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UCL Multimorbidity Project

"Socioeconomic Inequalities in Complex Multimorbidity"

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IFoA Mortality and Longevity Seminar, 22nd June 2017

Multimorbidity and socioeconomic disadvantage at older ages

- What we know (*from cross-sectional studies*) is that the level of deprivation affects:
  - The age of onset of MM
  - The prevalence of MM
  - The type of diseases in combination –physical and mental health more common in deprived than in affluent at ages <55
- What we don't know (*but could estimate from longitudinal cohorts*):
  - For similar disease combinations, is disease progression and/or time to death different in deprived and advantaged groups?
  - How much higher is the risk of death if people have 2 or more diseases – eg is it doubled?

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Defining Complex Multimorbidity

- Multimorbidity is “the co-occurrence of two or more chronic conditions within one person”. It is a count-based definition, without specifying disease combinations.
- *Piette & Kerr* identify 3 types of disease combinations:
  - ‘concordant’ – part of the same causal pathway and part of the same clinical management plan (eg diabetes, PAD, CHD)
  - ‘discordant’ – unrelated diseases (eg COPD, Parkinson’s)
  - ‘dominant’ – end-stage diseases whose management eclipses others (eg lung cancer, severe dementia)
- So we grouped our 30 in-scope chronic diseases into 7 broadly ‘concordant’ clinical clusters + ‘rest’
- Complex Multimorbidity: starting healthy, the accumulation of chronic diseases spanning 2 or more clinical clusters (ie combinations of ‘discordant’ diseases)
- Important from clinical disease management perspective; and likely to have a large impact on survival.

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Pre-defined disease clusters

Reduces the analysis of **30 diseases into a manageable problem - 7** clinically defined major disease-clusters plus ‘rest’

Disease cluster	N= 1,283k
1. **Cardiometabolic** diseases (*diabetes, CHD, AF, PAD, hypothyroidism, Stroke/TIA, CKD, HF)*	At study entry = 245k New onset = 162k
2. **Respiratory** diseases (*asthma/COPD/bronchiectasis)*	At study entry = 144k New onset = 52k
3. **Mental health** conditions (*depression, anxiety, substance and alcohol abuse, SMI, learning disability)*	At study entry = 265k New onset = 70k
4. **Cancer** (*excl. non-melanoma skin cancer; ever diagnosed*)	At study entry = 81k New onset = 92k
5. **Neurological** disease (*Parkinson’s, MND, Dementia/Alzheimer’s, MS, epilepsy)*	At study entry = 41k New onset = 33k
6. **Immune system** (*Rheumatoid arthritis, psoriasis, IBD)*	At study entry = 54k New onset = 25k
7. **Musculoskeletal** (*Osteoarthritis/pain (active Rx), osteoporosis*)	At study entry = 87k New onset = 82k
8. **Rest** *(Prostate disorder, glaucoma, chronic liver disease, diverticular disease of intestine)*	At study entry = 73k New onset = 74k
Healthy (none of the 30 diseases)	At study entry = 633k (49%) At exit = 441k (34%)

Data and Cohort specification

Data

- **CPRD,** England - linked patient-level Electronic Health Records across primary care, hospital admissions, diagnostic tests and death registry
- Patients in 225 practices with their addresses linked to national deprivation index, grouped into quintiles (Q1 = least deprived, Q5 = most deprived)

Inclusion criteria

- **Open cohort design**, with all patients aged 45 and over on Jan 1st 2001 and those who turn 45 between **1st Jan 2001 and 25th March 2010**, irrespective of initial health status.
- 1.3 million patients with 12 million consultations relating to selected 30 chronic diseases.

Follow up period – (from Jan 2001) to March 2010

- Patients' follow-up censored at the earliest date of death, deregistration from the practice, last data collection for the patient's practice, or overall study end date

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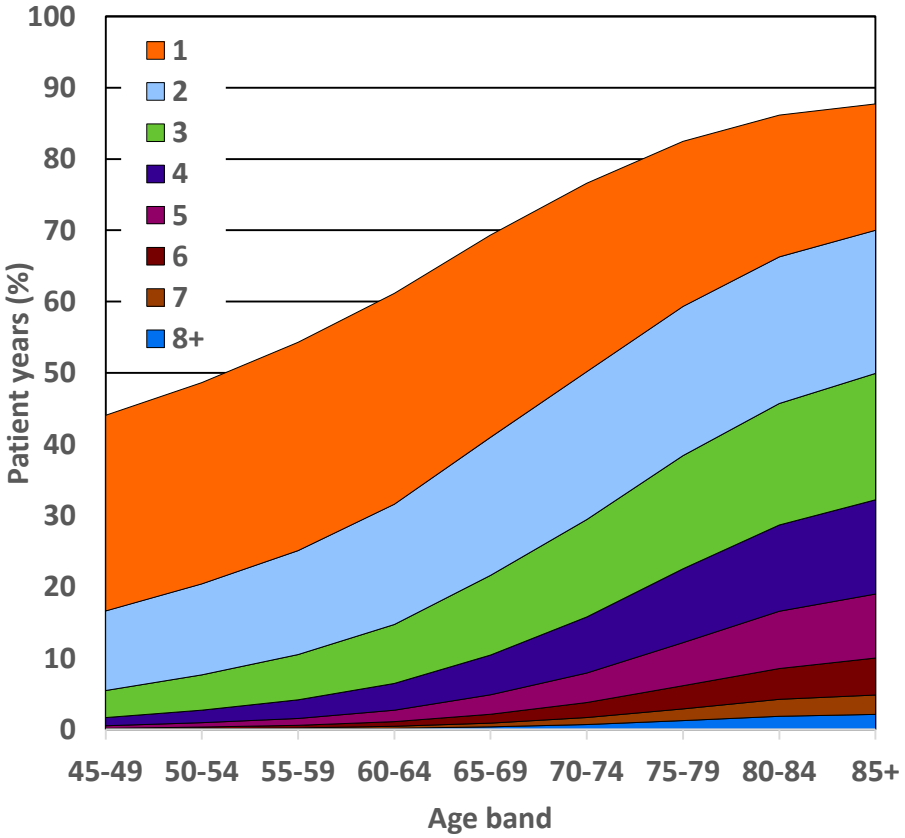
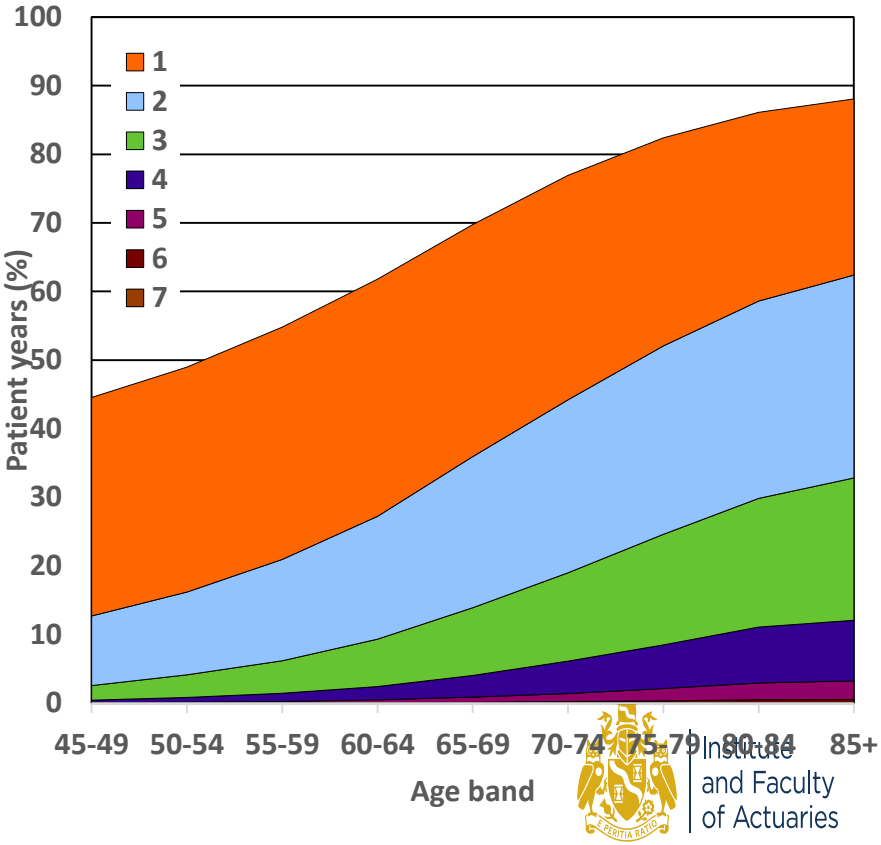
Simple vs Complex Multimorbidity: prevalence by age, persons

Single disease counts



Clusters counts



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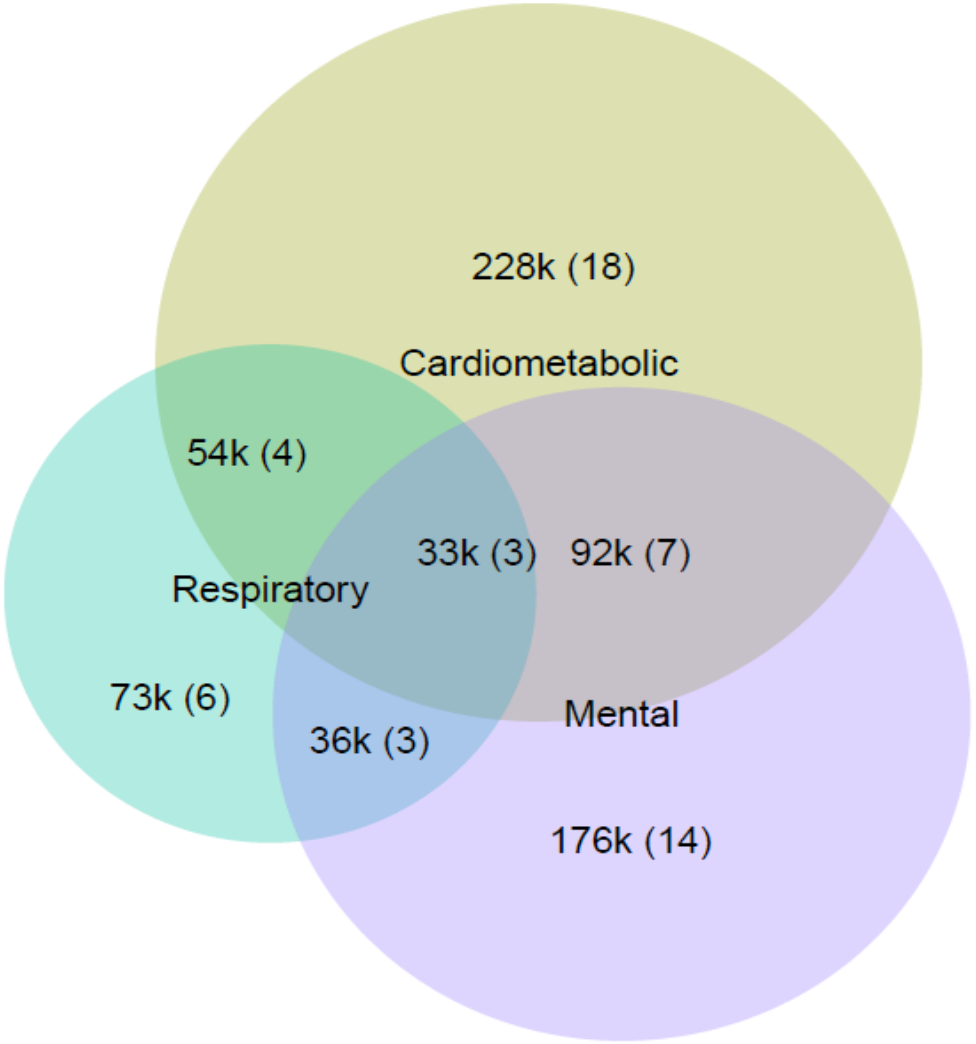
Patients diagnosed with diseases in the top 3 clusters: ‘ever-had’ at baseline + newly incident cases over study period

N (%)



None of these diseases:
590k (46)

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Disease cluster multi-state model – operating principles

- Unrealistic to include all 8 clusters and their combinations in a single ‘all-inclusive’ multi-state model (even if data is sufficient). Issues with interpreting hundreds of parameters, run time limits etc.

- So step by step approach which:
  - Starts with a simple model to quantify time spent in each state of increasingly complex multimorbidity (5-state model)
  - Selects the epidemiologically meaningful disease clusters to include; and their combinations
  - Reduces the complexity of the model
  - Reduces the number of models to run

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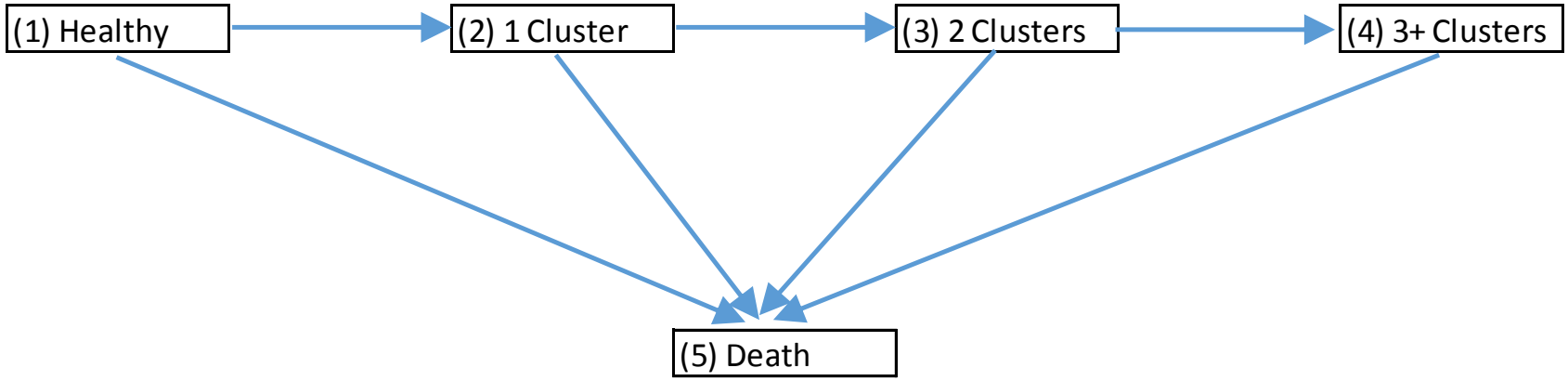
Cluster count model: Model structure (5-state model)

- Similar structure to the MSM on disease counts model present last year: ie a 5-state **progressive** model, i.e. no recovery; state 5 (death) is absorbing.

New:

- Covariates included – **IMD Q1/Q5** and **never/ever smoker**
- Run on a random sample of 10k males 10k females, selecting from the extreme ends of deprivation spectrum to identify significant differences in *relative* inequality in transition rates



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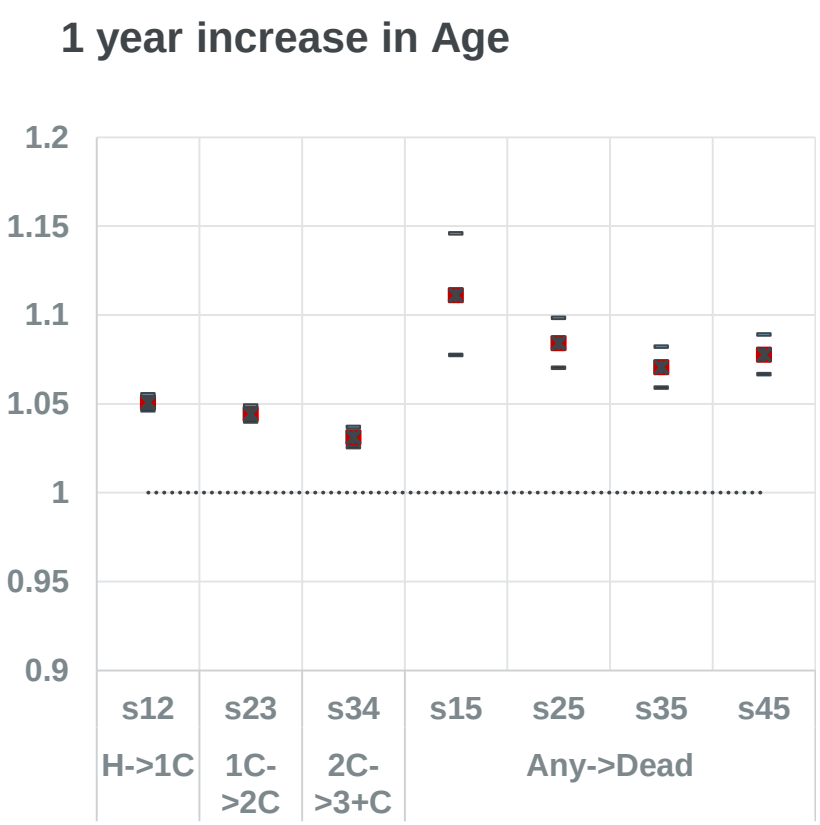
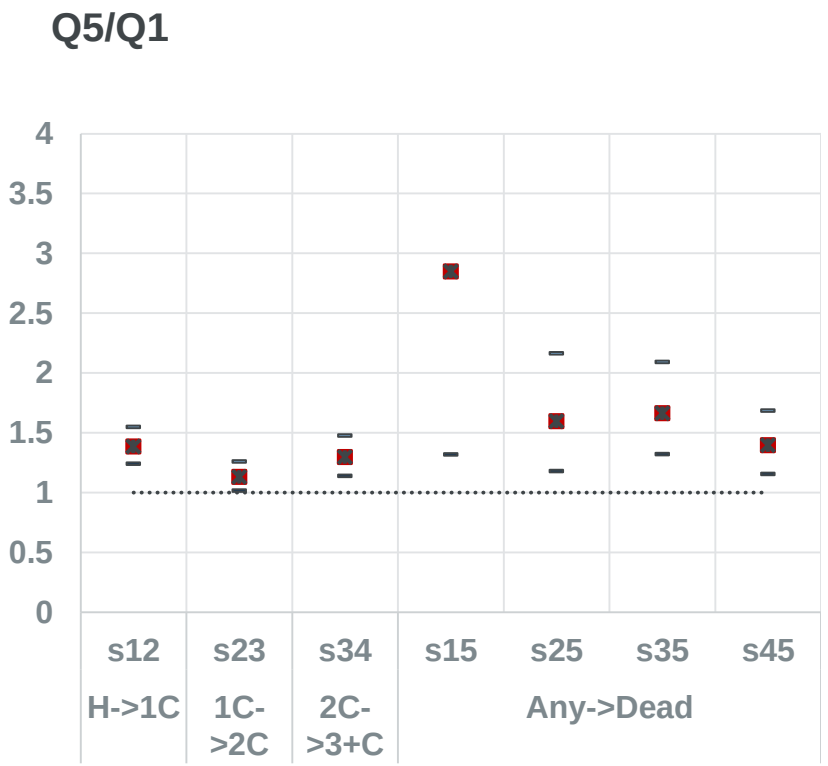
Hazard ratios: Age, and Q1 vs Q5, Males (5-state model)





Hazard ratio CI (normal approx.)

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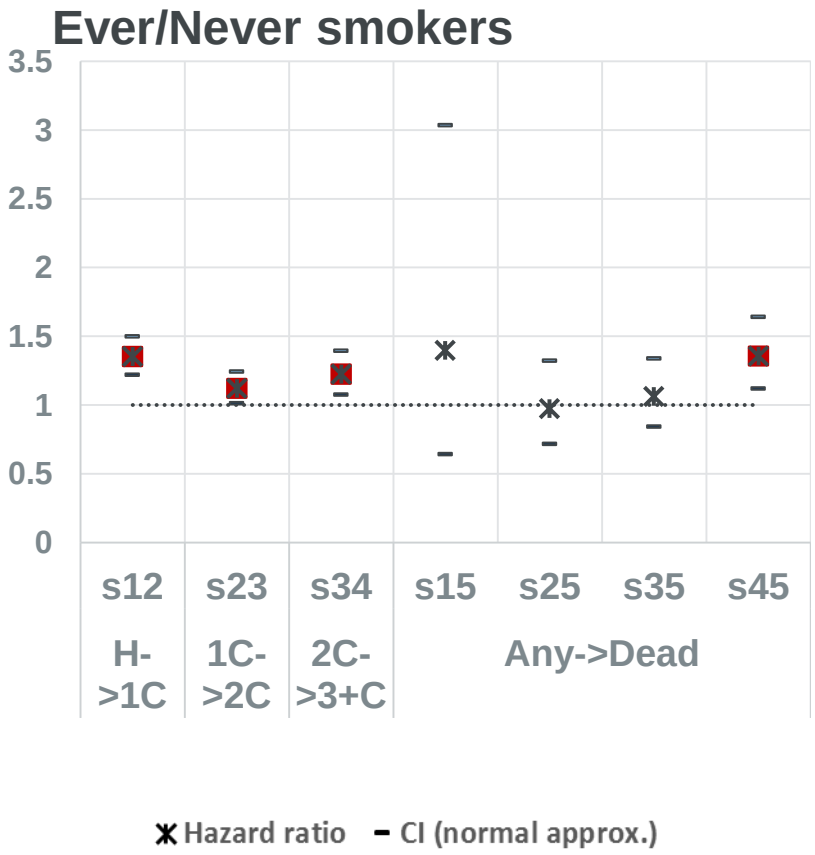
Hazard ratios: Ever vs Never smokers, males (5-state model)



- HR for ever smokers (ref never smokers) are raised for all 'live' transitions
- Transitions to death are significant only from 3+ clusters to death (s34)
- Smoking status to be included as a covariate for sensitivity check of final CMM models

Summary of the cluster count model shows that:

- **Age** is a significant risk for all transitions from health to 1C, 2C, 3+C and to death from any live starting state
- **Q5/Q1:** Hazard ratios are significant higher (reference Q1) for all 'live' states and for death from any state

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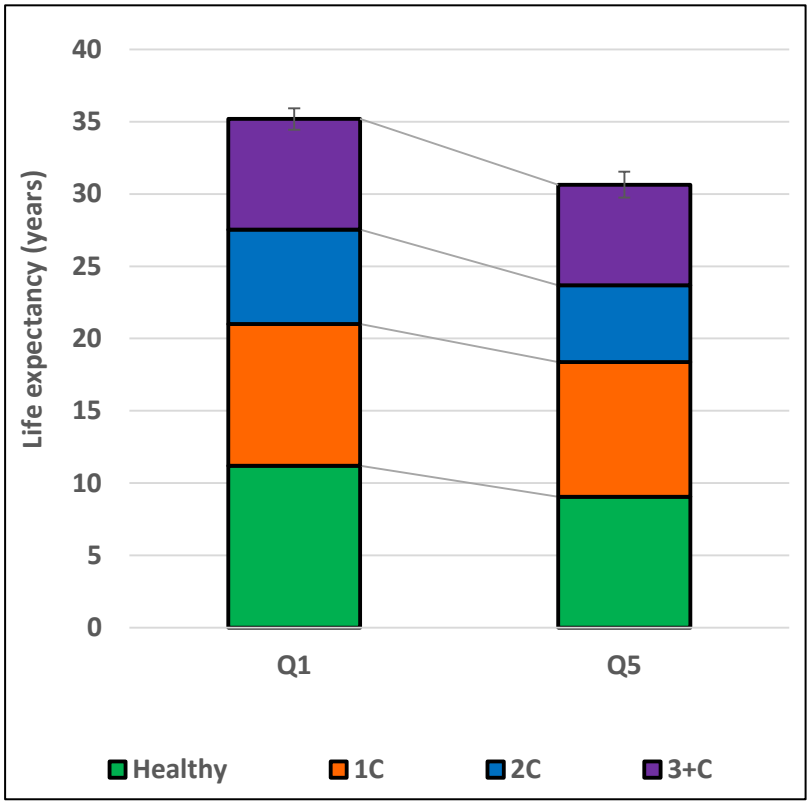
LE@45, Males (5-state model)



- The Q1 to Q5 gap in TLE c 4.5y
- Time spent in each state for Q1 (vs Q5) –
  - Higher for all states (both healthy and each morbid state)
  - But the same proportionately (60% without complex MM; 40% with complex multimorbidity)

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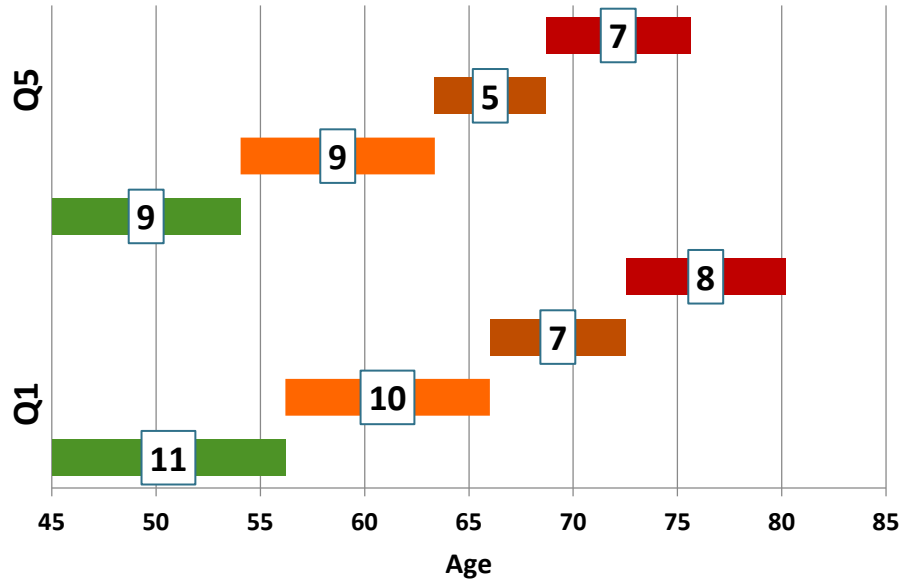
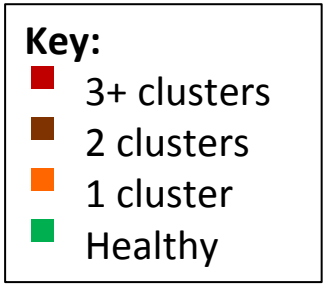
Males LE@45 Q1 vs Q5 (5-state-model)
Average duration in each state and age at transition





- Disease onset in Q5 is 2y earlier than in Q1
- Duration spent in successively more complex MM is shorter: ie faster disease accumulation
- Deaths from every disease-cluster state significantly higher
- Hence, from a starting gap of 2y in disease onset, total life expectancy gap widens to 4.5y
- Proportions of life years spent in each health state are similar (eg 32% v 30% healthy): ie no compression of morbidity in Q1 vs Q5.

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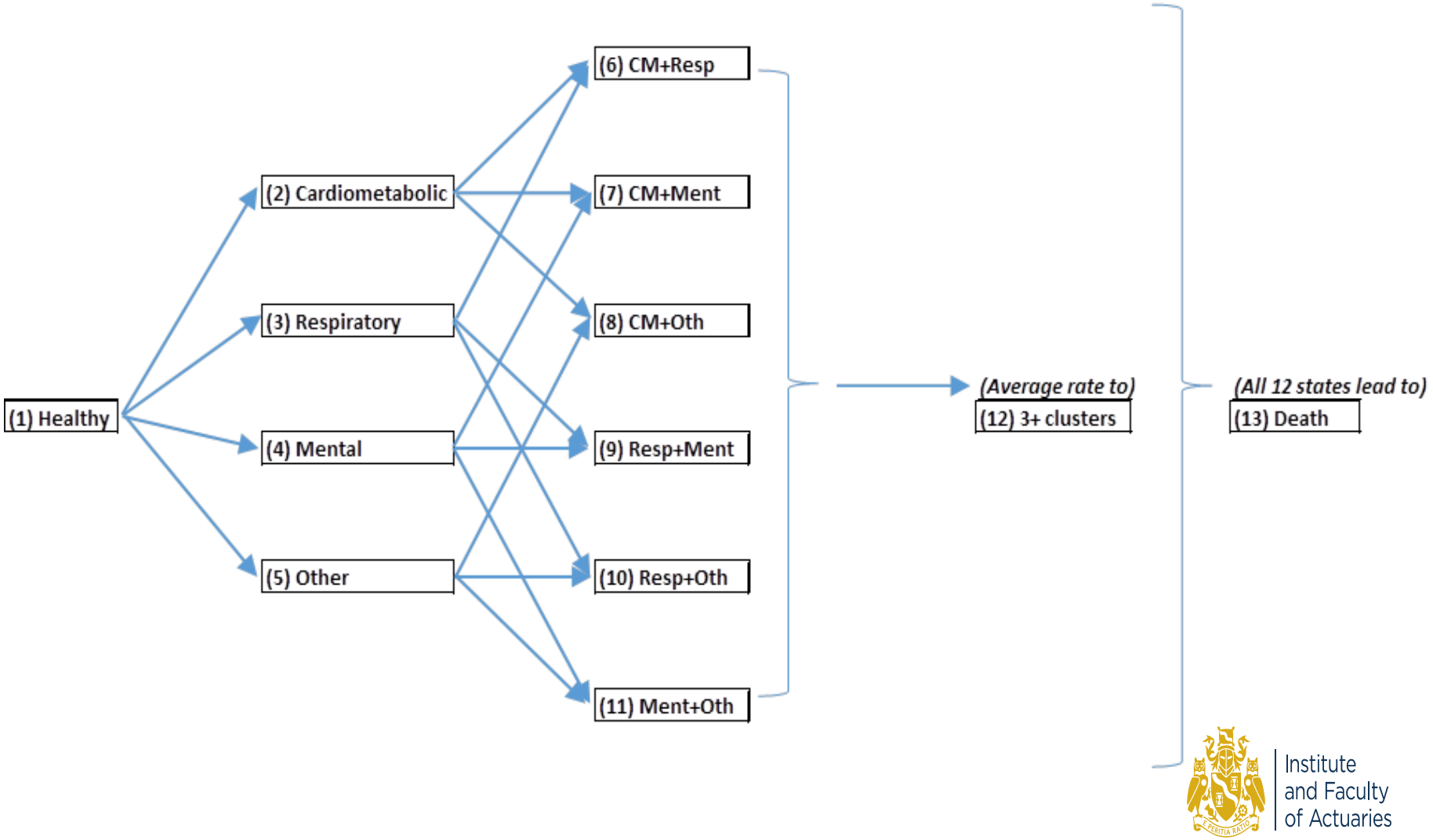
Model structure – 4 disease clusters (13 states, 29 transitions)



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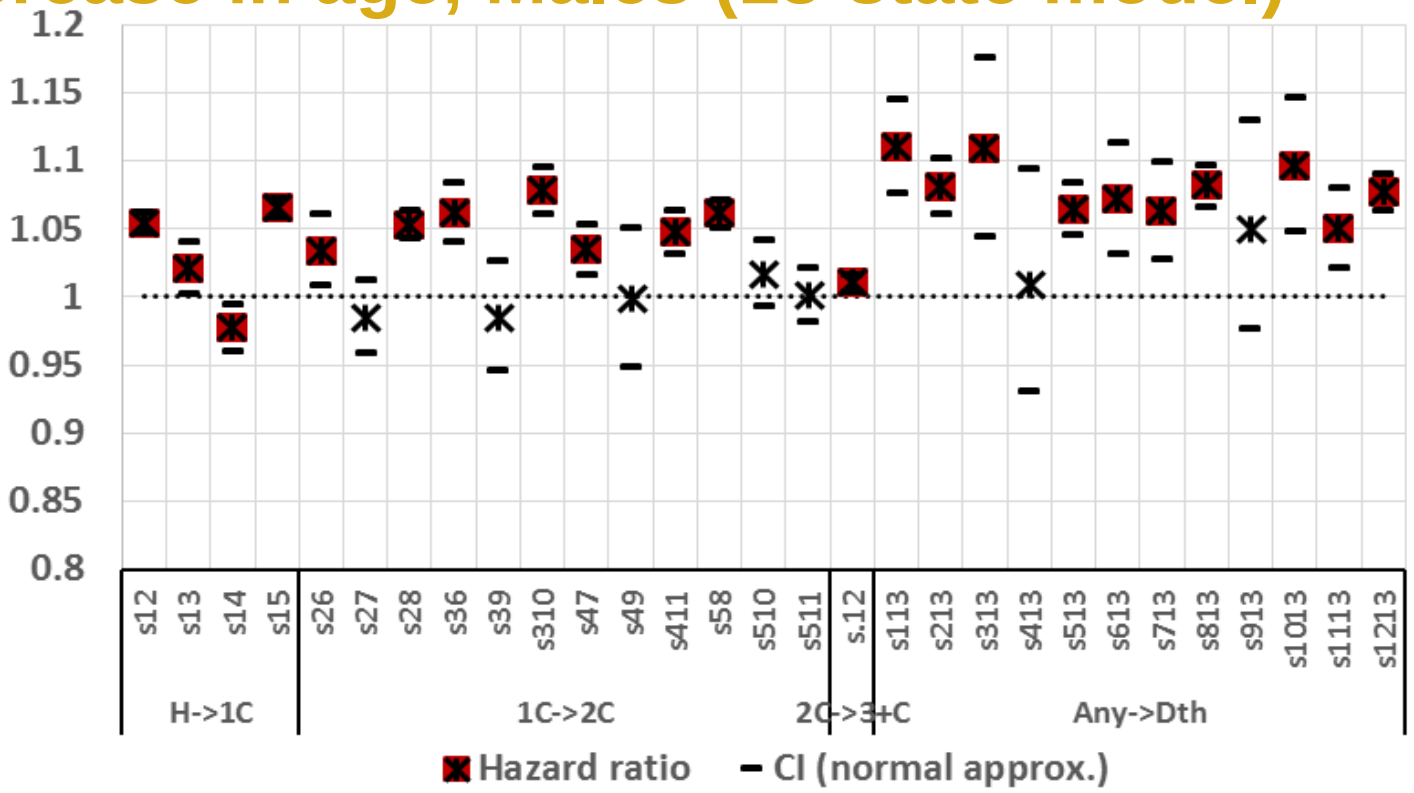
Model results - Hazard ratios (HR) for a 1 year increase in age, Males (13-state model)



- HRs are significantly higher than 1 for most transitions, i.e. disease accumulation and mortality rates increase with age
- The exceptions are transitions describing incidences of respiratory and mental diseases, where rates are flat by age

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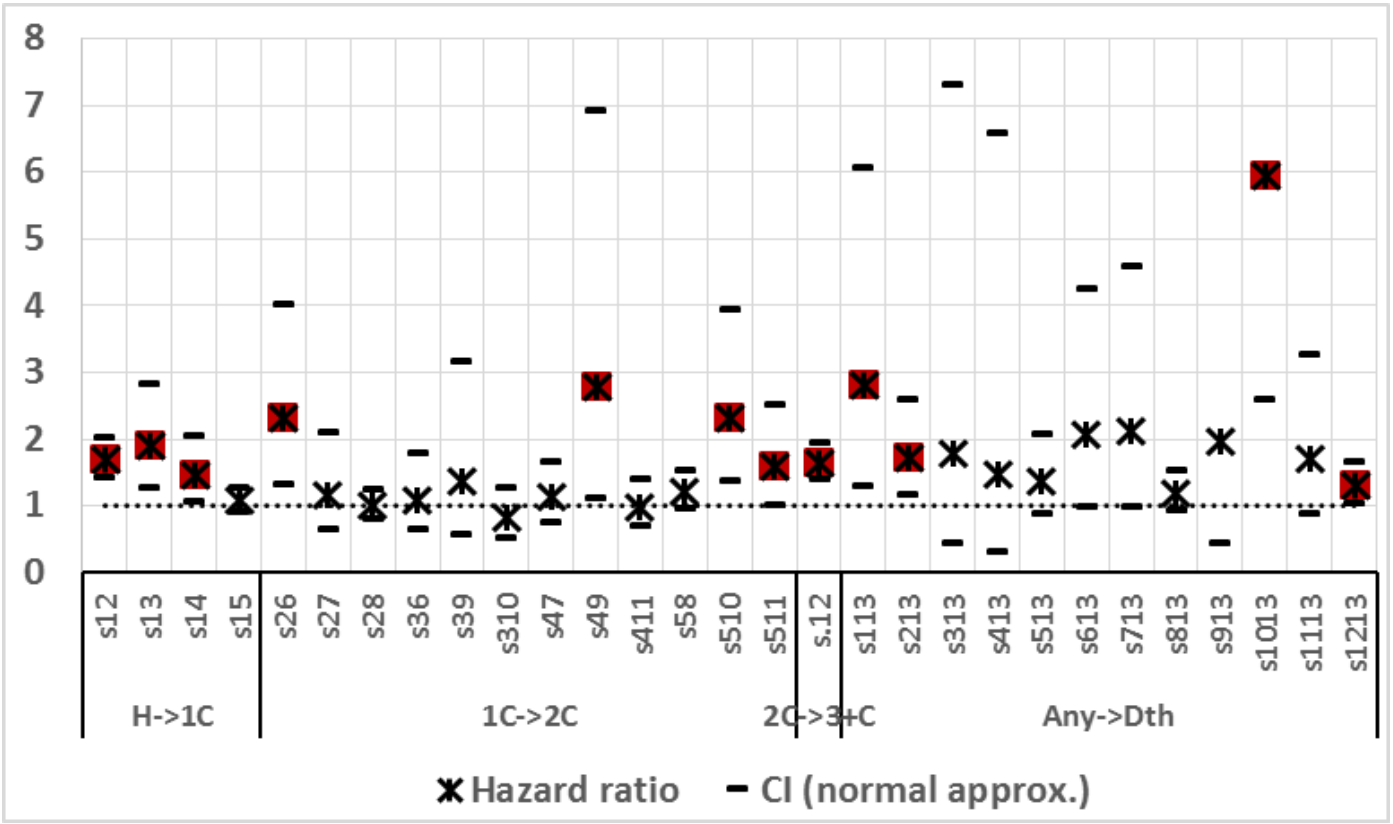
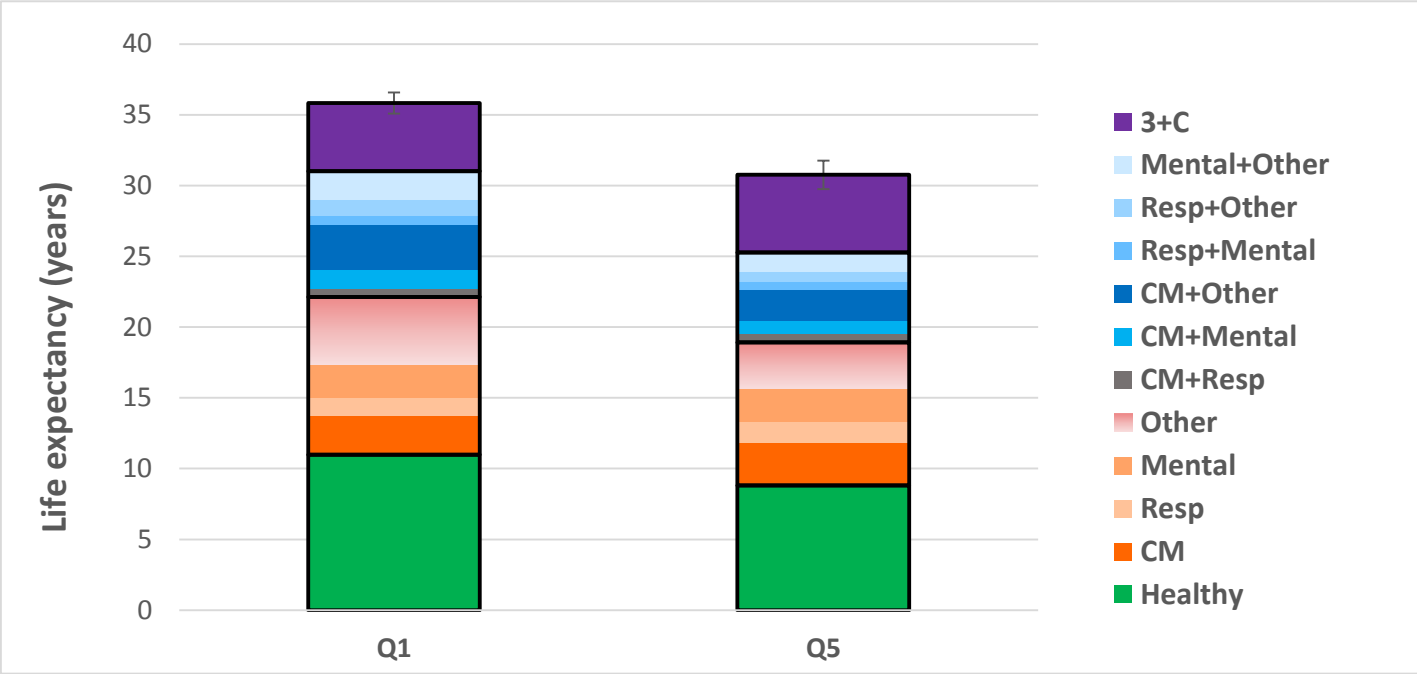
Model results - Hazard ratios (HR) for IMD 2007 Q5 vs Q1, males



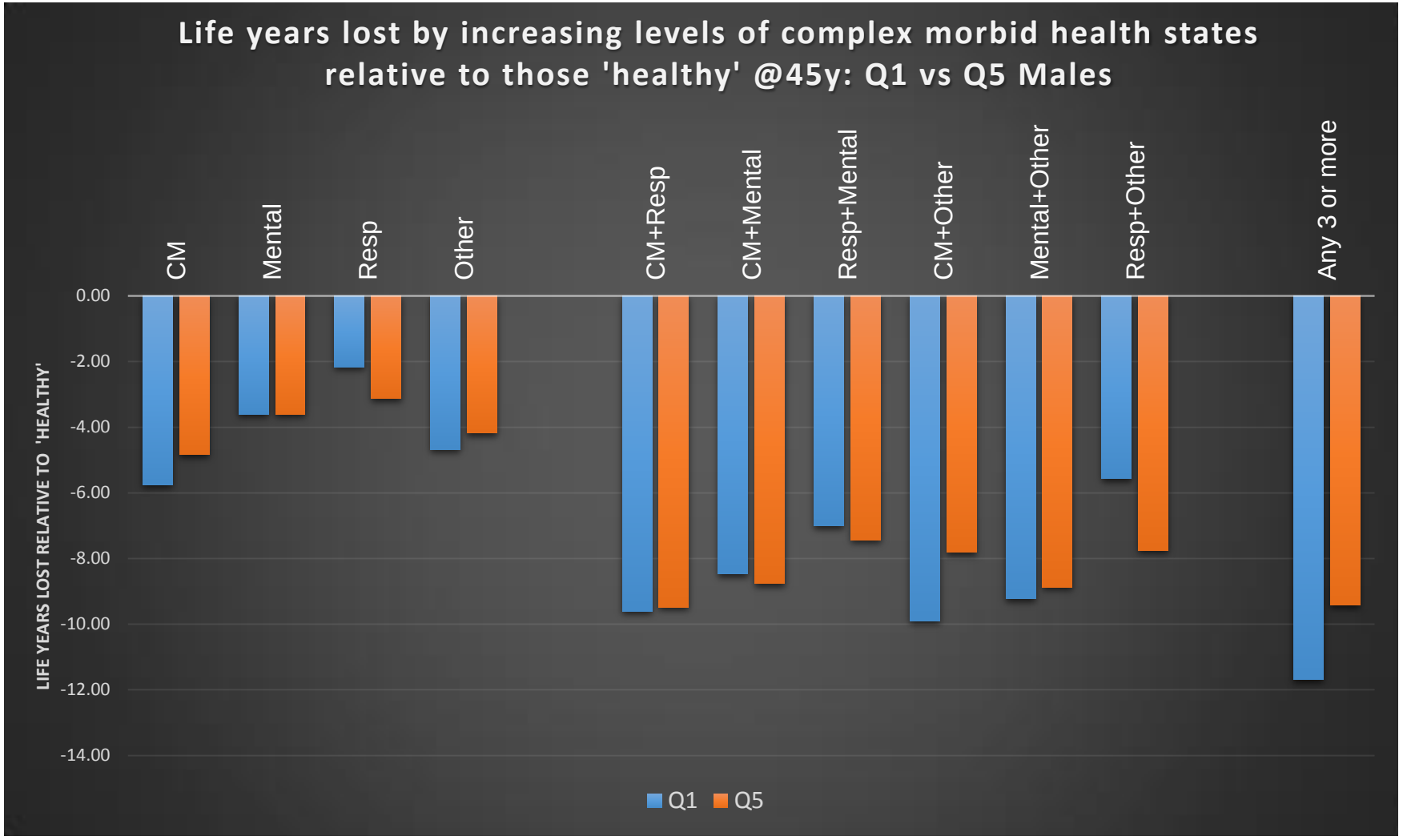
- HRs are generally higher than 1 across transitions, but only significantly higher than 1 for the H->1C and several of the mortality rates
- This suggests that the most deprived have significantly earlier disease onset for the 3 clusters in-scope, but do not accumulate complex multimorbidity at a faster rate
- Mortality from any state – mixed picture

Results - LE@45 by Q1 vs Q5, Males (13-state model)



- Time spent in complex multimorbidity (2C & 3+C states combined)–
  - Proportionally similar (c 40%) in both Q1 and Q5
  - BUT for Q5, split into more years with **very** complex multimorbidity (3+C)- in number of years (5.5y v 4.8y) and proportion (18% v 13%).
  - Q1 spend more year with 'other' diseases – in 1C and 2C – than Q5, suggesting the MM initiation and accumulation process is different for the 2 groups

Life years lost (relative to healthy) given starting state; M@45



Next steps

The fewer years spent with ‘other’ diseases in Q5 compared to Q1 suggests that the **pattern of disease accumulation might be different**.

- Run a second 13-state model to split out the ‘other’ diseases – ie selecting 3 different clusters (eg cancer, musculo-skeletal, neurological) – to make inferences about differential disease patterns between Q1 and Q5 for 6 disease clusters.

- Run stratified models (sex, IMD) to quantify absolute gap in health expectancy.

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Strengths and Limitations

- Data are large, representative, and record the disease trajectories of individuals over a long period, with exact date of first diagnoses and death

BUT

- CPRD data has limitations:
  - **Diagnostic coding practice** may vary between GP practices; and over time; missed diagnoses and underreporting of 'sensitive' diagnoses
  - No (simple) measure of **disease severity** or loss of function
  - High level of **missing-ness** for health risk factors, other than smoking status (13% missing)
  - No 'social' covariates – eg marital status, education attainments, occupation, social isolation etc – which influence health outcomes.

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Thanks to my co-authors

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7. **Prof Rosalind Raine,** Prof Healthcare Evaluation DAHR, UCL

Questions and comments?

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- The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health.

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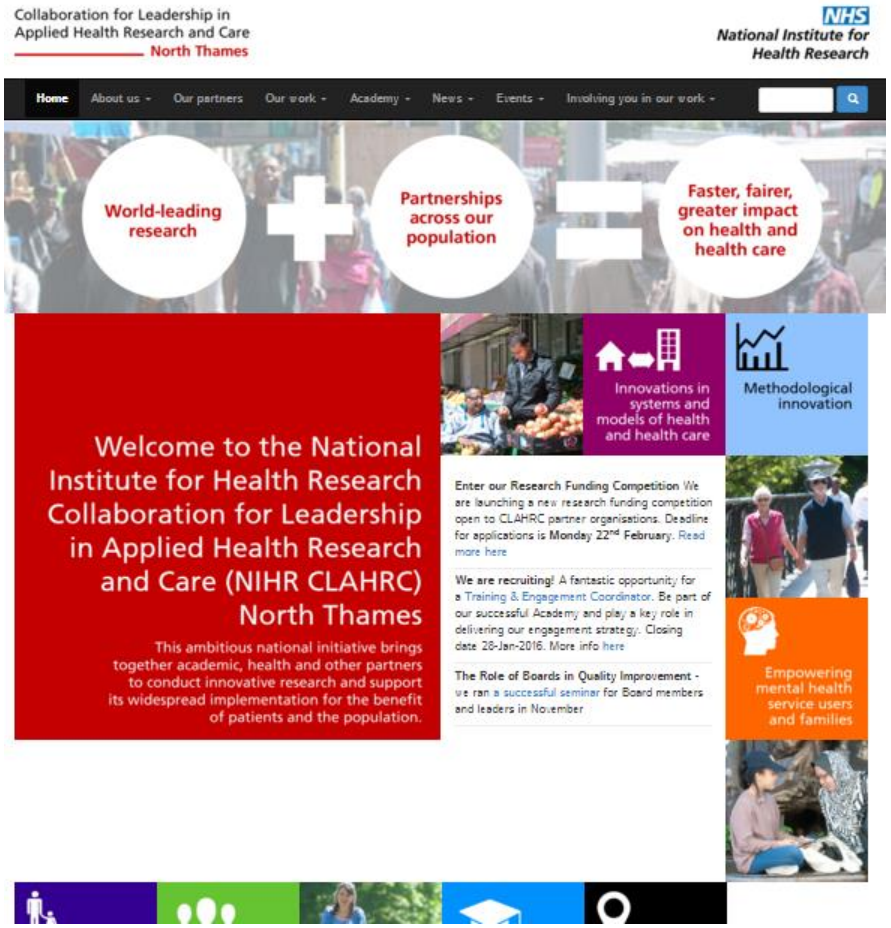

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