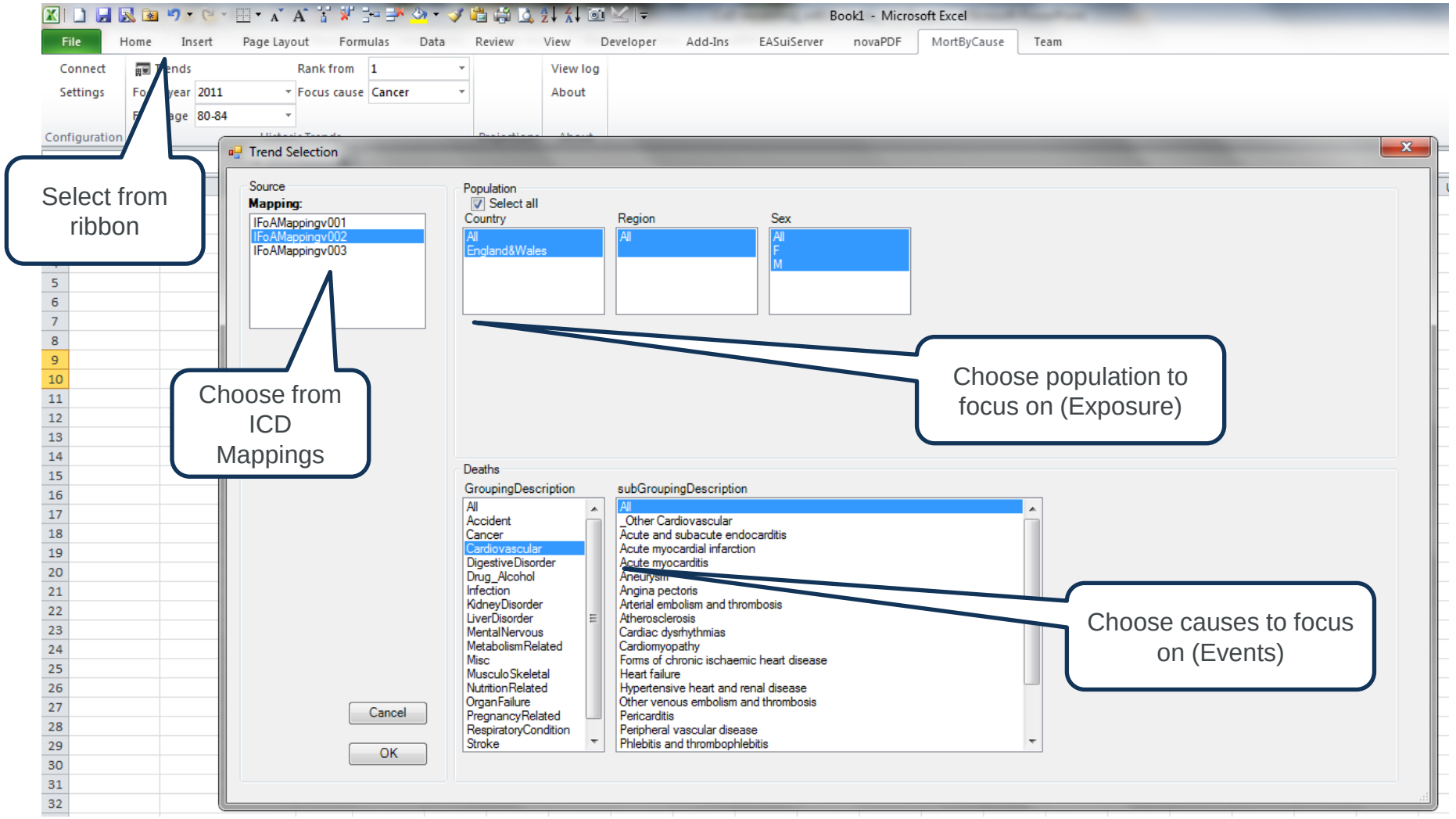
Centralised server – collaborative access

Overview of model (2)

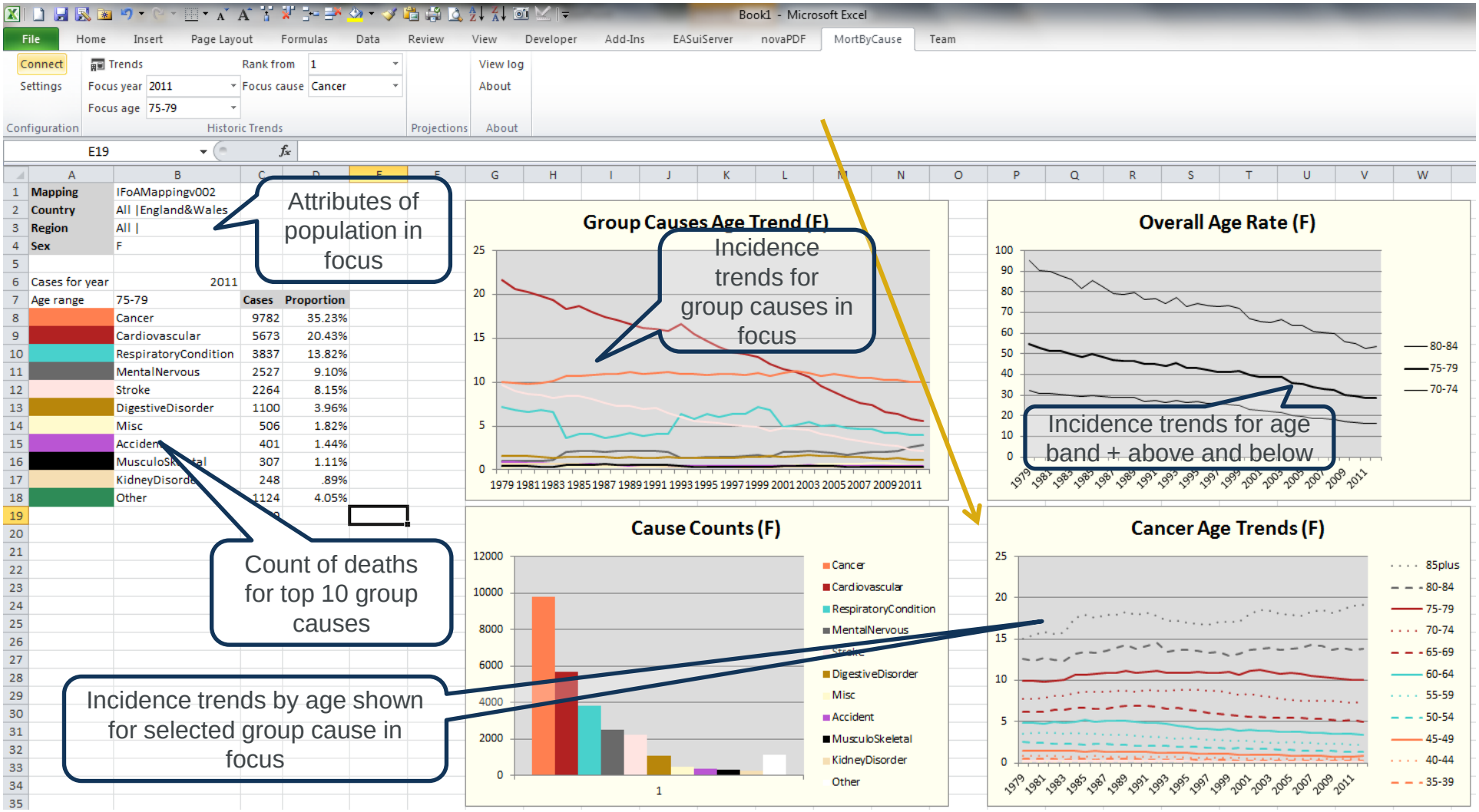
- Run Managed software in Excel – connect to remote server data:



Select and report on historic trends

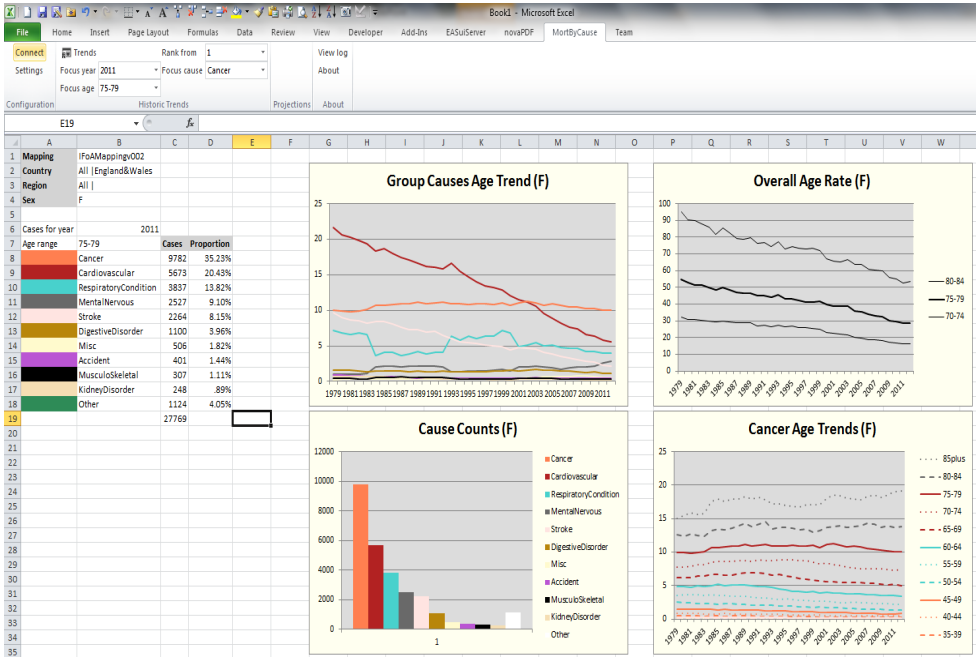


Historic results displayed



Points of interest

- Narrative
  - Over 85% of overall deaths for this population explained by top 5 causes
  - Cardiovascular and stroke causes show strong improvement
  - Respiratory conditions show more modest improvement
  - Cancer no change overall
  - Mental/nervous causes have nearly tripled
- Cancer cause focus
  - Older age deterioration
  - Younger age slight improvement



- Short of reincarnation some improving trends will end (soon)
- Data contains noise (changing reporting practices, etc)
- Patterns from age to age typically exhibit “expected” patterns (increase with age)
- Future enhancements can incorporate additional/improved reports.

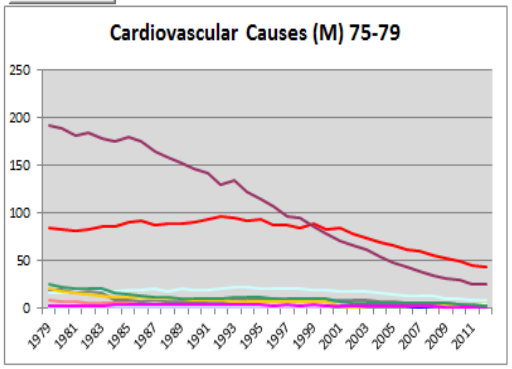
Historic results for sub-Group cause

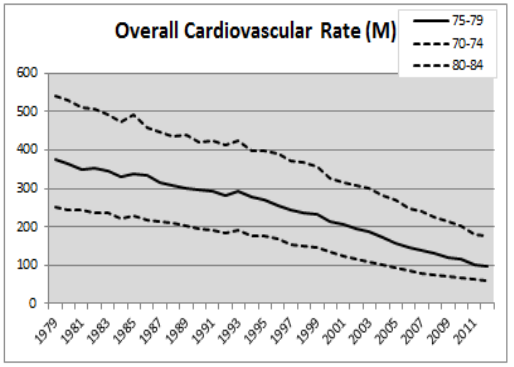
Country	UK
Region	England&Wales
Sex	M
Group cause	Cardiovascular

Rank	Age Range 75-79	Cases	Proportion
1	Forms of chronic ischaemic heart disea	3,639	44.2%
2	Acute myocardial infarction	2,095	25.5%
3	Aneurysm	702	8.5%
4	Valve disorder	366	4.4%
5	Heart failure	257	3.1%
6	Hypertensive heart and renal disease	234	2.8%
7	Cardiac dysrhythmias	208	2.5%
8	Phlebitis and thrombophlebitis	166	2.0%
9	_Other Cardiovascular	156	1.9%
10	Peripheral vascular disease	133	1.6%
	Other All	274	3.3%
	Total Deaths	8,230	
	Total Population	810,590	
	Rate per 10 000	101.5	

Cases for Year 2011

Toggle Scale

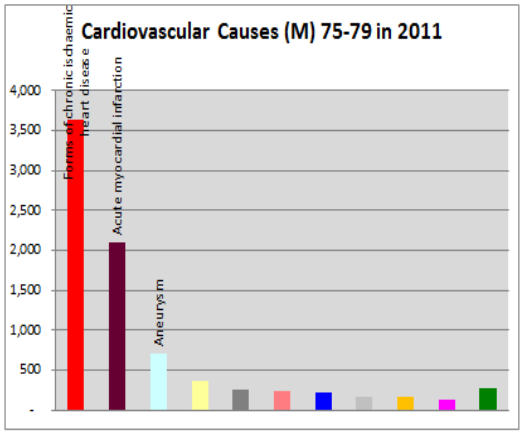


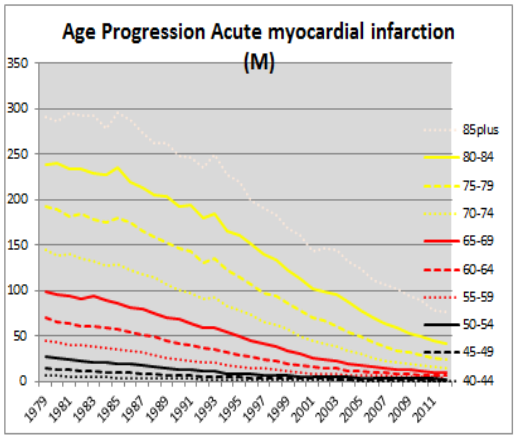


Acute myocardial infarction

Toggle Scale

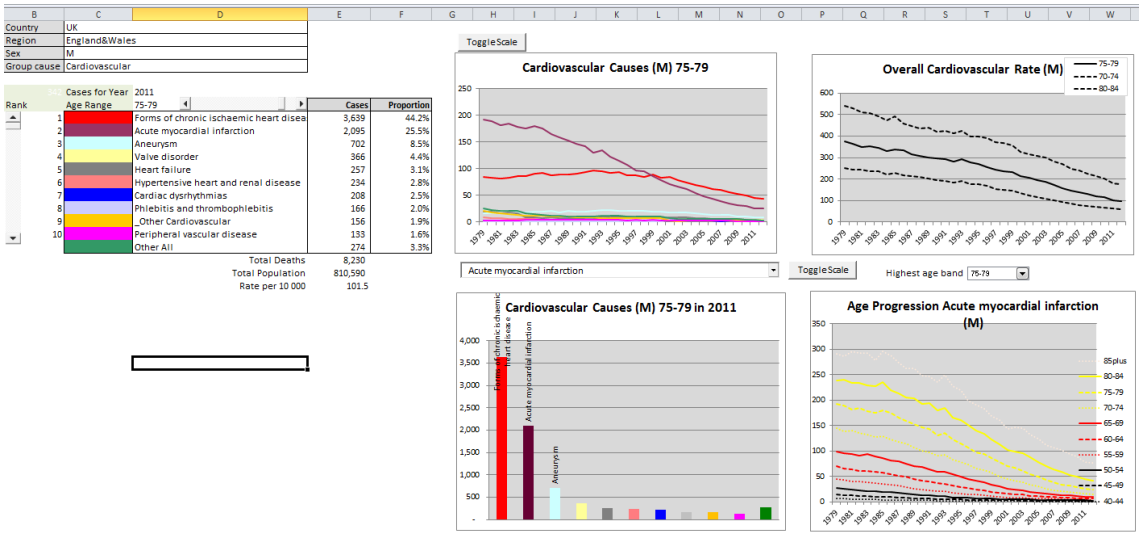
Highest age band 75-79





Historic results for sub-Group cause

- Narrative (Cardiovascular)
  - 85% of cardiovascular causes explained by top 5 sub-group causes
  - Within particular group causes, the sub-causes also show different trends
  - Myocardial infarction shows very strong improvement
  - Phlebitis/thrombosis halved to 1990 and then tripled to 2012
- Myocardial infarction focus
  - Older age slowing improvement
  - Younger age no improvement



Dynamics at the sub-group level exhibit “fractal” like paterns.

Insights of relevance for projection

- Relative force of mortality improvement varies by cause
- For many specific causes , the force of mortality is negative
- For many causes the historic incidence has closely aligned to bio-mathematical formulae
- Causes that have been the focus of policy intervention (screening, restrictive laws [smoking, seat belts], MRSA) show clear deviations from bio-mathematical formulae
- Fitting a rationally derived bio-mathematical formula to specific causes is able to produce remarkably prescient projections for a 5 to 15 year future and possibly even for slightly longer term horizons

Environment aspirations

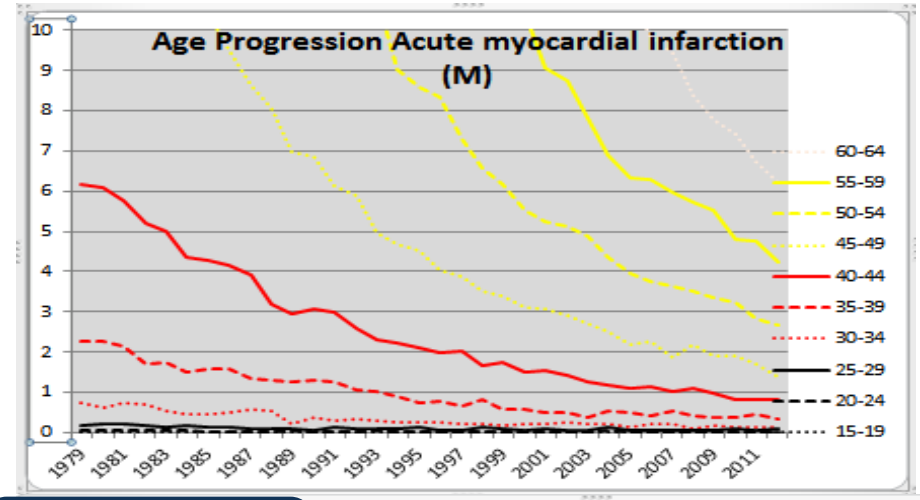
- Collect data for
  - broader range of UK regions
  - More attributes where possible – deprivation index, smoker categories, obesity measures, alcohol consumption, …
- Longer term allow contributions from regions/countries outside of UK.
- Common environment would permit immersive exploration of patterns (e.g. do improvement patterns exhibit
  - lead change in higher socio-economic regions and
  - lag follow from lower socio-economic regions)
- Common environment can be developed to incorporate different technical approaches and permit cross-comparison.
- Allow different ICD mappings to be used to connect and consolidate changing ICD series.

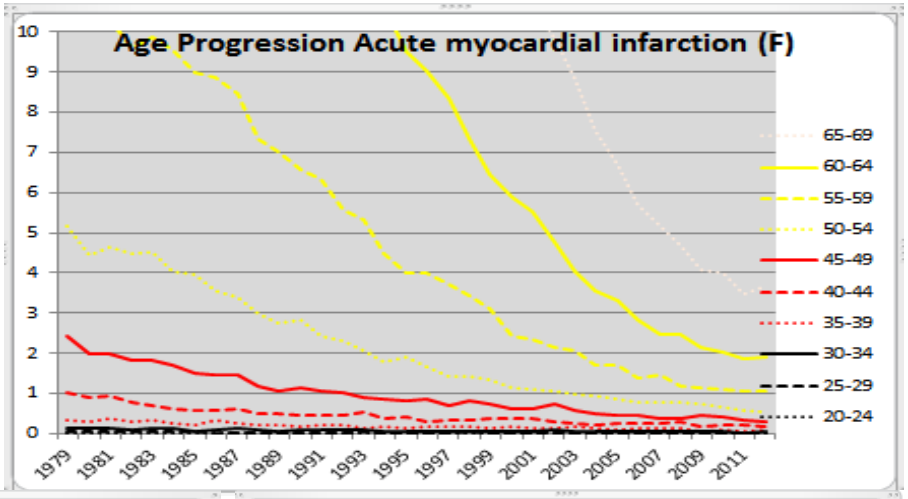
Initial causal model projection hypothesis

- The number of causal forces explaining aggregate mortality is currently dominated by a few causes – this is set to change from just a few to many.
- The mortality causes of interest for projection can and should be selected in numerous ways – analysis of past trends, advice from medical/ demographic professionals, etc
- Residual causes should be of modest significance allowing them to be projected in aggregate without severe distortion
- The model should eventually allow different causes to be projected using cause specific mathematical formulae (e.g sigmoid, linear, exponential).

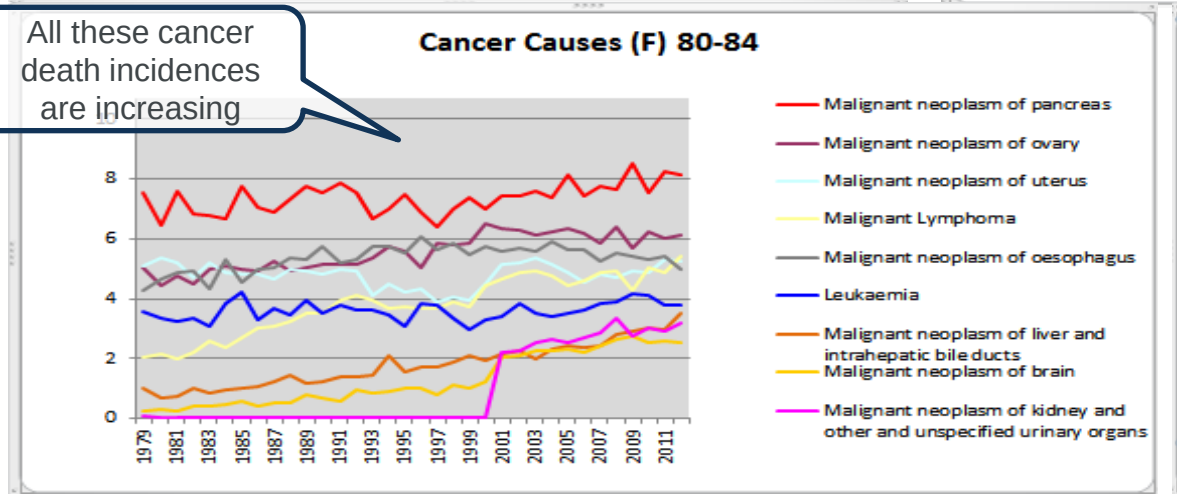
Patterns of interest

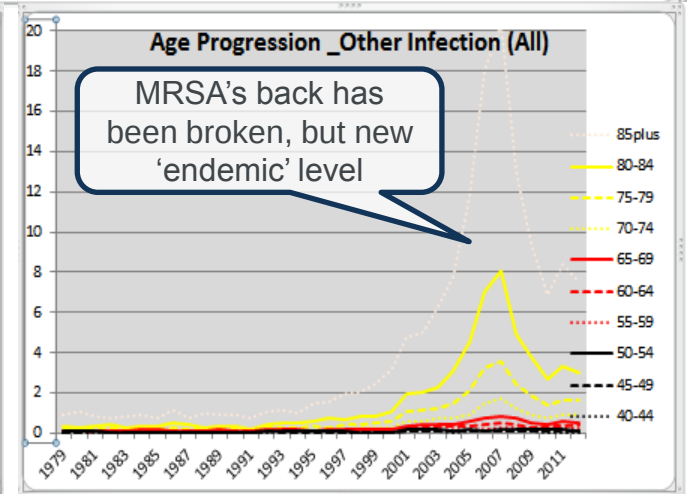
Improvement does slow (nothing goes below zero)





All these cancer death incidences are increasing





Future intentions

- Incorporate heat charts
- Cross compare different regions (or whatever reporting selections users would like to see)
- Incorporate simplistic modification projections to reflect intervention policies – e.g. interventions to modify smoking habits /alcohol consumption / dietary norms /… in specific regions/age groups/deprivation categories

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Causes of Cause of Death

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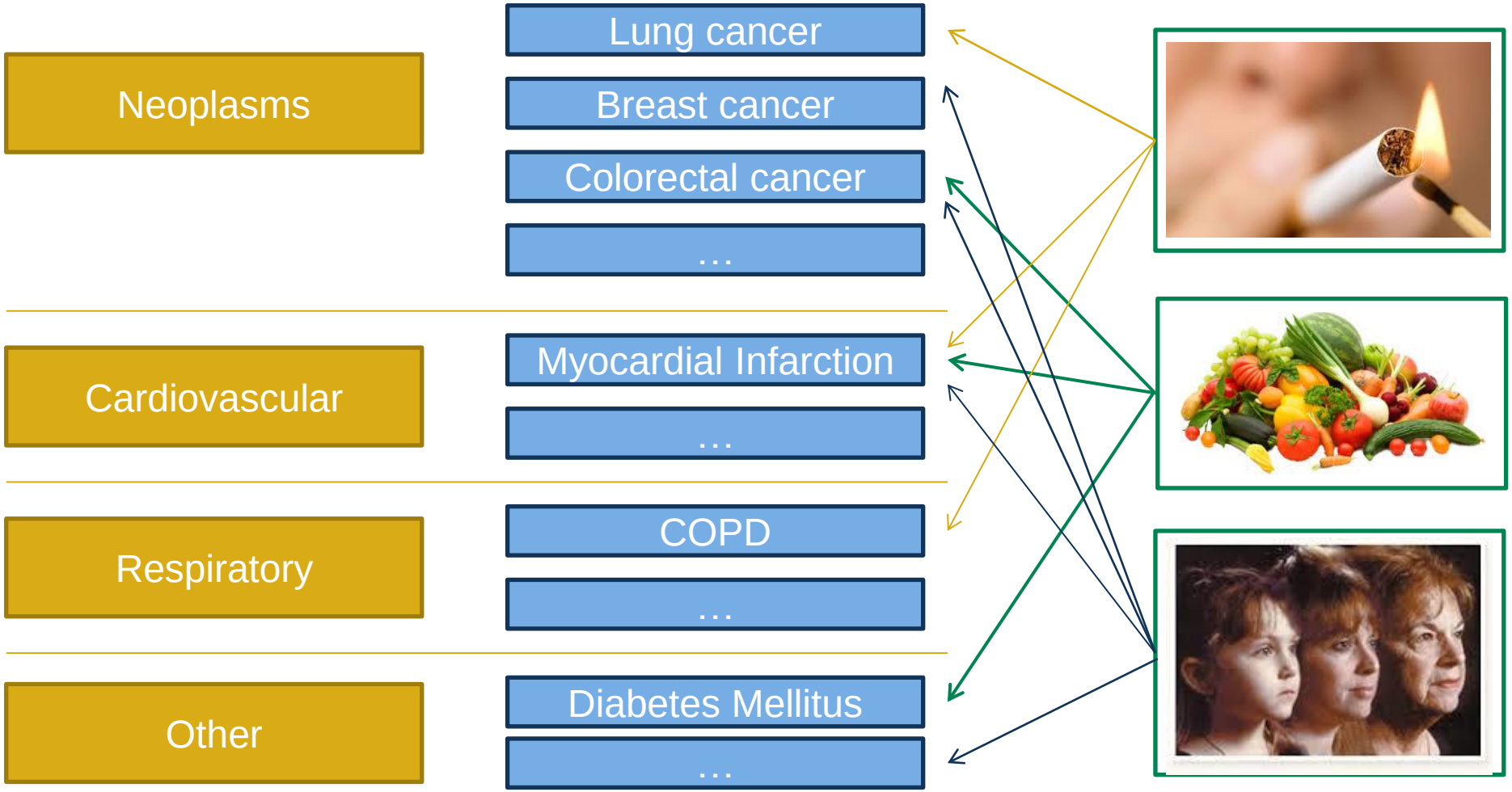
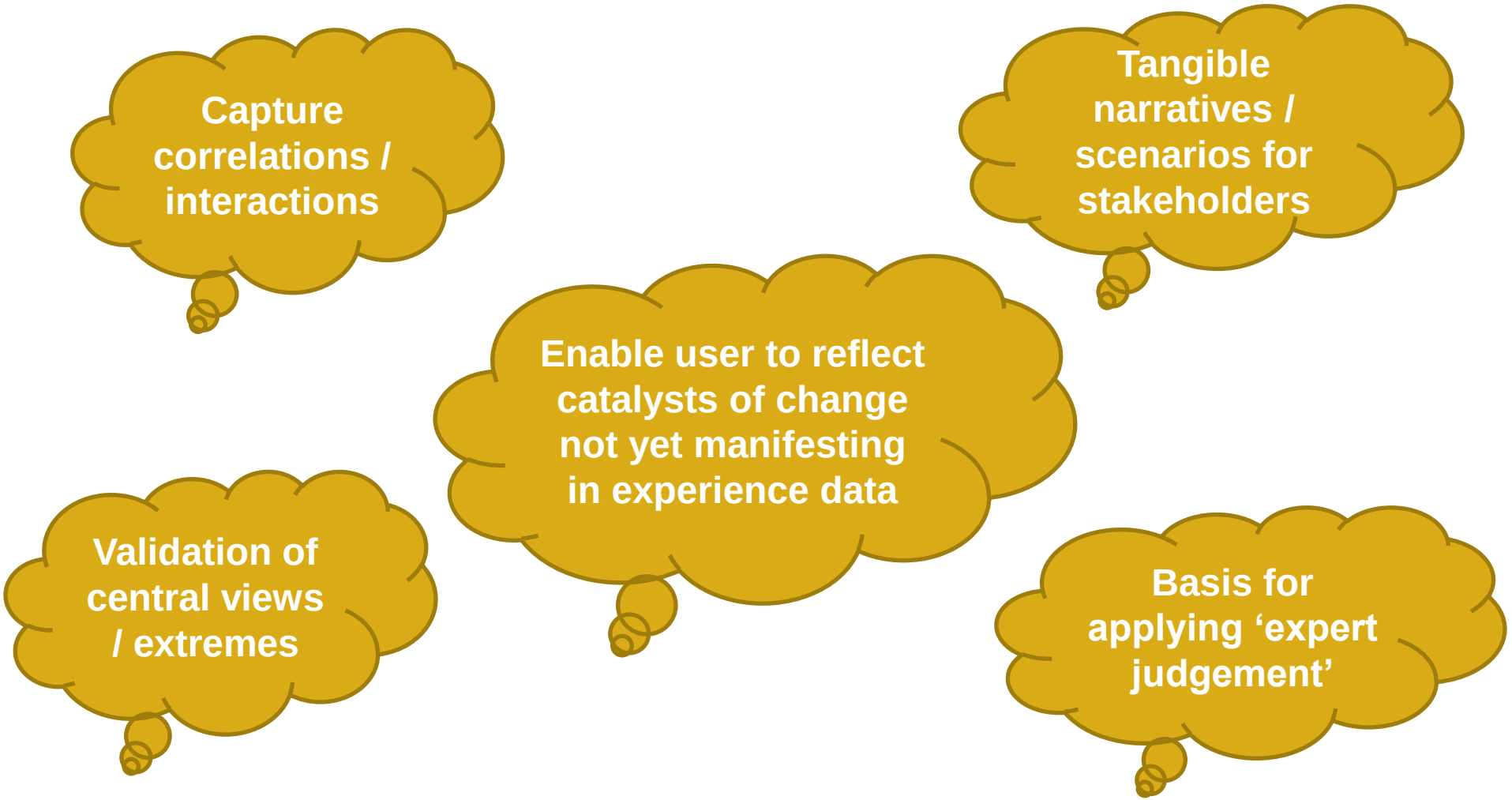
Cause of cause of death models

- What is a Cause of Cause of Death (CoCoD) model?
- Practical uses e.g. validating the CMI mortality improvements
- Different methods of CoCoD modelling
- Data considerations
- Challenges

Cause of Cause of Death (CoCoD) Models



How can CoCoD models help?



Conclusions

- Cause of death model is under construction
- Further development opportunities
- Development opportunities for CoCoD models

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 presenter.