

Use of “big data” in Primary and Secondary Healthcare

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Utilising health data

- Many sources of health data
 - NHS ISD
 - Surveys (Census)
 - UK Biobank
 - Retrospective cohort extraction by third parties
 - Routinely collected general practice data from Scotland (Albasoft)
 - Journey through the healthcare system

Big Data

- UK Biobank (secondary healthcare) contains data on over 500,000 participants.
- Primary healthcare analysis contains data from 13 million general practice appointments from 155 practices in Scotland.
- Large datasets like these allow us to examine population subsets whilst maintaining statistical significance.

Primary and secondary care data 1

Primary Care: Routinely collected GP data

- Missed appointments

Secondary Care: UK Biobank

- Multimorbidity

Using healthcare data to examine missed appointments in primary care

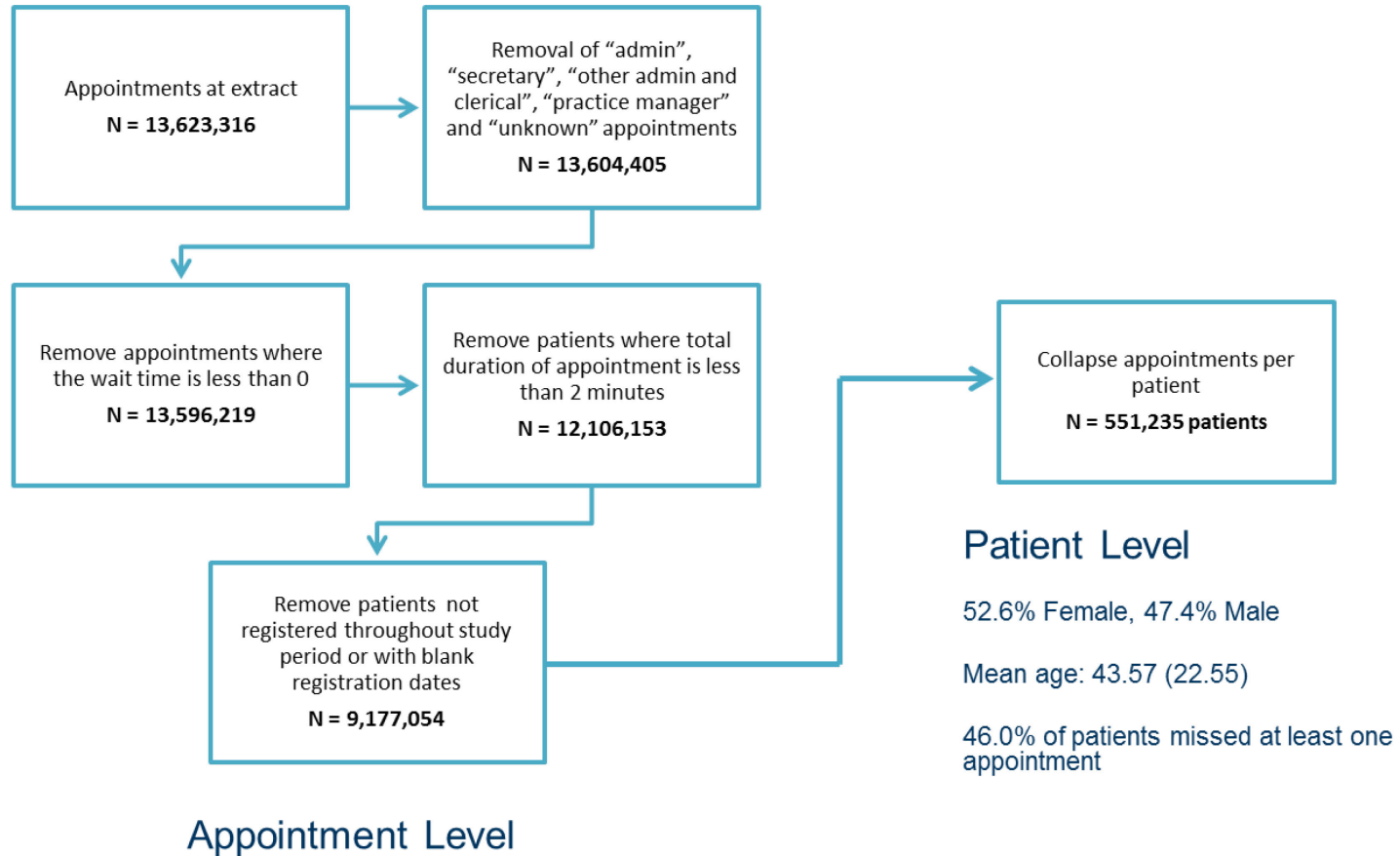
- To tackle health inequalities, it is essential that we understand the needs associated with patients who do not effectively engage with healthcare
 - This includes repeated missed appointments
- **Hypothesis: Serially missing general practice appointments act as a risk marker for vulnerability and poor health outcomes**

Participating Practices

- Data was collected for 13,623,316 appointments across 155 practices in Scotland

Board	Practice Count	Deep End
Argyll and Bute	2	0
Borders	1	0
Fife	8	0
Forth Valley	16	0
Greater Glasgow & Clyde	40	13
Grampian	2	0
Highland	28	0
Lanarkshire	2	0
Lothian	52	5
Shetlands	1	0
Tayside	3	3

Data workflow



Designating missed appointment groupings

Never missed appointments: 0 over 3 year period

Low missed appointments: <1 per year average over 3 year period

Medium missed appointments: 1-2 per year average over 3 year period

High missed appointments: >2 per year average over 3 year period

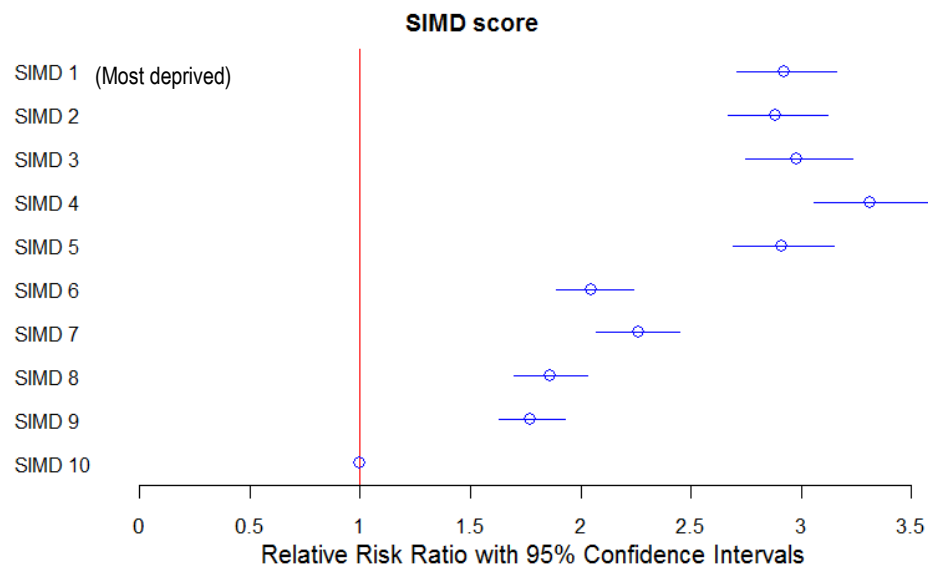
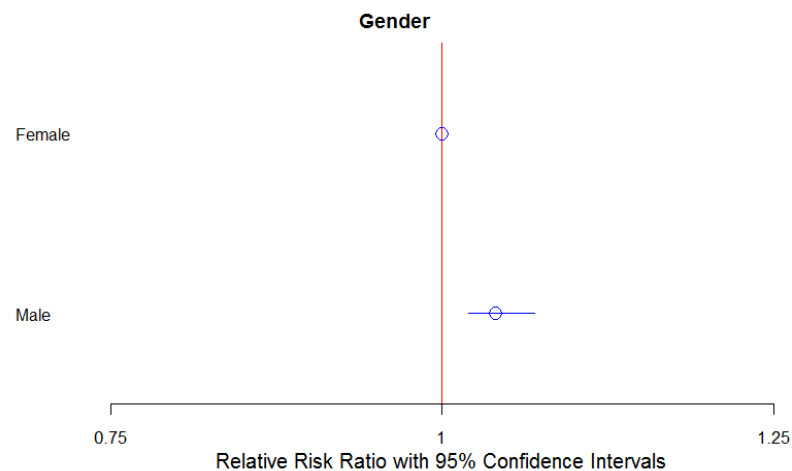
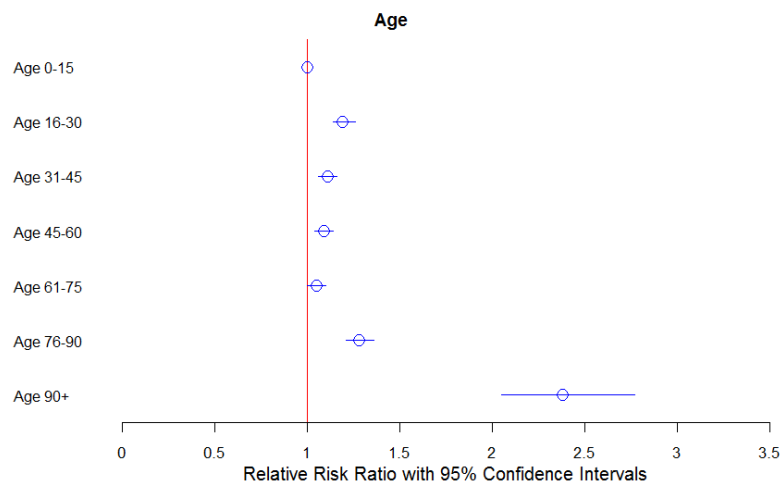
Practice and Patient Factors

Variable overview

Patient variables	Patients	Practices	Patients + practices
Age	yes		yes
Gender	yes		yes
SIMD	yes		yes
Distance to practice	yes		yes
Ethnicity	yes		yes
Practice variables			
Appointment delay		yes	yes
Number of appointments per patient		yes	yes
Average appointment length per patient		yes	yes
Practice distance to A&E		yes	yes

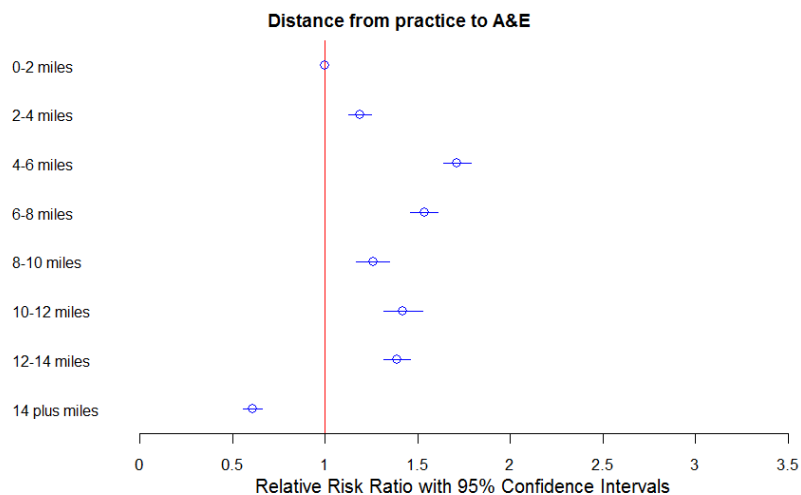
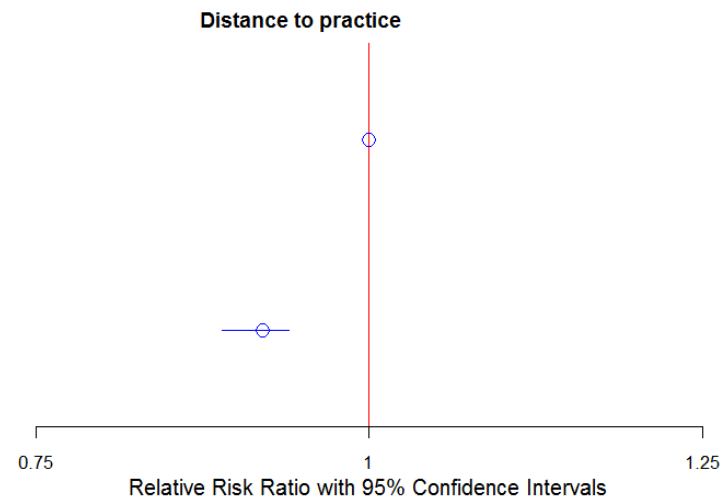
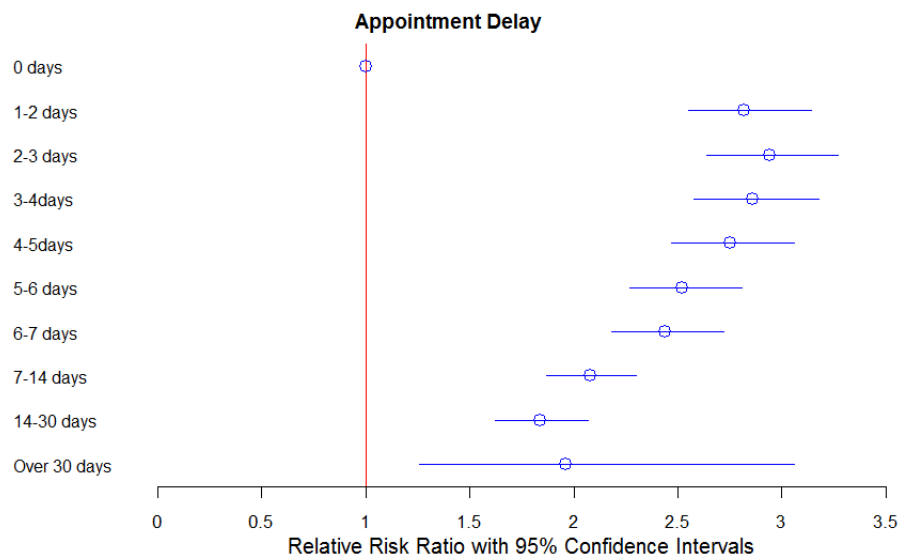
Regression modelling of any missed GP appointments 1.

(adjusted for age, gender, deprivation (SIMD), distance to practice, appointment delay, average appointment time per patient, number of appointments per patient and distance to A&E)



Regression modelling of any missed GP appointments 2.

(adjusted for age, gender, deprivation (SIMD), distance to practice, appointment delay, average appointment time per patient, number of appointments per patient and distance to A&E)



Future Work

Social Vulnerability	Health conditions	Health utilisation	(Low) Engagement in healthcare	Exit Coding
Adverse Childhood Events (ACE) descriptors	Multimorbidities	Screening	Practice exception reporting	De-registration
Severe and multiple disadvantage (SMD)	BNF psychoactive medications	Practice nurse and other healthcare activities	Did not attend	Death
Priority 1 diagnoses	Secondary care diagnoses (data linkage)	Secondary care referral	Inappropriate service usage	
SMR04- mental health admissions (data linkage)		SMR00 –hospital outpatients (data linkage)		
		SMR02 –maternity services including a family index		

Conclusions

- We have analysed GP appointment data from 552,235 patients from 155 practices across Scotland.
- Analysis shows both patient and practice factors affect non attendance.
- Socioeconomic deprivation (patient) and short appointment delays (practice) are the factors most strongly associated with non attendance.
 - Appointments on the day appear to reduce the risk of non-attendance

Primary and secondary care data 2

Primary Care: Routinely collected GP data

- Missed appointments

Secondary Care: UK Biobank

- Multimorbidity

UK Biobank

- What is UK Biobank?
- UK Biobank is a major national health resource, and a registered charity in its own right, with the aim of improving the prevention, diagnosis and treatment of a wide range of serious and life-threatening illnesses – including cancer, heart diseases, stroke, diabetes, arthritis, osteoporosis, eye disorders, depression and forms of dementia.
- UK Biobank recruited 500,000 people aged between 40-69 years in 2006-2010 from across the country to take part in this project. They have undergone measures, provided blood, urine and saliva samples for future analysis, detailed information about themselves and agreed to have their health followed. Over many years this will build into a powerful resource to help scientists discover why some people develop particular diseases and others do not.

What is multimorbidity?

Supplementary Table S1: List of the 40 disease conditions included in multimorbidity count

Barnett et al., 2012, Lancet

Condition	Variable definition	Mental/physical health condition	Prevalence (%)
Hypertension	Read code ever recorded	Physical	13.4
Depression	Read code recorded in last 12 months OR ≥ 4 anti-depressant prescriptions (excluding low dose tricyclics) in last 12 months	Mental	8.2
Painful condition	≥ 4 prescription only medicine analgesic prescriptions in last 12 months OR ≥ 4 specified anti-epileptics in the absence of an epilepsy Read code in last 12 months	Physical	7.2
Asthma (currently treated)	Read code ever recorded AND any prescription in last 12 months	Physical	6.0
Coronary heart disease	Read code ever recorded	Physical	4.7
Treated dyspepsia	≥ 4 prescriptions in last 12 months BNF 0103% excluding antacids AND NOT (≥ 4 NSAIDs or ≥ 4 aspirin/clopidogrel)	Physical	4.5
Diabetes	Read code ever recorded	Physical	4.3
Thyroid disorders	Read code ever recorded	Physical	4.1
Rheumatoid arthritis, other inflammatory polyarthropathies & systematic connective tissue disorders	Read code ever recorded	Physical	3.4
Hearing loss	Read code ever recorded	Physical	3.4
Chronic obstructive pulmonary disease	Read code ever recorded	Physical	3.2
Anxiety & other neurotic, stress related and somatoform disorders	Read code recorded in last 12 months OR ≥ 4 anxiolytic/hypnotic prescriptions in last 12 months OR $\geq 410/25$ mg amitriptyline in last 12 months and do not meet the criteria for "Pain"	Mental	3.2
Irritable bowel syndrome	Read code ever recorded OR ≥ 4 prescription only medicine antispasmodic prescription in last 12 months	Physical	3.0
New diagnosis of cancer in last five years	Read code first recorded in last 5 years	Physical	2.5
Alcohol problems	Read code ever recorded	Mental	2.4
Other psychoactive substance misuse	Read code ever recorded	Mental	2.4
Treated constipation	≥ 4 laxative prescriptions in last year	Physical	2.2
Stroke & transient ischaemic attack	Read code ever recorded	Physical	2.1
Chronic kidney disease	Read code ever recorded	Physical	1.9
Diverticular disease of intestine	Read code ever recorded	Physical	1.9
Atrial fibrillation	Read code ever recorded	Physical	1.4

Multimorbidity and comorbidity 1

- Comorbidity: examination with one “index condition”

Extract from previous table

Treated constipation	≥4 laxative prescriptions in last year	Physical	2.2
Stroke & transient ischaemic attack	Read code ever recorded	Physical	2.1
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Atrial fibrillation	Read code ever recorded	Physical	1.4

Multimorbidity and comorbidity 2

- Comorbidity: examination with one “index condition”
- Can look at events such as mortality (all cause, cardiovascular, cancer), hospitalisations etc

Extract from previous table

Treated constipation	≥4 laxative prescriptions in last year	Physical	2.2
Stroke & transient ischaemic attack	Read code ever recorded	Physical	2.1
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Atrial fibrillation	Read code ever recorded	Physical	1.4

Methods

- 3651 individuals identified with reported atrial fibrillation (prevalence 0.73%)
- Including data on 42 different Long term conditions (LTCs)
- Follow-up data using data linkage with mortality registers
- Statistical analysis of all-cause mortality as the outcome variable
- Compare the effect of number of LTCs in participants with and without AF
- Study the effect of different comorbid LTCs on mortality in participants with AF
- Confounders: Age, sex, deprivation score, smoking status, anti-coagulation status

Results

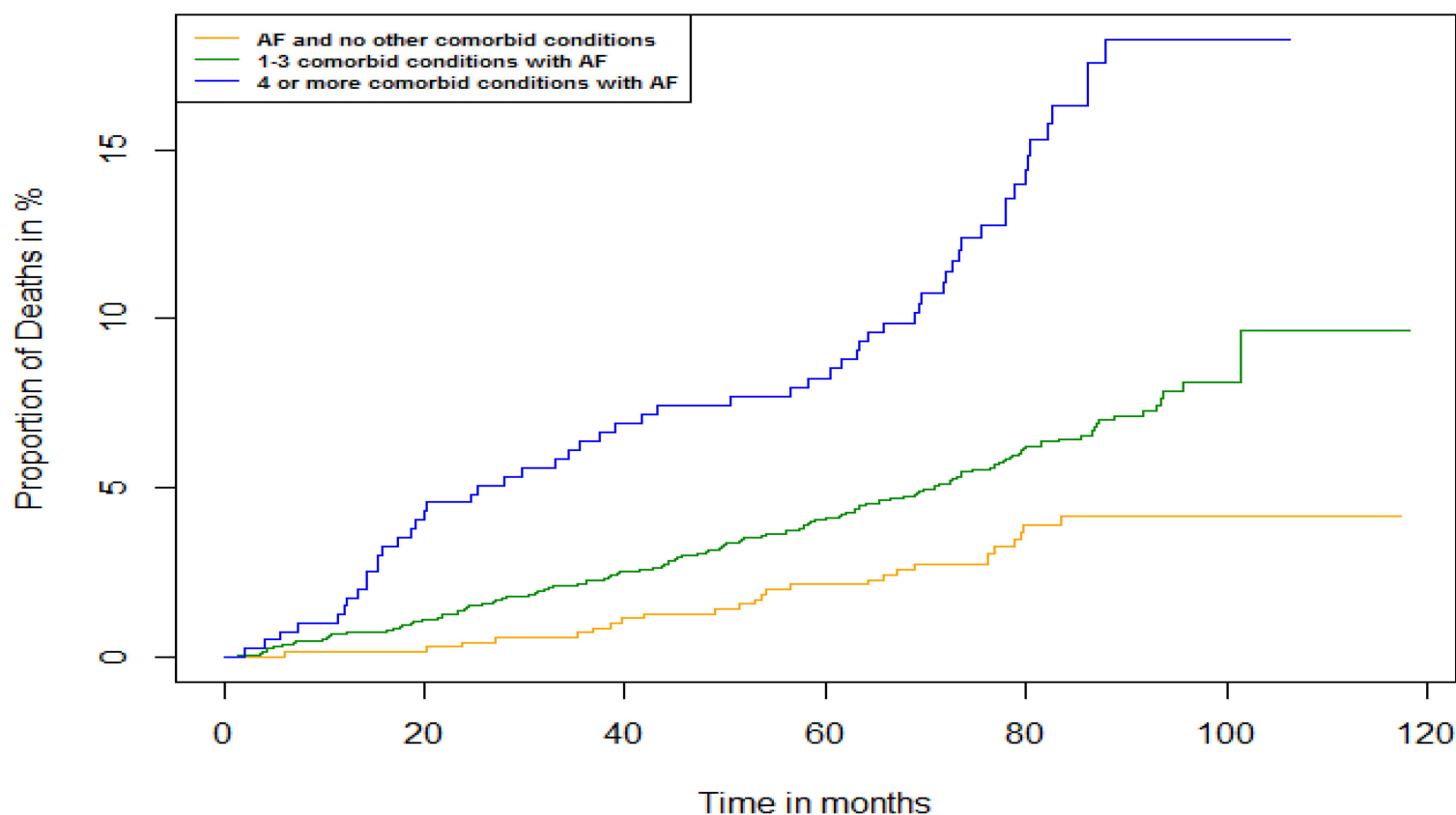
- 3651 patients reported a history of atrial fibrillation (prevalence of 0.73%); 68% were male
- Mean age of patients with AF was 61.9 + 6.1 years at entry to the study
- Total mortality in the patients with AF was 6.7% over median duration of follow-up of 7 years (84 months).
 - Mortality in the population without AF was 2.5%
- Mean age at time of death for AF patients was 65.6 + 6.9 years.

Results- Number of LTCs and Mortality

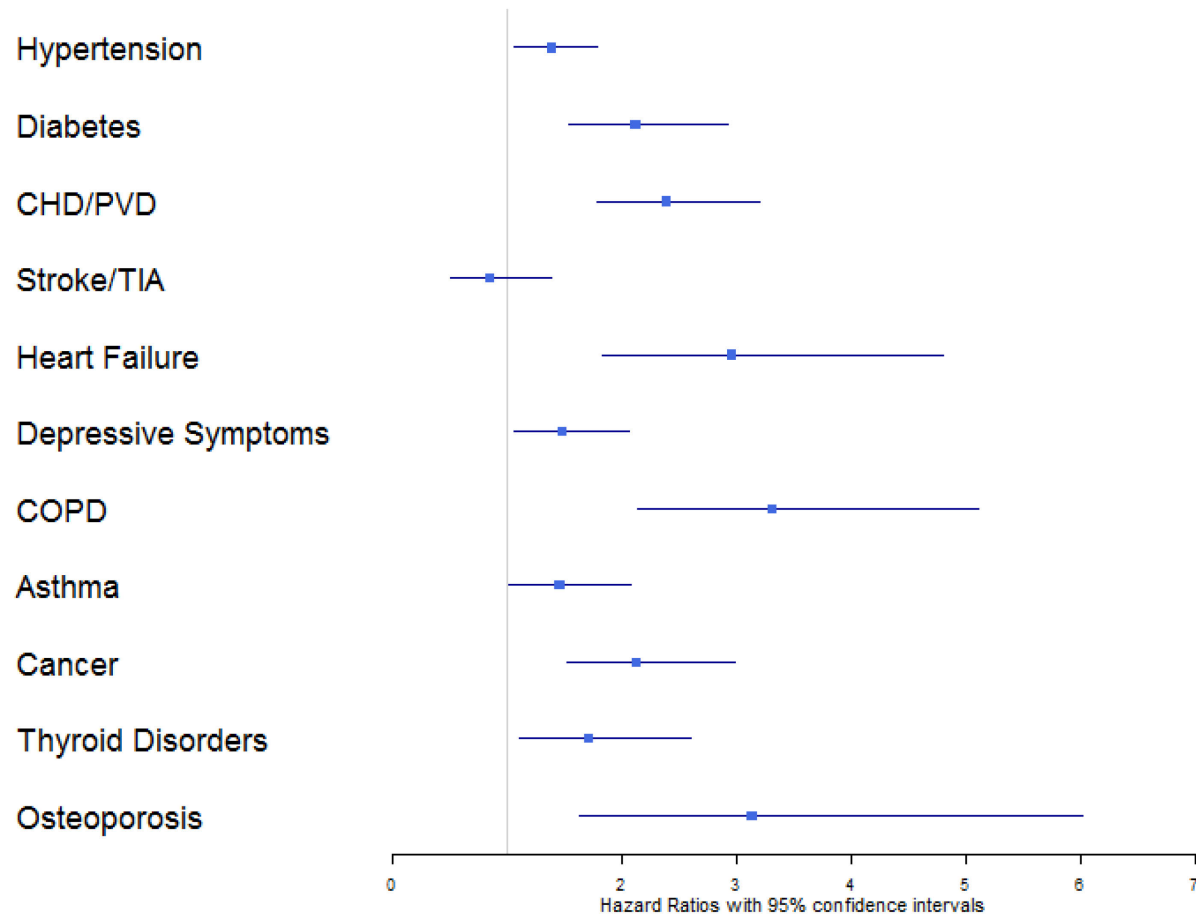
Participants Classification based on presence of AF and number of LTCs	Hazard Ratio with 95% Confidence Intervals	P-value
AF present and no other LTCs	2.06 (1.40 to 3.04)	<0.001
AF absent and 1-3 LTCs	2.07 (1.98 to 2.16)	<0.001
AF present and 1-3 other LTCs	3.17 (2.70 to 3.73)	<0.001
AF absent and 4 or more LTCs	4.25 (4.00 to 4.52)	<0.001
AF present and 4 or more other LTCs	6.80 (5.23 to 8.83)	<0.001

Results- Number of LTCs and Mortality in AF

All-cause mortality for participants with AF



Results – Comorbid LTCs and Mortality in AF



Atrial Fibrillation

- The prevalence of AF in the UK Biobank population is comparable with that in other population studies.
- Survival in patients with AF is strongly correlated with the presence of comorbidities.
- Patients with AF and 1-3 comorbidities have a mortality rate that is more than THREE times that of the controls, and AF participants with 4 or more comorbidities have a mortality rate that is more than SIX times that of the control population
- Presence of certain non cardiometabolic conditions such as COPD was associated with a very high risk of mortality in AF participants

Implications

- Young and middle-aged patients with atrial fibrillation and one or more co-morbidities are at increased risk of death over a follow-up period of 5-10 years
- We suggest that these patients should be prioritised for interventions to enhance their adherence to treatment, and in some cases to adjust their lifestyle in order to reduce the impact of their comorbidities on survival

Further studies in this population

- Causes of death
- Relation of outcome measures to treatments
- Anticoagulation
- Other cardiovascular medications
- Interventions including cardioversion & ablation
- Other outcome measures
- Including hospitalisation for AF / heart failure / stroke
- Exploration of individual co-morbidities
- e.g. neutral effect of prior stroke / TIA on survival

Conclusions on Big Data

- Large datasets allow us to study subsets of the population to ascertain risk of:
 - Missing primary healthcare appointments
 - Mortality
- These datasets directly inform policy
 - Consultation with Scottish Government on serial missed appointments helps inform the GP allocation formula
 - Multimorbidity/comorbidity data from UK biobank directly informs GP behaviour.

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