

## The dynamics of quality: a national panel study of evidence-based standards

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Max O Bachmann, Allan Clark, William E Henley, John L Campbell,  
David Melzer and Nicholas Steel*



***National Institute for  
Health Research***



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# Abstract

## The dynamics of quality: a national panel study of evidence-based standards

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**Background:** Shortfalls in the receipt of recommended health care have been previously reported in England, leading to preventable poor health.

**Objectives:** To assess changes over 6 years in the receipt of effective health-care interventions for people aged 50 years or over in England with cardiovascular disease, depression, diabetes or osteoarthritis; to identify how quality varied with participant characteristics; and to compare the distribution of illness burden in the population with the distributions of diagnosis and treatment.

**Setting and participants:** Information on health-care quality indicators and participant characteristics was collected using face-to-face structured interviews and nurse visits in participants' homes by the English Longitudinal Study of Ageing in 2004–5, 2006–7, 2008–9 and 2010–11. A total of 16,773 participants aged 50 years or older were interviewed at least once and 5114 were interviewed in all four waves; 5404 reported diagnosis of one or more of four conditions in 2010–11.

**Main outcome measures:** Percentage of indicated health care received by eligible participants for 19 quality indicators: seven for cardiovascular disease, three for depression, five for diabetes and four for osteoarthritis, and condition-level quality indicator achievement, including achievement of a bundle of three diabetes indicators.

**Analysis:** Changes in quality indicator achievement over time and variations in quality with participant characteristics were tested with Pearson's chi-squared test and logistic regression models. The size of inequality between the hypothetically wealthiest and poorest participants, for illness burden, diagnosis and treatment, was estimated using slope indices of wealth inequality.

**Results:** Achievement of indicators for cardiovascular disease was 82.7% [95% confidence interval (CI) 79.9% to 85.5%] in 2004–5 and 84.2% (95% CI 82.1% to 86.2%) in 2010–11, for depression 63.3% (95% CI 57.6% to 69.0%) and 59.8% (95% CI 52.4% to 64.3%), for diabetes 76.0% (95% CI 74.1% to 77.8%) and 76.5% (95% CI 74.8% to 78.1%), and for osteoarthritis 31.2% (95% CI 28.5% to 33.8%) and 35.6% (95% CI 34.2% to 37.1%). Achievement of the diabetes care bundle was 67.8% (95% CI 64.5% to 70.9%) in 2010–11. Variations in quality by participant characteristics were generally small. Diabetes indicator achievement was worse in participants with cognitive impairment [odds ratio (OR) 0.5, 95% CI 0.4 to 0.7] and better in those living alone (OR 1.7, 95% CI 1.3 to 2.0). Hypertension care was better for those aged over 74 years (vs. 50–64 years) (OR 3.2, 95% CI 2.0 to 5.3). Osteoarthritis care was

better for those with severe (vs. mild) pain (OR 1.8, 95% CI 1.4 to 2.2), limiting illness (OR 1.8, 95% CI 1.5 to 2.1), and obesity (OR 1.6, 95% CI 1.2 to 2.0). Previous non-achievement of the diabetes care bundle was the biggest predictor of non-achievement 2 years later (OR 3.3, 95% CI 2.2 to 4.7). Poorer participants were always more likely than wealthier participants to have illness burden (statistically significant OR 3.9 to 16.0), but not always more likely to be diagnosed or receive treatment (0.2 to 5.3).

**Conclusions:** Shortfalls in quality of care for these four conditions have persisted over 6 years, with only half of the level of indicated health care achieved for osteoarthritis, compared with the other three conditions. Quality for osteoarthritis improved slightly over time but remains poor. The relatively high prevalence of specific illness burden in poorer participants was not matched by an equally high prevalence of diagnosis or treatment, suggesting that barriers to equity may exist at the stage at diagnosis. Further research is needed into the association between quality and health system characteristics at the level of clinicians, general practices or hospitals, and regions. Linkage to routinely collected data could provide information on health service characteristics at the individual patient level.

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**BOX 1** English Longitudinal Study of Ageing sample members

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## List of abbreviations

ACE	angiotensin-converting enzyme	GP	general practitioner
ACOVE	Assessing Care of Vulnerable Elders	HbA <sub>1c</sub>	glycosylated haemoglobin
ADL	activities of daily living	HSE	Health Survey for England
BMI	body mass index	IADL	instrumental activities of daily living
CAPI	computer-assisted personal interview	IHD	ischaemic heart disease
CASP-19	Control, Autonomy, Self-realisation and Pleasure-19 quality of life scale	INR	international normalised ratio
CES-D	Centre for Epidemiological Studies – Depression Scale	LDL	low-density lipoprotein
CHD	coronary heart disease	MI	myocardial infarction
CI	confidence interval	NS-SEC	National Statistics Socio-Economic Classification
CVD	cerebrovascular disease	OR	odds ratio
DCCT	Diabetes Control and Complications Trial	PPIRes	Patient and Public Involvement in Research
ELSA	English Longitudinal Study of Ageing	QOF	Quality and Outcomes Framework



## Plain English summary

People with long-term health conditions do not always receive the health care they need, and so may suffer avoidable poor health. We aimed to find out if the quality of health care received by people in England had improved over 6 years, for four common long-term health conditions: cardiovascular disease (including heart disease and high blood pressure treatment), depression, diabetes and osteoarthritis. We wanted to know if some people got better care than others, and if this was related to things such as their wealth, education or social context.

We used information collected by interviewer and nurse visits to the homes of 16,773 people aged 50 years or older who had agreed to take part in a national survey called the English Longitudinal Study of Ageing. They were asked questions about their health, disability, health care, education, employment, money, social lives and well-being in 2004–5, 2006–7, 2008–9 and 2010–11.

We found that many people were still not receiving the care they needed, with little change over 6 years. The percentage of good care received for osteoarthritis was only 32%, compared with 83% for cardiovascular disease, 65% for depression and 76% for diabetes. There were no types of people who consistently missed out on care, although people with cognitive impairment received worse care for diabetes. Poorer people with specific illness burden may be less likely than wealthier people to receive a diagnosis, but people with a diagnosis were generally equally likely to get good-quality care.



# Scientific summary

## Background

Life expectancy at birth in high-income countries has increased by about 8 years since 1950, and approximately half of this can be attributed to health care. Improvements in health care offer many opportunities to increase the quality and length of life, and avoid some of the approximately 60,000 potentially avoidable deaths experienced annually by the population of England, which is more than in comparable countries. Deficits in quality of care have been reported from high-income countries over many years, and we have previously reported substantial variations in quality standards achieved in England for older people with long-term conditions.

International evidence has identified effective care processes that can be described in quality indicators of health care for many conditions. Quality indicators describe the minimum levels of acceptable health care, based on evidence of effectiveness in increasing patient health and reducing the risk of morbidity.

## Objectives

We aimed to assess changes over time in the receipt of effective healthcare interventions for people aged 50 years or older in England with cardiovascular disease, depression, diabetes or osteoarthritis; to identify how quality varied with participant characteristics; and to compare the distribution of illness burden in the population with the distributions of diagnosis and treatment.

Our three research questions were:

1. How does the prevalence of good quality of health care vary over time?
2. What characteristics are shared by people aged 50 years or older who received, or did not receive, specific items of recommended NHS or non-NHS care for cardiovascular disease, depression, diabetes and osteoarthritis, in a national population-based study followed up for 6 years?
3. Are factors such as wealth, patient education, physical activity, obesity and co-existing other chronic conditions, or practical factors such as good eyesight and marital status, independently associated with the quality of health care received, from burden of illness to diagnosis and, finally, to treatment?

## Methods

The English Longitudinal Study of Ageing (ELSA) is a national panel survey of people aged 50 years or older living in private households in England. The original cohort was drawn from households that had previously responded to the Health Survey for England (HSE) in 1998, 1999 and 2001, in order that it should be nationally representative. The first wave was conducted in 2002–3, with successive waves collected every 2 years since, up until 2010–11 (fifth wave). Replenishment cohorts were added in 2006–7 (sampled from HSE 2001–4) and 2008–9 (sampled from HSE 2006) to correct for the original cohort ageing and loss to follow-up. Data collection took place via face-to-face interviews in participants' homes, with additional biomedical information collected during nurse visits in 2004–5 and 2008–9. ELSA interviews obtained in-depth data on participants' demographics, finances, health, lifestyle and psychosocial characteristics.

### **Samples**

The four waves of ELSA that we studied comprised 16,773 participants. For the longitudinal analyses of ELSA we used data from the 5114 participants in the original cohort who responded at every successive wave, excluding proxy responders. We also used cross-sectional samples including all eligible participants at each wave: 2004–5, 2006–7, 2008–9 and 2010–11. For analysis of the diabetes care bundle, we used a cross-sectional sample of all eligible participants in 2010–11, who had also been non-proxy participants in 2008–9 ( $n = 8222$ ).

### **Outcome measures (quality indicator achievement)**

Questions on quality of care for a range of conditions have been implemented in ELSA since 2004–5. The quality indicators were developed using a rigorous process by researchers at RAND Corporation in the USA, who combined the best available evidence with expert opinion to assess appropriateness of treatment. They were then adapted for use in the UK by an expert panel of clinicians. The quality indicators were selected for suitability of use in patient interviews and underwent testing before implementation in ELSA. The quality indicators describe health-care processes, rather than health outcomes, and were designed to describe minimum acceptable levels of care.

The English Longitudinal Study of Ageing included 32 quality indicators overall, of which 19 were used in this study: seven quality indicators for cardiovascular disease (including five for ischaemic heart disease and one quality indicator for each of hypertension and cerebrovascular disease), three for depression, five for diabetes and four for osteoarthritis. ELSA also included seven questions about patient-centred health care. We calculated achievement rates for the 19 quality indicators by dividing the number of participants who reported receiving the indicated care by the number eligible for that care, expressed as a percentage. If a participant was eligible for an indicator, the indicator was described as 'triggered'. Quality scores at a condition level were the total number of times indicators for each condition were achieved, divided by the total number of times they were triggered for that condition.

### **Participant characteristics**

Possible covariates for modelling receipt of care were selected by a multidisciplinary panel consisting of academics, clinicians and public and patient representatives. The choices were based on clinical relevance, feasibility to extract the data from ELSA and previous work. Covariates were grouped into five domains: demographics, health and disability, health behaviours, physical measures, and psychological and social. Continuous variables were transformed into tertiles or quintiles. Missing data were coded as an extra category to maximise the sample available for analysis.

We used the slope order of inequality as an independent variable to estimate the relationship between the illness burden, diagnosis and treatment, respectively, and the categorised measure of wealth. The slope order of inequality consisted of wealth quintiles with values of 0.1, 0.3, 0.5, 0.7 and 0.9, that is the mid-points of each quintile on a scale of zero (least wealthy) to one (most wealthy). Advantages of this method of quantifying inequality are that it includes all participants; instead of just comparing the highest and lowest quintiles, it accounts for the number of participants in each category and it provides a single overall measure of inequality.

### **Analyses**

The primary outcome was achievement of each quality indicator, which was the number of times the indicator was achieved divided by the number of times it was triggered, expressed as a percentage, with possible values between 0% and 100%. The quality indicator achievement at the level of each condition (cardiovascular disease, depression, diabetes and osteoarthritis) was the number of times any indicator for that condition was achieved divided by the number of times any indicator for that condition was triggered, expressed as a percentage, with possible values between 0% and 100%. We calculated the percentage change in quality indicator achievement between wave 2 and the most recent year of follow-up, and tested the statistical significance of any changes in quality indicator achievement over time with a

Pearson's chi-squared test for comparing proportions. We generated a 'care bundle' of the three diabetes quality indicators that described monitoring checks.

Logistic regression models investigated which participant characteristics were independently associated with receipt of better-quality health care, at the level of health conditions. Each participant might have been eligible for more than one quality indicator within each condition, and so for the regression modelling we reshaped the data into 'long' format in Stata statistical software (StataCorp LP, College Station, TX, USA), with each participant having a separate record for each indicator. Intraperson correlation of outcomes was accounted for, and all data were weighted for historical non-response and non-response since the last wave.

For the diabetes quality indicators, including the care bundle of three routine monitoring indicators, we additionally explored which patient characteristics from one wave earlier (2008–9) were associated with subsequent non-receipt of diabetes care at the latest wave (2010–11), using the 2010–11 cross-sectional sample ( $n = 8222$ ). Potential covariates were entered into logistic regressions on outcomes for achievement of the care bundle and the fourth quality indicator [which assessed offering angiotensin-converting enzyme (ACE) inhibitors to patients with diabetes and an additional cardiac risk factor]. All models were adjusted for age, sex and differential non-response.

Multivariable logistic regression analysis was used to test for associations between age, sex and slope order of wealth inequality, with respect to illness burden, diagnosis and treatment. Further tests of possible covariates that might affect the population distribution of illness burden, diagnosis and treatment were performed.

## Results

The prevalence of receipt of indicated health care varied over time. Quality scores for condition were 82.7% [95% confidence interval (CI) 79.9% to 85.5%] in 2004–5 and 84.2% (95% CI 82.1% to 86.2%) at follow-up (2010–11) for cardiovascular disease ( $p = 0.53$ ), 63.3% (95% CI 57.6% to 69.0%) and 59.8% (95% CI 52.4% to 64.3%) for depression ( $p = 0.21$ ), 76.0% (95% CI 74.1% to 77.8%) and 76.5% (95% CI 74.8% to 78.1%) for diabetes ( $p = 0.67$ ), and 31.2% (95% CI 28.5% to 33.8%) and 35.6% (95% CI 34.2% to 37.1%) for osteoarthritis ( $p < 0.001$ ).

Achievement of the diabetes care bundle was 67.8% (95% CI 64.5% to 70.9%) in 2010–11. The diabetes care bundle was not fully received in nearly one-third of participants (32.8% in 2008–9, 32.2% in 2010–11) and nearly half of those eligible were not offered ACE inhibitors (44.6% in 2008–9, 44.5% in 2010–11). Previous non-achievement of the diabetes care bundle was the biggest predictor of non-achievement 2 years later [odds ratio (OR) 3.3, 95% CI 2.2 to 4.7]. Participants were also more likely to not receive the full bundle if they lacked diabetes self-management knowledge (OR 2.0, 95% CI 1.3 to 3.2) or were cognitively impaired (OR 1.8, 95% CI 1.1 to 2.9).

Participants' characteristics associated with quality indicator achievement over time were assessed on the 5114 participants who were interviewed in all four waves. There were few statistically significant associations. Quality indicator achievement in diabetes was lower with cognitive impairment (OR 0.5, 95% CI 0.4 to 0.7) and higher for those living alone (OR 1.7, 95% CI 1.3 to 2.0). Quality indicator achievement in hypertension was higher for those aged 75 and over (vs. 50–64 years) (OR 3.2; 95% CI 2.0 to 5.3). For osteoarthritis, quality indicator achievement was higher for those with severe (vs. mild) pain (OR 1.8, 95% CI 1.4 to 2.2), limiting illness (OR 1.8, 95% CI 1.5 to 2.1) and obesity (OR 1.6, 95% CI 1.2 to 2.0).

Wealth was the major factor associated with illness burden and diagnosis. Poorer participants were always more likely than wealthier participants to have illness burden (statistically significant OR 3.9 to 16.0), but not always more likely to be diagnosed or receive treatment (statistically significant OR 0.2 to 5.3).

## Conclusions

Shortfalls in quality of care have persisted over 6 years, with less than half of indicated health care achieved for osteoarthritis, compared with the other three conditions, although osteoarthritis was the only condition where quality had improved over time. Illness burden was much more common in poorer participants, but after diagnosis, there was remarkably little variation by participant characteristics, suggesting that while treatment for these four conditions is usually equitable, barriers to equity may exist at the stage at diagnosis. The shortfalls in quality of care by condition are much larger than the relatively few small variations found by participant characteristics.

This project is the first to investigate a wide range of clinical, behavioural, psychosocial and sociodemographic patient characteristics associated with subsequent receipt of care in older people in England, encompassing four common health conditions. Using the ELSA cohort, we were able to link reports of receipt of care indicated by evidence- and consensus-based standards developed specifically for older people with in-depth, sophisticated measures of a range of patient characteristics. This approach contrasts with previous research, which has typically been limited to exploring basic patient descriptors, such as age and sex, available from routine records.

Limitations include that, although the ELSA cohort was selected to be representative of older people in England, there has inevitably been some loss to follow-up with each wave. The effect has been minimised by the ELSA sample replenishment, and by weighting of all analyses for differential non-response using sampling weights. Quality of care was based on self-reports of care received up to 2 years previously, but recall problems were minimised by the selection for ELSA of only those quality indicators that were suitable for self-report, and by excluding participants if they had cognitive impairment and needed a proxy responder to help them to answer the questions.

### *Implications for health care and research recommendations*

The results are likely to be generalisable to the population of England aged 50 years or over, bearing in mind the limitations discussed above, because the sample was large and selected to be nationally representative, the results were weighted for non-response, and achievement rates were comparable with the Quality and Outcomes Framework. They may also be generalisable with caution to other countries with similar population demographics, but are likely to vary according to health system and availability of care.

Further research is needed to compare the results with measurements of quality of care from directly observed clinical care and from medical records. As this research has shown that the substantial variations in quality of care are generally not explained by participant characteristics, further research is needed into the association between quality and health system characteristics at micro (individual clinician), meso (general practice or hospital) and macro (regional and national) levels. Future research could use linked data sets to examine the effect of health service characteristics on the quality of care received at individual patient level. Different models of health care may improve quality of care received by older people, with common features being strong primary care, the use of care plans and complete electronic medical records. Promising models need to be tested in specific health-care contexts, and successful models implemented in routine health care.

Further research could explore why quality is so much lower in osteoarthritis than for other conditions studied, and also follow-up our preliminary finding that there may be system-level inequalities in the receipt of diagnosis that make it harder for disadvantaged people with specific illness burden to receive an appropriate diagnosis. These questions would benefit from a mixed qualitative and quantitative approach to explore the delivery of care in different systems and link to outcomes.



We found that participant's self-reported receipt of indicated health care across time was variable both between and within the four conditions studied. Shortfalls in quality of care have hardly changed over 6 years, with less than half as many quality indicators achieved for osteoarthritis as for the other conditions studied. Barriers to equity may exist at the stage at diagnosis, but for those with one of the four diagnosed health conditions studied, the persistent system-level deficits in the provision of care were generally distributed equitably across the population.

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# Chapter 1 Background and aims

## Introduction

Life expectancy at birth in high-income countries has increased by about 8 years since 1950, and approximately half of this can be attributed to health care.<sup>1</sup> Improvements in health care offer many opportunities to increase the quality and length of life. For example, the population of England experiences approximately 60,000 potentially avoidable deaths annually, which is higher than in comparable countries.<sup>2</sup> Deficits in quality of care have been reported from high-income countries over many years,<sup>3-6</sup> and we have previously reported substantial variations in quality standards achieved in England for older people with chronic conditions.<sup>7,8</sup>

A wealth of international evidence has identified care processes that are suitable quality indicators of health care for many conditions. Quality indicators describe the minimum levels of acceptable health care, based on evidence of effectiveness in increasing patient health and reducing the risk of morbidity. The quality indicators used in this study were originally developed by researchers at RAND Corporation, who combined the best available evidence with expert opinion to assess appropriateness of treatment, and they were then adapted for use in the UK.<sup>9</sup>

The UK has a long-established 'free at the point of use' health-care system, with relatively strong primary care services. Since 2004 there has been a major drive to improve receipt of indicated care through the Quality and Outcomes Framework (QOF), a scheme to pay general practices according to their performance with respect to quality indicators. Despite concentrated efforts to improve the quality of care, there is only weak evidence of improvement in quality of care since the introduction of the QOF.<sup>10</sup> Many geriatric conditions commonly affecting older people, such as osteoarthritis, are not included in this scheme. There is evidence that quality of care has not improved for some excluded conditions, such as falls.<sup>8,11,12</sup> QOF data are only available at the level of practices, precluding a detailed analysis of how individual patient characteristics (such as age, sex or degree of deprivation) might influence receipt of care.

The English Longitudinal Study of Ageing (ELSA) is a national survey following a cohort of people aged 50 years or older every 2 years since 2002. Questions assessing receipt of quality of care using quality indicators have been included since 2004. The baseline results derived from the 2004 data<sup>7</sup> show that the amount of care that people were eligible for, and the amount they subsequently received, was highest for ischaemic heart disease (IHD) (83%) but lower for hypertension (72%), diabetes (74%), depression (64%) and osteoarthritis (29%). It is not known if receipt of this indicated care has improved since 2004 or whether or not patient characteristics are associated with variability in quality of care. ELSA has a broad range of participant demographics, and using these data it is possible to extract much more information on each participant than is available at a practice level. Gaining a clearer picture of who is at most risk of receiving poor quality of care is needed in order to inform the design of targeted interventions to improve quality of care, and to improve access for previously underserved groups.

## Aims

Our objective was to analyse data from four waves from ELSA in order to identify opportunities for improving health care in older adults in England.

We aimed to assess changes over time in the receipt of effective health-care interventions for people aged  $\geq 50$  years in England with cardiovascular disease, depression, diabetes or osteoarthritis; to identify how quality varied with participant characteristics; and to compare the distribution of illness burden in the population with the distributions of diagnosis and treatment.

We had three research questions:

1. Research question 1: how does the prevalence of good quality of health care vary over time?
2. Research question 2: what characteristics are shared by people aged  $\geq 50$  years who received or did not receive specific items of recommended NHS or non-NHS care for cardiovascular disease, depression, diabetes and osteoarthritis in a national population-based study followed up for 6 years?
3. Research question 3: are factors such as wealth, patient education, physical activity, obesity and coexisting other chronic conditions, or practical factors such as good eyesight or marital status, independently associated with the quality of health care received, from burden of illness to diagnosis and, finally, to treatment?

## Ethical approval

The English Longitudinal Study of Ageing received ethical approval from the National Research Ethics Service (reference number 09/H0505/124). Participants gave written informed consent before taking part.

## Background

### Cardiovascular disease

Cardiovascular disease is an umbrella term for a number of associated conditions. ELSA gathered information on achievement of quality indicators for IHD, hypertension and cerebrovascular disease (CVD) (stroke). A systematic review of 17 quality-of-care papers reporting on the RAND Corporation's Assessing Care of Vulnerable Elders (ACOVE) quality indicators<sup>13</sup> revealed that achievement rates are often high in primary care settings for indicated care for hypertension (72%) and stroke (69%).

Data from all 8409 general practices in the UK between 2005 and 2006, collected for the QOF, showed that quality indicator achievement for cardiovascular prescribing was generally high, with a mean achievement for all 26 indicators of 79.0% (standard deviation 4.4%).<sup>14</sup> This included antiplatelet therapy (89.75%), hypertension (74.83%) and beta-blockers (50.94%). An audit of 254 general practitioners (GPs) in the USA between 2007 and 2009, using quality indicators from the National Quality Forum and RAND Corporation, found that eligible patients with coronary artery disease were prescribed lipid-lowering medication on 76% of occasions and that beta-blockers were prescribed post myocardial infarction (MI) on 84% of occasions, though achievement for a quality indicator assessing prescriptions of antiplatelet therapy was lower at 48%.<sup>15</sup>

Fürthauer *et al.*<sup>16</sup> assessed adherence to nine quality indicators by 58 GPs covering a range of cardiovascular conditions and interviewed patients and practitioners about the reasons for deviations from guideline recommendations. Approximately 70% of non-adherence was accounted for by physicians' lack of knowledge and patients' lack of awareness of the guidelines. Ludt *et al.*<sup>17</sup> sought to identify patient and practice characteristics that predicted good quality of care for prevention of cardiovascular disease using data from the clinical records of 7846 patients across primary care settings in 10 European countries. They did not find that practice factors predicted outcomes, but good risk factor control was more likely in those with higher health-related quality of life and lower for those whose marital status was single or who had achieved lower educational levels.

### Diabetes

In 2009–10 the national audit on diabetes care<sup>18</sup> reported that 1.8 million people were diagnosed with type 1 or type 2 diabetes and registered with an English general practice (5.24% adult prevalence). Despite 95.4% of patients with type 2 diabetes having consulted their GP at least once in the last year, the proportion receiving all processes included in a bundle of nine diabetes quality indicators<sup>19</sup> was low (52.9%). Some processes [e.g. weight measurement 90.5% and glycosylated haemoglobin (HbA<sub>1c</sub>)

measurement 92.6%] were more frequently measured than others (e.g. retinopathy screening 78.9%, foot risk assessment 85.2% and renal risk assessment 54.4%). Similarly, De Wet *et al.*<sup>20</sup> reported compliance with 10 individual diabetes quality indicators and a 'care bundle' – a composite measure of the individual quality indicators – in nine Scottish general practices (56,948 patients). Achievement of individual quality indicators was high (ranging from 85.9% to 97.8%), but all-or-nothing receipt of the care bundle was lower (58.4%).

There is considerable variation in the delivery of core diabetes care between providers.<sup>18</sup> For example, practices located in more deprived areas perform less well relative to their wealthier counterparts.<sup>21,22</sup> Less is known about patient factors, even though we need to better understand why such variation arises in order to improve receipt of basic care processes.<sup>20</sup> The national diabetes audit<sup>18</sup> reported that social deprivation, sex and time since diagnosis did not affect the likelihood of receiving a complete care bundle, although patient age (< 55 years or ≥ 85 years vs. 55–84 years) and ethnicity ('non-white' vs. 'white' patients) were associated. Kontopantelis *et al.*<sup>22</sup> analysed longitudinal data (2000–1 to 2006–7) from 23,920 patients with diabetes who were registered with one of 148 practices. Older patients (≥ 65 years vs. 17–39 years), those with comorbidities (three or more vs. none), and number of years living with diabetes (1–4 years vs. newly diagnosed) were more likely to receive a complete package, although no sex effect was observed.

### Osteoarthritis

Osteoarthritis is the most prevalent chronic joint disease globally.<sup>23</sup> Key clinical practice guidelines for osteoarthritis include non-pharmacological interventions (e.g. exercise and weight optimisation), provision of information regarding the disease and treatments, and joint replacement for severe disease.<sup>23</sup>

Previous work assessing quality of care for osteoarthritis<sup>7</sup> found that indicated care was received on only 29% of occasions. A meta-analysis of 17 studies using ACOVE quality indicators found that achievement rates for quality indicators for osteoarthritis had an interquartile range of 29–41%.<sup>13</sup> A recent review of chronic disease management found similarly poor quality of care for osteoarthritis across the quality domains of effectiveness, efficiency, safety, timeliness and appropriateness and patient-centred care, despite the availability of several evidence-based clinical practice guidelines.<sup>23</sup> A longitudinal study following 268 patients newly referred to an orthopaedic specialist in the UK over 12 months found that information was provided regarding their condition, pain management and exercise on 42%, 35% and 43% of occasions, respectively.<sup>24</sup> There is a need for research to assess quality of care for osteoarthritis over a longer time period. Using basic patient descriptors taken from medical records, Li *et al.*<sup>25</sup> found that receipt of advice on exercise and weight optimisation was not provided equitably across sex, age, disability and levels of formal education in 1349 patients with osteoarthritis of the knee and/or hip.

### Depression

Quality indicators of health-care processes for depression focus on the provision of pharmacological and psychotherapy treatments. A recent meta-analysis<sup>13</sup> of studies using quality indicators developed for the ACOVE project found low achievement of quality indicators for depression in both primary care settings (31%) and in nursing homes (16%). Duhoux *et al.*<sup>26</sup> assessed adherence rates to 27 quality indicators for depression in 915 adults who consulted a GP, regardless of the reason for the consultation, who also met established criteria for a major depressive episode. Adherence to guidelines was high (> 75%) for around one-third of assessed quality indicators, but less impressive for over half of quality indicators (< 60% achievement). Only 52.2% of the sample received at least one minimally acceptable treatment for depression (i.e. pharmacotherapy or psychotherapy). Patient characteristics that were associated with receipt of indicated care included old age (≥ 65 years), having a comorbid anxiety disorder, having a family physician, having supplementary insurance cover and the increasing severity of the depressive episode.



## Chapter 2 Methods

### The English Longitudinal Study of Ageing

The English Longitudinal Study of Ageing is a survey of adults aged  $\geq 50$  years and their partners living in private households in England. It began in 2002 and the respondents have been followed up with 2-yearly interviews, or waves. There have been five waves of data released to date – wave 1 2002–3, wave 2 2004–5, wave 3 2006–7, wave 4 2008–9 and wave 5 2010–11 – with a sixth wave due for release in early 2014. The original sample (2002–3) was drawn from households that had previously responded to the Health Survey for England (HSE) in 1998, 1999 and 2001. These years were chosen from the HSE because they were recent and could provide a sufficiently large sample size to make the survey representative of all adults living in England. The HSE is an annual cross-sectional household survey that gathers a broad range of biometric and health data. It was intended that the original sample of ELSA in 2002–3 would be representative of older people living independently in England. Further information about ELSA, including all questionnaires, is available from the ELSA website.<sup>27</sup> ELSA data are available from the UK Data Service.<sup>28</sup>

#### Scope of the English Longitudinal Study of Ageing

The aim of ELSA is 'to explore what it means to grow older in the 21st century and to understand which factors account for the variety of observed patterns'.<sup>29</sup> There is, therefore, an emphasis in the interviews on measuring change over time, with some measures being repeated exactly at each wave and others asking about change or giving respondents the opportunity to amend or update previous responses. A core set of modules on specific domains was included in all waves, with certain topics additionally covered at various waves. ELSA aimed to cover a broad array of salient domains, using standardised measures where possible. The modules common to all waves are listed in *Table 1*.

#### Data collection methods

Face-to-face interviews were conducted using computer-assisted personal interviews (CAPIs) and took place in respondents' homes. A self-completion questionnaire was also given to respondents for them to complete and return at their convenience. If there were several respondents for a given household, interviews could be conducted at the same time using concurrent interview techniques, with modules requiring private answers still performed individually. Both the CAPI and self-completion instruments were piloted for each wave approximately 1 year before the main data collection, using a separate sample of households.

Additionally, a nurse visited the respondents in waves 2 (2004) and 4 (2008), and collected anthropometric data and blood samples. The blood samples were analysed for HbA<sub>1c</sub> and many other biomarkers.

The CAPI instrument used in ELSA adopted the technique of 'feeding forward' data. That is, certain responses that individuals made in previous waves were used to improve consistency of their responses across waves, or to aid recall. For example, a respondent who had previously reported a certain diagnosis would be asked at subsequent waves to confirm that they previously had that diagnosis and whether or not they still had it. Previous responses were also used in the routing of the computerised interviews.

#### Sample design

Three cohorts of participants make up the ELSA sample. Recruits were sourced from HSE samples, as these were nationally representative. Households were eligible for ELSA if they contained at least one individual from one of the respective core HSE samples who was still living at a private residential address in England at the wave of ELSA at which that cohort was introduced. They also had to be age-eligible and had given permission to be recontacted in the future (though they were not specifically informed of ELSA at HSE). 'Cohort 1' was introduced at wave 1 (2002) and was selected from HSE samples in 1998, 1999 and 2001, with people being age-eligible if they were born on or before 29 February 1952. The HSE in 1999

**TABLE 1** Core survey content overview

Module	Description
Household demographics	Answered by one person on behalf of the household. Collects basic demographic characteristics of everyone in the household. Uses feed forward data from HSE
Individual demographics	Answered by all. Included questions on marital status, family members and childhood circumstances
Health	Answered by all. Included self-reported general health; long-standing illness or disability; eyesight and hearing; specific diagnoses, symptoms and care processes received; pain; difficulties with activities and instruments of daily living; health behaviours; and quality of care. Those aged $\geq 60$ years were asked about falls and fractures
Social participation	Answered by all. Covered frequency of participation in social activities, limitations to these activities, their care giving and usage of public transport
Work and pensions	Answered by all. Included current work activities; and current or past pensions, including amounts if currently receiving them
Income and assets	If a couple's finances are kept together one of them answers. If separate, both answer. Asked about all income and assets
Housing	Answered by one person on behalf of the household. Included: current housing situation (e.g. size, quality); housing-related expenses; ownership of durables and cars; expenditure on food. House owners were asked about value of property, mortgage details, etc.
Cognitive function	Answered by all at start of 'private modules' block. Measured cognitive function including memory, speed, mental flexibility and numeracy
Expectations	Answered privately by all. Measured expectations regarding financial decision-making and certainty of future events
Psychosocial health	Answered privately by all. Measured respondents' views on life including a depression scale and attitudes towards ageing
Walking speed	Completed by those aged $\geq 60$ years when safe to do so. Measured time taken to walk 2.4 m (taken twice)
Self-completion	Completed either during other members' private blocks or after and returned by post

Based on Banks *et al.*<sup>30</sup>

originally included a 'boost' sample that represented ethnic minorities, but funding constraints meant that this sample were not included in ELSA. 'Cohort 3' was introduced at wave 3 (2006) to replenish the ageing sample with people aged 50–52 years and was taken from HSE in 2001–4. 'Cohort 4' was introduced at wave 4 (2008) to both replenish the youngest age range, as in cohort 3, and bolster the sample of people aged 52–74 years that had lost numbers due to participant attrition over the waves. It was sourced from people born between 1 March 1933 and 29 February 1958 who participated in HSE in 2006, which was chosen because it included a nurse visit with measures taken that could be compared with those obtained in the wave 4 nurse visits.

Recruits selected for one of these cohorts were termed 'core members' of their respective cohort and remained eligible to take part in ELSA at subsequent waves as long as they had not moved out of Britain or had died. At each wave, partners of core members who lived in the household could also be interviewed. From wave 2 onwards, core members who had moved out of the private sector (e.g. into a nursing home) since the previous wave were approached for an 'institution interview'. Proxy interviews were attempted if cognitive impairment, physical or mental ill health prevented someone from participating in a face-to-face interview. The person who answered on behalf of the respondent was aged  $\geq 16$  years and knew enough about the individual's circumstances to provide the required information. Not all of the core modules were included in the proxy interviews, and we excluded proxies for the purposes of all our analyses. *Box 1* summarises the different types of sample member eligible for ELSA. Further details of the sampling design and fieldwork procedures can be found in the ELSA technical reports.<sup>31–34</sup>



**BOX 1** English Longitudinal Study of Ageing sample members

Core members were participants who were living within the household that participated in HSE (not all were personally interviewed for HSE). They were age-eligible for ELSA ( $\geq 50$  years of age) and had their first ELSA interview at a private residential address in England.

Core partners were participants who, like core members, were living within the household at the time of the HSE interview and were age-eligible for inclusion in ELSA. They differ from core members in that they were not interviewed when first approached. Therefore, they were only approached by virtue of their being the partner of a core member.

Younger partners were the cohabiting younger spouses or partners of core members, who had been living within the household at the time of HSE and the first ELSA interview, but who were not age-eligible.

Older partners (for cohorts 3 and 4 only) were the cohabiting spouses or partners of age-eligible sample members selected for ELSA, who had been living within the household at the time of the HSE or ELSA interview, but were themselves over the ages eligible for these cohorts.

New partners were the cohabiting spouses or partners (of any age) of core members at the time of the ELSA interview who had joined the household since the HSE interview.

**Participant response rates**

The technical reports for the first four waves of ELSA provide a variety of in-depth response rates.<sup>31–34</sup> Here, we report the 'individual response rates' from initial HSE samples to the entry wave of ELSA for each of the three cohorts, the total number of core members at each wave and the 'study response rate' of cohort 1 core members (the longitudinal sample) across the five waves (*Table 2*). 67% of individuals determined to be eligible for ELSA from HSE in 1998, 1999 and 2001 took part in ELSA wave 1.<sup>34</sup> Of individuals from HSE in 2001–4 who were eligible for ELSA as part of cohort 3, 60% were interviewed at wave 3.<sup>32</sup> A response rate of 65% was achieved for cohort 4 core members sourced from HSE in 2006.<sup>31</sup> Of the 11,392 core members from cohort 1 interviewed at wave 1, only 5315 (47%) completed all subsequent waves up to and including wave 5. The replenishment samples from cohorts 3 and 4 meant that numbers of all core members ranged from 8780 in wave 2 to 9886 in wave 4.

**TABLE 2** Core members and the longitudinal sample response rate across waves

Wave of ELSA	Total interviews (all samples types), <i>n</i>	Total core members (all available cohorts), <i>n</i>	Longitudinal sample size (cohort 1), <i>n</i>	Longitudinal sample retained in next wave, %
Wave 1: 2002–3	12,100	11,392	11,392	100.0
Wave 2: 2004–5	9432	8780	8780	77.1
Wave 3: 2006–7	9771	8810	7197	63.2
Wave 4: 2008–9	11,050	9886	6018	52.8
Wave 5: 2010–11	10,274	9090	5315	46.7

## Creating the data sets for analysis

The core ELSA data (see *Table 1* for included modules) for each wave were contained in separate data sets, which needed to be merged into a single data set for analyses. Additionally, there were data sets containing financial derived variables for waves 1–4 and data sets for nurse data collected at waves 2 and 4. *Table 3* lists the data sets that were merged.

Before a data set was merged, the variables it contained were given a prefix that identified the wave to which it belonged. Participants' data were linked across data sets by a unique individual identification number. For each merge, no participant was excluded, even if they had no data in the new data set or if they had not been present in previous data sets. This allowed our final data set to include participants who had missed a number of waves, or had joined the ELSA sample as part of cohorts 3 and 4. *Table 4* displays the number of participants merged at each step. There were 16,778 ELSA responders in the final data set. New participants were added to the sample from the core data set at each wave owing to partners being interviewed, or owing to the additions of cohorts 3 and 4.

### Longitudinal and cross-sectional samples

To answer our research questions, cross-sectional samples from each wave of ELSA and a longitudinal sample of those who were interviewed at all waves were required. Proxy interviews were excluded, as we required accurate reporting of diagnoses and received care, as were interviews held in institutions, because these would not be representative of those living in private residences. The 5114 ELSA cohort 1 core members who were interviewed at all four waves, excluding proxies and those in institutions, formed our longitudinal sample (*Table 5*). This represents 45.5% of the original sample of 11,233 who responded at wave 1. The additions of cohorts 3 and 4 kept the cross-sectional samples above 8500 core members each. For analysis of the diabetes care bundle, we used a cross-sectional sample of all core members in 2010–11, who had also been non-proxy participants in 2008–9 ( $n = 8222$ ).

**TABLE 3** English Longitudinal Study of Ageing data sets used to create the study data set

Data set	Filename as retrieved from UK Data Archive	Description
Wave 1 core data	Wave_1_Core_Data_v2.1	Data from core ELSA modules for wave 1
Wave 1 financial derived variables	Wave_1_Financial_Derived_Variables_v2	Financial variables derived by the Institute of Fiscal Studies for wave 1
Wave 2 core data	Wave_2_Core_Data_v2	Data from core ELSA modules for wave 2
Wave 2 financial derived variables	Wave_2_Financial_Derived_Variables	Financial variables derived by the Institute of Fiscal Studies for wave 2
Wave 2 nurse data	Wave_2_Nurse_Data_v2	Data obtained from the nurse visit in wave 2
Wave 3 core data	Wave_3_Core_Data_Phase_2_v2	Data from core ELSA modules for wave 3
Wave 3 financial derived variables	Wave_3_Financial_Derived_Variables	Financial variables derived by the Institute of Fiscal Studies for wave 3
Wave 4 core data	Wave_4_Core_Data_Phase_2	Data from core ELSA modules for wave 4
Wave 4 financial derived variables	Wave_4_Financial_Derived_Variables	Financial variables derived by the Institute of Fiscal Studies for wave 4
Wave 4 nurse data	Wave_4_Nurse_Data	Data obtained from the nurse visit in wave 4
Wave 5 core data	elsa_wave_5_with_dvs_	Data from core ELSA modules for wave 5

**TABLE 4** Number of ELSA sample members added at each step of the merging process

Data set merged	Total sample size, <i>N</i>	Number of participants matched on merger	Number of participants not matched on merger	
			Not in added data set	New in added data set
Wave 1 core data (start point)	12,100	N/A	N/A	N/A
Wave 1 financial derived variables	12,100	12,099	1	0
Wave 2 core data	12,208	9324	2776	108
Wave 2 financial derived variables	12,208	9432	2776	0
Wave 2 nurse data	12,208	7666	4542	0
Wave 3 core data	13,944	8043	4165	1736
Wave 3 financial derived variables	13,948	9767	4177	4
Wave 4 core data	16,636	8362	5586	2688
Wave 4 financial derived variables	16,636	11,050	5586	0
Wave 4 nurse data	16,636	8643	7993	0
Wave 5 core data	16,778	10,132	6504	142

N/A, not applicable.

**TABLE 5** Sizes of the longitudinal and cross-sectional samples derived for analysis

Sample	<i>n</i>
Wave 1	11,322
Wave 2	8688
Wave 3	8628
Wave 4	9578
Wave 5	8729
Longitudinal (all waves)	5114

## Quality indicators

The health module of ELSA included questions on the receipt of health care, as described in quality indicators. The quality indicators were originally developed by RAND Corporation for the ACOVE project<sup>35</sup> and adapted for use in patient interview surveys in England<sup>9</sup> to assess care for a range of common medical conditions affecting older people, as described in more detail in *Quality indicators in the English Longitudinal Study of Ageing*, below. Studies using these indicators have found a substantial shortfall in quality of care in both the USA in 1999<sup>6</sup> and the ELSA.<sup>7</sup>

### Composite measures of quality

It is possible to combine individual quality indicators into composites that summarise quality of care at a higher level, such as for a condition or even for all health care in a system. There are both advantages and disadvantages of this approach. Summary measures are useful for conveying a complex range of information to policy-makers and the public, but important variations in individual health-care processes can be masked if combined without care.<sup>36</sup> Composites should, therefore, avoid overgeneralisation and have a specific focus and aim, such as formative quality improvement for specific conditions.<sup>37</sup>

'Care bundles' are composites that comprise processes of care which should all be received by the eligible population for certain conditions, such as annual monitoring checks for patients with diabetes. The 'gap' in performance between individual indicators and the care bundle may be a more valid reflection of variation in expected care delivery.<sup>20</sup>

There are a number of different methods for deriving composite measures, with different strengths and weaknesses. Below, we describe the main methods.

### Indicator-level achievement

Indicator-level achievement is the number of a group of indicators achieved, divided by the number of that group of indicators triggered. This is the most straightforward measure to calculate, and the most transparent in that it is clear where the underlying data come from. We use this measure to describe quality indicator achievement for each of the four conditions in this study. Its weakness is that the most prevalent conditions will drive the final composite score, and the scores for rare (but perhaps important) conditions can be lost in the greater numbers.

### Average indicator-level achievement

The mean of the set of indicators is calculated, representing the average rate at which the indicated care was received. For example, if a condition had three quality indicators and their achievements at a given wave were 75%, 80% and 85%, then the indicator-level achievement for that condition would be  $(75 + 80 + 85)/3 = 80\%$ . This method is suitable for comparing heterogeneous samples, as it is not greatly affected by the number of components included. Rare processes (those for which a comparatively small sample are eligible) are given the same importance as common processes of health care.<sup>38</sup>

### Patient-level achievement

This approach represents the average percentage of triggered aspects of care that were successfully met for each participant per condition. It is calculated by dividing the number of quality indicators each participant passed by the number they were eligible for per condition, taking the mean of the results and expressing them as a percentage. For example, if a participant is eligible for all five diabetes quality indicators at a given wave and passed three of them, their score would be  $3/5 = 0.6$ , or 60%. The mean of all participants' scores would be the average for that condition.

This method is best at assessing quality of care delivered to each patient. It can provide scores for individual patients and can therefore be used in a wide range of statistical analyses.<sup>38</sup>

### All-or-nothing achievement

In this method, the care for a patient is achieved only if all quality indicators for which they were eligible for that condition were achieved. This approach is helpful when considering sets of quality indicators for a condition that easily form 'care bundles', such as the three annual monitoring checks for diabetes. This is a stringent criterion and in our data set we were able to apply the care bundle approach only to diabetes, as the quality indicators available all map onto those required for annual diabetes checks. The patient-level achievement is calculated as above for the set of indicators that make a care bundle. Those whose percentage of received care was 100% were scored 0 and those who did not meet this criterion were scored 1. This is used to predict who did not receive all the bundled care items, so the proportion of eligible participants who were scored 1 is calculated.

The derived scores are intrinsically affected by the number of components included, as the more care processes involved, the harder it is to achieve all of them,<sup>20</sup> and so only a few carefully selected quality indicators should be used with this method. Weighting can be hard to interpret with this approach and common care processes (those for which a comparatively large sample is eligible) can dominate the scoring.<sup>38</sup> However, this method is amenable to a broad range of statistical analyses<sup>38</sup> and may be more clinically meaningful, as receipt of all indicated health care should be the ideal.

### Quality indicators in the English Longitudinal Study of Ageing

In total, 32 quality of care indicators were used in ELSA. These quality indicators were adapted from a set of 236 quality indicators originally developed in the USA for the ACOVE project<sup>39</sup> for conditions chosen for their prevalence, impact, effectiveness of treatment or prevention, importance in older people, feasibility of measurement and potential for quality improvement. They were based on systematic reviews of evidence of improved outcomes and focus on processes of care rather than health outcomes, as processes are under the control of the health-care system and are not subject to the array of other factors that influence health outcomes. Approximately half of the ACOVE indicators could be used in an interview survey without the use of clinical records, and these were rated for validity by an expert panel of clinicians for validity in patient interview surveys in England, using an adapted form of the RAND Corporation/University of California in Los Angeles appropriateness method for combining evidence with expert opinion.<sup>9,40</sup> The clinical panel reviewed the evidence for 119 quality indicators and scored them on the extent to which they reflected good practice in England. Two rounds of anonymous rating were used, with face-to-face discussion between the rounds. Indicators were excluded if the panel disagreed on their validity. The quality indicators were designed to reflect the minimum acceptable standard of care rather than the optimum, and the panel were informed that they were to be used in a national longitudinal panel survey.

The panel identified 17 of the 119 indicators that were not suitable for use in the UK. Forty-three of the remaining 102 quality indicators were not piloted in ELSA owing to difficulties in implementing them, or because they did not relate to conditions found to be a common cause of morbidity in HSE 2000. A further 27 were not used in ELSA owing to problems found with their implementation in the pilots or main survey.<sup>7</sup> The remaining 32 indicators were incorporated in wave 2 of ELSA, with many also repeated at subsequent waves. These covered 13 conditions: CVD (stroke), depression, diabetes mellitus, falls, hearing problems, hypertension, IHD, osteoarthritis, osteoporosis, pain management, smoking cessation, urinary incontinence and cataracts.

### Generation of quality indicators

From wave 2 onwards, the health module contained questions that enabled generation of the quality indicators developed by ACOVE and adapted for use in England that were implemented in ELSA. In total, there are five quality indicators for diabetes, three for depression, one for CVD (stroke), one for hypertension, five for IHD and four for osteoarthritis. There were also seven questions about patient-centred care. Quality indicators were generated at every wave for which they were available (see *Availability of quality indicators across waves*). A non-software specific syntax is given in *Appendix 2*.

### Description of quality indicators and their generation from English Longitudinal Study of Ageing questions

The quality indicators for each condition are described below. Each quality indicator starts with an 'if' clause that determines the eligible population, followed by a 'then' clause that states the indicated care. The quality indicators specify that they are for those with the relevant condition who are aged  $\geq 50$  years or over. Some of the quality indicators specify that treatment should be offered 'at least once' or relate to treatments that are usually continuous in practice. For these quality indicators, participants who were eligible at the current wave and had reported receiving the indicated treatment at a previous wave were deemed to have also passed the indicator at the current wave. The derivation of each quality indicator follows its description. *Appendix 1* shows the translation of each quality indicator and patient-centred question into its corresponding ELSA questions.

#### Cerebrovascular disease (stroke)

##### *Stroke antihypertensives description*

IF a person aged  $\geq 50$  years has had a previous stroke, THEN the patient should be offered antihypertensive medication.

***Stroke antihypertensives generation***

At each wave, participants were asked 'Has a doctor ever told you that you have (or have had) any of the conditions on this card [includes 'stroke (cerebral vascular disease)']?' Participants who reported a diagnosed stroke at that wave, or who confirmed a previous report of diagnosed stroke from an earlier wave, formed the eligible sample if they had also given a yes/no response to the question 'Did a doctor or nurse ever suggest you take any medication to lower your blood pressure?' at any wave up to and including the current wave. Respondents from this sample passed the quality indicator if they answered 'yes' to this last question at least once.

**Hypertension*****Hypertension treatment description***

IF a person aged  $\geq 50$  years remains hypertensive after non-pharmacological intervention, THEN pharmacological antihypertensive treatment should be initiated.

***Hypertension treatment generation***

At each wave, participants were asked 'Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes 'high blood pressure or hypertension')?' Participants who reported diagnosed hypertension at the current wave, or confirmed that they still had hypertension reported at an earlier wave, formed the eligible sample if they had also given a yes/no response to the question 'Did a doctor or nurse ever suggest you take any medication to lower your blood pressure?' at any wave up to and including the current wave. Respondents from this sample passed the quality indicator if they answered 'yes' to this last question at least once.

**Ischaemic heart disease**

Four of the five quality indicators for IHD specify that they are for those with established coronary heart disease (CHD). We defined CHD as prevalent angina and/or MI. At each wave, participants were asked 'Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes 'angina' and 'heart attack')?' We determined participants to have established CHD if they reported angina or MI at the current wave, or confirmed that they still had angina and/or a previous report of MI.

***Ischaemic heart disease cholesterol description***

IF a person aged  $\geq 50$  years has established CHD and low-density lipoprotein (LDL) cholesterol  $> 3$  mmol/l, THEN he or she should be offered an intervention to lower cholesterol.

***Ischaemic heart disease cholesterol generation***

Participants whom we determined to have established CHD at the current wave and who gave a yes/no response to the question 'Has any doctor talked to you about how to lower your cholesterol? This would include changing your diet, losing weight, getting more exercise or taking medication' formed the eligible sample. Those who answered 'yes' to this question passed the indicator.

***Ischaemic heart disease antiplatelets description***

IF a person aged  $\geq 50$  years has established CHD and is not on warfarin, THEN he or she should be offered antiplatelet therapy.

***Ischaemic heart disease antiplatelets generation***

Participants whom we determined to have established CHD at the current wave, who also answered 'no' to the question 'Are you taking warfarin?' and who gave a yes/no response to the question 'Did a doctor suggest that you take medication to thin your blood such as warfarin or aspirin, Plavix, Ticlid, or other blood thinning medication?' formed the eligible sample. Participants passed the indicator if they answered 'yes' to this last question.

***Ischaemic heart disease smoking description***

IF a person aged  $\geq 50$  years with established CHD smokes, THEN he or she should be offered counseling for smoking cessation.

***Ischaemic heart disease smoking generation***

Participants were eligible for this quality indicator if we determined them to have established CHD at the current wave, if they answered 'yes' to the question 'Do you smoke cigarettes at all nowadays?' at the current wave and if they gave a yes/no response to the question 'Has a doctor or nurse ever advised you to stop smoking?' at any wave up to and including the current wave. Participants passed the indicator if they answered 'yes' to this last question at least once.

***Myocardial infarction beta-blocker description***

IF a person aged  $\geq 50$  years has had a recent MI, THEN he or she should be offered a beta-blocker.

***Myocardial infarction beta-blocker generation***

Unlike most other quality indicators, this quality indicator requires incident cases and not prevalent cases. We determined participants to have incident MI if they reported a MI in response to the question 'Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes 'heart attack')?' at the current wave, but not at the previous wave. Of these cases, those who gave a yes/no response to the question 'Did any doctor ever tell you that you should take a medication called a beta-blocker?' or indicated whether or not they were taking a beta-blocker in response to the question 'Please could you show me the medications or the repeat prescription list for any medications you have taken over the last week (checked against card F beta-blockers)?' formed the eligible sample. Participants from this sample passed the indicator if they either answered 'yes' to the former question, or indicated that they were taking beta-blockers at the latter question.

***International normalised ratio test description***

IF a person aged  $\geq 50$  years is prescribed warfarin, THEN an international normalised ratio (INR) should be determined at least every 12 weeks.

***International normalised ratio test generation***

Participants who reported CHD at the current wave were filtered to the question 'Are you taking warfarin?' Those who answered 'yes' were then filtered to the question 'Many doctors ask patients on warfarin to get their blood tested regularly. The test checks how thin their blood is, and is sometimes called an INR test. Do you get your blood checked for this?' Participants who answered 'yes' to this question were then filtered to the question 'Have you had this blood test in the past 12 weeks?' Those who gave a yes/no response to this question formed the eligible population and passed the indicator if their answer was 'yes'.

**Diabetes mellitus*****Diabetes glycosylated haemoglobin description***

IF a person aged  $\geq 50$  years has diabetes, THEN his or her HbA<sub>1c</sub> or fructosamine level should be measured at least annually.

***Diabetes glycosylated haemoglobin generation***

At each wave from wave 2 onwards, participants were asked 'Has a doctor ever told you that you have diabetes?' Those who responded 'yes' at any wave up to and including the current wave were filtered to the question 'Have you ever had a special blood test to see how well your blood sugar was controlled? This test is called a glycosylated haemoglobin, or haemoglobin A1c, or fructosamine. This is a blood test taken at a doctor's surgery or health centre or laboratory'. Participants who gave a yes/no response to this question at the current wave formed the eligible sample. Those who responded 'yes' to this question were filtered to a further question that asked 'Have you had this test (glycosylated haemoglobin or

fructosamine) performed in the past 12 months?’ Eligible participants who responded ‘yes’ to this final question passed the quality indicator.

### ***Diabetes proteinuria description***

IF a diabetic person aged  $\geq 50$  years does not have established renal disease and is not receiving an angiotensin-converting enzyme (ACE) inhibitor or angiotensin II receptor blocker, THEN he or she should receive an annual test for proteinuria.

### ***Diabetes proteinuria generation***

Participants who responded ‘yes’ to the question ‘Has a doctor ever told you that you have diabetes?’ at any wave up to and including the current wave were filtered to the question ‘I would like to check whether any of the medications you are taking are on this list of ACE inhibitor or A2 receptor blockers (show card G ACE inhibitors)?’ Those who answered ‘no’ to this question formed the eligible sample if they also answered ‘no’ to the question ‘Has a doctor ever told you that your diabetes has caused trouble with your kidneys?’ and gave a yes/no response to the question ‘Have you had a urine test for protein in the last 12 months?’ Participants who answered ‘yes’ to this final question passed the indicator.

### ***Diabetes cholesterol description***

IF a diabetic person aged  $\geq 50$  years has a fasting total cholesterol level of  $\geq 5$  mmol/l, THEN he or she should be offered an intervention to lower cholesterol.

### ***Diabetes cholesterol generation***

Participants who responded ‘yes’ to the question ‘Has a doctor ever told you that you have diabetes?’ at any wave up to and including the current wave, and who also reported high cholesterol at the current wave in response to the question ‘Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes ‘high cholesterol’)?’ were filtered to the question ‘Has any doctor talked to you about how to lower your cholesterol? This would include changing your diet, losing weight, getting more exercise or taking medication’. Those who answered this question formed the eligible sample. Participants who answered ‘yes’ passed the indicator.

### ***Diabetes ACE inhibitor description***

IF a diabetic person aged  $\geq 50$  years has one additional cardiac risk factor (i.e. smoker, hypertension, hypercholesterolemia or renal insufficiency/microalbuminuria), THEN he/she should be offered an ACE inhibitor or receptor blocker.

### ***Diabetes ACE inhibitor generation***

Participants who responded ‘yes’ to the question ‘Has a doctor ever told you that you have diabetes?’ at any wave up to and including the current wave were filtered to the questions ‘Has a doctor discussed with you whether you should take a medication called an ACE inhibitor or A2 receptor blocker?’ and ‘I would like to check whether any of the medications you are taking are on this list of ACE inhibitor or A2 receptor blockers (show card G ACE inhibitors)?’ Those who gave a yes/no response to either of these questions formed the eligible sample if they also met at least one of the following criteria:

- Answered ‘yes’ to the question ‘Do you smoke cigarettes at all nowadays?’
- Answered ‘yes’ to the question ‘Has a doctor ever told you that your diabetes has caused trouble with your kidneys?’
- Answered ‘yes’ to the question ‘Has a doctor ever told you that you have protein in your urine?’
- Reported high cholesterol when asked ‘Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes ‘high cholesterol’)?’ at the current wave, or confirmed they still have high cholesterol reported at a previous wave.
- Reported hypertension when asked ‘Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes ‘high blood pressure or hypertension’)?’ at the current wave, or confirmed they still have hypertension reported at a previous wave.



Waves 2 and 4 only (nurse data): their mean systolic blood pressure was  $\geq 140$  mmHg or their mean diastolic blood pressure was  $\geq 90$  mmHg.

Eligible participants who answered 'yes' to either being offered or taking an ACE inhibitor/A2 receptor blocker passed the indicator.

### ***Diabetes foot check description***

ALL diabetic persons aged  $\geq 50$  years should have an annual examination of his or her feet.

### ***Diabetes foot check generation***

Participants who responded 'yes' to the question 'Has a doctor ever told you that you have diabetes?' at any wave up to and including the current wave were filtered to the question 'Some doctors suggest that some patients with diabetes have a regular foot examination. In the past year, has any doctor or nurse examined your bare feet?' Those who gave a yes/no response to this question formed the eligible population. Participants who answered 'yes' passed the indicator.

### **Osteoarthritis**

At each wave, participants were asked 'Has a doctor ever told you that you have (or have had) any of the conditions on this card [includes 'arthritis (including osteoarthritis, or rheumatism)']?' Those who reported arthritis were filtered to the question 'Which type or types of arthritis do you have (includes 'osteoarthritis')?' Participants who reported arthritis at a previous wave were also asked to confirm if they still had the condition. Below, we refer to participants as having current osteoarthritis if they reported osteoarthritis at the current wave, or confirmed that they still have arthritis previously reported, if the type of arthritis was also osteoarthritis.

### ***Osteoarthritis exercise description***

IF an ambulatory person aged  $\geq 50$  years has had a diagnosis of symptomatic osteoarthritis of the knee for longer than 3 months and has no contraindications to exercise and is physically and mentally able to exercise, THEN a directed or supervised strengthening or aerobic exercise programme should have been prescribed at least once.

### ***Osteoarthritis exercise generation***

All participants were asked 'Are you often troubled with pain?' All who responded 'yes' were filtered to the question 'How would you rate your pain if you were walking on a flat surface? Please rate your pain from 0–10 for each of the following where 0 is no pain and 10 is severe or excruciating pain, as bad as you can imagine'. Unless respondents stated that they could not walk or never walk, they were then filtered to a set of questions that rated pain in different body parts, including their knees. Participants who rated the pain in their knees from 1–10 (i.e. at least some pain), and who reported current osteoarthritis, were filtered to the question 'How long has the pain in your knee been bothering you?' Respondents who reported that the pain had been bothering them for over 3 months were then asked 'Has a doctor or nurse suggested that you receive physiotherapy or attend a supervised exercise program for your knee pain?' Participants were eligible for this quality indicator if they gave a yes/no response to this final question at any wave up to and including the current wave and passed the indicator if their answer was 'yes' at least once.

### ***Osteoarthritis education description***

IF an ambulatory person aged  $\geq 50$  years has a diagnosis of symptomatic osteoarthritis, THEN education regarding the natural history, treatment and self-management of the disease should be offered at least once.

### ***Osteoarthritis education generation***

Participants with current osteoarthritis were filtered to the three questions 'Has any doctor or nurse ever talked to you about . . . what your arthritis or joint pain will be like as time goes on?', '. . . how to keep

your arthritis or joint pain from getting worse?’ and ‘. . . how your arthritis or joint pain will be treated?’ Those with osteoarthritis at the current wave were eligible for this quality indicator if they gave a yes/no response to all three questions at any wave up to and including the current wave. Participants passed the quality indicator if they answered ‘yes’ to all three questions at least once.

### ***Osteoarthritis paracetamol description***

IF oral pharmacological therapy is initiated to treat osteoarthritis among people aged  $\geq 50$  years, THEN paracetamol should be the first drug used, unless there is a contraindication to use.

### ***Osteoarthritis paracetamol generation***

Participants with current osteoarthritis were filtered to the question ‘Some doctors suggest trying paracetamol as the first medication for arthritis or joint pain. Did any doctor or nurse recommend you try paracetamol before other medicines for your joint pain?’ Those who gave a yes/no response to this question at any wave up to and including the current wave formed the eligible sample. Participants passed the indicator if they answered ‘yes’ at least once.

### ***Osteoarthritis referral description***

IF a person aged  $\geq 50$  years with severe symptomatic osteoarthritis of the knee or hip has failed to respond to non-pharmacological and pharmacological therapy, THEN the patient should be offered referral to an orthopaedic surgeon to be evaluated for total joint replacement within 6 months unless surgery is contraindicated.

### ***Osteoarthritis referral generation***

All participants were asked ‘Are you often troubled with pain?’ All who responded ‘yes’ were filtered to the question ‘How would you rate your pain if you were walking on a flat surface? Please rate your pain from 0–10 for each of the following where 0 is no pain and 10 is severe or excruciating pain, as bad as you can imagine’. Unless respondents stated that they could not walk or never walk, they were then filtered to a set of questions that rated pain in different body parts, including their knees and hips. Participants who rated the pain in their knee or hip from 6–10, and who reported current osteoarthritis, were filtered to the question ‘Has your knee or hip pain been bothering you for more than 6 months?’ Those who responded ‘yes’ were then asked ‘Do exercises and medicines control the pain in your knee or hip?’ If participants responded ‘no’, they were asked ‘Did any doctor recommend that you should have surgery or joint replacement?’ All who gave a yes/no response to this final question were eligible for this quality indicator and passed the indicator if their answer was ‘yes’.

## **Depression**

All of the quality indicators for depression used incident cases only. At each wave, participants were asked ‘Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes ‘any emotional, nervous or psychiatric problems’)?’ Those reporting emotional, nervous or psychiatric problems were filtered to a question that asked ‘What type of emotional, nervous or psychiatric problems do you have (includes ‘depression’)?’ Participants who reported such problems at a previous wave were also asked to confirm if they still had the condition. Below, we define incident depression as reports of depression at the current wave, excluding those who reported depression at the previous wave.

### ***Depression suicide description***

IF a person aged  $\geq 50$  years receives a diagnosis of a new depression episode, THEN the diagnosing physician should ask on the day of diagnosis if the person aged  $\geq 50$  years had any thoughts about suicide.

### ***Depression suicide generation***

Participants reporting psychiatric problems were filtered to the question ‘When you talked about these feelings with a doctor or nurse, did they ask you on that day if you had thoughts about suicide?’ Participants were eligible for this quality indicator if they reported incident depression and gave a yes/no response to the question. Those who answered ‘yes’ passed the indicator.

***Depression treatment description***

IF a person aged  $\geq 50$  years is diagnosed with clinical depression, THEN antidepressant treatment, talking treatment or electroconvulsive therapy should be offered within 2 weeks after diagnosis unless within that period the patient has improved, or unless the patient has substance abuse or dependence, in which case treatment may wait until 8 weeks after the patient is in a drug- or alcohol-free state.

***Depression treatment generation***

Participants reporting depression were filtered to the question 'I have some questions about any treatment you may have had for your depression. Did a doctor or nurse suggest that you take medication, or see a mental health professional for counselling?' Those with incident depression were eligible for this quality indicator if they responded to this question. Participants passed the indicator if they indicated that they had been offered a form of treatment and answered 'yes' to the question 'Did you start medication or counselling within 2 weeks of being offered this treatment?'

***Depression review description***

IF a person aged  $\geq 50$  years has no meaningful symptom response after 6 weeks of treatment, THEN one of the following treatment options should be initiated by the eighth week of treatment: medication dose should be optimised (if initial treatment was medication), or medication should be initiated (if initial treatment was psychotherapy alone), or referral to a psychiatrist should be offered.

***Depression review generation***

Participants reporting depression were filtered to the question 'I have some questions about any treatment you may have had for your depression. Did a doctor or nurse suggest that you take medication, or see a mental health professional for counselling?' Those who indicated that they were on a treatment for depression were then asked 'Did you start medication or counselling within 2 weeks of being offered this treatment?' Participants who answered 'yes' to this question were filtered to a question that asked 'Did you feel better within 6 weeks after starting to take medication, or seeing a mental health professional for counselling?' Those who answered 'no' were eligible for this quality indicator if they had incident depression and gave a yes/no response to the question 'Did any doctor or nurse start you on medication, change the dose of the medication that you were taking or, change the medications to help you feel better?' Participants passed the indicator if they answered 'yes' to this final question.

**Patient-centred care*****Diabetes training description***

Some people with diabetes receive training to help them manage their diabetes themselves. Have you ever participated in a course or class about diabetes, or received special training on how you can live with your diabetes from day to day?

***Diabetes training generation***

Participants who responded 'yes' to the question 'Has a doctor ever told you that you have diabetes?' at any wave up to and including the current wave were filtered to the question 'Some people with diabetes receive training to help manage their diabetes themselves. Have you ever participated in a course or class about diabetes, or received special training on how you can live with your diabetes from day to day?' Participants formed the eligible sample if they gave a yes/no response to this question at any wave and passed the indicator if they ever answered 'yes'.

***Diabetes knowledge description***

How much do you think you know about managing your diabetes?

***Diabetes knowledge generation***

Participants who responded 'yes' to the question 'Has a doctor ever told you that you have diabetes?' at any wave up to and including the current wave were filtered to the question 'How much do you think you know about managing your diabetes?' Possible responses were 'just about everything you need to know', 'most of what you need to know', 'some of what you need to know', 'a little of what you need to know' and 'almost none of what you need to know'. Participants formed the eligible sample if they gave a response and passed the indicator if they answered 'just about everything you need to know' or 'most of what you need to know'.

***Cholesterol explanation description***

Has a doctor or nurse explained high cholesterol in a way you could understand?

***Cholesterol explanation generation***

Participants who reported high cholesterol in response to the question 'Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes 'high cholesterol')?' were filtered to the question 'Has a doctor or nurse explained high cholesterol in a way you could understand?' Participants formed the eligible sample if they gave a yes/no response to this question and passed the indicator if their response was 'yes'.

***Cholesterol preferences description***

Have doctors or nurses taken your preferences into account when making treatment decisions about your high cholesterol?

***Cholesterol preferences generation***

Participants who reported high cholesterol in response to the question 'Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes 'high cholesterol')?' were filtered to the question 'Have doctors or nurses taken your preferences into account when making treatment decisions about your high cholesterol?' Participants formed the eligible sample if they gave a yes/no response to this question and passed the indicator if their response was 'yes'.

***Blood pressure explanation description***

Has a doctor or nurse explained high blood pressure in a way you could understand at any time since you were first told you had high blood pressure?

***Blood pressure explanation generation***

Participants who reported hypertension in response to the question 'Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes 'high blood pressure or hypertension')?' at the current wave, or who confirmed that they still had hypertension reported at an earlier wave, were filtered to the question 'Has a doctor or nurse explained high blood pressure in a way you could understand at any time since you were first told you had high blood pressure?' Participants formed the eligible sample if they gave a yes/no response to this question at any wave and passed the indicator if their response was 'yes' at any wave.

***Blood pressure choice description***

In general, have doctors or nurses given you any choice about how to treat your high blood pressure?

***Blood pressure choice generation***

Participants who reported hypertension in response to the question 'Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes 'high blood pressure or hypertension')?' at the current wave, or who confirmed they still had hypertension reported at an earlier wave, were filtered to the question 'In general, have doctors or nurses given you any choice about how to treat your high blood pressure?' Participants formed the eligible sample if they gave a yes/no response to this question at any wave and passed the indicator if their response was 'yes' at any wave.

### ***Osteoarthritis treatment purpose description***

Has any doctor or nurse ever talked to you about what the specific purpose of the treatment for your arthritis or joint pain is?

### ***Osteoarthritis treatment purpose generation***

Participants with current osteoarthritis were filtered to the question 'Has any doctor or nurse ever talked to you about how your arthritis or joint pain will be treated?' Those who answered 'yes' were then filtered to the question 'Has any doctor or nurse ever talked to you about what the specific purpose of the treatment for your arthritis or joint pain is?' Participants formed the eligible sample if they gave a yes/no response to this last question at any wave and passed the indicator if their response was 'yes' at any wave.

### ***Availability of quality indicators across waves***

There were changes in the questions included in ELSA between the waves. As a result, not all quality indicators could be generated at all waves. *Table 6* displays the availability of the quality indicators. All quality indicators were generated at wave 2. Wave 5 was the next most complete wave, where all quality indicators except those for depression could be generated. Apart from wave 2, depression quality indicators were available only at wave 4, and then only two out of the three could be derived. For diabetes, CVD and osteoarthritis, there were at least two waves at which quality of care could be compared using all quality indicators.

## **Variables**

### ***Potential covariates***

Possible covariates were selected by a panel consisting of academics, clinicians, researchers and Patient and Public Patient Involvement in Research (PPIRes) members of the team. The choices were based on clinical relevance, feasibility to extract the data from ELSA and previous work. Covariates were grouped into five domains: demographics, health and disability, health behaviours, physical measures, and psychological and social measures. *Table 7* lists all covariates that were used in any of the analyses in this work. Any relevant descriptors, explanations and groups are also shown.

### ***Standardised scales***

Standardised scales available to use as covariates are described below.

### **Rose Angina Scale**

The Rose Angina Scale is an epidemiological measure of angina pectoris.<sup>45</sup> It defines angina according to standard criteria as chest pain or discomfort that fulfils all of the following criteria:

- It is brought on by exertion.
- It is situated in the central or left anterior chest or left arm or sternum.
- It forces the subject to slow down or stop.
- It is relieved if the subject does slow down or stop.
- It is relieved within 10 minutes.

This is further subcategorised into:

- A: severe (grade II) if exertional pain came on while walking on level ground.
- B: not severe (grade I) if chest pain only came on when hurrying or walking uphill.

TABLE 6 Availability of quality indicators across the waves of ELSA

Quality indicator	Wave 2	Wave 3	Wave 4	Wave 5
Diabetes mellitus				
Diabetes HbA <sub>1c</sub>	✓	✓	✓	✓
Diabetes proteinuria	✓	✓	✓	✓
Diabetes cholesterol	✓			✓
Diabetes ACE inhibitor	✓	✓	✓	✓
Diabetes foot check	✓	✓	✓	✓
Cardiovascular disease				
Stroke antihypertensives	✓	✓	✓	✓
Hypertension treatment	✓	✓	✓	✓
IHD cholesterol	✓			✓
IHD antiplatelets	✓			✓
IHD smoking	✓			✓
MI beta-blocker	✓			✓
INR test	✓			✓
OA				
OA exercise	✓	✓	✓	✓
OA education	✓	✓	✓	✓
OA paracetamol	✓	✓	✓	✓
OA referral	✓	✓	✓	✓
Depression				
Depression suicide	✓		✓	
Depression treatment	✓		✓	
Depression review	✓			
Patient-centred care				
Diabetes training	✓	✓	✓	
Diabetes knowledge	✓	✓	✓	
Cholesterol explanation	✓			
Cholesterol preferences	✓			
Blood pressure explanation	✓			
Blood pressure choice	✓			
OA treatment purpose	✓	✓	✓	

OA, osteoarthritis.

**TABLE 7** Full list of possible patient characteristics associated with quality of care

Covariate	Description	Groups
<b>Demographics</b>		
Age groups	Age. Participants $\geq 90$ years old have their age recorded as 'over 90 years' to help maintain anonymity	50–64 years, 65–74 years, $\geq 75$ years
Sex		Women, men
Marital status		Cohabiting/not cohabiting
NS-SEC	Three-class version used	Managerial/professional, intermediate, routine/manual
Education	Highest educational qualification achieved	No qualifications, intermediate or degree or higher education below a degree
Age-specific total wealth quintile	Net financial wealth and physical wealth, private and state pension, and primary housing value less housing debt	Quintiles defined within the three age bands
Weighting (see <i>Weighting</i> )		Wave specific cross-sectional or longitudinal
<b>Health and disability</b>		
General health	Self-reported general health	Excellent/very good/good/fair/poor
Eyesight	Self-reported eyesight	Excellent/very good/good/fair/poor/blind
Hearing	Self-reported hearing	Excellent/very good/good/fair/poor
Chronic pain	Self-reported severity of chronic pain	None/mild/moderate/severe
Long-standing illness	Whether or not reports long-standing illness, and whether or not this illness limits activities	None/long-standing illness/limiting long-standing illness
Basic activities of daily living	Number of self-reported difficulties with basic activities of daily living of dressing, walking across a room, bathing, eating, getting in/out of bed and using the toilet	None/one, two or more
Instrumental activities of daily living	Number of self-reported difficulties with instrumental activities of daily living of orientation, preparing meals, shopping, using the telephone, taking medications, housekeeping and money management	None/one, two or more
<b>Health behaviours</b>		
Health literacy	Number of correct responses to four questions on health literacy. This was not available at 2008–9 so was taken from 2010–11	No errors (high), one or more errors (low)
Alcohol consumption	Self-reported frequency of alcohol consumption	1–2 days/week or less, 3–4 days/week or more
Smoking history	Smoking status	Never smoked, smoked in past, currently smokes
Physical activity level	Classified using the reported level of work activity and frequency of low, moderate and vigorous leisure-time activity. Definition in ELSA wave 5 documentation (Banks <i>et al.</i> <sup>29</sup> )	Moderate/high, sedentary/low
Diet	Whether eats five portions of fruit and/or vegetables per day	Eats '5 a day', does not eat '5 a day'

continued

**TABLE 7** Full list of possible patient characteristics associated with quality of care (*continued*)

Covariate	Description	Groups
<b>Psychological and social measures</b>		
Access to GP	The answer to 'how easy or difficult is it to get to your GP using your usual form of transport?'	Very easy/quite easy/quite difficult/very difficult/unable to go/do not wish to go
Social detachment	Social detachment is a multidimensional construct. Four domains are derived: civic participation, leisure activities, cultural engagement and social networks. Those classified as detached on three or more of these domains were classified as socially detached. See ELSA wave 5 documentation for derivation <sup>27</sup>	Not socially detached, socially detached
Quality of life	The CASP-19 scale <sup>41</sup> transformed into tertiles	High, medium, low
Cognitive impairment	Composite score of prospective memory, attention, processing speed, verbal fluency, orientation, immediate word recall, delayed word recall and numeracy. Component scores were standardised and summed to form a cognitive performance scale. This scale was then standardised and the bottom 10% of scores were classified as cognitively impaired <sup>42</sup>	Not cognitively impaired, cognitively impaired
Lives alone	Whether or not respondent lives alone (reports no cohabitators)	No, yes
LOC	Respondents rated the extent to which they agreed with the statement 'what happens in life is often determined by factors beyond [his/her] control' on a six-point Likert scale. Those who strongly/slightly agreed were classified as having 'external' LOC and those who strongly/slightly disagreed were classified as having 'internal' LOC	Internal, external
<b>Physical measures</b>		
BMI category	Height and weight assessed in a nurse visit. BMI calculated from weight/(height) <sup>2</sup> and defined from WHO criteria	Underweight/normal weight ( $\leq 25$ kg/m <sup>2</sup> ), overweight ( $\geq 25$ , $< 30$ kg/m <sup>2</sup> ), obese ( $\geq 30$ kg/m <sup>2</sup> )
HbA <sub>1c</sub> levels	Used to define symptomatic diabetes, samples taken in waves 2 and 4 for analysis of HbA <sub>1c</sub> . Symptomatic diabetes defined as a fasting HbA <sub>1c</sub> level of $\geq 7.5\%$ (DCCT)	Has symptomatic diabetes/do not have symptomatic diabetes
Total cholesterol	Blood total cholesterol levels in mmol/l. QOF cut-off of $> 5$ mmol/l indicates high cholesterol	High cholesterol/acceptable cholesterol
MAP in mmHg	Defined as the average arterial pressure during a single cardiac cycle. MAP = diastolic BP + 1/3 (systolic BP – diastolic BP)	High $\geq 110$ mmHg/regular $< 110$ mmHg
<b>Disease-specific variables</b>		
Comorbidities	Number of comorbid conditions measured in ELSA	$\geq 2$ /none or one
Previous care (diabetes)	Whether or not the indicated care was achieved at the previous wave for the care bundle of annual monitoring checks (all-or-nothing achievement) and diabetes ACE inhibitor. New cases since the last wave were added as a separate category	Achieved, not achieved, new case
Knows mostly everything about managing diabetes	Responses to the question 'How much do you think you know about managing your diabetes?'	Just about everything/most of what they need to know (yes), some/a little/almost none of what you need to know (no)
Time since diagnosis for all conditions	Measured in waves of ELSA (2-year increments) since the diagnosis was reported. IHD split into time since heart attack and time since angina. Hypertension given in wave first diagnosed	Range of 0 (new case in 2010–11) to 3 (reported in 2004–5). Entered as ordinal variable



**TABLE 7** Full list of possible patient characteristics associated with quality of care (*continued*)

Covariate	Description	Groups
CES-D depression classification	Self-reported depressive symptoms (eight items) using the CES-D scale <sup>43</sup>	Not depressed, depressed ( $\geq 4$ symptoms)
Rose Angina Scale	Defined as grade 2 on the Rose Angina Scale <sup>44</sup>	Has symptomatic angina/does not have symptomatic angina
Joint replacement payment (used in OA)	Was your joint replacement paid for by the NHS or privately or a mixture of both?	NHS/private and mixed NHS private payment
Cataract extraction payment (used in cataract)	Was your cataract extraction paid for by the NHS or privately or a mixture of both?	NHS/private and mixed NHS private payment
Symptomatic OA by pain and disability <sup>45</sup>	Often troubled by pain in knee or hip, and this pain was rated 5 or more out of 10 when walking on a flat surface. Also had some or much difficulty or were unable to walk a quarter of a mile	Has symptomatic OA/does not have symptomatic OA

BMI, body mass index; BP, blood pressure; CASP-19, Control, Autonomy, Self-realisation and Pleasure-19 quality of life scale; CES-D, Centre for Epidemiological Studies – Depression Scale; DCCT, Diabetes Control and Complications Trial; GP, general practitioner; LOC, locus of control; MAP, mean arterial pressure; NS-SEC, National Statistics Socio-Economic Classification; OA, osteoarthritis; WHO, World Health Organization.

### Centre for Epidemiological Studies – Depression scale

A short form of the Centre for Epidemiological Studies – Depression Scale (CES-D), consisting of eight items, was included in the psychosocial health module at each wave from wave 2 onwards. Participants were asked to say whether or not eight statements relating to symptoms of depression were true of them in the past week, giving yes/no responses. The established criterion of likely depression is the presence of four or more symptoms.<sup>43</sup>

### Control, Autonomy, Self-realisation and Pleasure-19 quality of life scale

This scale is designed for use with older people and assesses quality of life over four domains, from which its name is taken: **C**ontrol, **A**utonomy, **S**elf-realisation and **P**leasure (**CASP-19**).<sup>41</sup> It consists of 19 items, which were asked of participants in the self-completion module. Responses to these items are summed, after reverse scoring where necessary, to produce an overall measure of quality of life.

### Activities of daily living

Markers of physical function available in ELSA included grip strength, walking speed, use of stick or mobility aids, leg raise, tandem or side stand, and the ability to walk a quarter of a mile without special equipment. We used the activities of daily living (ADL) scale in this study, as it is a well-known and widely used measure of physical function.<sup>46,47</sup>

### Definition of comorbidities

In our regression analyses we used a measure of comorbid conditions and these were defined as having two or more comorbid conditions as opposed to one or none. This is a commonly used definition of multimorbidity.<sup>48</sup> This variable was created by counting the number of comorbid conditions that every participant had out of a possible 16 conditions, and excluding those conditions closely related to the specific condition. For example, those with osteoarthritis often also had the more general diagnosis of 'arthritis', and this was not counted as a condition comorbid to osteoarthritis. For diabetes, hypertension, congestive heart failure, diabetes and high cholesterol were not considered comorbid conditions; for depression, Alzheimer's disease and dementia were not considered comorbidities. For IHD, hypertension, prevalent angina, prevalent heart attack, heart murmur, arrhythmia, CVD and high cholesterol were not considered comorbid conditions.

### Excluded variables

It was agreed by the clinical screening panel that ethnicity should be tested for association with health care; however, owing to < 2% of the sample being non-white this could not be used in the regression analyses. Other covariates that were not included in analyses were country of birth (not specific enough as recorded as UK or non-UK), geography (not available), internet use (missing data), employment status (majority not employed as they were past retirement age) and fasting glucose measurements (not used in QOF as a measure of diabetes). Previous work on ELSA accounted for the clustering and stratification of the participants in the HSE. On advice from the ELSA data manager at the National Centre for Social Research (NatCen), we did not include these variables as the ELSA sample is now effectively unclustered owing to non-response and people moving.

### Additional variables excluded from the diabetes care bundle analysis

A number of the selected covariates measure very similar concepts. To reduce collinearity, the clinical screening panel selected one covariate to assess a domain where there were several options. Thus, National Statistics Socio-Economic Classification (NS-SEC)<sup>49</sup> was used to represent socioeconomic status, and highest educational qualification and age-stratified wealth were excluded. Reports of long-standing illness, including limiting long-standing illness, were used as a measure of overall health, and participants' reports of general health and comorbidities were excluded. Variables for whether or not respondents exceeded QOF criteria for high HbA<sub>1c</sub> and cholesterol were also excluded, as they were highly associated with whether or not participants had previously received indicated care. Ratings of the accessibility of participants' GPs were excluded as < 10% of respondents' ratings were anything other than 'very easy'.

### Data quality

Many covariates had missing data for some participants. In most cases, the frequency of missing data was small (< 2%). However, the frequency of missing data was much larger for some covariates, particularly those taken from the self-completion module or nurse visits, which had lower response rates or covariates that were derived scales and required responses to all scale components. To maximise the samples available for regression modelling, missing data were coded as an extra category for each covariate if the frequency was > 2% (continuous covariates were first transformed into tertiles). This criterion was chosen as a balance between including as many respondents as possible in the models and not causing multicollinearity issues in models due to low category frequencies. The frequencies of all covariates' categories were checked for the samples to be used in statistical models. Where there were < 10% of responses in a category, we combined categories or, if combining categories was not suitable, excluded the covariate on the basis of poor data quality.

### Weighting

The English Longitudinal Study of Ageing is designed to be analysed either cross-sectionally or longitudinally. Cross-sectional analysis uses data collected at a single wave, whereas longitudinal data analysis uses data collected in more than one wave. Owing to non-response, the refreshment samples in waves 3 and 4, and the original clustered recruitment from the HSE, sampling weights have been calculated for use in analyses to allow for these factors.

Longitudinal weights were designed to adjust for historical non-response as well as to response since the last wave; therefore, at wave 5 the longitudinal weights adjust for non-response to HSE as well as for non-response to each wave of ELSA. Cross-sectional weights were designed to adjust the sample to be representative of the English population  $\geq 50$  years old.

In our analyses we used the weighting where appropriate, depending on the wave used, and whether we were performing cross-sectional or longitudinal analyses. The precise methods of calculating the weights are given in the ELSA user guides and technical reports, available from the Economic and Social Data Service.

## Statistical methods

All analyses described below were conducted using Stata SE version 12.1 (StataCorp LP, College Station, Texas, USA).

### Quality indicator achievement

The entire ELSA sample for this study consisted of all participants who had been interviewed at any of the four waves ( $n = 16,773$ ). The primary outcome was achievement of each quality indicator, which was the number of times the indicator was achieved divided by the number of times it was triggered, expressed as a percentage, with possible values between 0% and 100%. The quality indicator achievement at the level of each condition (cardiovascular disease, depression, diabetes or osteoarthritis) was the number of times any indicator for that condition was achieved divided by the number of times any indicator for that condition was triggered, expressed as a percentage, with possible values between 0% and 100% (see *Table 9*).

The percentage change in achievement was calculated between wave 2 and the most recent year of follow-up, and the statistical significance of changes over time were tested with Pearson's chi-squared test for comparing proportions (see *Table 10*). Some data points were paired within individuals between wave 2 and the most recent year of follow-up, and some were not, as different individuals were eligible for indicators at different waves. For this reason we did not use McNemar's test for paired data, although McNemar's test would have had greater power and precision had it been appropriate to use. We excluded 'don't know' responses from both the numerator and the denominator when calculating quality scores.

We used correlation analysis to investigate whether or not quality of care for one condition was associated with quality of care in another.

### Transitions in receipt of care across time

We explored the extent to which participants with diabetes, cardiovascular disease, osteoarthritis and depression transitioned from non-receipt of indicated care to subsequently receiving it, and vice versa, across the available waves of ELSA. To achieve this, we used cross-tabulations of whether or not an indicator was passed at one wave with whether or not it was subsequently passed at the wave at which it was next available. Some quality indicators were only available at one wave other than the baseline (wave 2), either wave 4 or wave 5 (see *Availability of quality indicators across waves*). As a result, owing to participant attrition and changes in individuals' health status, sample sizes for these quality indicators were too small for comparisons across waves. Additionally, sample sizes were too small for osteoarthritis referral and osteoarthritis paracetamol was not suitable, as if paracetamol for pain relief was not the first prescribed drug, this could never be rectified. We therefore report the proportions of individuals who successfully transition from non-receipt of care to receiving their care, who transition from receipt of care to subsequent non-receipt of care, and those who do not transition, for stroke antihypertensives, hypertension treatment, diabetes HbA<sub>1c</sub>, diabetes proteinuria, diabetes ACE inhibitor, diabetes foot check, all-or-nothing receipt of the care bundle for diabetes, osteoarthritis exercise and osteoarthritis education.

### Modelling for longitudinal quality of care

For the modelling we used a longitudinal data set comprising only those participants who had completed interviews at all four waves ( $n = 5114$ ) (see *Table 13*). We calculated quality indicator achievement for these 5114 participants in exactly the same way as we calculated it for the entire data set, described in *Quality indicator achievement* – that is, the quality indicator achievement at the level of each condition was the number of times any indicator for that condition was achieved divided by the number of times any indicator for that condition was triggered, expressed as a percentage, with possible values between 0% and 100% (see *Table 15*).

For the regression, modelling we needed to calculate quality indicator eligibility by participant rather than by condition, as the covariates were linked to participants rather than to conditions (cardiovascular disease, depression, diabetes or osteoarthritis). Each participant might have been eligible for more than one indicator within each condition, and so we reshaped the data into 'long' format in Stata statistical software, with each participant having a separate record for each indicator. These person-indicator level records of quality achievement were the unit of analysis for the modelling, using 'svy' commands in Stata 'long' format. This was done for each condition separately, and the outcome was expressed as the odds of achievement of any quality indicator that a participant was eligible for, within the relevant condition, with adjustment for participant characteristics. Intraperson correlation of outcomes was accounted for using robust adjustment with Stata, with each participant's unique identifier included in the regression equation as a cluster variable. All data were weighted for historical non-response and non-response since the last wave (see *Table 15*).

Age group (50–64, 65–74 and  $\geq 75$  years) and sex were included in all regression models, and the following were examined as potential explanatory variables, and included in final models if they were significantly associated with the outcome before adjustment for other variables: wealth, marital status, education, socioeconomic status, NHS or independent sector delivery of joint surgery, general health, eyesight, hearing, chronic pain, limiting illnesses, instrumental activities of daily living (IADL) (scale of 1–7), ADL (scale of 1–6), GP access, the Rose Angina Scale,<sup>44</sup> cognitive impairment, comorbidities, smoking, eating five portions of fruit and vegetables a day, alcohol consumption, physical activity levels, body mass index (BMI), blood pressure, blood glucose (HbA<sub>1c</sub>) levels, self-perceived social status, CASP-19, social detachment, and depression (CES-D).

We categorised BMI according to the World Health Organization criteria,<sup>21</sup> blood glucose [HbA<sub>1c</sub>  $\geq 7.5\%$  (Diabetes Control and Complications Trial: DCCT) or 59 mmol/mol (International Federation of Clinical Chemistry and Laboratory Medicine: IFCC)] and cholesterol ( $\leq 5$  mmol/l or less) according to the QOF criteria,<sup>8</sup> and depression according to the CES-D (a score of 4 or more was classified as depression).<sup>22</sup>

A single fasting plasma glucose was used to estimate the prevalence of diabetes, rather than the two separate measurements recommended by the World Health Organization. This approach is not recommended for clinical care, but is acceptable at population level and has been used in other studies.<sup>50</sup> It may overestimate diabetes<sup>51</sup> but will also not identify the small number of people whose diabetes can be detected only on an oral glucose tolerance test.<sup>52</sup>

All characteristics that were significantly associated with quality of care at the 5% level for the conditions using univariate regression analyses were used in the final models.

### **Predicting non-receipt of indicated care for diabetes care bundles**

We used the care bundle approach as an alternative method to model quality of care for diabetes, to explore which characteristics were predictive of not receiving indicated care for diabetes 2 years later. For the diabetes care bundle analyses we used a data set comprising ELSA core members at wave 5 who also responded at wave 4 ( $n = 8222$ ) (see *Table 17*). The latest outcomes were deemed to be the most clinically relevant to model, so we used wave 5 outcomes and covariates from wave 4. A covariate of particular interest was whether or not participants had previously received the indicated care.

We therefore had two outcomes: all-or-nothing receipt of the care bundle and whether or not the diabetes ACE inhibitor quality indicator was passed. Separate logistic regression models were developed for each of the two outcomes using the following process: short-listed covariates were first entered into univariate regressions, adjusted for age and sex, and the models were weighted for non-response using the wave 5 cross-sectional sample weights (see *Weighting*). All characteristics that were significantly associated with quality of care at the 5% level for either outcome were then entered into a forced entry logistic regression, adjusted and weighted as above, for both outcomes (see *Table 17*).

### ***Patient characteristics associated with the illness burden, diagnosis and treatment pathway***

To examine whether or not factors such as wealth are associated with quality of health care received through the care pathway, we defined burden of illness, diagnosis and treatment for four conditions from data generated from the four waves of ELSA. We used the sample of ELSA core members who had been interviewed at any of the four waves ( $n = 16,773$ ).

#### **Variable definitions**

The illness burden for angina was defined as grade 2 on the Rose Angina Scale [pain or discomfort in chest when walking at an ordinary pace on the level on most occasions or more often, which makes subject stop or slow down if occurs while walking, and which then goes away within 10 minutes, and which includes either sternum (any level), or left arm and left anterior chest]. Illness burden for diabetes was defined as a fasting HbA<sub>1c</sub> level of  $> 7.5\%$ . Illness burden for depression was defined as a score of  $\geq 3$  on the eight-item CES-D. The application of these standardised scales in ELSA has been described previously. Illness burden for osteoarthritis was defined as self-reported pain in the hip or knee of  $\geq 5$  on a scale of 0 to 10.

A medical diagnosis was considered to exist if a participant answered 'yes' when asked if a doctor had ever told them they had the condition of interest. For arthritis, a follow-up question asked whether they had been told that they had osteoarthritis, rheumatoid or other arthritis.

Treatment for depression and diabetes was defined by reported achievement of quality of care indicators, derived through a robust process of literature reviews, expert panel assessment and piloting. For depression, the quality indicator was about receipt of treatment since the previous wave: 'if a person is diagnosed with clinical depression, then antidepressive treatment, talking treatment or electroconvulsive treatment should be offered within 2 weeks after diagnosis unless within that period the patient has improved, or unless the patient has substance abuse or dependence, in which case treatment may wait until 8 weeks after the patient is in a drug-or alcohol-free state'. For diabetes, treatment was measurement of HbA<sub>1c</sub> or fructosamine levels in the preceding 12 months. Treatment for angina was defined as ever being offered or currently taking beta-blockers (ELSA variables hebeta or hebetc). Treatment for osteoarthritis was defined as reporting ever having had surgery for the condition; this excluded those with hips or knees replaced due to fracture. Data on hip and knee replacements were available only for respondents aged 60 and over, and so respondents aged  $< 60$  years ( $n = 3186$ ) were excluded from the analysis of osteoarthritis.

Wealth was defined as the sum of financial, physical and housing wealth plus state and private pension income. Age was categorised into three groups: 50–59 years, 60–74 years and  $\geq 75$  years (see *Table 20*).

### **Analysis**

We used two approaches to analysis: a main analysis using serial cross-sectional data and then a subsidiary analysis using longitudinal data. Multivariable logistic regression analysis was used, with the outcome variables defined as one of illness burden, medical diagnosis or treatment for each of the four conditions in each cross-sectional wave (Stata statistical software version 12.1). This regression analysis was repeated for each of the four waves of ELSA from 2004 to 2011 separately and then 'overall' for all four waves combined. For the 'overall' analysis, the data were reshaped into 'long' format in Stata statistical software, with each participant having a separate record for each indicator and wave, as explained earlier (see *Statistical methods and Modelling for longitudinal quality of care*). Intraperson correlation of outcomes was accounted for using robust adjustment with Stata, with each participant's unique identifier included in the regression equation as a cluster variable. Missing data were excluded from the analyses.

The independent variables were age group, sex and slope order of inequality. We used the slope order of inequality as an independent variable to estimate the relationship between the outcome measures and the categorised measure of wealth. The slope order of inequality consisted of wealth quintiles with values of 0.1, 0.3, 0.5, 0.7 and 0.9, that is the mid-points of each quintile on a scale of zero (least wealthy) to one (most wealthy). The slope order of inequality was modelled as a continuous variable, and its odds ratio (OR) represents the ratio of the least wealthy compared with the wealthiest participant. This OR is also known as a relative index of inequality. Advantages of this method of quantifying inequality are that it includes all participants, instead of just comparing the highest and lowest quintiles, it accounts for the number of participants in each category and it provides a single overall measure of inequality.

We included all participants in the main cross-sectional analysis in order to compare the distribution of illness burden in the whole population with the distributions of diagnoses and treatments in the whole population. This meant that diagnosis was assessed even in those who did not meet the criteria for 'illness burden', and treatment was assessed even in those with no diagnosis. For the subsidiary analysis using longitudinal data, we estimated the OR of receiving a diagnosis by a subsequent wave only for those who had met the criteria for 'illness burden' in a previous wave, and then the likelihood of receiving treatment only for those who had received a diagnosis in a previous wave. This was a subsidiary analysis as the numbers of participants who could be followed over time in this manner was small, particularly for treatment in angina and depression.

Other factors, such as health literacy, obesity, access to GP, comorbidities, education and health behaviours, were used to investigate whether or not they had an additional impact on the care pathway as well as wealth. This was performed not at each wave but as an overall measure, where burden of illness, diagnosis and treatment were defined as having the burden of disease, diagnosis or receiving treatment at any wave, respectively. The sensitivity analyses adjusted for age group, sex and slope index of inequality at wave 5 as well as one other confounder at a time.

## Chapter 3 Results

The results are presented in this chapter in the following four sections: *Demographics for all waves of the English Longitudinal Study of Ageing*, *Achievement of quality indicators over time* (this section also gives the results for the diabetes care bundle and for transitions in quality over time), *Regression modelling for quality of care* and *Population distribution of illness burden, diagnosis and treatment*.

### Demographics for all waves of the English Longitudinal Study of Ageing

At any of the four waves 16,773 participants were interviewed, of whom 3810 had at least one condition at wave 2 and 5404 had at least one condition of interest at wave 5 (Table 8). The mean age of the participants at baseline was 65.8 years (range 52 to > 90 years), and just under half were women. This sample was used to address research question 1: how does the prevalence of good quality of health care vary over time?

### Achievement of quality indicators over time

#### *Achievement of quality indicators*

The eligibility and achievement rates of individual quality indicators for each wave of data for every participant ( $n = 16,773$ ) show that quality indicator pass rates varied substantially within conditions, with the depression suicide indicator being achieved by 46.5% in wave 2 and treatment by 78.9% at the same wave (Table 9). There was also variation between pass rates at different waves; the greatest percentage increase in quality indicator achievement over the waves was seen in osteoarthritis exercise, where there was a 20% improvement in passing the quality indicator, while the worst performing indicator was depression treatment, with a 17% drop between the two waves where it was measured.

We used quality indicator achievement at condition level to see whether care for specific conditions had increased or decreased over the 6 years of the study (Table 10). A statistically significant difference between wave 2 (2004–5) and wave 5 (2010–11) was seen only for osteoarthritis quality indicators. Although the achievement rates for osteoarthritis show a small increase, they are still very low (36% in 2010–11). We used the chi-squared test for associations, as the number of people with conditions at both time points was small ( $n = 185$  for cardiovascular disease,  $n = 6$  for depression,  $n = 349$  for diabetes and  $n = 366$  for osteoarthritis).

Those who reported 'don't know' were not included in the analyses. The numbers reporting this were extremely low and in wave 2 (total  $n$  at wave 2 = 9432) only four did not know if they had been asked about osteoarthritis and paracetamol use. This dropped to two at wave 5 (total  $n$  at wave 5 = 10,274). The offer of antihypertensive medication after a stroke was not known by 19 people at wave 2 and by two at wave 5.

#### *Associations of care between conditions*

We assessed whether or not quality of care for one condition was associated with quality of care for another condition at each wave that data were available (see Chapter 2, *Availability of quality indicators across waves*, and Table 6). The only statistically significant association was at wave 2, with quality of care for diabetes and cardiovascular disease correlated ( $r = 0.13$ ,  $p = 0.035$ ). No associations between quality of care for other diseases were found at wave 2 (osteoarthritis and diabetes,  $r = 0.16$ ,  $p = 0.18$ ; osteoarthritis and cardiovascular disease  $r = -0.044$ ,  $p = 0.72$ ; depression and osteoarthritis  $r = -0.17$ ,  $p = 0.48$ ; depression and cardiovascular disease  $r = 0.20$ ,  $p = 0.41$ ; and depression and diabetes  $r = 0.43$ ,  $p = 0.28$ ). At wave 3 quality of care for osteoarthritis and diabetes were not associated ( $r = 0.078$ ,  $p = 0.27$ ). At wave 4,

**TABLE 8** Characteristics of the ELSA participants interviewed at any of the four waves where quality of care was measured

Characteristics	2004–5: wave 2	2006–7: wave 3	2008–9: wave 4	2010–11: wave 5
Total number at wave	9432	9771	1150	10,274
Age (years), mean	65.8	64.6	65.3	66.8
Range <sup>a</sup>	52 to > 90	54 to > 90	56 to > 90	58 to > 90
Sex				
Female, <i>n</i> (%)	4125 (47.3)	4295 (44.0)	4925 (44.6)	4569 (44.5)
Male, <i>n</i> (%)	5307 (56.3)	5476 (56.0)	6125 (55.4)	5705 (55.5)
Ethnicity				
White, <i>n</i> (%), wave 2	9432 (97.5)			
Non-white, <i>n</i> (%)	229 (2.4)			
Education (highest qualification), <i>n</i> (%)				
Degree or equivalent	2721 (16.2)			
Intermediate	4335 (25.9)			
No qualifications	5008 (29.9)			
Missing	4709 (28.1)			
Total net household financial wealth, £				
Median	188,851	207,631	217,098	231,049
Range	–111,700 to 9,297,227	–1,578,980 to $2.08 \times 10^7$	–255,580 to $3.93 \times 10^7$	–10,500 to $1.06 \times 10^7$
One or more conditions, <i>n</i> (%)	3868 (41)	4754 (49)	5404 (49)	3810 (37)
Number of conditions for which participants were eligible				
Mean	1	1	1	1
Range	0 to 6	0 to 4	0 to 4	0 to 3
Number of indicators for which participants were eligible				
Mean	1	1	1	1
Range	0 to 13	0 to 8	0 to 12	0 to 12
Clinical incidence over 2 years, <i>n</i> (%)				
CVD		110 (1.2)	168 (1.6)	136 (1.4)
Depression		125 (1.3)	288 (2.7)	
IHD				298 (3.1)
Osteoarthritis		877 (10.7)	1105 (11.8)	877 (10.7)
Hypertension		817 (12.8)	1599 (18.9)	933 (13.2)
Clinical prevalence, <i>n</i> (%)				
Diabetes mellitus	739 (7.8)	1000 (10.1)	1330 (11.7)	1566 (14.6)

a All respondents aged > 90 years had their exact age withheld from released data.



**TABLE 9** Achievement rates for quality indicators at each wave of ELSA for all the participants interviewed at that wave

Quality indicator (n = 32) or patient-centred question (n = 7)	2004–5, wave 2: % pass rate (95% CI); n pass/n eligible	2006–7, wave 3: % pass rate (95% CI); n pass/n eligible	2008–9, wave 4: % pass rate (95% CI); n pass/n eligible	2010–11, wave 5: % pass rate (95% CI); n pass/n eligible	% change wave 2 to most recent follow-up wave
Stroke antihypertensives	77.3 (71.0 to 83.5); 136/176	74.9 (70.7 to 79.2); 305/407	82.1 (78.5 to 85.7); 354/431	84.8 (81.4 to 88.2); 375/442	+ 7.5
Depression suicide	46.5 (37.8 to 55.2); 60/129	N/A	57.8 (52.0 to 63.7); 162/280	N/A	+ 11.3
Depression treatment	78.9 (71.9 to 86.0); 105/133	N/A	61.8 (56.0 to 67.4); 176/285	N/A	– 17.1
Depression review	75.8 (59.3 to 92.4); 22/29	N/A	N/A	N/A	N/A
Diabetes HbA <sub>1c</sub>	83.0 (80.2 to 85.8); 562/677	83.5 (80.9 to 86.1); 648/776	80.4 (77.8 to 83.0); 723/899	82.0 (76.0 to 84.4); 815/994	– 1.0
Diabetes proteinuria	83.2 (79.1 to 87.4); 263/316	80.9 (76.6 to 85.2); 263/325	78.4 (74.1 to 82.7); 279/356	79.5 (75.6 to 83.4); 326/410	– 3.7
Diabetes cholesterol	85.6 (79.9 to 91.4); 125/146	N/A	N/A	88.7 (82.2 to 95.0); 86/97	+ 3.1
Diabetes ACE inhibitor	48.1 (44.3 to 52.0); 311/646	53.1 (49.2 to 56.9); 345/650	56.6 (53.2 to 59.9); 489/864	56.9 (53.7 to 60.1); 511/898	+ 8.8
Diabetes foot check	83.7 (81.0 to 86.3); 606/724	82.3 (79.7 to 84.9); 671/815	81.8 (79.3 to 84.2); 781/955	82.8 (80.5 to 85.1); 863/1042	– 0.9
Hypertension treatment (prevalent hypertension)	71.6 (68.0 to 75.1); 451/630	67.8 (64.8 to 70.9); 614/905	80.3 (78.0 to 82.6); 915/1139	74.6 (71.1 to 78.1); 453/607	+ 3.0
Hypertension treatment (incident hypertension)	84.6 (82.9 to 86.3); 1423/1682	87.1 (85.9 to 88.3); 2736/3130	90.7 (89.7 to 91.6); 3277/3615	92.7 (91.8 to 93.5); 3299/3560	+ 8.1
IHD cholesterol	85.2 (80.0 to 90.3); 161/189	N/A	N/A	86.2 (78.8 to 93.6); 75/87	+ 1.0
IHD antiplatelets	82.6 (78.8 to 86.5); 309/374	N/A	N/A	82.4 (79.8 to 84.9); 719/873	– 0.2
IHD smoking	89.7 (84.8 to 94.7); 132/147	N/A	N/A	90.7 (86.4 to 94.9); 165/182	+ 3.0
MI beta-blocker (incident MI)	64.0 (53.9 to 74.2); 57/89	N/A	N/A	75.6 (66.3 to 84.8); 65/86	+ 11.6
MI beta-blocker (prevalent MI)	69.1 (60.8 to 77.4); 85/123	N/A	N/A	72.8 (65.6 to 80.0); 110/151	+ 3.7
INR test	100 (100 to 100); 44/44	N/A	N/A	93.9 (89.8 to 98.1); 124/132	– 6.1
OA exercise	26.1 (21.4 to 30.8); 88/337	34.6 (30.3 to 38.9); 161/465	41.6 (38.7 to 44.5); 459/1103	46.2 (43.5 to 48.9); 613/1326	+ 20.6
OA education	21.6 (17.7 to 25.3); 99/459	20.0 (18.3 to 21.8); 404/2019	25.6 (23.9 to 27.4); 606/2366	32.1 (30.3 to 33.9); 824/2569	+ 10.5
OA paracetamol	45.2 (40.6 to 49.8); 206/456	42.6 (38.7 to 46.4); 273/641	44.8 (41.9 to 47.7); 497/1109	46.0 (43.1 to 48.8); 552/1201	+ 0.8

continued

**TABLE 9** Achievement rates for quality indicators at each wave of ELSA for all the participants interviewed at that wave (*continued*)

Quality indicator (n = 32) or patient-centred question (n = 7)	2004–5, wave 2: % pass rate (95% CI); n pass/n eligible	2006–7, wave 3: % pass rate (95% CI); n pass/n eligible	2008–9, wave 4: % pass rate (95% CI); n pass/n eligible	2010–11, wave 5: % pass rate (95% CI); n pass/n eligible	% change wave 2 to most recent follow-up wave
OA referral	35.8 (28.3 to 43.3); 57/159	39.2 (31.0 to 47.3); 56/143	39.1 (29.8 to 48.4); 43/110	33.6 (24.8 to 42.5); 38/113	–2.2
Diabetes training	25.4 (22.2 to 28.6); 184/724	29.8 (27.0 to 32.7); 290/972	33.2 (30.6 to 35.7); 426/1284	N/A	+7.8
Diabetes knowledge	78.0 (74.9 to 81.0); 564/723	78.2 (75.3 to 81.0); 634/811	81.3 (78.9 to 83.8); 772/949	N/A	+3.3
Cholesterol explanation	78.6 (76.7 to 80.5); 1356/1725	N/A	N/A	N/A	N/A
Cholesterol preferences	49.1 (46.7 to 51.4); 839/1708	N/A	N/A	N/A	N/A
Blood pressure explanation	68.7 (66.4 to 70.9); 1151/1676	N/A	N/A	N/A	N/A
Blood pressure choice	42.7 (40.3 to 45.1); 704/1648	N/A	N/A	N/A	N/A
OA treatment purpose	77.9 (72.2 to 83.6); 162/208	79.1 (76.3 to 81.8); 654/827	81.9 (80.0 to 84.1); 974/1189	N/A	+4.0

CI, confidence interval; N/A, not applicable; OA, osteoarthritis.

**TABLE 10** Quality indicator achievement for the four conditions in each of the four waves (n = 16,773)

Condition	2004–5, wave 2: % achievement (95% CI); n pass/n eligible	2006–7, wave 3: % achievement (95% CI); n pass/n eligible	2008–9, wave 4: % achievement (95% CI); n pass/n eligible	2010–11, wave 5: % achievement (95% CI); n pass/n eligible	<sup>a</sup> χ <sup>2</sup>
Cardiovascular disease	82.7 (79.9 to 85.5); 703/843	N/A	N/A	84.2 (82.1 to 86.2); 1148/1360	0.53
Depression	63.3 (57.6 to 69.0); 187/291	N/A	59.8 (52.4 to 64.3); 338/565	N/A	0.21
Diabetes	76.0 (74.1 to 77.8); 1867/2509	76.6 (74.8 to 78.5); 1927/2566	75.3 (73.5 to 77.1); 2272/3074	76.5 (74.8 to 78.1); 2661/3441	0.67
Osteoarthritis	31.2 (28.5 to 33.8); 450/1411	23.9 (22.4 to 25.4); 894/3268	31.2 (29.8 to 32.7); 1605/4688	35.6 (34.2 to 37.1); 2027/5209	<0.001

CI, confidence interval; N/A, not applicable.  
<sup>a</sup> Pearson's chi-squared test was used to test for differences between the baseline wave (2) and the last wave that the condition was measured in.

depression and osteoarthritis and depression and diabetes care showed no associations ( $r = 0.18$ ,  $p = 0.11$  and  $r = 0.037$ ,  $p = 0.85$ , respectively). Likewise, there was no relationship between quality of care at wave 4 for osteoarthritis and diabetes ( $r = 0.075$ ,  $p = 0.23$ ). At wave 5, similarly, there were no associations found between quality of care in the different diseases (cardiovascular disease and diabetes  $r = 0.14$ ,  $p = 0.074$ ; cardiovascular disease and osteoarthritis  $r = 0.057$ ,  $p = 0.3$ ; and osteoarthritis and diabetes  $r = 0.039$ ,  $p = 0.47$ )

### Achievement of diabetes care bundle quality indicators

This analysis used participants who were core members at wave 5 and had also responded at wave 4 ( $n = 8222$ ). Eligibility and non-achievements rates of the individual indicators that made up the diabetes care bundle and the one indicator (diabetes ACE inhibitor) were calculated. At least one of the three monitoring checks included in the care bundle was not received in 288 out of 907 cases in 2010–11 [weighted rate = 32.2%, 95% confidence interval (CI) 29.1% to 35.5%]. This is equivalent to achievement of 67.8% for all three quality indicators in the bundle. The HbA<sub>1c</sub> test, proteinuria test and foot check quality indicators had similar, low rates of non-achievement (weighted 2010–11 range = 17.4–22.8%), although the ACE inhibitor quality indicator had much higher non-achievement (weighted 2010–11 score = 44.5%). The non-achievements of the individual quality indicators and the care bundle varied little between waves in the study (Table 11).

### Transitions in quality of care across time

Transitions from receiving indicated care in one wave to not receiving care in a subsequent wave, and also from not receiving care to subsequently receiving care, were calculated for wave 2 to wave 3, wave 3 to wave 4, and wave 4 to wave 5 for the quality indicators available at every wave (see Chapter 2, Availability of quality indicators across waves) (Table 12). Different patterns were seen for different conditions. Two quality indicators for cardiovascular disease could be derived at every wave: the quality indicator for stroke antihypertensives and the quality indicator for hypertension treatment. The percentage of eligible participants who did not receive the indicated care for stroke antihypertensives in either the earlier or subsequent wave of each wave pairing ranged from 65.4% in waves 2–3 to 73.1% in waves 4–5. Only 26.9–34.6% transitioned to receiving their care at the subsequent wave. For hypertension treatment the percentage of those who were not offered an antihypertensive who then transitioned to subsequently passing the quality indicator was much higher (59.6–69.0%), though 31.0–40.4% continued to not receive the indicated care. In contrast, only 1.5–2.8% of those who were previously offered antihypertensive medication transitioned to not receiving this care at the subsequent wave.

A similar pattern to that seen with hypertension was observed in diabetes HbA<sub>1c</sub>, proteinuria and foot check and the care bundle of these three indicators. Of eligible participants who did not receive all indicated care in the bundle at the earlier wave, 51.7–54.5% did transition to receiving the care at the subsequent wave, while 45.5–48.3% continued to not receive the full bundle. Of those who received all

**TABLE 11** Non-achievement of quality indicators and the care bundle in 2008–9 and 2010–11 ( $n = 8222$ )

Quality indicator	2008–9		2010–11	
	Failed/eligible	% (95% CI)	Failed/eligible	% (95% CI)
Diabetes HbA <sub>1c</sub>	130/692	20.0 (16.8 to 23.3)	154/861	17.4 (14.8 to 20.1)
Diabetes proteinuria	58/273	22.7 (17.3 to 28.0)	76/349	22.8 (18.0 to 27.6)
Diabetes foot check	129/735	17.8 (14.8 to 20.8)	150/905	17.5 (14.8 to 20.2)
Care bundle <sup>a</sup>	235/736	32.8 (29.2 to 36.4)	288/907	32.2 (29.1 to 35.5)
Diabetes ACE inhibitor	289/665	44.6 (40.6 to 48.6)	325/759	44.5 (40.7 to 48.3)

Percentages and CIs are adjusted for differential non-response.

a The care bundle comprised the HbA<sub>1c</sub> test, proteinuria test and foot check quality indicators.

TABLE 12 Transitions in quality of care over 6 years for quality indicators available at every ELSA wave

Quality indicator	W2 to W3				W3 to W4				W4 to W5			
	No → no, n (% of participants who did not receive this care at W2)	No → yes, n (% of participants who received this care at W2)	Yes → no, n (% of participants who received this care at W2)	Yes → yes, n (% of participants who received this care at W2)	No → no, n (% of participants who did not receive this care at W3)	No → yes, n (% of participants who did not receive this care at W3)	Yes → no, n (% of participants who received this care at W3)	Yes → yes, n (% of participants who received this care at W3)	No → no, n (% of participants who did not receive this care at W4)	No → yes, n (% of participants who did not receive this care at W4)	Yes → no, n (% of participants who received this care at W4)	Yes → yes, n (% of participants who received this care at W4)
Stroke antihypertens <sup>a</sup>	17 (65.4)	9 (34.6)	N/A	92 (100)	46 (73.0)	17 (27.0)	N/A	201 (100)	38 (73.1)	14 (26.9)	N/A	239 (100)
Hypertension treatment	26 (31.0)	58 (69.0)	25 (2.8)	862 (97.2)	57 (40.4)	84 (59.6)	29 (1.6)	1821 (98.4)	44 (36.4)	77 (63.6)	36 (1.5)	2350 (98.5)
Diabetes HbA <sub>1c</sub>	32 (40.5)	47 (59.5)	47 (11.3)	368 (88.7)	30 (36.6)	52 (63.4)	72 (15.9)	382 (84.1)	34 (28.3)	86 (71.7)	76 (14.1)	462 (85.9)
Diabetes proteinuria	6 (26.1)	17 (73.9)	25 (21.6)	91 (78.5)	12 (42.9)	16 (57.1)	17 (14.3)	102 (85.7)	12 (35.3)	22 (64.7)	17 (13.0)	114 (87.0)
Diabetes ACE inhibitor	132 (64.1)	74 (35.9)	46 (22.6)	158 (77.5)	127 (63.8)	72 (36.2)	42 (17.0)	205 (83.0)	162 (66.4)	82 (33.6)	68 (19.8)	275 (80.2)
Diabetes foot check	42 (46.2)	49 (53.9)	42 (9.1)	422 (91.0)	40 (38.8)	63 (61.2)	47 (9.6)	444 (90.4)	48 (38.1)	78 (61.9)	52 (8.6)	550 (91.4)
Diabetes bundle <sup>b</sup>	75 (47.2)	84 (52.8)	84 (21.2)	313 (78.8)	81 (45.5)	97 (54.5)	101 (24.2)	317 (75.8)	112 (48.3)	120 (51.7)	97 (19.4)	402 (80.6)
Osteoarthritis exercise <sup>a</sup>	147 (91.3)	14 (8.7)	N/A	64 (100)	186 (92.1)	16 (7.9)	N/A	106 (100)	397 (83.8)	77 (16.2)	N/A	321 (100)
Osteoarthritis education <sup>a</sup>	170 (85.0)	30 (15.0)	N/A	65 (100)	861 (87.7)	121 (12.3)	N/A	251 (100)	1026 (86.3)	163 (13.7)	N/A	414 (100)

N/A, not applicable; W, wave.

<sup>a</sup> For these quality indicators, participants who received the indicated care at a previous wave automatically passed the quality indicator at subsequent waves. As a result, it was not possible to transition from receiving the care to subsequently not receiving the care.

<sup>b</sup> The care bundle comprised diab1, diab2 and diab9, all of which are annual monitoring checks for diabetes.

three annual monitoring checks at the earlier wave, only 19.4–24.2% subsequently transitioned to not receiving the complete bundle, as 75.8–80.6 received all the indicated care at both waves across the wave pairings. The diabetes quality indicator for ACE inhibitors showed a slightly different pattern. Achievement of this quality indicator was lower (see *Table 9*), and a greater proportion (63.8–66.4%) of eligible participants who were not offered the indicated medication at the earlier wave continued to not receive the care at the subsequent wave. In comparison, only 17.0–22.6% of those who were offered the indicated medication at the earlier wave subsequently transitioned to not pass the indicator.

As described above (see *Achievement of quality indicators*), achievements of the osteoarthritis quality indicators were low. Most of the eligible participants who did not receive their indicated care continued to subsequently not receive their care (osteoarthritis exercise 83.8–92.1%; osteoarthritis education 85.0–87.7%). Only a small minority transitioned to passing the quality indicators at the subsequent wave (osteoarthritis exercise 7.9–16.2%; osteoarthritis education 12.3–15.0%).

## Regression modelling for quality of care

### Demographics for the longitudinal data set

In all four waves 5114 participants were interviewed, and the number with at least one condition of interest in any wave ranged from 1998 to 2961 (*Table 13*). The mean age of participants was 65 years (range 52 to > 90 years) in 2004–5 and just over half were women. This sample was used to address

**TABLE 13** Baseline characteristics of the participants in the longitudinal data set who were interviewed in all four waves ( $n = 5114$ )

Characteristics	2004–5	2006–7	2008–9	2010–11
Age (years), mean	64.8	66.6	68.7	70.9
Sex				
Female, $n$ (%)	2882 (56.4)	2882 (56.4)	2882 (56.4)	2882 (56.4)
Male, $n$ (%)	2232 (43.6)	2232 (43.6)	2232 (43.6)	2232 (43.6)
One or more conditions, $n$ (%)	1998 (39)	2738 (54)	2961 (58)	2290 (44.8)
Number of conditions for which participants were eligible				
Mean	1	1	1	1
Range	0–6	0–4	0–4	0–3
Number of indicators for which participants were eligible				
Mean	1	1	1	1
Range	0–13	0–7	0–8	0–8
Clinical incidence over 2 years, $n$ (%) <sup>a</sup>				
CVD		32 (0.7)	53 (1.1)	60 (1.2)
Depression		65 (1.3)	53 (1.1)	
IHD				183 (3.7)
Osteoarthritis		415 (11.1)	372 (9.7)	415 (11.1)
Hypertension		253 (8.5)	453 (13.5)	334 (10.7)
Clinical prevalence, $n$ (%)				
Diabetes mellitus	351 (6.9)	447 (8.7)	542 (10.6)	634 (12.4)

<sup>a</sup> Incidence rates refer to the approximately 2 years since the previous survey wave or have been adjusted for 2 years.

research question 2: what characteristics are shared by people aged  $\geq 50$  years who received or did not receive specific items of recommended NHS or non-NHS care for cardiovascular disease, depression, diabetes and osteoarthritis in a national population-based study followed up for 6 years? A detailed breakdown of the whole ELSA sample by covariate and wave is given in *Appendix 5*.

### Time varying covariates

Some covariates were expected to change over time, but in fact the changes we found in the data were generally small. The greatest change in the number of participants reporting potentially time-varying covariates was seen in cognitive impairment, which was reported by over twice as many participants in wave 5 as in wave 2 (*Table 14*). This was explored further in the regression models, which found that the only condition in which cognitive impairment was associated with quality was diabetes (see *Associations between quality of care and patient characteristics* and *Table 16*). Only 5.8% more participants with diabetes also had cognitive impairment in wave 5 than did those in wave 2.

**TABLE 14** Changes in time-varying covariates between wave 2 and wave 5 in the longitudinal data set ( $n = 5114$ )

Covariate	Wave 2 ( $n$ unless % stated)	Wave 5 ( $n$ unless % stated)	Change ( $n$ unless % stated)
Cognitively impaired	256	557	+ 301
Cognitively impaired and diabetes	29	89	+ 60
Cognitively impaired as percentage of participants with diabetes	8.2%	14.0%	5.8%
Mean number of ADLs			
1	472	558	+ 86
2	186	237	+ 51
3	95	111	+ 16
4	56	67	+ 11
5	34	50	+ 24
6	11	12	+ 1
Mean number of IADLs			
1	537	518	- 19
2	218	189	- 29
3	90	68	- 22
4	38	32	- 6
5	17	24	+ 7
6	4	5	+ 1
7	4	6	+ 2
MAP > 110 mmHg	458	372	- 86 <sup>a</sup>
HbA <sub>1c</sub> $\geq 7.5\%$ DCCT values	89	132	+ 43 <sup>a</sup>
BMI			
Normal/underweight	1231	1159	- 72 <sup>a</sup>
Overweight	2033	1931	- 102 <sup>a</sup>
Obese	1328	1405	+ 77 <sup>a</sup>

MAP, mean arterial pressure.

<sup>a</sup>  $p \leq 0.05$  paired samples *t*-test.

Quality indicator achievement in the entire data set of 16,773 participants is reported earlier in this results chapter (see *Tables 10 and 11*). Here, we report quality indicator achievement in the smaller longitudinal data set of 5114 participants who were used for regression modelling, before going on to give the regression results. Quality achievement for this data set was very similar to that for the entire data set. Receipt of indicated care in 2010–11 varied substantially and ranged from 89% (95% CI 85% to 92%) for CVD to 34% (95% CI 32% to 36%) for osteoarthritis (*Table 15*). As a further check that the data sets were similar, we compared the overall quality indicators achievement in both data sets. Overall, quality indicator achievement dropped slightly from 59% (95% CI 57% to 61%) in 2004–5 to 54% (95% CI 53% to 55%) in 2010–11 ( $p < 0.001$ ), giving a drop of 3.4% for the core longitudinal sample of 5114 participants. This compared with an overall 3.7% drop in achievement of quality indicators using the 16,773 participants who had been interviewed at any wave of ELSA.

### Associations between quality of care and patient characteristics

We found few statistically significant associations between quality of care and most participant characteristics (*Table 16 and Figure 1*). This analysis was conducted as described in *Chapter 2* (see *Statistical methods and Modelling for longitudinal quality of care*). For each condition, univariate models tested each of the covariates listed in *Table 7* for association with quality indicator achievement at the 5% level of statistical significance. For all covariates that were associated at the 5% level for each condition, we ran a multivariate model that also included age and sex (see *Table 16*).

We found univariate associations between CVD and wealth, BMI and CASP-19. In the multivariate model only increased wealth was associated with poorer care for CVD. Hypertension care was associated in the univariate analyses with age, BMI and mean arterial blood pressure. In the final multivariate model only increasing age was associated with better care for hypertension. IHD care showed univariate associations with age, cognitive impairment, physical activity level, mean arterial blood pressure and cohabiting status, and in the final multivariate regression model, only cohabiting status and increased age were significantly associated with quality of care.

Diabetes care was associated with socioeconomic classification, wealth, cognitive impairment, physical activity and cohabiting status in the univariate analyses. In the multivariate model, only being cognitively impaired and living alone were associated with quality of care for diabetes.

**TABLE 15** Quality indicator achievement in the longitudinal data set ( $n = 5114$ )

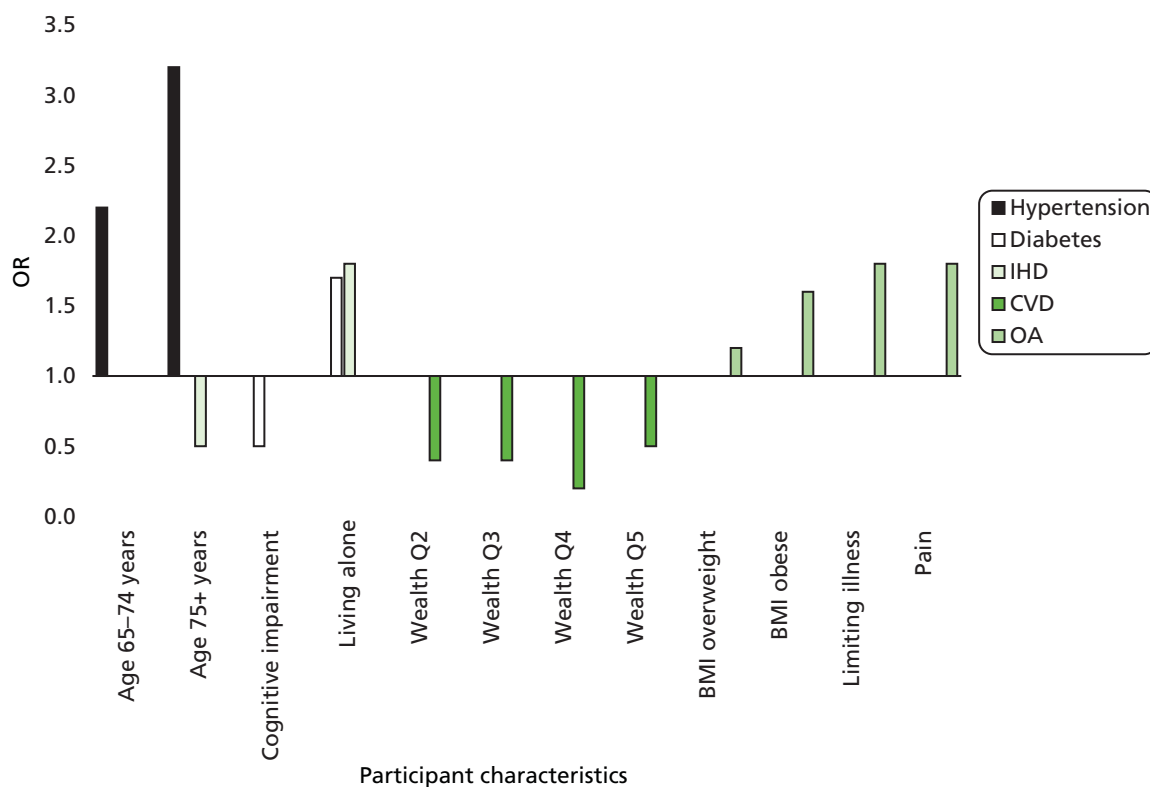
Condition	Wave 2		Wave 3		Wave 4		Wave 5	
	<i>n</i> pass/ <i>n</i> eligible	% (95% CI)	<i>n</i> pass/ <i>n</i> eligible	% (95% CI)	<i>n</i> pass/ <i>n</i> eligible	% (95% CI)	<i>n</i> pass/ <i>n</i> eligible	% (95% CI)
CVD	61/73	83.6 (74.9 to 92.2)	160/205	78.0 (72.3 to 83.8)	208/248	83.9 (79.3 to 88.5)	264/298	88.6 (85.0 to 92.2)
Depression	105/157	67.5 (60.4 to 74.6)			73/118	61.9 (52.7 to 71.0)		
Diabetes	935/1245	76.3 (73.7 to 79.0)	1081/1428	77.5 (75.0 to 80.0)	1273/1732	75.2 (72.9 to 77.6)	1541/2048	76.6 (74.6 to 78.7)
Hypertension	222/320	69.4 (64.3 to 74.5)	219/324	67.6 (62.5 to 72.7)	169/247	68.4 (62.6 to 74.3)	208/268	77.6 (72.6 to 82.6)
IHD	321/375	77.7 (72.2 to 83.1)					701/820	81.4 (78.4 to 84.4)
Osteoarthritis	229/780	29.4 (25.8 to 32.9)	512/1989	22.4 (20.4 to 24.3)	788/2508	28.3 (26.3 to 30.2)	1091/2986	33.6 (31.7 to 35.5)

**TABLE 16** Participant baseline characteristics significantly associated with longitudinal achievement of quality indicators, multivariate logistic regression adjusted for weighted data

Condition <sup>a</sup>	Characteristic	% quality indicator achievement	OR (95% CI)
CVD	Wealth		
	Quintile 1 (poorest)	92	1.0
	Quintile 2	84	0.4 (0.1 to 1.1)
	Quintile 3	84	0.4 (0.1 to 1.0)
	Quintile 4	69	0.2 (0.1 to 0.5)
	Quintile 5 (richest)	87	0.5 (0.2 to 1.3)
Diabetes	Cognitive impairment		
	No	77	1.0
	Yes	63	0.5 (0.4 to 0.7)
	Cohabiting		
	Lives with partner	69	1.0
	Lives alone	79	1.7 (1.3 to 2.0)
Hypertension	Age (years)		
	50–64	61	1.0
	65–74	79	2.2 (1.6 to 3.1)
	75+	86	3.2 (2.0 to 5.3)
IHD	Age (years)		
	50–64	89	1.0
	65–74	87	1.0 (0.6 to 1.6)
	75+	79	0.5 (0.3 to 0.8)
	Cohabiting		
	Lives with partner	81	1.0
	Lives alone	88	1.8 (1.3 to 2.5)
Osteoarthritis	Pain		
	Mild	30	1.0
	Moderate	30	1.0 (0.8 to 1.2)
	Severe	42	1.8 (1.4 to 2.2)
	Limiting illness		
	No	26	1.0
	Yes	37	1.8 (1.5 to 2.1)
	BMI		
	Under-/normal weight (< 25 kg/m <sup>2</sup> )	26	1.0
Overweight (25 to 30 kg/m <sup>2</sup> )	29	1.2 (0.9 to 1.5)	
Obese (> 30 kg/m <sup>2</sup> )	37	1.6 (1.2 to 2.0)	

a Covariates associated with quality of care that were included in the multivariate analyses with age and sex for the five diseases were for CVD: wealth, BMI and CASP-19; for diabetes: socioeconomic status (NS-SEC), wealth, cognitive impairment, physical activity level and cohabiting status; for hypertension: BMI and mean arterial pressure; for ischaemic heart disease: cognitive impairment, physical activity level, mean arterial pressure and cohabiting status; and for osteoarthritis: pain, BMI, limiting illness, ADL, IADL, frequency of alcohol intake, physical activity level, CASP and cohabiting status. Only those variables that were statistically significant at the 5% level are listed.





**FIGURE 1** Direction and size of associations between quality of care and participant characteristics by condition and logistic regression ORs. OA, osteoarthritis; Q, quintile.

Osteoarthritis care was associated with age, pain, BMI, limiting illness, ADL, IADL, frequency of alcohol consumption, physical activity level, CASP and cohabiting status at the univariate 5% level, but only obesity, limiting illness and pain remained significantly associated with better quality of care for osteoarthritis in the multivariate model.

We did not model depression as the relatively small number of participants with depression in the longitudinal data set (see *Table 15*) led to very small numbers of participants with depression and specific covariates. Instead, we included depression as a covariate in the regression models for the other condition, and, notably, depression was not associated with worse quality of care. The full results from the multivariate regression models, including statistically non-significant results, are reported in *Appendix 6*.

### Demographics for the diabetes care bundle

The sample for modelling associations between participant characteristics and achievement of the diabetes care bundle consisted of ELSA core members at wave 5 who had also responded at wave 4 ( $n = 8222$ ). At wave 5, 907 (11.0%) of this sample had diabetes and were eligible for at least one quality indicator in the diabetes care bundle and 759 (9.2%) had diabetes with additional cardiac risk factors and were eligible for the diabetes ACE inhibitor quality indicator. Participants in these two groups tended to comprise more males than the whole sample, had more respondents in the 75-and-older age group and fewer in the youngest group, were more likely to be from the lowest socioeconomic classification and had a greater proportion with no educational qualification (*Table 17*).

### Logistic regression models for the diabetes care bundle

Participant characteristics were modelled on subsequent non-receipt of care two years later. The key predictor of non-receipt of care for the diabetes care bundle was non-receipt 2 years earlier, which more than trebled the odds of subsequent non-receipt of the care bundle (OR 3.26, 95% CI 2.24 to 4.74;  $p < 0.001$ ) and increased the odds nearly sevenfold for the diabetes ACE inhibitor quality indicator for diabetes with other cardiac risk factors (OR 6.94, 95% CI 4.54 to 10.60;  $p < 0.001$ ) (*Table 18*). Besides

**TABLE 17** Participant characteristics in the sample for the diabetes care bundle modelling

Covariate	Whole sample ( <i>n</i> = 8222), <i>n</i> (%)	Care bundle ( <i>n</i> = 907), <i>n</i> (%)	Diabetes ACE inhibitor ( <i>n</i> = 759), <i>n</i> (%)
Sex			
Female	4561 (55.5)	425 (46.8)	363 (47.8)
Male	3661 (44.5)	483 (53.2)	396 (52.2)
Age (years)			
50–64	4250 (51.7)	369 (40.7)	306 (40.3)
65–74	2533 (30.8)	316 (34.8)	274 (36.10)
75 +	1439 (17.5)	222 (24.5)	179 (23.58)
NS-SEC			
Managerial/professional	2827 (34.4)	249 (27.5)	207 (27.3)
Intermediate	2085 (25.4)	208 (22.9)	173 (22.8)
Routine	3193 (38.8)	432 (47.6)	364 (48.0)
Missing	117 (1.4)	18 (2.0)	15 (2.0)
Previous care <sup>a</sup>			
Achieved	–	496 (54.7)	342 (45.1)
Not achieved	–	225 (24.8)	240 (31.6)
New case	–	175 (19.3)	144 (19.0)
Missing	–	11 (1.2)	33 (4.4)
Eyesight			
Good to excellent	7227 (87.9)	726 (80.0)	602 (79.3)
Fair to blind	995 (12.1)	181 (20.0)	157 (20.7)
Hearing			
Good to excellent	6610 (80.4)	673 (74.2)	563 (74.2)
Fair to poor	1612 (19.6)	234 (25.8)	196 (25.8)
Chronic pain			
None/mild	5893 (71.7)	545 (60.1)	438 (57.7)
Moderate/severe	2278 (27.7)	354 (39.0)	315 (41.5)
Has long-standing illness			
No	3761 (45.7)	121 (13.4)	100 (13.2)
Yes	1725 (21.0)	318 (35.0)	253 (33.3)
Yes – limiting	2735 (33.3)	468 (51.5)	406 (53.5)
Difficulties with basic ADL			
None/one	7588 (92.3)	783 (86.3)	651 (85.8)
Two or more	634 (7.7)	124 (13.7)	108 (14.2)

**TABLE 17** Participant characteristics in the sample for the diabetes care bundle modelling (*continued*)

Covariate	Whole sample ( <i>n</i> = 8222), <i>n</i> (%)	Care bundle ( <i>n</i> = 907), <i>n</i> (%)	Diabetes ACE inhibitor ( <i>n</i> = 759), <i>n</i> (%)
ADL			
None/one	7560 (92.0)	773 (85.2)	649 (85.5)
Two or more	662 (8.1)	134 (14.8)	110 (14.5)
Cognitive impairment			
No	6757 (82.2)	699 (77.0)	593 (78.1)
Yes	634 (7.7)	115 (12.7)	96 (12.7)
Missing	831 (10.1)	93 (10.4)	70 (9.2)
Health literacy			
High	5798 (70.5)	548 (60.4)	470 (61.9)
Low	2069 (25.2)	278 (30.7)	227 (29.9)
Missing	355 (4.3)	81 (8.9)	62 (8.2)
Time since diagnosis <sup>b</sup>			
Wave 5 (new case)	–	165 (18.2)	134 (17.7)
Wave 4	–	216 (23.8)	176 (23.2)
Wave 3	–	154 (17.0)	126 (16.6)
Wave 2	–	371 (40.9)	371 (40.9)
Alcohol consumption			
1–2 times/week or less	4538 (55.2)	579 (63.8)	498 (65.6)
3–4 times/week or more	2670 (32.5)	178 (19.6)	148 (19.5)
Missing	1014 (12.3)	150 (16.5)	113 (14.9)
Physical activity level			
Moderate/high	5907 (71.8)	499 (55.0)	406 (53.5)
Sedentary/low	2314 (28.1)	407 (44.8)	353 (46.5)
Smoking status			
Never	3258 (39.6)	304 (33.5)	251 (33.1)
In past	3828 (46.6)	478 (52.7)	394 (51.9)
Current smoker	1108 (13.5)	123 (13.6)	113 (14.9)
Diet			
Eats '5-a-day'	3113 (37.9)	320 (35.3)	267 (35.2)
Does not eat '5-a-day'	2393 (29.1)	259 (28.6)	229 (30.2)
Missing	2716 (33.0)	328 (36.2)	263 (34.7)

continued

**TABLE 17** Participant characteristics in the sample for the diabetes care bundle modelling (*continued*)

Covariate	Whole sample ( <i>n</i> = 8222), <i>n</i> (%)	Care bundle ( <i>n</i> = 907), <i>n</i> (%)	Diabetes ACE inhibitor ( <i>n</i> = 759), <i>n</i> (%)
Knows mostly everything about managing diabetes			
Yes	–	604 (66.6)	505 (66.5)
No	–	123 (13.6)	109 (14.4)
Missing	–	180 (19.9)	145 (19.1)
Married/civil partnership			
Yes	5456 (66.4)	558 (61.5)	460 (60.6)
No	2765 (33.6)	348 (38.4)	299 (39.4)
Social detachment			
Not detached	5631 (68.5)	523 (57.7)	432 (56.9)
Detached	961 (11.7)	142 (15.7)	125 (16.5)
Missing	1630 (19.8)	242 (26.7)	202 (26.6)
Quality of life (CASP-19)			
High	2116 (25.7)	150 (16.5)	109 (14.4)
Mid	2534 (30.8)	252 (27.8)	216 (28.5)
Low	2351 (28.6)	328 (36.2)	295 (38.9)
Missing	1221 (14.9)	177 (19.5)	139 (18.3)
Locus of control			
Internal	1659 (20.2)	134 (14.8)	108 (14.2)
External	5545 (67.4)	618 (68.1)	532 (70.1)
Missing	1018 (12.4)	155 (17.1)	119 (15.7)
CES-D depression classification			
Not depressed	6970 (84.8)	708 (78.1)	579 (76.3)
Depressed	1132 (13.8)	179 (19.7)	163 (21.5)
Missing	120 (1.5)	20 (2.2)	17 (2.2)
Lives alone			
No	2773 (33.7)	252 (27.8)	215 (28.3)
Yes	5140 (62.5)	618 (68.1)	512 (67.5)
Missing	309 (3.8)	37 (4.1)	32 (4.2)

a Previous care was assessed in wave 4.

b Time since diagnosis is measured in waves since the diagnosis was reported in ELSA and was entered into models as an ordinal variable.

Model *n*: care bundle = 903; ACE inhibitor quality indicator = 757. Some cases were lost owing to missing values. The reference category of each covariate is listed first. Frequency of missing data is not reported if these account for < 1% of cases.

**TABLE 18** Associations between baseline characteristics and subsequent non-receipt of diabetes care 2 years later: logistic regression

Covariate	Care bundle, OR (95% CI)	Diabetes ACE inhibitor, OR (95% CI)
Sex		
Female	1.0 (–)	1.0 (–)
Male	1.14 (0.76 to 1.70)	1.11 (0.73 to 1.70)
Age group, years (trend) <sup>a</sup>		
50–64	1.0 (–)	1.0 (–)
65–74	1.26 (0.86 to 1.86)	0.91 (0.61 to 1.37)
75 +	1.40 (0.89 to 2.22)	0.57 (0.34 to 0.97) <sup>b</sup>
Previous care <sup>c</sup>		
Achieved	1.0 (–)	1.0 (–)
Not achieved	3.26 (2.24 to 4.74) <sup>d</sup>	6.94 (4.54 to 10.60) <sup>d</sup>
New case	1.16 (0.35 to 3.81)	2.23 (0.66 to 7.49)
Missing	–	2.17 (0.92 to 5.11)
NS–SEC (trend) <sup>a</sup>		
Managerial/professional	1.0 (–)	1.0 (–)
Intermediate	0.88 (0.55 to 1.41)	1.14 (0.68 to 1.91)
Routine/manual	1.41 (0.95 to 2.10)	1.36 (0.89 to 2.10)
Missing	1.41 (0.45 to 4.47)	1.53 (0.47 to 5.06)
Eyesight		
Excellent/good	1.0 (–)	1.0 (–)
Fair/blind	0.96 (0.63 to 1.46)	1.03 (0.65 to 1.63)
Has long-standing illness (trend) <sup>a</sup>		
No	1.0 (–)	1.0 (–)
Yes	0.96 (0.56 to 1.63)	0.96 (0.53 to 1.74)
Yes to limiting	0.91 (0.55 to 1.51)	1.06 (0.61 to 1.84)
Cognitively impaired		
No	1.0 (–)	1.0 (–)
Yes	1.78 (1.09 to 2.89) <sup>b</sup>	1.63 (0.90 to 2.97)
Missing	1.59 (0.93 to 2.73)	1.04 (0.52 to 2.08)
Health literacy		
High	1.0 (–)	1.0 (–)
Low	1.10 (0.77 to 1.57)	1.51 (1.01 to 2.26) <sup>b</sup>
Missing	0.93 (0.50 to 1.72)	2.46 (1.22 to 4.99) <sup>b</sup>
Time since diagnosis (waves)	1.04 (0.84 to 1.30)	0.99 (0.79 to 1.25)

continued

**TABLE 18** Associations between baseline characteristics and subsequent non-receipt of diabetes care 2 years later: logistic regression (*continued*)

Covariate	Care bundle, OR (95% CI)	Diabetes ACE inhibitor, OR (95% CI)
Knows everything about managing diabetes		
Yes	1.0 (–)	1.0 (–)
No	2.03 (1.28 to 3.22) <sup>e</sup>	1.32 (0.77 to 2.26)
Missing	3.40 (1.16 to 9.94) <sup>b</sup>	2.46 (0.79 to 7.66)
BMI category (trend) <sup>a</sup>		
Under-/normal weight	1.0 (–)	1.0 (–)
Overweight	1.06 (0.59 to 1.91)	0.71 (0.37 to 1.37)
Obese	0.98 (0.55 to 1.73)	0.49 (0.26 to 0.90) <sup>b</sup>
Missing	0.88 (0.45 to 1.72)	0.64 (0.31 to 1.33)
Married/in civil partnership		
Yes	1.0 (–)	1.0 (–)
No	1.09 (0.73 to 1.63)	2.17 (1.40 to 3.38) <sup>d</sup>
CES–D depression classification		
No	1.0 (–)	1.0 (–)
Yes	0.92 (0.61 to 1.40)	0.98 (0.62 to 1.55)
Missing	0.68 (0.24 to 1.93)	2.96 (0.84 to 10.47)
Lives alone		
No	1.0 (–)	1.0 (–)
Yes	0.75 (0.48 to 1.19)	0.96 (0.59 to 1.55)
Missing	0.66 (0.28 to 1.55)	0.78 (0.29 to 2.07)
Log-likelihood	–519.22	–424.94
Wald $\chi^2$	86.54	134.17
<i>p</i> -value	0.000	0.000
Pseudo <i>R</i> <sup>2</sup>	0.103	0.198
<i>n</i>	903	757

a Linear trends were performed for appropriate covariates, which are displayed on the same line as the covariate name followed by '(trend)'.

b  $p < 0.05$ .

c 'Previous care' was assessed at wave 4 (2 years prior to the outcome).

d  $p < 0.001$ .

e  $p < 0.01$ .

All outcomes adjusted for age and sex, and weighted for differential non-response at wave 5. The reference category for each covariate is the first category listed and has an OR of 1.0. An OR > 1.0 represents increased odds of subsequent non-receipt of care, whereas an OR of < 1.0 indicates reduced odds of this.

previous care, the two models diverged in their significant predictors. Respondents classified as cognitively impaired had 78% increased odds of non-receipt of the care bundle (OR 1.78, 95% CI 1.09 to 2.89;  $p = 0.021$ ). Those who did not feel they knew at least most of what they needed to know about managing their diabetes had double the odds of not receiving all three of the annual checks included in the bundle (OR 2.03, 95% CI 1.28 to 3.22;  $p = 0.003$ ), but knowledge of diabetes management was not significantly associated with not being offered an ACE inhibitor (OR 1.32, 95% CI 0.77 to 2.26;  $p = 0.31$ ).

On the other hand, patients with low health literacy had 50% higher odds for non-receipt of ACE inhibitor (OR 1.51, 95% CI 1.01 to 2.26;  $p = 0.043$ ) than those with high health literacy, with no significant difference apparent for the care bundle. The odds of not being offered an ACE inhibitor were decreased in the oldest age group (OR 0.57, 95% CI 0.34 to 0.97;  $p = 0.038$ ) and in those categorised as obese (OR 0.49, 95% CI 0.26 to 0.90;  $p = 0.021$ ), but were increased over twofold for those not married or in a civil partnership (OR 2.17, 95% CI 1.40 to 3.38;  $p < 0.001$ ).

### Sensitivity analyses for missing data

Sensitivity analyses were conducted to determine whether or not using multiple imputation of missing data would alter the final results for non-receipt of the diabetes care bundle and the ACE inhibitor/receptor blocker quality indicator (Table 19). The results from the model using multiple imputation were remarkably similar to the original models for both the care bundle and the ACE inhibitor quality indicator. A small number of differences were evident. For the model assessing non-receipt of the ACE inhibitor quality indicator, the difference found between those aged  $\geq 75$  years and those aged 50–64 years was no longer

**TABLE 19** Comparison of logistic regression models predicting non-receipt of the diabetes care bundle, with and without multiple imputation of missing data

Covariate	Missing data as a category, OR (95% CI)	Multiple imputation of missing data, OR (95% CI)
Sex		
Female	1.0 (–)	1.0 (–)
Male	1.14 (0.76 to 1.70)	1.16 (0.78 to 1.72)
Age (years)		
50–64	1.0 (–)	1.0 (–)
65–74	1.26 (0.86 to 1.86)	1.21 (0.83 to 1.78)
75+	1.40 (0.89 to 2.22)	1.37 (0.86 to 2.17)
Previous care		
Complete	1.0 (–)	1.0 (–)
Incomplete	3.26 (2.24 to 4.74) <sup>a</sup>	3.16 (2.17 to 4.61) <sup>a</sup>
New case	1.16 (0.35 to 3.81)	2.80 (1.47 to 5.31) <sup>b</sup>
NS-SEC		
Managerial/professional	1.0 (–)	1.0 (–)
Intermediate	0.88 (0.55 to 1.41)	0.87 (0.53 to 1.43)
Routine/manual	1.41 (0.95 to 2.10)	1.37 (0.90 to 2.08)
Missing	1.41 (0.45 to 4.47)	–
Eyesight		
Excellent/good	1.0 (–)	1.0 (–)
Fair/blind	0.96 (0.63 to 1.46)	0.95 (0.63 to 1.43)

continued

**TABLE 19** Comparison of logistic regression models predicting non-receipt of the diabetes care bundle, with and without multiple imputation of missing data (*continued*)

Covariate	Missing data as a category, OR (95% CI)	Multiple imputation of missing data, OR (95% CI)
Has long-standing illness		
No	1.0 (–)	1.0 (–)
Yes	0.96 (0.56 to 1.63)	0.93 (0.55 to 1.57)
Yes to limiting	0.91 (0.55 to 1.51)	0.90 (0.54 to 1.48)
Cognitively impaired		
No	1.0 (–)	1.0 (–)
Yes	1.78 (1.09 to 2.89) <sup>c</sup>	1.78 (1.12 to 2.88) <sup>c</sup>
Missing	1.59 (0.93 to 2.73)	–
Health literacy		
High	1.0 (–)	1.0 (–)
Low	1.10 (0.77 to 1.57)	1.11 (0.77 to 1.62)
Missing	0.93 (0.50 to 1.72)	–
Time since diagnosis (waves)	1.04 (0.84 to 1.30)	1.01 (0.81 to 1.25)
Knows everything about managing diabetes		
Yes	1.0 (–)	1.0 (–)
No	2.03 (1.28 to 3.22) <sup>b</sup>	1.98 (1.25 to 3.13) <sup>c</sup>
Missing	3.40 (1.16 to 9.94) <sup>c</sup>	–
BMI category		
Under-/normal weight	1.0 (–)	1.0 (–)
Overweight	1.06 (0.59 to 1.91)	1.00 (0.55 to 1.82)
Obese	0.98 (0.55 to 1.73)	0.93 (0.52 to 1.65)
Missing	0.88 (0.45 to 1.72)	–
Married/in civil partnership		
Yes	1.0 (–)	1.0 (–)
No	1.09 (0.73 to 1.63)	1.06 (0.72 to 1.58)
CES–D depression classification		
No	1.0 (–)	1.0 (–)
Yes	0.92 (0.61 to 1.40)	0.90 (0.59 to 1.36)
Missing	0.68 (0.24 to 1.93)	–
Lives alone		
No	1.0 (–)	1.0 (–)
Yes	0.75 (0.48 to 1.19)	0.73 (0.46 to 1.16)
Missing	0.66 (0.28 to 1.55)	–

a  $p < 0.001$ .b  $p < 0.01$ .c  $p < 0.05$ .

All outcomes adjusted for age and sex, and weighted for differential non-response at wave 5. The reference category for each covariate is the first category listed and has an OR of 1.0. An OR > 1.0 represents increased odds of subsequent non-receipt of care, whereas an OR of < 1.0 indicates reduced odds of this.



significant, though the ORs and CIs were very similar. Cognitive impairment became significant ( $p < 0.05$ ) in this model when using multiple imputation. The biggest difference between the two methods was apparent for the 'new case' category in the 'previous care' covariate, that is those reporting a diagnosis of diabetes only at the latest wave (2010–11). These participants were found to be at greatly increased odds of not receiving the care bundle and/or the ACE inhibitor quality indicator in the models using multiple imputation. However, it should be noted that, as we cannot tell at what point between the two waves these participants were told they had diabetes, it is inappropriate to draw conclusions on their likelihood of not receiving care. It may be the case that they have not had the diagnosis for sufficiently long to have the opportunity to receive a complete care cycle. Thus, we feel that it is sensible to treat the 'new case' category as if it were a special kind of 'missing data' in its own right.

## Population distribution of illness burden, diagnosis and treatment

### Demographics

The sample of participants aged 50 years or over who had responded to at least one wave of ELSA from wave 2 in 2004–5 until wave 5 in 2010–11 and were core members was used to address research question 3: are factors such as wealth, or patient education, physical activity, obesity, coexisting other chronic conditions or practical factors such as good eyesight or marital status independently associated with the quality of health care received, from symptoms to diagnosis and, finally, to treatment?

There were 12,765 core members in the sample, and 8729 in wave 5, of whom slightly over half were women, and slightly over half were aged  $\geq 60$  years (Table 20). Diagnosed diabetes, angina and osteoarthritis were more prevalent with increasing age, but the opposite trend was seen with depression, with 10% of the youngest age group reporting a diagnosis compared with only 3% in the oldest age group. The highest prevalence of all conditions was seen in the poorest quintile. For example, the prevalence of depression was 4% in the wealthiest quintile and 11% in the least wealthy.

**TABLE 20** Characteristics of ELSA participants at wave 5 (2010–11) and self-reported medical diagnosis of the diagnosed conditions

Characteristics	<i>n</i>	Angina, %	Depression, %	Diabetes, %	Osteoarthritis, %
Sex					
Male	3886	8.2	5.4	13.3	19.8
Female	4843	6.3	7.8	9.4	32.9
Age (years)					
50–59	1906	2.2	10.1	7.2	17.1
60–74	4766	5.8	7.0	11.0	28.1
75 +	2057	15.0	2.9	15.0	34.1
Wealth quintile					
1 (wealthiest)	1716	3.4	4.1	6.0	21.5
2	1714	4.9	5.9	8.0	24.2
3	1723	6.6	5.7	11.3	25.7
4	1716	8.2	6.7	13.6	31.6
5 (poorest)	1715	12.9	11.5	16.7	33.1
Missing	145	5.5	4.8	9.7	20.0
Total	8729	7.2	6.7	11.1	27.1

There was very little variation in the prevalence of illness burden, diagnosis and treatment between the waves for each of the four conditions (Table 21).

### Modelling with illness burden, diagnosis and treatment

The hypothetically poorest participant had higher odds of illness burden than the hypothetically richest for each of the four conditions at all four time points (ORs ranging from 3.9 to 16.0) (Table 22). The odds were generally smaller for diagnosis (ORs 0.6 to 5.3) and appropriate treatment (ORs 0.2 to 3.3). The substantially higher illness burden in less wealthy participants was not matched by higher levels of diagnosis and treatment (Figure 2).

For angina, the overall OR for meeting the criteria for illness burden was 7.6, indicating that the hypothetically least wealthy individual was almost eight times more likely to have angina symptoms (defined by the Rose Angina Scale) than the wealthiest. The OR for reported medical diagnosis was 4.5, suggesting that some less wealthy people with angina symptoms had not received a diagnosis of angina, as the expected OR for equitably distributed diagnosis would be 7.6. The OR for treatment was 3.2, and again the expected OR for equitably distributed treatment would have been around 8.

For depression, the overall OR for illness burden was 6.4, while for medical diagnosis it was 3.3 and for treatment it was 2.6, again suggesting that some poorer people with illness burden of depression were less likely to have received a diagnosis or indicated health care.

For diabetes, the overall ORs for illness burden were 4.2 and 4.0 for diagnosis, suggesting that diabetes diagnosis was distributed equitably. However, the OR for treatment was 0.9 and not statistically different from 1, again suggesting that some less wealthy people with medically diagnosed diabetes had not received treatment, as the expected OR for equitably distributed treatment would have been around 4.

**TABLE 21** Prevalence of illness burden, self-reported medical diagnosis and treatment for angina, cataract, depression, diabetes and osteoarthritis in four waves of ELSA

Wave	Angina, n (%)	Depression, n (%)	Diabetes, n (%)	Osteoarthritis, n (%)
Illness burden				
Wave 2 (2004–5)	397 (4.6)	2037 (23.4)	160 (1.8)	1106 (12.7)
Wave 3 (2006–7)	300 (3.6)	1929 (23.3)	N/A	917 (11.1)
Wave 4 (2008–9)	300 (3.1)	2049 (21.4)	220 (2.3)	1088 (11.4)
Wave 5 (2010–11)	254 (2.9)	1956 (22.4)	N/A	1046 (12.0)
Medical diagnosis				
Wave 2	668 (7.6)	402 (4.6)	715 (8.2)	1861 (21.4)
Wave 3	591 (7.1)	490 (5.9)	935 (11.3)	1952 (23.6)
Wave 4	645 (6.7)	601 (6.3)	1215 (12.7)	2262 (23.6)
Wave 5	655 (7.5)	602 (6.9)	1413 (16.2)	2416 (27.7)
Treatment				
Wave 2	85 (1.0)	98 (1.1)	552 (6.4)	202 (2.3)
Wave 3	N/A	N/A	618 (7.5)	141 (1.7)
Wave 4	N/A	155 (1.6)	671 (7.0)	226 (2.4)
Wave 5	88 (1.0)	N/A	748 (8.6)	208 (2.4)

N/A, data not available.

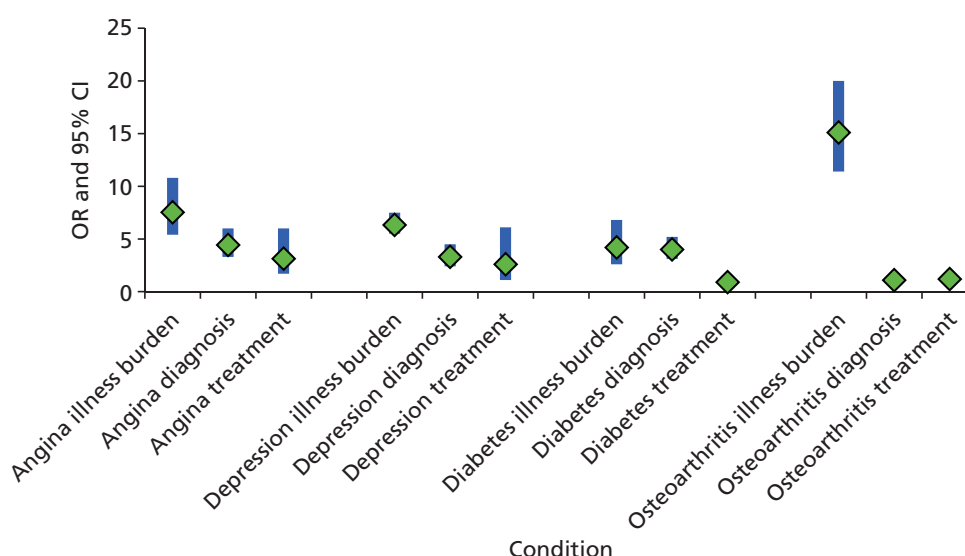
**TABLE 22** Illness burden, medical diagnosis and treatment of angina, depression, diabetes and osteoarthritis, comparing the least wealthy with the wealthiest: logistic regression

	Wave 2 (2004–5), adjusted OR <sup>a</sup> (95% CI)		Wave 3 (2006–7), adjusted OR (95% CI)		Wave 4 (2008–9), adjusted OR (95% CI)		Wave 5 (2010–11), adjusted OR (95% CI)		Overall, adjusted OR (95% CI)			
	Illness burden	Diagnosis Treatment	Illness burden	Diagnosis Treatment	Illness burden	Diagnosis Treatment	Illness burden	Diagnosis Treatment	Illness burden	Diagnosis Treatment		
Angina	5.6 (3.8 to 8.3)	2.9 (2.2 to 3.9)	2.6 (1.2 to 5.7)	4.9 (3.6 to 6.8)	6.7 (4.2 to 10.5)	4.3 (3.2 to 5.9)	8.4 (5.1 to 13.7)	5.3 (3.9 to 7.3)	3.3 (1.5 to 7.3)	7.6 (5.4 to 10.8)	4.5 (3.3 to 6.0)	3.2 (1.7 to 6.0)
Depression	5.1 (4.3 to 6.2)	4.8 (3.3 to 7.0)	0.6 (0.1 to 2.9)	0.7 (0.4 to 1.4)	5.9 (4.9 to 7.1)	0.7 (0.4 to 1.2)	5.9 (4.8 to 7.1)	1.7 (1.0 to 2.8)	2.4 (1.0 to 5.9)	6.4 (5.5 to 7.5)	3.3 (2.4 to 4.5)	2.6 (1.1 to 6.1)
Diabetes	4.4 (2.5 to 8.0)	3.1 (2.3 to 4.2)	0.7 (0.3 to 1.5)	3.4 (2.6 to 4.4)	3.9 (2.4 to 6.4)	3.9 (2.4 to 6.4)	3.9 (2.4 to 6.4)	4.3 (3.4 to 5.4)	0.2 (0.1 to 0.6)	4.2 (2.6 to 6.8)	4.0 (3.1 to 5.2)	0.9 (0.5 to 1.4)
OA	11.0 (8.1 to 14.9)	1.6 (1.3 to 2.0)	1.1 (0.7 to 1.9)	0.6 (0.4 to 0.8)	14.0 (10.3 to 19.1)	0.6 (0.4 to 0.8)	16.0 (11.7 to 21.8)	0.6 (0.4 to 0.8)	1.0 (0.6 to 1.6)	15.1 (11.4 to 20.0)	1.1 (0.9 to 1.3)	1.2 (0.8 to 1.6)

OA, osteoarthritis.

a Adjusted for age group, sex and slope index of inequality for wealth.

Ages were  $\geq 50$  years, except for osteoarthritis where all analyses were only performed on those aged  $\geq 60$  years, as data on osteoarthritis treatment were only collected in those aged  $\geq 60$  years.



**FIGURE 2** Illness burden, medical diagnosis and treatment of angina, depression, diabetes and osteoarthritis, comparing the least wealthy with the most wealthy: overall ORs (adjusted for age and sex) and 95% confidence bars (logistic regression).

We also calculated the ORs of receiving a diagnosis in a subsequent wave, only for those who were estimated to have had the relevant long-term condition in a previous wave, and then the likelihood of receiving treatment, only for those who had received a medical diagnosis in a previous wave. This is a secondary analysis as the numbers of participants that could be followed over time in this manner was small, particularly for treatment in angina and depression, and so these results should be interpreted with great caution. The substantial inequalities in the estimated prevalence of conditions by wealth are similar to *Table 23*, as expected, and subsequently the numbers are too small for the results to be statistically significant. The general pattern, however, is consistent with less medical diagnosis and treatment in less wealthy participants. Taking osteoarthritis as an example, ORs were 12.7 (95% CI 9.1 to 17.8) for estimated prevalence in wave 3, 0.7 (95% CI 0.3 to 1.8) for diagnosis in wave 4 and 0.7 (95% CI 0.3 to 1.6) for treatment in wave 5 (*Table 23*).

**TABLE 23** Odds ratios for meeting the 'illness burden' criteria for angina, depression, diabetes and osteoarthritis; receiving a medical diagnosis for those who previously met the 'illness burden' criteria; and receiving treatment for those with a previous diagnosis, comparing the least wealthy with the most wealthy: logistic regression<sup>a</sup>

Condition	OR <sup>a</sup> (95% CI)			<i>n</i> receiving treatment <sup>b</sup>
	Illness burden (wave 3)	Medical diagnosis (wave 4)	Treatment (wave 5)	
Angina	8.7 (5.5 to 13.8)	1.4 (0.5 to 4.0)	1.6 (0.3 to 9.0)	11
Osteoarthritis	12.7 (9.1 to 17.8)	0.7 (0.3 to 1.8)	0.7 (0.3 to 1.6)	30
	Illness burden (wave 2)	Medical diagnosis (wave 3)	Treatment (wave 4)	
Depression	5.1 (4.3 to 6.2)	0.4 (0.1 to 1.4)	17.3 (0.5 to 60.4)	12
Diabetes	4.4 (2.5 to 8.0)	0.1 (0.0 to 3.6)	0.5 (0.2 to 1.1)	99

a Adjusted for age group and sex.

b Followed through the waves.

Waves used in analysis were the most recent with available data.

## Modelling with illness burden, diagnosis and treatment: additional covariates

The regression models immediately above for comparing the distribution by wealth of illness burden, diagnosis and treatment, respectively (see previous section), were adjusted for age, sex and slope index of inequality only. This section reports the results when additional covariates were added to the models above and the results when one more covariate at a time was added to the models, which are presented separately for illness burden (see *Table 24*), diagnosis (see *Table 25*) and treatment (see *Table 26*).

### Illness burden

*Table 24* presents the results for illness burden.

Having two or more comorbidities is associated with having increased odds of having angina illness burden [OR 7.5 (95% CI 6.0 to 9.4)]; there is a smaller, but still significant effect for the other diseases. Having poorer eyesight was also associated with increasing odds of having illness burden of all four diseases, with ORs ranging from 2.5 (95% CI 1.5 to 4.1) for diabetes to 3.9 (95% CI 3.0 to 5.0) for osteoarthritis. Difficulty in accessing a GP was also associated with increasing odds for having illness burden for all four diseases [osteoarthritis OR 6.9 (95% CI 5.5 to 8.9)]. Looking at BMI, there was an increment in odds of having illness burden the more the BMI increased for all the diseases, though the effect was lowest in depression [overweight 0.9 (95% CI 0.8 to 1.0) and obese 1.2 (95% CI 1.1 to 1.4)].

**TABLE 24** Associations between participant characteristics and illness burden for angina, depression, diabetes and osteoarthritis: logistic regression, adjusted for age, sex and slope index of inequality

Covariate added to the age, sex and slope index of inequality model	Angina, OR (95% CI)	Depression, OR (95% CI)	Diabetes, OR (95% CI)	Osteoarthritis, OR (95% CI)
Highest educational qualification vs. none				
Degree or higher education	0.6 (0.5 to 0.8)	0.7 (0.7 to 0.8)	0.7 (0.5 to 1.0)	0.6 (0.5 to 0.7)
Physical activity level vs. sedentary				
High	0.3 (0.2 to 0.5)	0.2 (0.2 to 0.3)	0.3 (0.2 to 0.5)	0.07 (0.05 to 0.09)
Comorbidities vs. none or one				
Two or more	7.5 (6.0 to 9.4)	2.0 (1.8 to 2.2)	2.0 (1.5 to 2.6)	3.1 (2.7 to 3.5)
Eyesight vs. excellent				
Fair/poor/blind	2.8 (2.1 to 4.0)	3.3 (2.8 to 4.0)	2.5 (1.5 to 4.1)	3.9 (3.0 to 5.0)
Cohabiting				
vs. living alone	0.9 (0.8 to 1.1)	0.6 (0.5 to 0.6)	0.9 (0.7 to 1.2)	1.0 (0.9 to 1.2)
Access to GP				
Difficult/impossible vs. very easy	2.4 (1.8 to 3.2)	4.3 (3.5 to 5.4)	1.5 (0.9 to 2.4)	6.9 (5.5 to 8.9)
Health literacy vs. literate				
Health illiterate	0.8 (0.7 to 1.0)	0.7 (0.6 to 0.8)	0.8 (0.6 to 1.1)	0.7 (0.6 to 0.9)
BMI vs. normal/underweight				
Overweight	1.5 (1.2 to 2.0)	0.9 (0.8 to 1.0)	1.7 (1.1 to 2.7)	1.4 (1.2 to 1.8)
Obese	2.3 (1.8 to 3.0)	1.2 (1.1 to 1.4)	4.0 (2.6 to 6.1)	3.7 (3.0 to 4.6)

### Diagnosis

Very similar findings were seen in the adjusted diagnosis model, where the odds of having diagnosis of angina were 11-fold if you had two or more comorbidities. There was still a gradient seen in increasing BMI and increasing odds of being diagnosed for all four conditions (*Table 25*).

### Treatment

For the treatment model, having comorbidities was less associated with angina [OR 0.9 (95% CI 0.3 to 2.7)] than in the diagnosis or illness burden models. Being more physically active was associated with increased odds of being treated for angina [OR medium physical activity 3.3 (95% CI 1.2 to 8.6); OR high physical activity 6.5 (95% CI 1.1 to 37.1)]. Depression and osteoarthritis treatment was associated with being overweight or obese, and the strongest predictor for diabetes treatment was high physical activity and not living alone [OR 1.5 (95% CI 0.5 to 4.2) and OR 1.5 (95% CI 0.9 to 2.5)], respectively (*Table 26*).

**TABLE 25** Associations between participant characteristics and diagnosis for angina, depression, diabetes and osteoarthritis: logistic regression, adjusted for age, sex and slope index of inequality

Covariate added to the age, sex and slope index of inequality model	Angina, adjusted OR (95% CI)	Depression, adjusted OR (95% CI)	Diabetes, adjusted OR (95% CI)	Osteoarthritis, adjusted OR (95% CI)
Highest educational qualification vs. none				
Degree or higher education	0.7 (0.6 to 0.9)	1.2 (0.9 to 1.4)	0.7 (0.6 to 0.9)	0.9 (0.8 to 1.1)
Physical activity level vs. sedentary				
High	0.4 (0.3 to 0.5)	0.5 (0.3 to 0.6)	0.3 (0.2 to 0.4)	0.5 (0.4 to 0.6)
Comorbidities vs. none or one				
Two or more	11.0 (8.8 to 13.8)	1.3 (1.1 to 1.5)	1.9 (1.7 to 2.2)	1.7 (1.5 to 1.9)
Eyesight vs. excellent				
Fair/poor/blind	2.5 (1.9 to 3.3)	1.8 (1.4 to 2.5)	1.7 (1.3 to 2.2)	1.6 (1.3 to 2.0)
Cohabiting				
vs. living alone	0.9 (0.8 to 1.1)	0.7 (0.6 to 0.8)	1.0 (0.9 to 1.2)	1.0 (0.9 to 1.2)
Access to GP				
Difficult/impossible vs. very easy	1.8 (1.4 to 2.3)	1.9 (1.4 to 2.6)	2.0 (1.6 to 2.6)	2.0 (1.0 to 2.5)
Health literacy vs. literate				
Health illiterate	1.3 (1.0 to 1.6)	1.1 (0.9 to 1.3)	0.9 (0.8 to 1.0)	1.0 (0.9 to 1.1)
BMI vs. normal/underweight				
Overweight	1.2 (1.0 to 1.6)	0.9 (0.8 to 1.2)	1.7 (1.3 to 2.1)	1.3 (1.1 to 1.5)
Obese	1.6 (1.3 to 2.0)	1.6 (1.3 to 2.0)	4.0 (3.1 to 5.0)	1.8 (1.5 to 2.1)

**TABLE 26** Associations between participant characteristics and treatment for angina, depression, diabetes and osteoarthritis: logistic regression, adjusted for age, sex and slope index of inequality

Covariate added to the age, sex and slope index of inequality model	Angina, OR (95% CI) after adjusting for age, sex, slope index	Depression, OR (95% CI) after adjusting for age, sex, slope index	Diabetes, OR (95% CI) after adjusting for age, sex, slope index	Osteoarthritis, OR (95% CI) after adjusting for age, sex, slope index
Highest educational qualification vs. none				
Intermediate	2.6 (1.1 to 6.0)	1.1 (0.6 to 2.0)	0.9 (0.5 to 1.5)	0.9 (0.7 to 1.1)
Degree or higher education	2.1 (1.1 to 6.0)	0.9 (0.5 to 1.7)	1.2 (0.6 to 2.3)	0.9 (0.7 to 1.2)
Physical activity level vs. sedentary				
Medium	3.3 (1.2 to 8.6)	0.6 (0.2 to 1.7)	1.2 (0.6 to 2.5)	0.7 (0.5 to 0.9)
High	6.5 (1.1 to 37.1)	0.5 (0.1 to 1.4)	1.5 (0.5 to 4.2)	0.5 (0.4 to 0.8)
Comorbidities vs. two or more				
None or one	0.9 (0.3 to 2.7)	1.2 (0.7 to 2.0)	1.1 (0.7 to 1.7)	1.3 (1.1 to 1.6)
Eyesight vs. excellent				
Fair/poor/blind	1.5 (0.4 to 5.3)	1.1 (0.5 to 2.7)	2.2 (0.8 to 5.8)	1.1 (0.8 to 1.6)
Cohabiting				
vs. living alone	1.4 (0.7 to 3.0)	1.2 (0.7 to 2.0)	1.5 (0.9 to 2.5)	1.0 (0.8 to 1.3)
Access to GP				
Easy vs. very easy	1.7 (0.6 to 4.3)	1.2 (0.7 to 2.0)	0.9 (0.5 to 1.5)	1.2 (1.0 to 1.5)
Difficult/impossible vs. very easy	2.4 (0.8 to 7.2)	1.5 (0.5 to 4.4)	0.9 (0.4 to 2.1)	2.2 (1.6 to 3.0)
Health literacy				
Health illiterate vs. literate	1.7 (0.8 to 2.1)	0.7 (0.4 to 1.4)	1.0 (0.6 to 1.6)	0.8 (0.7 to 1.0)
BMI				
Overweight vs. normal/underweight	0.7 (0.2 to 2.1)	1.8 (0.9 to 3.5)	0.8 (0.3 to 1.9)	2.0 (1.4 to 2.7)
Obese vs. normal/underweight	0.4 (0.2 to 1.3)	1.8 (0.9 to 3.7)	1.0 (0.4 to 2.3)	3.8 (2.7 to 5.2)
Joint replacement payment type				
Private vs. NHS				1.7 (0.8 to 3.6)





## Chapter 4 Discussion

These analyses of quality of care and participant characteristics from the ELSA have shown that, despite relatively high levels of quality achievement in cardiovascular disease and individual diabetes care processes, important shortfalls in quality of care have persisted over 6 years. Shortfalls were greater for the diabetes care bundle, for depression and particularly for osteoarthritis, with less than half of indicated health care achieved for osteoarthritis compared with the other three conditions. Osteoarthritis was, however, the only condition where quality had improved over time, perhaps partly because of the low starting point.

Variations in quality by participant characteristics were generally small, with the few statistically significant associations including worse care for diabetes in participants with cognitive impairment, and better care in those living alone. Hypertension care was better for those aged > 74 years, and osteoarthritis care was better for those with greater pain, limiting illness and obesity. Previous non-achievement of the diabetes care bundle was the biggest predictor of non-achievement 2 years later. The surprising lack of variation in quality of care by participant characteristics suggests that future quality improvement interventions may be more effective when directed at health-care delivery systems rather than at individuals.

The comparison of the distribution by wealth of illness burden with the distribution of diagnoses and treatments showed that the relatively high prevalence of specific illness burden in poorer participants was not matched by an equally high prevalence of diagnosis or treatment, suggesting that barriers to equity may exist at the stage at diagnosis.

### Comparison of main results with previous research

#### Quality indicator achievement

Our findings are broadly consistent with the findings of a systematic review by Askari *et al.*<sup>13</sup> of 17 papers reporting on achievement of the ACOVE quality indicators, which showed large variation between conditions, and notably low rates for osteoarthritis quality indicators. This review only found a few conditions with a stable pass rate range over multiple studies, and noted that caution is required in making direct comparisons of quality indicator achievement between studies. Most indicators were reported in only a small number of studies and were drawn from different countries and diverse populations (e.g. nursing home residents or primary care settings).

For the cardiovascular disease indicators reported here, the proportion of eligible patients who reported receiving care ranged between 64% for MI beta-blocker and 100% for INR test in wave 2. By wave 5 these figures ranged between 73% for MI beta-blocker and 94% for INR test. Improvements were observed in the achievement rates for some indicators between waves 2 and 5 (stroke antihypertensives +7%, hypertension treatment +8%, MI beta-blocker +12%). However, achievement rates of the remaining indicators stayed constant across time with the exception of the INR test, which declined by 6% from the 100% attainment noted at wave 2. Askari *et al.*<sup>13</sup> reported comparable achievement rates in primary care settings for hypertension (72% vs. 75% prevalent hypertension treatment at wave 5) and stroke (69% vs. 85% achievement in ELSA) indicators.

For the diabetes indicators, achievement rates in wave 2 ranged between 48% for ACE inhibitor and 83% for diabetes HbA<sub>1c</sub> testing. By wave 5 these figures ranged between 57% for ACE inhibitor and 89% for diabetes cholesterol test. Most diabetes indicators remained largely unchanged across time, with the exception of the ACE inhibitor one, which increased by 9% between waves 2 and 5. Our findings are broadly consistent with figures reported for 2009–10 in the recent National Diabetes Audit<sup>18</sup> which examined all available clinical records in the UK. This audit found achievement rates of 93%, 74% and 85% for HbA<sub>1c</sub> checks, renal risk checks and foot checks, respectively. This compares with wave 5 data, where 82% patients reported having HbA<sub>1c</sub> levels checked, 79% had a proteinuria check and 83% received a foot check.

Receipt of care for depression at wave 2 was 46% (suicide), 79% (treatment) and 76% (review), and at wave 4 was 58% (suicide) and 62% (treatment). Although depression is a condition included in the QOF for UK general practice, the QOF indicators do not map perfectly to the criteria used in ELSA and no direct comparisons can be made.

Achievement of the osteoarthritis indicators was lower than for any cardiovascular disease, depression or diabetes indicators, ranging from 26% (education) to 45% (paracetamol) at wave 2, and from 32% (education) to 46% (exercise) at wave 5. Although a prevalent condition in later life, osteoarthritis is not included in the QOF. For both depression and osteoarthritis we found no national audit data that could be compared with our sample. The review by Askari *et al.*<sup>13</sup> found very similar rates of achievement of osteoarthritis indicators (interquartile range 29% to 41%), which they described as 'notably low'.

### **Transitions in quality indicator achievement over time**

We explored transitions in quality indicator achievement across time by tabulating whether or not patients received their care at a given wave with subsequent receipt of that care by the next wave. This allowed us to investigate the rates of transitions from poor-quality care to good-quality care and vice versa, as well as the rates of continued receipt of poor- or good-quality care. Not all quality indicators were suitable for this analysis as some indicators (e.g. depression) referred to the management of incident disease within specific time scales.

For other quality indicators it was not possible to transition from receiving care at one wave to subsequently not receiving it, as the indicated care either only needed to be provided once (osteoarthritis exercise and education), or referred to the provision of long-term treatment (stroke antihypertensives). However, there were relatively low rates of transitions from not receiving the care to subsequently receiving it, especially for the two osteoarthritis quality indicators. The majority of eligible people who did not receive indicated care continued to receive poor quality of care subsequently.

A different pattern emerged from the follow-up for the hypertension quality indicator, the three quality indicators for annual monitoring checks for diabetes (HbA<sub>1c</sub> test, proteinuria and foot check) that compose the diabetes care bundle, and the quality indicator assessing the prescription of ACE inhibitors to those with diabetes and additional cardiac risk factors. For these quality indicators, more participants who did not receive their care at a given wave transitioned to subsequently receiving it than to continuing to not receive it. There were comparatively low rates of patients transitioning from receiving good quality of care to not receiving their care (e.g. 2% to 3% for hypertension and 19% to 24% for the diabetes care bundle) in relation to those who continued to receive poor-quality care (e.g. 31% to 40% for hypertension and 45% to 48% for the diabetes care bundle). Overall, our results suggest that those participants who received poor care tended to persistently receive poor care, and that time alone did not rectify deficits in care.

### **Participant characteristics associated with receipt of indicated health care**

The results of multivariate logistic regression modelling for individual conditions found that very few of the wide range of personal characteristics that we measured were significantly and independently associated with eligible individuals achieving indicated care. At condition level, some participant characteristics were associated with achievement of care. For example, achievement of diabetes care was higher for patients without cognitive impairment, or for patients who lived alone than those cohabiting. In contrast, care achievement for patients with osteoarthritis was associated with participants reporting severe pain or having a limiting illness, or being obese compared with their healthier counterparts.

### **Modelling achievement of the care bundle for diabetes**

This analysis included 8222 ELSA participants at wave 5 who also responded at wave 4, of whom 11% had diabetes. Despite low non-achievement for the individual diabetes quality indicators (17% to 23%) in wave 5, we found that at least one of the three bundled annual monitoring checks was not achieved in one-third of eligible patients in 2010–11 (33%). Our figure is somewhat lower than data from the National Diabetes Audit in 2009–10,<sup>18</sup> which found that 47% of patients did not receive all nine National Institute for Health and Care Excellence quality indicated diabetes care processes.

Only a limited number of variables were found to be independently and significantly associated with receipt of incomplete care. Previous (2008–9) non-achievement of the care bundle was the best predictor of subsequent non-achievement 2 years later, increasing the odds of this by over threefold. Patients who had previously reported in 2008–9 that they did not know ‘everything about managing their diabetes’ or who were cognitively impaired were more likely to subsequently report not having a complete diabetes care bundle. Individuals who were single or had low health literacy were more likely to report not having been offered an ACE inhibitor. In contrast, people in the oldest age group, or classified as obese according to their BMI category, were more likely to have been offered an ACE inhibitor.

The National Diabetes Audit modelled, in a cross-sectional sample, the impact of patient characteristics (available from routine records) on the likelihood of receiving a complete bundle of care.<sup>18</sup> Common to both studies is the finding that only a limited number of patient characteristics explained variability in the receipt of incomplete care. Patient social deprivation, sex and duration of diabetes were not found to affect the likelihood of receiving complete care, but age and ethnicity were. Significant geographical variation was observed across the 151 primary care trusts that contributed data.

The variations in indicator achievement by condition were much larger than those by participant characteristics. This, together with the findings from the diabetes care bundle analysis, suggests that the major causes of variations in health-care quality may lie elsewhere than with the patient, although ELSA could not account for all patient factors which contribute to variation and are difficult to capture in a survey, such as patient behaviour. We were unable to model health service performance data as they are not in ELSA, although participants were asked to consent to linkage of ELSA data to NHS data (e.g. Hospital Episode Statistics), which opens the possibility for future research on linked data sets.

### **Distribution of illness burden, diagnosis and treatment**

This analysis suggested that barriers to equitable receipt of health care according to need may exist predominantly at the stage at diagnosis rather than treatment. For angina, depression, diabetes and osteoarthritis, the hypothetically poorest participant always had higher odds of illness burden than the hypothetically richest. Poorer participants usually had no higher odds for subsequent receipt of diagnosis or treatment. This serial cross-sectional analysis of four waves of ELSA included all eligible participants in each wave in order to maximise the sample size. This approach means that some participants with a diagnosed condition would no longer have had illness burden, if they were being successfully treated. Examples would be diabetic participants whose blood sugar levels were being successfully controlled by treatment, and participants with successfully treated depression. We checked our main results with the secondary (longitudinal) analysis, which assessed subsequent diagnosis in those with illness burden, and subsequent treatment in those with illness burden, and found a similar picture of inequalities in illness burden not being fully addressed by appropriately greater levels of diagnosis and treatment for poorer participants.

Care-seeking behaviour and patient preferences may differ with wealth. Given the same information, patients may be less likely to seek treatment than their doctors<sup>53,54</sup> and pessimism about availability of treatment may make older people reluctant to seek help.<sup>55</sup> People from poorer backgrounds may view living with illness burden (such as pain or emotional problems) as a normal part of ageing rather than a disease.<sup>56</sup> It is possible to imagine that the response of the primary care physician may also vary according to the wealth of the patient, however subconsciously. For example, a physician might initially consider symptoms such as aches and pains to be part of the tapestry of life, or the natural ageing process, when they occur in a patient from a deprived background. The same symptoms in a wealthier, well-educated and articulate patient might arguably be considered more unusual and, therefore, more likely to lead to a diagnosis. Our results fit with research showing that while people from deprived groups were more likely to have Rose angina, they were not more likely to receive a GP diagnosis of CHD.<sup>57</sup> Comorbidity is more common in deprived populations, and may make diagnosis of all conditions harder for doctors within the constraints of a short consultation.<sup>58</sup>

## Strengths and limitations

This project is the first to investigate a wide range of clinical, behavioural, psychosocial and sociodemographic patient characteristics as predictors of subsequent receipt of care in older people in England, encompassing four common health conditions. Its major strengths include that this is the first national cohort study to measure quality of care for a range of common chronic conditions, with individual-level data on a wide range of participant characteristics. We were able to pair reports of receipt of care indicated by evidence- and consensus-based standards developed specifically for older people<sup>35</sup> with in-depth, sophisticated patient characteristics assessed using established measures, whereas previous work has usually been limited to basic patient descriptors available from routine records (e.g. age or sex). The quality indicators for all four conditions were developed using the same robust methods, and were based on similar strengths of evidence of effectiveness.

Limitations include the difficulty, common to all longitudinal studies (particularly of ageing), of maintaining a sample that is representative of the national population. The ELSA cohorts were selected from HSE to be representative of people aged  $\geq 50$  years living in private accommodation in England. However, as *Table 2* shows, there was inevitably attrition of the sample over time. ELSA added replenishment samples at waves 3 and 4 to bolster the younger age bands and correct for attrition to some extent. Therefore, cross-sectional analyses, or comparisons of wave pairs, are less affected by this limitation. All analyses were weighted for differential non-response, using longitudinal or cross-sectional sample weights as appropriate, to mitigate any potential lack of representativeness. Ethnic groups other than white British represented approximately 2% of the sample, which is reasonably representative of the population at that age in the UK, and too small a sample to allow separate analysis of quality indicator achievement. It could be argued that people who respond to ELSA over several years are also more likely to use and benefit from health services. For example, their GP would have been notified of any abnormal results identified at the nurse visit, and so we expect that the ELSA quality indicator achievement rates presented in this paper are likely to be slightly higher than in the general population.

Minor technical problems with the computer-assisted questionnaire that filtered ELSA participants to different parts of the ELSA questionnaire temporarily affected the sample sizes of those eligible for diabetes cholesterol and IHD cholesterol quality indicators, as is explained in the ELSA wave 2 documentation.<sup>33</sup> This did not affect the quality of data from those quality indicators.

The ELSA questionnaire, including the quality indicators, was based on self-reports about processes of care that participants might have received up to 2 years previously. The indicators used in ELSA were highly selected on the basis of suitability for use with self-report in an interview survey, as described in *Chapter 2* (see *Quality indicators in the English Longitudinal Study of Ageing*). The ACOVE researchers compared interview data and medical notes where feasible and found that the ACOVE interview data were comparable with notes data, and for some indicators respondents remembered higher rates of achievement than had been recorded in the medical notes. Approximately half of the 236 ACOVE indicators could be used in an interview survey without the use of clinical records, and after conducting literature reviews, expert clinical panel assessment for validity in England, and piloting in ELSA, only 32 indicators were taken forward for implementation in ELSA on the basis that they could be answered meaningfully in a survey. For certain areas of care, recorded data are more likely to reflect actual clinical practice, but for some chronic conditions and process of care measures, including prescription of medication, self-reported data appear to be at least as accurate as clinical records. Clinical records do not contain in-depth information on patient characteristics, and for some of the ELSA questions, such as the presence of pain, it could be argued that the patient's report is more likely to be accurate than the medical record, and so finding a perfect data source is difficult. Self-reports tend to score the same as, or higher than, medical records. ELSA did not include potential participants if they had severe cognitive issues, and we excluded proxy respondents from our selected samples. Our findings are comparable with other work as discussed above, including an audit of care for diabetes using all clinical records in the UK.<sup>59,60</sup>

The statistical significance of the changes in achievement between wave 2 and the most recent year of follow-up was tested with Pearson's chi-squared test for comparing proportions (see *Table 10*). This test was chosen because some data points were paired within individuals between wave 2 and the most recent year of follow-up, and some were not, as different individuals were eligible for indicators at different waves. For this reason we did not use McNemar's test for paired data, although McNemar's test would have had greater power and precision had it been appropriate to use.

If key covariates change over time, and the analysis only considers baseline values, then this can be a source of bias. In this study, changes in potentially time-varying covariates were generally small. The greatest change in the number of participants reporting potentially time-varying covariates was seen in cognitive impairment, which was reported by over twice as many participants in wave 5 as in wave 2 (see *Chapter 3, Regression modelling for quality of care, Demographics for the diabetes care bundle, and Table 14*). The only condition in which cognitive impairment was associated with quality was diabetes, and only 5.8% more participants with diabetes also had cognitive impairment in wave 5 than in wave 2. Because the change over time was only 5.8%, any impact on the overall results was thought to be minimal. To check this we also repeated the final regression model for diabetes in *Table 19* with both the baseline values for cognitive impairment and the value at wave 5. The result was that cognitive impairment was no longer significant in wave 2 or wave 5, supporting the idea that there was no additional explanatory effect from cognitive impairment at wave 5 that had not been captured by cognitive impairment at wave 2.

If missing data are not properly accounted for, they can bias the results of a study. We considered the alternate approaches of multiple imputation, and including missing data as a 'missing' category in the analyses. We recognise that multiple imputation is a powerful and flexible approach for handling missing data in epidemiological studies. However, as with all procedures for handling missing data, multiple imputation has advantages and disadvantages. For example, although the chained equations approach often works well in practice, it does not necessarily have a strong theoretical basis. Other multiple imputation approaches typically require distributional assumptions (e.g. multivariate normality). Based on our experience of other studies, we decided to adopt an alternative strategy for handling missing data: use of a missing category. This approach, although ad hoc, is easily communicated to non-methodologists and often gives results that are consistent with more formal model-based procedures (including multiple imputation). We conducted sensitivity analyses to determine whether or not using multiple imputation of missing data would alter the final results for the diabetes care bundle and the ACE inhibitor/receptor blocker quality indicator (see *Chapter 3, Regression modelling for quality of care, Demographics for the diabetes care bundle, and Table 19*). The results from the model using multiple imputation were generally very similar to the original models for both the care bundle and the ACE inhibitor quality indicator.

One specific potential limitation of the analysis of distribution of illness burden, diagnoses and treatment is that standardised measures were used to assess illness burden of depression, angina and diabetes, but not illness burden of osteoarthritis and cataract. This means that the illness burden we attributed to osteoarthritis and cataract may not be 100% specific for those conditions, as indeed they are not in clinical situations. However, this lack of specificity is unlikely to vary with wealth, and so should not be a source of bias. Self-reported data may be a source of bias if self-report varies by factors other than objective health status, such as wealth or social experience. This is a recognised problem with some self-reported morbidity data, but is less of a problem with measures of pain, where self-report is the best means of assessment.<sup>61</sup>

We did not adjust in the main analysis for related factors that are also more prevalent in poorer populations, such as smoking, obesity and comorbidity, because none of these is a reason for not making a diagnosis. Comorbid conditions are more common in those with lower socioeconomic status, but there is no evidence that comorbidities make diagnosis less likely. On the contrary, a higher number of comorbid conditions in older people may be associated with higher quality of care.<sup>62</sup> We adjusted for the effects of adding individual additional covariates in additional analyses found different patterns in different conditions, which fits with other research showing that wealth acts differently in different conditions.<sup>63</sup>

## Generalisability

The results are likely to be generalisable to the population of England aged  $\geq 50$  years, bearing in mind the limitations discussed above, because the sample was large and selected to be nationally representative, the results were weighted for non-response, and achievement rates were comparable with QOF. They may also be generalisable with caution to other countries with similar population demographics, but are likely to vary according to health system and availability of care. Previous US studies have used similar methods and found similar quality scores.

## Chapter 5 Conclusions

This project is the first to investigate a wide range of clinical, behavioural, psychosocial and sociodemographic participant characteristics as predictors of subsequent receipt of care in older people in England, encompassing four common health conditions. The results show that there were persistent shortfalls in quality for all conditions, and particularly for osteoarthritis, and that these changed little over 6 years of follow-up, although quality for osteoarthritis did improve slightly. The analysis of transitions shows that the strongest predictor of future poor care was past poor care, which means that it was often the same people who did not receive indicated care year after year. We found that quality varied little by participant characteristics, despite the wide range of characteristics (e.g. patient education, socioeconomic status, health and health behaviours, and cognition) available for analysis. There were some participant characteristics that were significantly associated with achievement of quality indicators, but these were generally different for the different conditions. For example, we found that participants with diabetes, and who had cognitive impairment or who were cohabiting (as opposed to living alone), were more likely to report poor-quality care. The good news is that, for those with one of the four diagnosed health conditions studied, receipt of indicated care is generally distributed equitably across the population.

The implications for policy are that shortfalls in quality of care for these four common and important long-term conditions have persisted over 6 years, despite much policy attention and major initiatives such as payment for performance in primary care through the QOF. The variations in quality within and between conditions are not, for the most part, explained by participant characteristics, so a different source or sources of variation must be driving these. Health system characteristics are known to be strongly associated with quality of care in other countries, and are a possible explanation for the shortfalls in quality of care that are not explained by patient characteristics. Fisher *et al.*<sup>64</sup> showed that health care is often driven by the availability of specialist services rather than by the health needs of the population, with no detectable difference in health outcomes.

Health system characteristics affect the quality of health care received by patients at micro (individual clinician), meso (general practice or hospital) and macro (regional and national) levels. The shortfall in quality was particularly marked for osteoarthritis. This research has found that the QOF seems to have had little effect on the quality of care received by ELSA participants for the four conditions studied. Common features of successful models of care for older people are strong generalist or primary care, the use of care plans, and electronic medical records with continuity of care.<sup>65,66</sup>

Participant characteristics may not explain access to treatment, but they, especially wealth, do explain large variations in the distribution of illness burden for the four conditions studied. The analysis of inequalities in access to diagnosis and treatment presented here is preliminary and limited by the availability of data, but suggests that less-wealthy people may be less likely to be diagnosed. This matters as, after diagnosis, the results show that, for the most part, treatment is remarkably equitable. Diagnosis is a key step in equitable access to treatment for those with long-term conditions.

### Recommendations for further research

Further research could compare the results with measurements from directly observed clinical care and from medical records. As this research has shown that the substantial variations in quality of care are generally not explained by participant characteristics, further research is needed into the association between quality and health system characteristics at micro (individual clinician), meso (general practice or hospital) and macro (regional and national) levels. Future research could use linked data sets (such as the

GP patient survey, and Hospital Episode Statistics) to examine the effect of health service characteristics on the quality of care received at the individual patient level. For the few areas where specific participant characteristics were associated with quality of care, further qualitative research could explore how these characteristics affect treatment quality.

Further research could explore why quality is so much lower in osteoarthritis than for other conditions studied, and this may include investigating GPs' knowledge about treatment options, and availability of further care such as physiotherapy. The preliminary finding that there may be system level inequalities in the receipt of diagnosis that make it harder for disadvantaged people with specific illness burden to receive an appropriate diagnosis could be investigated further. What are the barriers that may differentially hinder access to an appropriate diagnosis? A mixed qualitative and quantitative approach could explore the delivery of care in different systems, and link care to patient health outcomes.



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## Publications

Steel N, Hardcastle AC, Clark A, Mounce LTA, Bachmann MO, Richards SH, *et al.* Self-reported quality of care for older adults from 2004 to 2011: a cohort study. *Age Ageing* 2014;**43**:716–20.

Steel N, Hardcastle AC, Bachmann MO, Richards SH, Mounce LTA, Clark A, *et al.* Economic inequalities in burden of illness, diagnosis and treatment of five long-term conditions in England: panel study. *BMJ Open* 2014;**4**:e005530.

Mounce LTA, Steel N, Hardcastle AC, Henley WE, Bachmann MO, Campbell JL, *et al.* Patient characteristics predicting failure to receive indicated care for type 2 diabetes. *Diabetes Res Clin Pract* 2015;**107**:247–58.



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# Appendix 1 Translating quality indicators to the English Longitudinal Study of Ageing

Condition, quality indicator abbreviated title and quality indicator/question text	Denominator <sup>a</sup>	Numerator <sup>a</sup>	Corresponding ELSA variable(s) <sup>a</sup> and question(s)
<b>Diabetes mellitus</b>			
Diabetes HbA <sub>1c</sub> . IF a person aged ≥ 50 years has diabetes, THEN his or her glycosylated haemoglobin or fructosamine level should be measured at least annually	Age ≥ 50 years. All diabetes cases up to current wave ( <b>heacd</b> )	<b>Hesuga</b> = 'yes'	<p><b>Heacd</b>: Has a doctor ever told you that you have diabetes?</p> <p><b>Hesug</b>: Have you ever had a special blood test to see how well your blood sugar was controlled? This test is called a glycosylated haemoglobin, or haemoglobin A<sub>1c</sub>, or fructosamine. This is a blood test taken at a doctor's surgery or health centre or laboratory</p> <p><b>Hesuga</b>: Have you had this test (glycosylated haemoglobin or fructosamine) performed in the past 12 months?</p>
Diabetes proteinuria. IF a diabetic person aged ≥ 50 years does not have established renal disease and is not receiving an ACE inhibitor or angiotensin II receptor blocker, THEN he or she should receive an annual test for proteinuria	Age ≥ 50 years. All diabetes cases up to current wave, and <b>hekidn</b> = 'no', and <b>heacea</b> = 'not taking ACE inhibitor or A2 receptor blocker'	<b>Hewee</b> = 'yes'	<p><b>Hekidn</b>: Has a doctor ever told you that your diabetes has caused trouble with your kidneys?</p> <p><b>Heacea</b>: I would like to check whether any of the medications you are taking are on this list of ACE inhibitor or A2 receptor blockers (show card G ACE inhibitors)?</p> <p><b>Hewee</b>: Have you had a urine test for protein in the last 12 months?</p>
Diabetes cholesterol. IF a diabetic person aged ≥ 50 years has a fasting total cholesterol level of ≥ 5 mmol/l, THEN he or she should be offered an intervention to lower cholesterol	Age ≥ 50 years. All diabetes cases up to current wave, and 'high cholesterol' at current wave, but not at previous wave	<b>Hechol</b> = 'yes'	<p><b>Hediaa</b>: Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes 'high cholesterol')?</p> <p><b>Hechol</b>: Has any doctor talked to you about how to lower your cholesterol? This would include changing your diet, losing weight, getting more exercise or taking medication (asked if has diabetes and high cholesterol)</p>

Condition, quality indicator abbreviated title and quality indicator/question text	Denominator <sup>a</sup>	Numerator <sup>a</sup>	Corresponding ELSA variable(s) <sup>a</sup> and question(s)
Diabetes ACE inhibitor. IF a diabetic person aged $\geq 50$ years has one additional cardiac risk factor (i.e. smoker, hypertension, hypercholesterolemia, or renal insufficiency/microalbuminuria), THEN he/she should be offered an ACE inhibitor or receptor blocker	Age $\geq 50$ years. All diabetes cases up to current wave, and at current wave [ <b>heska</b> = 'yes', or systolic blood pressure (BP) $\geq 140$ or diastolic BP $\geq 90$ ], or <b>hekidn</b> = 'yes', or <b>heweaa</b> = 'yes', or reported diagnosed 'high cholesterol' or 'high blood pressure or hypertension', or prevalent hypertension	<b>Heace</b> = 'yes' or <b>Heacea</b> = 'yes'	<p><b>Hediaa</b>: Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes 'high blood pressure or hypertension' and 'high cholesterol')?</p> <p><b>Heweaa</b>: Some doctors check to see if patients with diabetes have protein in their urine. Have you had a urine test for protein in the past 12 months? (This test may also be called a microalbumin test, and involves a first morning urine sample or 24-hour urine collection)</p> <p><b>Heweaa</b>: Has a doctor ever told you that you have protein in your urine?</p> <p><b>Hekidn</b>: Has a doctor ever told you that your diabetes has caused trouble with your kidneys?</p> <p><b>Heska</b>: Do you smoke cigarettes at all nowadays?</p> <p><b>Sysval</b>: valid mean systolic BP (measured)</p> <p><b>Diaval</b>: valid mean diastolic BP (measured)</p> <p><b>Heace</b>: Has a doctor discussed with you whether you should take a medication called an ACE inhibitor or A2 receptor blocker?</p> <p><b>Heacea</b>: I would like to check whether any of the medications you are taking are on this list of ACE inhibitor or A2 receptor blockers (show card G ACE inhibitors)?</p>
Diabetes foot check. ALL diabetic persons aged $\geq 50$ years should have an annual examination of his or her feet	Age $\geq 50$ years. All diabetes cases up to current wave	<b>Heftchk</b> = 'yes'	<b>Heftchk</b> : Some doctors suggest that some patients with diabetes have a regular foot examination. In the past year, has any doctor or nurse examined your bare feet?

Condition, quality indicator abbreviated title and quality indicator/question text	Denominator <sup>a</sup>	Numerator <sup>a</sup>	Corresponding ELSA variable(s) <sup>a</sup> and question(s)
<b>CVD</b>			
Stroke antihypertensives. IF a person aged $\geq 50$ years has had a previous stroke, THEN the patient should be offered antihypertensive medication	Age $\geq 50$ years. Newly reported stroke ( <b>hediaa</b> ), or confirmed stroke previously reported ( <b>hediac</b> )	<b>Hehibpb1</b> = 'yes'	<p><b>Hediaa</b>: Has a doctor ever told you that you have (or have had) any of the conditions on this card [includes 'stroke (cerebral vascular disease)']?</p> <p><b>Hediac</b>: Whether confirms stroke diagnosis</p> <p><b>Hehibpb1</b>: Did a doctor or nurse ever suggest you take any medication to lower your blood pressure?</p>
<b>Hypertension</b>			
Hypertension treatment. IF a person aged $\geq 50$ years remains hypertensive after non-pharmacological intervention, THEN pharmacological antihypertensive treatment should be initiated	Age $\geq 50$ years. Newly reported hypertension ( <b>hediaa</b> ), or still has hypertension previously reported ( <b>hedias</b> )	<b>Hehibpb</b> = 'yes'	<p><b>Hedias</b>: Do you still have (hypertension)?</p> <p><b>Hehibpb</b>: Some doctors suggest that some patients take medication to lower their blood pressure. Did a doctor or nurse ever suggest that you take medication to lower your blood pressure?</p>
<b>IHD</b>			
IHD cholesterol. IF a person aged $\geq 50$ years has established CHD and LDL cholesterol $> 3$ mmol/l, THEN he or she should be offered an intervention to lower cholesterol	Age $\geq 50$ years. Diagnosed high cholesterol at current wave ( <b>hediaa</b> ) and diagnosed angina or heart attack (including MI or coronary thrombosis) at current wave ( <b>hediaa</b> ) or still has angina ( <b>hedias</b> ) or confirms heart attack previously reported ( <b>hediac</b> )	<b>Hechol</b> = 'yes'	<b>Hechol</b> : Has any doctor talked to you about how to lower your cholesterol? This would include changing your diet, losing weight, getting more exercise or taking medication
IHD antiplatelets. IF a person aged $\geq 50$ years has established CHD and is not on warfarin, THEN he or she should be offered antiplatelet therapy	Age $\geq 50$ years. Diagnosed angina or heart attack (including MI or coronary thrombosis) at current wave ( <b>hediaa</b> ) or still has angina ( <b>hedias</b> ) or confirms heart attack previously reported ( <b>hediac</b> ), and <b>Hehrtc</b> = 'no'	<b>Hehrta</b> = 'yes'	<p><b>Hehrtc</b>: Are you taking warfarin?</p> <p><b>Hehrta</b>: Did a doctor suggest that you take medication to thin your blood such as warfarin or aspirin, Plavix, Ticlid, or other blood-thinning medication?</p>
IHD smoking. IF a person aged $\geq 50$ years with established CHD smokes, THEN he or she should be offered counselling for smoking cessation	Age $\geq 50$ years. Diagnosed angina or heart attack (including MI or coronary thrombosis) at current wave ( <b>hediaa</b> ) or still has angina ( <b>hedias</b> ) or confirms heart attack previously reported ( <b>hediac</b> ), and <b>heska</b> = 'yes'	<b>Hecgstp</b> = 'yes'	<p><b>Heska</b>: Do you smoke cigarettes at all nowadays?</p> <p><b>Hecgstp</b>: Has a doctor or nurse ever advised you to stop smoking?</p>

Condition, quality indicator abbreviated title and quality indicator/question text	Denominator <sup>a</sup>	Numerator <sup>a</sup>	Corresponding ELSA variable(s) <sup>a</sup> and question(s)
MI beta-blocker. IF a person aged $\geq 50$ years has had a recent MI, THEN he or she should be offered a beta-blocker	Age $\geq 50$ years. Diagnosed heart attack (including MI or coronary thrombosis) at current wave ( <b>hediaa</b> ) and not at previous wave	<b>Hebeta</b> = 'yes' or <b>Hebetb</b> = currently taking beta-blockers	<p><b>Hebeta:</b> Did any doctor ever tell you that you should take a medication called a beta-blocker?</p> <p><b>Hebetb:</b> Please could you show me the medications or the repeat prescription list for any medications you have taken over the last week (checked against card F beta-blockers)?</p>
INR test. IF a person aged $\geq 50$ years is prescribed warfarin, THEN an INR should be determined at least every 12 weeks	Age $\geq 50$ years. Diagnosed angina or heart attack (including MI or coronary thrombosis) at current wave ( <b>hediaa</b> ) or still has angina ( <b>hedias</b> ) or confirms heart attack previously reported ( <b>hediac</b> ), and <b>Hehrtc</b> = 'yes'	<b>Hehrte</b> = 'yes'	<p><b>Hehrtc:</b> Are you taking warfarin?</p> <p><b>Hehrtd:</b> Many doctors ask patients on warfarin to get their blood tested regularly. The test checks how thin their blood is, and is sometimes called an INR test. Do you get your blood checked for this?</p> <p><b>Hehrte:</b> Have you had this blood test in the past 12 weeks?</p>
<b>OA</b>			
OA exercise. IF an ambulatory person aged $\geq 50$ years has had a diagnosis of symptomatic osteoarthritis of the knee for longer than 3 months and has no contraindications to exercise and is physically and mentally able to exercise, THEN a directed or supervised strengthening or aerobic exercise programme should have been prescribed at least once	Age $\geq 50$ years. Diagnosed osteoarthritis at current wave (heart) or still has osteoarthritis ( <b>hedids</b> + heart), and knee pain ( <b>hekne</b> ) for more than 3 months ( <b>heknea</b> )	<b>Hekneb</b> = 'yes'	<p><b>Heart:</b> Which type or types of arthritis do you have (includes 'osteoarthritis')?</p> <p><b>Hedids:</b> Do you still have (arthritis)?</p> <p><b>Hekne:</b> How would you rate the pain in your knees? ('Where 0 is no pain and 10 is severe or excruciating pain, as bad as you can imagine.' Range: 0–10)</p> <p><b>Heknea:</b> Has your knee pain been bothering you for more than 3 months?</p> <p><b>Hekneb:</b> Has a doctor or nurse suggested that you receive physiotherapy or attend a supervised exercise program for your knee pain?</p>
OA education. IF an ambulatory person aged $\geq 50$ years has a diagnosis of symptomatic osteoarthritis, THEN education regarding the natural history, treatment and self-management of the disease should be offered at least once	Age $\geq 50$ years. Diagnosed osteoarthritis at current wave (heart) or still has osteoarthritis ( <b>hedids</b> + heart)	<b>Hearta</b> = 'yes' and <b>Heartb</b> = 'yes' and <b>Heartc</b> = 'yes'	<p>Has any doctor or nurse ever talked to you about:</p> <p><b>Hearta:</b> What your arthritis or joint pain will be like as time goes on?</p> <p><b>Heartb:</b> How to keep your arthritis or joint pain from getting worse?</p> <p><b>Heartc:</b> How your arthritis or joint pain will be treated?</p>

Condition, quality indicator abbreviated title and quality indicator/question text	Denominator <sup>a</sup>	Numerator <sup>a</sup>	Corresponding ELSA variable(s) <sup>a</sup> and question(s)
OA paracetamol. IF oral pharmacological therapy is initiated to treat osteoarthritis among people aged $\geq 50$ years, THEN paracetamol should be the first drug used, unless there is a contraindication to use	Age $\geq 50$ years. Diagnosed osteoarthritis at current wave (heart) or still has osteoarthritis ( <b>hedids</b> + heart)	<b>Hearte</b> = 'yes'	<b>Hearte</b> : Did any doctor or nurse recommend you to try paracetamol before other medicines for your joint pain?
OA referral. IF a person aged $\geq 50$ years with severe symptomatic osteoarthritis of the knee or hip has failed to respond to non-pharmacological and pharmacological therapy, THEN the patient should be offered referral to an orthopaedic surgeon to be evaluated for total joint replacement within 6 months unless surgery is contraindicated	Age $\geq 50$ years. All diagnosed cases of osteoarthritis up to current wave ( <b>heartoa</b> ), and knee or hip pain for more than 6 months ( <b>hekne</b> and <b>hehip</b> ), both rated 6–10, and not controlled by treatment ( <b>hepae</b> = 'no')	<b>Hepaf</b> = 'yes'	<p><b>Hehip</b>: How would you rate the pain in your hips? ('Where 0 is no pain and 10 is severe or excruciating pain, as bad as you can imagine.' Range: 0–10)</p> <p><b>Hepac</b>: Has your knee or hip pain been bothering you for more than 6 months?</p> <p><b>Hepad/hepmed</b>:<sup>b</sup> Are you taking or have you taken any medication or exercises to control the pain in your knee or hip?</p> <p><b>Hepae/heknef</b><sup>b</sup> and <b>hehipc</b>:<sup>b</sup> Do exercises and medicines control the pain in your knee or hip?</p> <p><b>Hepaf/hypesur</b>:<sup>b</sup> Did any doctor recommend that you should have surgery or joint replacement?</p>
<b>Depression</b>			
Depression suicide. IF a person aged $\geq 50$ years receives a diagnosis of a new depression episode, THEN the diagnosing physician should ask on the day of diagnosis whether or not the person aged $\geq 50$ years had any thoughts about suicide	Age $\geq 50$ years. Diagnosed depression at current wave, but not at previous wave ( <b>hediab</b> )	<b>Hepsye</b> = 'yes'	<p><b>Hediab</b>: Has a doctor ever told you that you have (or have had) any of the conditions on this card (includes 'any emotional, nervous or psychiatric problems')?</p> <p><b>Hepsy</b>: What type of emotional, nervous or psychiatric problems do you have (includes 'depression')?</p> <p><b>Hepsye</b>: When you talked about these feelings with a doctor or nurse, did they ask you on that day if you had thoughts about suicide?</p>
Depression treatment. IF a person aged $\geq 50$ years is diagnosed with clinical depression, THEN antidepressant treatment, talking treatment, or electroconvulsive therapy should be offered within 2 weeks after diagnosis unless within that period the patient has improved, or unless the patient has substance abuse or dependence, in which case treatment may wait until 8 weeks after the patient is in a drug- or alcohol-free state	Age $\geq 50$ years. Diagnosed depression at current wave, but not at previous wave ( <b>hediab</b> ), and <b>hepsya</b> $\neq$ 'none'	<b>Hepsyb</b> = 'yes'	<p><b>Hepsya</b>: I have some questions about any treatment you may have had for your depression. Did a doctor or nurse suggest that you take medication, or see a mental health professional for counselling?</p> <p><b>Hepsyb</b>: Did you start medication or counselling within 2 weeks of being offered this treatment?</p>

Condition, quality indicator abbreviated title and quality indicator/question text	Denominator <sup>a</sup>	Numerator <sup>a</sup>	Corresponding ELSA variable(s) <sup>a</sup> and question(s)
Depression review. IF a person aged $\geq 50$ years has no meaningful symptom response after 6 weeks of treatment, THEN one of the following treatment options should be initiated by the 8th week of treatment: medication dose should be optimised (if initial treatment was medication), or medication should be initiated (if initial treatment was psychotherapy alone), or referral to a psychiatrist should be offered	Age $\geq 50$ years. Diagnosed depression at current wave, but not at previous wave ( <b>hediab</b> ), and <b>Hepsyc</b> = 'no'	<b>Hepsyd</b> = 'yes'	<b>Hepsyc</b> : Did you feel better within 6 weeks after starting to take medication, or seeing a mental health professional for counselling?  <b>Hepsyd</b> : Did any doctor or nurse start you on medication, change the dose of the medication that you were taking or, change the medications to help you feel better?
<b>Patient-centred care</b>			
Diabetes training. Some people with diabetes receive training to help manage their diabetes themselves. Have you ever participated in a course or class about diabetes, or received special training on how you can live with your diabetes from day to day?	Age $\geq 50$ years. All diabetes cases up to current wave ( <b>heacd</b> )	<b>Heslfc</b> = 'yes' at any wave	<b>Heslfc</b> : Some people with diabetes receive training to help manage their diabetes themselves. Have you ever participated in a course or class about diabetes, or received special training on how you can live with your diabetes from day to day?
Diabetes knowledge. How much do you think you know about managing your diabetes ('just about everything you need to know' or 'most of what you need to know')?	Age $\geq 50$ years. All diabetes cases up to current wave ( <b>heacd</b> )	<b>Heslfc</b> = 1 ('just about everything ...') or 2 ('most ...')	<b>Heslfc</b> : How much do you think you know about managing your diabetes? Do you know ...  1 just about everything you need to know; 2 most of what you need to know; 3 some of what you need to know; 4 a little of what you need to know; or 5 almost none of what you need to know?
Cholesterol explanation. Has a doctor or nurse explained high cholesterol in a way you could understand?	Age $\geq 50$ years. Diagnosed high cholesterol at current wave ( <b>hediaa</b> ), or confirms still has high cholesterol previously reported ( <b>hedias</b> )	<b>Hecholb</b> = 'yes' at any wave	<b>Hedias</b> : Do you still have (high cholesterol)?  <b>Hecholb</b> : Has a doctor or nurse explained high cholesterol in a way you could understand?
Cholesterol preferences. Have doctors or nurses taken your preferences into account when making treatment decisions about your high cholesterol?	Age $\geq 50$ years. Diagnosed high cholesterol at current wave ( <b>hediaa</b> ), or confirms still has high cholesterol previously reported ( <b>hedias</b> )	<b>Hecholc</b> = 'yes' at any wave	<b>Hecholc</b> : Have doctors or nurses taken your preferences into account when making treatment decisions about your high cholesterol?
Blood pressure explanation. Has a doctor or nurse explained high blood pressure in a way you could understand at any time since you were first told you had high blood pressure?	Age $\geq 50$ years. Newly reported hypertension ( <b>hediaa</b> ), or still has hypertension previously reported ( <b>hedias</b> )	<b>Hehibp</b> = 'yes' at any wave	<b>Hehibp</b> : Has a doctor or nurse explained high blood pressure in a way you could understand at any time since you were first told you had high blood pressure?

Condition, quality indicator abbreviated title and quality indicator/question text	Denominator <sup>a</sup>	Numerator <sup>a</sup>	Corresponding ELSA variable(s) <sup>a</sup> and question(s)
Blood pressure choice. In general, have doctors or nurses given you any choice about how to treat your high blood pressure?	Age $\geq$ 50 years. Newly reported hypertension ( <b>hediaa</b> ), or still has hypertension previously reported ( <b>hedias</b> )	<b>Hehibpa</b> = 'yes' at any wave	<b>Hehibpa</b> : In general, have doctors or nurses given you any choice about how to treat your high blood pressure?
OA treatment purpose. Has any doctor or nurse ever talked to you about what the specific purpose of the treatment for your arthritis or joint pain is?	Age $\geq$ 50 years. Diagnosed osteoarthritis at current wave ( <b>heart</b> ) or still has osteoarthritis ( <b>hedids</b> + <b>heart</b> ), and doctor has discussed treatment ( <b>Heartc</b> = 'yes')	<b>Heartd</b> = 'yes'	<b>Heartc</b> : Has any doctor or nurse ever talked to you about how your arthritis or joint pain will be treated?  <b>Heartd</b> : Has any doctor or nurse ever talked to you about what the specific purpose of the treatment for your arthritis or joint pain is?

OA, osteoarthritis.

a ELSA variables are displayed in bold font. The variable names are those used in the ELSA data set, downloaded from the UK Data Archive: <http://discover.ukdataservice.ac.uk/catalogue/?sn=5050&type=Data%20catalogue>. The 'he' prefix denotes a variable from the health section of ELSA.

b Variable names from wave 3 onwards.





## Appendix 2 Syntax to generate quality of care variables

### Recode multiresponse items to generate diagnostic variables

**Recoding:** waves 1 and 2 flashcard questions need recoding to gather up responses into one variable. These variables are then used to calculate the prevalence rates for quality of care work; not needed after wave 3 as replaced by feed forward variables.

#### Wave 1

Coded 0 if they mention having no problem (i.e. refusals and don't knows are excluded)

make w1\_dim01\_d = 0 if w1\_hedim01=96

label variable w1\_dim01\_d 'Hypertension'

make w1\_dim02\_d = 0 if w1\_hedim01=96

label variable w1\_dim02\_d 'Angina'

make w1\_dim03\_d = 0 if w1\_hedim01=96

label variable w1\_dim03\_d 'Heart attack'

make w1\_dim04\_d = 0 if w1\_hedim01=96

label variable w1\_dim04\_d 'Congestive heart failure'

make w1\_dim05\_d = 0 if w1\_hedim01=96

label variable w1\_dim05\_d 'Heart murmur'

make w1\_dim06\_d = 0 if w1\_hedim01=96

label variable w1\_dim06\_d 'Abnormal heart rhythm'

make w1\_dim07\_d = 0 if w1\_hedim01=96

label variable w1\_dim07\_d 'diabetes or high blood sugar'

make w1\_dim08\_d = 0 if w1\_hedim01=96

label variable w1\_dim08\_d 'Stroke'

replace w1\_dim01\_d = 1 if (w1\_hedim01=1 or w1\_hedim02=1 or w1\_hedim03=1 or w1\_hedim04=1 or w1\_hedim05=1 or w1\_hedim06=1 or w1\_hedim07=1)

replace w1\_dim02\_d = 1 if (w1\_hedim01=2 or w1\_hedim02=2 or w1\_hedim03=2 or w1\_hedim04=2 or w1\_hedim05=2 or w1\_hedim06=2 or w1\_hedim07=2)

replace w1\_dim03\_d = 1 if (w1\_hedim01=3 or w1\_hedim02=3 or w1\_hedim03=3 or w1\_hedim04=3 or w1\_hedim05=3 or w1\_hedim06=3 or w1\_hedim07=3)

replace w1\_dim04\_d = 1 if (w1\_hedim01=4 or w1\_hedim02=4 or w1\_hedim03=4 or w1\_hedim04=4 or w1\_hedim05=4 or w1\_hedim06=4 or w1\_hedim07=4)

replace w1\_dim05\_d = 1 if (w1\_hedim01=5 or w1\_hedim02=5 or w1\_hedim03=5 or w1\_hedim04=5 or w1\_hedim05=5 or w1\_hedim06=5 or w1\_hedim07=5)

replace w1\_dim06\_d = 1 if (w1\_hedim01=6 or w1\_hedim02=6 or w1\_hedim03=6 or w1\_hedim04=6 or w1\_hedim05=6 or w1\_hedim06=6 or w1\_hedim07=6)

replace w1\_dim07\_d = 1 if (w1\_hedim01=7 or w1\_hedim02=7 or w1\_hedim03=7 or w1\_hedim04=7 or w1\_hedim05=7 or w1\_hedim06=7 or w1\_hedim07=7)

replace w1\_dim08\_d = 1 if (w1\_hedim01=8 or w1\_hedim02=8 or w1\_hedim03=8 or w1\_hedim04=8 or w1\_hedim05=8 or w1\_hedim06=8 or w1\_hedim07=8)

### Recode eye diseases wave 1

Coded 0 if they mention having no problem (i.e. refusals and don't knows are excluded)

make w1\_opt1\_d=0 if w1\_heopt1=96

label variable w1\_opt1\_d 'glaucoma'

make w1\_opt2\_d=0 if w1\_heopt1=96

label variable w1\_opt2\_d 'diabetic eye disease'

make w1\_opt3\_d=0 if w1\_heopt1=96

label variable w1\_opt3\_d 'macular degeneration'

make w1\_opt4\_d=0 if w1\_heopt1=96

label variable w1\_opt4\_d 'cataract'

make w1\_opt96\_d=0 if w1\_heopt1=96

label variable w1\_opt96\_d 'no eye disease'

replace w1\_opt1\_d=1 if (w1\_heopt1=1 or w1\_heopt2=1 or w1\_heopt3=1 or w1\_heopt4=1)

replace w1\_opt2\_d=1 if (w1\_heopt1=2 or w1\_heopt2=2 or w1\_heopt3=2 or w1\_heopt4=2)

replace w1\_opt3\_d=1 if (w1\_heopt1=3 or w1\_heopt2=3 or w1\_heopt3=3 or w1\_heopt4=3)

replace w1\_opt4\_d=1 if (w1\_heopt1=4 or w1\_heopt2=4 or w1\_heopt3=4 or w1\_heopt4=4)

replace w1\_opt96\_d=1 if (w1\_heopt1=96)

**Recode hedia which is the cardiovascular flashcard question merged with hedix (any other heart conditions)**

Coded 0 if they mention having no problem (i.e. refusals and don't knows are excluded)

Recode dia and dib variables to make those who do not have a cardio problem = 96

make w1\_dia01\_d=0 if w1\_hedia01=96

label variable w1\_dia01\_d 'hypertension'

make w1\_dia02\_d=0 if w1\_hedia01=96

label variable w1\_dia02\_d 'Angina'

make w1\_dia03\_d=0 if w1\_hedia01=96

label variable w1\_dia03\_d 'MI'

make w1\_dia04\_d=0 if w1\_hedia01=96

label variable w1\_dia04\_d 'CHF'

make w1\_dia05\_d=0 if w1\_hedia01=96

label variable w1\_dia05\_d 'murmur'

label values w1\_dia05\_d recode

make w1\_dia06\_d=0 if w1\_hedia01=96

label variable w1\_dia06\_d 'abnormal rhythm'

make w1\_dia07\_d=0 if w1\_hedia01=96

label variable w1\_dia07\_d 'diabetes'

make w1\_dia08\_d=0 if w1\_hedia01=96

label variable w1\_dia08\_d 'stroke'

make w1\_dia95\_d=0 if w1\_hedia01=96

label variable w1\_dia95\_d 'other heart trouble'

make w1\_dia96\_d=0 if w1\_hedia01=96

label variable w1\_dia96\_d 'no diagnosed heart trouble'

replace w1\_dia01\_d=1 if (w1\_hedia01=1 or w1\_hedia02=1 or w1\_hedia03=1 or w1\_hedia04=1 or w1\_hedia05=1 or w1\_hedia06=1 or w1\_hedia07=1 or w1\_hedia08=1 or w1\_hedia09=1)

replace w1\_dia02\_d=1 if (w1\_hedia01=2 or w1\_hedia02=2 or w1\_hedia03=2 or w1\_hedia04=2 or w1\_hedia05=2 or w1\_hedia06=2 or w1\_hedia07=2 or w1\_hedia08=2 or w1\_hedia09=2)

replace w1\_dia03\_d=1 if (w1\_hedia01=3 or w1\_hedia02=3 or w1\_hedia03=3 or w1\_hedia04=3 or w1\_hedia05=3 or w1\_hedia06=3 or w1\_hedia07=3 or w1\_hedia08=3 or w1\_hedia09=3)

replace w1\_dia04\_d=1 if (w1\_hedia01=4 or w1\_hedia02=4 or w1\_hedia03=4 or w1\_hedia04=4 or w1\_hedia05=4 or w1\_hedia06=4 or w1\_hedia07=4 or w1\_hedia08=4 or w1\_hedia09=4)

replace w1\_dia05\_d=1 if (w1\_hedia01=5 or w1\_hedia02=5 or w1\_hedia03=5 or w1\_hedia04=5 or w1\_hedia05=5 or w1\_hedia06=5 or w1\_hedia07=5 or w1\_hedia08=5 or w1\_hedia09=5)

replace w1\_dia06\_d=1 if (w1\_hedia01=6 or w1\_hedia02=6 or w1\_hedia03=6 or w1\_hedia04=6 or w1\_hedia05=6 or w1\_hedia06=6 or w1\_hedia07=6 or w1\_hedia08=6 or w1\_hedia09=6)

replace w1\_dia07\_d=1 if (w1\_hedia01=7 or w1\_hedia02=7 or w1\_hedia03=7 or w1\_hedia04=7 or w1\_hedia05=7 or w1\_hedia06=7 or w1\_hedia07=7 or w1\_hedia08=7 or w1\_hedia09=7)

replace w1\_dia08\_d=1 if (w1\_hedia01=8 or w1\_hedia02=8 or w1\_hedia03=8 or w1\_hedia04=8 or w1\_hedia05=8 or w1\_hedia06=8 or w1\_hedia07=8 or w1\_hedia08=8 or w1\_hedia09=8)

replace w1\_dia95\_d=1 if (w1\_hedia01=95 or w1\_hedia02=95 or w1\_hedia03=95 or w1\_hedia04=95 or w1\_hedia05=95 or w1\_hedia06=95 or w1\_hedia07=95 or w1\_hedia08=95 or w1\_hedia09=95)

replace w1\_dia96\_d=1 if (w1\_hedia01=96)

### Recode hedib: non-cardio disease flashcard question

Coded 0 if they mention having no problem (i.e. refusals and don't knows are excluded)

make w1\_dib01\_d=0 if w1\_hedib01=96

label variable w1\_dib01\_d 'chronic bronchitis/emphysema'

make w1\_dib02\_d=0 if w1\_hedib01=96

label variable w1\_dib02\_d 'asthma'

make w1\_dib03\_d=0 if w1\_hedib01=96

label variable w1\_dib03\_d 'arthritis'

make w1\_dib04\_d=0 if w1\_hedib01=96

label variable w1\_dib04\_d 'osteoporosis'

make w1\_dib05\_d=0 if w1\_hedib01=96

label variable w1\_dib05\_d 'cancer'

make w1\_dib06\_d=0 if w1\_hedib01=96

label variable w1\_dib06\_d 'Parkinson's'

make w1\_dib07\_d=0 if w1\_hedib01=96

label variable w1\_dib07\_d 'psychiatric problems'

make w1\_dib08\_d=0 if w1\_hedib01=96

label variable w1\_dib08\_d 'Alzheimer's'

make w1\_dib09\_d=0 if w1\_hedib01=96

label variable w1\_dib09\_d 'dementia'

make w1\_dib96\_d=0 if w1\_hedib01=96

label variable w1\_dib96\_d 'none of these'

replace w1\_dib01\_d=1 if (w1\_hedib01=1 or w1\_hedib02=1 or w1\_hedib03=1 or w1\_hedib04=1 or w1\_hedib05=1 or w1\_hedib06=1)

replace w1\_dib02\_d=1 if (w1\_hedib01=2 or w1\_hedib02=2 or w1\_hedib03=2 or w1\_hedib04=2 or w1\_hedib05=2 or w1\_hedib06=2)

replace w1\_dib03\_d=1 if (w1\_hedib01=3 or w1\_hedib02=3 or w1\_hedib03=3 or w1\_hedib04=3 or w1\_hedib05=3 or w1\_hedib06=3)

replace w1\_dib04\_d=1 if (w1\_hedib01=4 or w1\_hedib02=4 or w1\_hedib03=4 or w1\_hedib04=4 or w1\_hedib05=4 or w1\_hedib06=4)

replace w1\_dib05\_d=1 if (w1\_hedib01=5 or w1\_hedib02=5 or w1\_hedib03=5 or w1\_hedib04=5 or w1\_hedib05=5 or w1\_hedib06=5)

replace w1\_dib06\_d=1 if (w1\_hedib01=6 or w1\_hedib02=6 or w1\_hedib03=6 or w1\_hedib04=6 or w1\_hedib05=6 or w1\_hedib06=6)

replace w1\_dib07\_d=1 if (w1\_hedib01=7 or w1\_hedib02=7 or w1\_hedib03=7 or w1\_hedib04=7 or w1\_hedib05=7 or w1\_hedib06=7)

replace w1\_dib08\_d=1 if (w1\_hedib01=8 or w1\_hedib02=8 or w1\_hedib03=8 or w1\_hedib04=8 or w1\_hedib05=8 or w1\_hedib06=8)

replace w1\_dib09\_d=1 if (w1\_hedib01=9 or w1\_hedib02=9 or w1\_hedib03=9 or w1\_hedib04=9 or w1\_hedib05=9 or w1\_hedib06=9)

replace w1\_dib96\_d=1 if (w1\_hedib01=96)

### Recode heart: arthritis

Coded 0 if mentioned arthritis, 1 if the form of arthritis is dealt with by that variable

make w1\_art1\_d=0 if w1\_heart10 & not missing(w1\_heart1)

label variable w1\_art1\_d 'osteoarthritis'

make w1\_art2\_d=0 if w1\_heart10 & not missing(w1\_heart1)

label variable w1\_art2\_d 'rheumatoid arthritis'

make w1\_art3\_d=0 if w1\_heart10 & not missing(w1\_heart1)

label variable w1\_art3\_d 'other arthritis'

make w1\_art8\_d=0 if w1\_heart10 & not missing(w1\_heart1)

label variable w1\_art8\_d 'unknown arthritis type'

replace w1\_art1\_d=1 if (w1\_heart1=1 or w1\_heart2=1 or w1\_heart3=1)

replace w1\_art2\_d=1 if (w1\_heart1=2 or w1\_heart2=2 or w1\_heart3=2)

replace w1\_art3\_d=1 if (w1\_heart1=3 or w1\_heart2=3 or w1\_heart3=3)

replace w1\_art8\_d=1 if (w1\_heart1=-8 or w1\_heart2=-8 or w1\_heart3=-8)

### Recode hepsy

Coded 0 if mentioned psych difficulty, 1 if the form of psychiatric difficulty dealt with by that variable

make w1\_psy1\_d=0 if w1\_hepsy10 & not missing(w1\_hepsy1)

label variable w1\_psy1\_d 'hallucinations'

make w1\_psy2\_d=0 if w1\_hepsy10 & not missing(w1\_hepsy1)

label variable w1\_psy2\_d 'anxiety'

make w1\_psy3\_d=0 if w1\_hepsy10 & not missing(w1\_hepsy1)

label variable w1\_psy3\_d 'depression'

make w1\_psy4\_d=0 if w1\_hepsy10 & not missing(w1\_hepsy1)

label variable w1\_psy4\_d 'emotional problems'

make w1\_psy5\_d=0 if w1\_hepsy10 & not missing(w1\_hepsy1)

label variable w1\_psy5\_d 'schizophrenia'

make w1\_psy6\_d=0 if w1\_hepsy10 & not missing(w1\_hepsy1)

label variable w1\_psy6\_d 'psychosis'

make w1\_psy7\_d=0 if w1\_hepsy10 & not missing(w1\_hepsy1)

label variable w1\_psy7\_d 'mood swings'

make w1\_psy8\_d=0 if w1\_hepsy10 & not missing(w1\_hepsy1)

label variable w1\_psy8\_d 'manic depression'

make w1\_psy95\_d=0 if w1\_hepsy10 & not missing(w1\_hepsy1)

label variable w1\_psy95\_d 'other psych problem'

replace w1\_psy1\_d=1 if (w1\_hepsy1=1 or w1\_hepsy2=1 or w1\_hepsy3=1 or w1\_hepsy4=1 or w1\_hepsy5=1 or w1\_hepsy6=1 or w1\_hepsy7=1)

replace w1\_psy2\_d=1 if (w1\_hepsy1=2 or w1\_hepsy2=2 or w1\_hepsy3=2 or w1\_hepsy4=2 or w1\_hepsy5=2 or w1\_hepsy6=2 or w1\_hepsy7=2)

replace w1\_psy3\_d=1 if (w1\_hepsy1=3 or w1\_hepsy2=3 or w1\_hepsy3=3 or w1\_hepsy4=3 or w1\_hepsy5=3 or w1\_hepsy6=3 or w1\_hepsy7=3)

replace w1\_psy4\_d=1 if (w1\_hepsy1=4 or w1\_hepsy2=4 or w1\_hepsy3=4 or w1\_hepsy4=4 or w1\_hepsy5=4 or w1\_hepsy6=4 or w1\_hepsy7=4)

replace w1\_psy5\_d=1 if (w1\_hepsy1=5 or w1\_hepsy2=5 or w1\_hepsy3=5 or w1\_hepsy4=5 or w1\_hepsy5=5 or w1\_hepsy6=5 or w1\_hepsy7=5)

replace w1\_psy6\_d=1 if (w1\_hepsy1=6 or w1\_hepsy2=6 or w1\_hepsy3=6 or w1\_hepsy4=6 or w1\_hepsy5=6 or w1\_hepsy6=6 or w1\_hepsy7=6)

replace w1\_psy7\_d=1 if (w1\_hepsy1=7 or w1\_hepsy2=7 or w1\_hepsy3=7 or w1\_hepsy4=7 or w1\_hepsy5=7 or w1\_hepsy6=7 or w1\_hepsy7=7)

replace w1\_psy8\_d=1 if (w1\_hepsy1=8 or w1\_hepsy2=8 or w1\_hepsy3=8 or w1\_hepsy4=8 or w1\_hepsy5=8 or w1\_hepsy6=8 or w1\_hepsy7=8)

replace w1\_psy95\_d=1 if (w1\_hepsy1=95 or w1\_hepsy2=95 or w1\_hepsy3=95 or w1\_hepsy4=95 or w1\_hepsy5=95 or w1\_hepsy6=95 or w1\_hepsy7=95)

## Wave 2

For dim variable use the same coding as wave 1

For dia variable use the same coding as wave 1

For dib variable use the same coding as wave 1

For opt variable use:

make w2\_opt1\_d=0 if w2\_heopt1=96

label variable w2\_opt1\_d 'w2 glaucoma'

make w2\_opt2\_d=0 if w2\_heopt1=96

label variable w2\_opt2\_d 'w2 diabetic eye disease'

make w2\_opt3\_d=0 if w2\_heopt1=96

label variable w2\_opt3\_d 'w2 macular degeneration'

make w2\_opt4\_d=0 if w2\_heopt1=96

label variable w2\_opt4\_d 'w2 cataract'

make w2\_opt96\_d=0 if w2\_heopt1=96

label variable w2\_opt96\_d 'w2 no eye dis'

replace w2\_opt1\_d=1 if (w2\_heopt1=1 or w2\_heopt2=1)

replace w2\_opt2\_d=1 if (w2\_heopt1=2 or w2\_heopt2=2)

replace w2\_opt3\_d=1 if (w2\_heopt1=3 or w2\_heopt2=3)

replace w2\_opt4\_d=1 if (w2\_heopt1=4 or w2\_heopt2=4)

replace w2\_opt96\_d=1 if (w2\_heopt1=96)

### For arthritis variable use

make w2\_art1\_d=0 if w2\_heart10 & not missing(w2\_heart1)

label variable w2\_art1\_d 'w2 osteoarthritis'

make w2\_art2\_d=0 if w2\_heart10 & not missing(w2\_heart1)

label variable w2\_art2\_d 'w2 rheumatoid arthritis'

make w2\_art3\_d=0 if w2\_heart10 & not missing(w2\_heart1)

label variable w2\_art3\_d 'w2 other arthritis'

make w2\_art8\_d=0 if w2\_heart10 & not missing(w2\_heart1)

label variable w2\_art8\_d 'w2 unknown arthritis type'

replace w2\_art1\_d=1 if (w2\_heart1=1 or w2\_heart2=1)

replace w2\_art2\_d=1 if (w2\_heart1=2 or w2\_heart2=2)

replace w2\_art3\_d=1 if (w2\_heart1=3 or w2\_heart2=3)

replace w2\_art8\_d=1 if (w2\_heart1=-8 or w2\_heart2=-8)

### For psy variable use

make w2\_psy1\_d=0 if w2\_hepsy10 & not missing(w2\_hepsy1)

label variable w2\_psy1\_d 'w2 hallucinations'

make w2\_psy2\_d=0 if w2\_hepsy10 & not missing(w2\_hepsy1)

label variable w2\_psy2\_d 'w2 anxiety'

make w2\_psy3\_d=0 if w2\_hepsy10 & not missing(w2\_hepsy1)

label variable w2\_psy3\_d 'w2 depression'

make w2\_psy4\_d=0 if w2\_hepsy10 & not missing(w2\_hepsy1)

label variable w2\_psy4\_d 'w2 emotional problems'



make w2\_psy5\_d=0 if w2\_hepsy10 & not missing(w2\_hepsy1)

label variable w2\_psy5\_d 'w2 schizophrenia'

make w2\_psy6\_d=0 if w2\_hepsy10 & not missing(w2\_hepsy1)

label variable w2\_psy6\_d 'w2 psychosis'

make w2\_psy7\_d=0 if w2\_hepsy10 & not missing(w2\_hepsy1)

label variable w2\_psy7\_d 'w2 mood swings'

make w2\_psy8\_d=0 if w2\_hepsy10 & not missing(w2\_hepsy1)

label variable w2\_psy8\_d 'w2 manic depression'

make w2\_psy95\_d=0 if w2\_hepsy10 & not missing(w2\_hepsy1)

label variable w2\_psy95\_d 'w2 other psych problem'

replace w2\_psy1\_d=1 if (w2\_hepsy1=1 or w2\_hepsy2=1 or w2\_hepsy3=1 or w2\_hepsy4=1 or w2\_hepsy5=1 or w2\_hepsy6=1)

replace w2\_psy2\_d=1 if (w2\_hepsy1=2 or w2\_hepsy2=2 or w2\_hepsy3=2 or w2\_hepsy4=2 or w2\_hepsy5=2 or w2\_hepsy6=2)

replace w2\_psy3\_d=1 if (w2\_hepsy1=3 or w2\_hepsy2=3 or w2\_hepsy3=3 or w2\_hepsy4=3 or w2\_hepsy5=3 or w2\_hepsy6=3)

replace w2\_psy4\_d=1 if (w2\_hepsy1=4 or w2\_hepsy2=4 or w2\_hepsy3=4 or w2\_hepsy4=4 or w2\_hepsy5=4 or w2\_hepsy6=4)

replace w2\_psy5\_d=1 if (w2\_hepsy1=5 or w2\_hepsy2=5 or w2\_hepsy3=5 or w2\_hepsy4=5 or w2\_hepsy5=5 or w2\_hepsy6=5)

replace w2\_psy6\_d=1 if (w2\_hepsy1=6 or w2\_hepsy2=6 or w2\_hepsy3=6 or w2\_hepsy4=6 or w2\_hepsy5=6 or w2\_hepsy6=6)

replace w2\_psy7\_d=1 if (w2\_hepsy1=7 or w2\_hepsy2=7 or w2\_hepsy3=7 or w2\_hepsy4=7 or w2\_hepsy5=7 or w2\_hepsy6=7)

replace w2\_psy8\_d=1 if (w2\_hepsy1=8 or w2\_hepsy2=8 or w2\_hepsy3=8 or w2\_hepsy4=8 or w2\_hepsy5=8 or w2\_hepsy6=8)

replace w2\_psy95\_d=1 if (w2\_hepsy1=95 or w2\_hepsy2=95 or w2\_hepsy3=95 or w2\_hepsy4=95 or w2\_hepsy5=95 or w2\_hepsy6=95)

## Generate incidence and prevalence for diagnosed conditions

### Wave 1

#### Eye disease

make w1\_eye\_d=0 if w1\_heopt1=96

replace w1\_eye\_d=1 if w1\_heopt10 & w1\_heopt1<96

#### Coronary heart disease

make w1\_chd\_d=0 if not missing(w1\_finstat)

replace w1\_chd\_d=1 if w1\_dim02\_d=1orw1\_dim03\_d=1

### Wave 2

NOTE: there was an error at w2 whereby not everyone with a cardiovascular disease at w1 was fed forward to w2. This makes ascertaining prevalence rates for w2 CVD conditions tricky. We decided that we would use report of the condition at w1 or w2 for prevalence of the typically chronic CVD conditions: hypertension, heart attack, heart murmur, heart failure, diabetes and stroke. For angina and abnormal heart rhythm, we will need to use the feed forward variable 'confirms diagnosis from previous wave' (hediac) and 'still has condition from previous wave' (hedias) for the conditions respectively, because many reporting the condition at the previous wave may not still have it at w2.

#### Incident depression

make depres\_d=0 if member of the sample at that wave

replace depres\_d=1 if psy3\_d=1 & w1\_psy3\_d!=1

#### Prevalent hypertension

make hibp\_d=0 if member of the sample at that wave

replace hibp\_d=1 if w1\_dim01\_d=1ordim01\_d=1

#### Prevalent angina

make angina\_d=0 if member of the sample at that wave

replace angina\_d=1 if hediac2=1ordim02\_d=1

#### Prevalent heart attack

make hrtattack\_d=0 if member of the sample at that wave

replace hrtattack\_d=1 if w1\_dim03\_d=1ordim03\_d=1

#### Coronary heart disease/myocardial infarction

make chd\_d=0 if member of the sample at that wave

replace chd\_d=1 if angina\_d=1orhrtattack\_d=1

#### Prevalent congestive heart failure

make hrtfail\_d=0 if member of the sample at that wave

replace hrtfail\_d=1 if w1\_dim04\_d=1ordim04\_d=1

**Prevalent heart murmur**

make murmur\_d=0 if member of the sample at that wave

replace murmur\_d=1 if w1\_dim05\_d=1ordim05\_d=1

**Prevalent abnormal heart rhythm**

make rhythm\_d=0 if member of the sample at that wave

replace rhythm\_d=1 if hedias6=1ordim06\_d=1

**Prevalent diabetes**

make diab\_d=0 if member of the sample at that wave

replace diab\_d=1 if heacd=1

**Prevalent stroke**

make stroke\_d=0 if member of the sample at that wave

replace stroke\_d=1 if w1\_dim08\_d=1ordim08\_d=1

**Prevalent high cholesterol**

make hichol\_d=0 if member of the sample at that wave

replace hichol\_d=1 if dia09\_d=1

**Prevalent lung disease**

make lungdis\_d=0 if member of the sample at that wave

replace lungdis\_d=1 if hedids1=1ordib01\_d=1

**Prevalent asthma**

make asthma\_d=0 if member of the sample at that wave

replace asthma\_d=1 if hedids2=1ordib02\_d=1

**Prevalent arthritis**

make arthritis\_d=0 if member of the sample at that wave

replace arthritis\_d=1 if hedids3=1ordib03\_d=1

**Prevalent osteoporosis**

make osteop\_d=0 if member of the sample at that wave

replace osteop\_d=1 if hedids4=1ordib04\_d=1

**Prevalent cancer**

make cancer\_d=0 if member of the sample at that wave

replace cancer\_d=1 if hedids5=1ordib05\_d=1

**Prevalent Parkinson's disease**

make parkins\_d=0 if member of the sample at that wave

replace parkins\_d=1 if hedids6=1ordib06\_d=1

**Prevalent psychiatric difficulties**

make psychdiff\_d=0 if member of the sample at that wave

replace psychdiff\_d=1 if hedids7=1ordib07\_d=1

**Prevalent Alzheimer's disease**

make alzheimers\_d=0 if member of the sample at that wave

replace alzheimers\_d=1 if hedids8=1ordib08\_d=1

**Prevalent dementia**

make dementia\_d=0 if member of the sample at that wave

replace dementia\_d=1 if hedids9=1ordib09\_d=1

**Prevalent eye condition**

make eye\_d=0 if heopt1=96

replace eye\_d=1 if heops=1or(heopt10 & heopt1<96)

**Wave 3 onwards****Prevalent stroke**

make stroke\_d=0 if member of the sample at that wave

replace stroke\_d=1 if hedimst=1 or hedacst=1

**Incident depression**

make depres\_d=0 if member of the sample at that wave

replace depres\_d=1 if hepsyde=1 & hedibps=1

**Prevalent diabetes**

make diab\_d=0 if member of the sample at that wave

replace diab\_d=1 if heacd=1at any previous wave

**Prevalent hypertension**

make hibp\_d=0 if member of the sample at that wave

replace hibp\_d=1 if hedimbp=1 or hedasbp=1

**Prevalent angina**

make angina\_d=0 if member of the sample at that wave

replace angina\_d=1 if hediman=1 or hedasan=1

**Prevalent heart attack**

make hrtattack\_d=0 if member of the sample at that wave

replace hrtattack\_d=1 if hedimmi=1 or hedacmi=1

**Coronary heart disease/myocardial infarction**

make chd\_d=0 if member of the sample at that wave

replace chd\_d=1 if angina\_d=1 or hrtattack\_d=1

**Prevalent high cholesterol**

make hichol\_d=0 if member of the sample at that wave

replace hichol\_d=1 if hedimch=1 or hedgesch=1

**Prevalent heart murmur**

make murmur\_d=0 if member of the sample at that wave

replace murmur\_d=1 if hedimhm=1 or hedashm=1

**Prevalent abnormal heart rhythm**

make rhythm\_d=0 if member of the sample at that wave

replace rhythm\_d=1 if hedimar=1 or hedgesar=1

**Prevalent congestive heart failure**

make hrtfail\_d=0 if member of the sample at that wave

replace hrtfail\_d=1 if hedimhf=1 or hedgeshf=1

**Prevalent lung disease**

make lungdis\_d=0 if member of the sample at that wave

replace lungdis\_d=1 if hediblu=1 or hedbslu=1

**Prevalent asthma**

make asthma\_d=0 if member of the sample at that wave

replace asthma\_d=1 if hedibas=1 or hedbsas=1

**Prevalent arthritis**

make arthritis\_d=0 if member of the sample at that wave

replace arthritis\_d=1 if hedibar=1 or hedbsar=1

**Prevalent osteoporosis**

make osteop\_d=0 if member of the sample at that wave

replace osteop\_d=1 if hedibos=1 or hedbsos=1

**Prevalent cancer**

make cancer\_d=0 if member of the sample at that wave

replace cancer\_d=1 if hedibca=1 or hedbsca=1

**Prevalent Parkinson's disease**

make parkins\_d=0 if member of the sample at that wave

replace parkins\_d=1 if hedibpd=1 or hedbspd=1

**Prevalent psychiatric difficulties**

make psychdiff\_d=0 if member of the sample at that wave

replace psychdiff\_d=1 if hedibps=1 or hedbdps=1

**Prevalent Alzheimer's disease**

make alzheimers\_d=0 if member of the sample at that wave

replace alzheimers\_d=1 if hedibad=1 or hedbdad=1

**Prevalent dementia**

make dementia\_d=0 if member of the sample at that wave

replace dementia\_d=1 if hedibde=1 or hedbsde=1

**Prevalent eye condition**

make eye\_d=0 if member of the sample at that wave

replace eye\_d=1 if (heopsgl=1 or heopsdi=1 or heopsmd=1 or heopsca=1)  
or (heoptgl=1 or heoptdi=1 or heoptmd=1 or heoptca=1)

**Generate quality indicators**

Wave 2 followed by subsequent waves.

**Wave 2**

dk=don't knows

ref=refusals

**Indicator stroke antihypertensives**

IF a person aged 50 or older has had a previous stroke, THEN the patient should be offered antihypertensive medication.

make w2\_bpmed=w2\_hehbbp

replace w2\_bpmed=w2\_hehbbp1 if (w2\_hehbbp=-1)

make w2\_basecvd4=0 if not missing(w2\_finstat)

replace w2\_basecvd4=1 if w2\_stroke\_d=1 & w2\_bpmed0 & not missing(w2\_bpmed)

make w2\_dkcvd4=0 if not missing(w2\_finstat)

replace w2\_dkcvd4=1 if w2\_stroke\_d=1 & w2\_bpmed=-8

make w2\_refcvd4=0 if not missing(w2\_finstat)

replace w2\_refcvd4=1 if w2\_stroke\_d=1 & w2\_bpmed=-9

make w2\_passcvd4=0 if w2\_basecvd4=1

replace w2\_passcvd4=1 if w2\_basecvd4=1 & w2\_bpmed=1

### Indicator depression suicide

IF a person aged 50 or older receives a diagnosis of a new depression episode, THEN the diagnosing physician should ask on the day of diagnosis whether the person aged 65 or older had any thoughts about suicide.

make w2\_basedep1=0 if not missing(w2\_finstat)

replace w2\_basedep1=1 if w2\_depres\_d=1 & w2\_hepsye=0

make w2\_dkdep1=0 if not missing(w2\_finstat)

replace w2\_dkdep1=1 if w2\_depres\_d & w2\_hepsye=-8

make w2\_refdep1=0 if not missing(w2\_finstat)

replace w2\_refdep1=1 if w2\_depres\_d & w2\_hepsye=-9

make w2\_passdep1=0 if w2\_basedep1=1

replace w2\_passdep1=1 if w2\_basedep1=1 & w2\_hepsye=1

### Indicator depression treatment (first iteration, diagnosed depression)

IF a person aged 50 or older is diagnosed with clinical depression, THEN antidepressant treatment, talking treatment, or electroconvulsive therapy should be offered within 2 weeks after diagnosis unless within that period the patient has improved, or unless the patient has substance abuse or dependence, in which case treatment may wait until 8 weeks after the patient is in a drug- or alcohol-free state.

make w2\_basedep2=0 if not missing(w2\_finstat)

replace w2\_basedep2=1 if w2\_depres\_d & w2\_hepsya=0 & not missing(w2\_hepsya)

make w2\_dkdep2=0 if not missing(w2\_finstat)

replace w2\_dkdep2=1 if w2\_depres\_d & w2\_hepsya=-8

make w2\_dkrdep2=0 if not missing(w2\_finstat)

replace w2\_dkrdep2=1 if w2\_depres\_d & w2\_hepsya<-7

make w2\_passdep2=0 if w2\_basedep2=1

replace w2\_passdep2=1 if w2\_basedep2=1 & w2\_hepsyb=1

### Indicator depression review

IF a person aged 50 or older has no meaningful symptom response after 6 weeks of treatment, THEN one of the following treatment options should be initiated by the 8th week of treatment: medication dose should be optimised (if initial treatment was medication), or medication should be initiated (if initial treatment was psychotherapy alone), or referral to a psychiatrist should be offered.

make w2\_basedep3=0 if not missing(w2\_finstat)

replace w2\_basedep3=1 if w2\_depres\_d & w2\_hepsyc=2

make w2\_passdep3=0 if w2\_basedep3=1

replace w2\_passdep3=1 if w2\_basedep3=1 & w2\_hepsyd=1

### Indicator diabetes Hb<sub>A1c</sub>

IF a person aged 50 or older has diabetes, THEN his or her glycosylated haemoglobin or fructosamine level should be measured at least annually.

make w2\_basediab1=0 if not missing(w2\_finstat)

replace w2\_basediab1=1 if w2\_hesug0 & w2\_hesuga-8 & not missing(w2\_hesug)

make w2\_passdiab1=0 if w2\_basediab1=1

replace w2\_passdiab1=1 if w2\_basediab1=1 & w2\_hesuga=1

### Indicator diabetes proteinuria

IF a diabetic person aged 50 or older does not have established renal disease and is not receiving an ACE inhibitor or angiotensin II receptor blocker, THEN he or she should receive an annual test for proteinuria.

make w2\_basediab2=0 if not missing(w2\_finstat)

replace w2\_basediab2=1 if w2\_hekidn!=1 & w2\_heacea=2 & w2\_hewee=0 & not missing(w2\_hewee)

make w2\_dkdiab2=0 if not missing(w2\_finstat)

replace w2\_dkdiab2=1 if w2\_hekidn!=1 & w2\_heacea=2 & w2\_hewee=-8

make w2\_dkrdiab2=0 if not missing(w2\_finstat)

replace w2\_dkrdiab2=1 if w2\_hekidn!=1 & w2\_heacea=2 & w2\_hewee<-7

make w2\_passdiab2=0 if w2\_basediab2=1

replace w2\_passdiab2=1 if w2\_basediab2=1 & w2\_hewee=1



**Indicator diabetes cholesterol**

IF a diabetic person aged 50 or older has a fasting total cholesterol level of 5 mmol/l or greater, THEN he or she should be offered an intervention to lower cholesterol.

make w2\_basediab6=0 if not missing(w2\_finstat)

replace w2\_basediab6=1 if w2\_heacd=1 & w2\_hechol=0 & not missing(w2\_hechol)

make w2\_passdiab6=0 if w2\_basediab6=1

replace w2\_passdiab6=1 if w2\_basediab6=1 & w2\_hechol=1

**Indicator diabetes ACE inhibitor**

IF a diabetic person aged 50 or older has one additional cardiac risk factor (ie, smoker, hypertension, hypercholesterolemia, or renal insufficiency/microalbuminuria), THEN he/she should be offered an ACE inhibitor or receptor blocker.

make w2\_highbp2=0 if not missing(w2\_finstat)

replace w2\_highbp2 = 1 if (w2n\_sysval=140 & not missing(w2n\_sysval)) or (w2n\_diaval=90 & not missing(w2n\_diaval))

make w2\_basediab8=0 if not missing(w2\_finstat)

replace w2\_basediab8 = 1 if w2\_heacd=1 & (w2\_heska=1orw2\_highbp2=1orw2\_hekidn=1orw2\_heweea=1orw2\_hichol\_d=1orw2\_hibp\_d=1)& ((w2\_heace0 & not missing(w2\_heace))or(w2\_heacea=0 & not missing(w2\_heacea)))

make w2\_dkdiab8=0 if not missing(w2\_finstat)

replace w2\_dkdiab8=1 if w2\_heacd=1 & (w2\_heska=1orw2\_highbp2=1orw2\_hekidn=1orw2\_heweea=1orw2\_hichol\_d=1orw2\_hibp\_d=1)& (w2\_heace=-8 & w2\_heacea=-8)

make w2\_passdiab8=0 if w2\_basediab8=1

replace w2\_passdiab8 = 1 if w2\_basediab8=1 & (w2\_heace=1orw2\_heacea=1)

**Indicator diabetes foot check**

ALL diabetic persons aged 50 or older should have an annual examination of his/her feet.

make w2\_basediab9=0 if not missing(w2\_finstat)

replace w2\_basediab9=1 if w2\_heacd=1 & not missing(w2\_heftchk) & w2\_heftchk=0

make w2\_passdiab9=0 if w2\_basediab9=1

replace w2\_passdiab9=1 if w2\_basediab9=1 & w2\_heftchk=1

**Indicator hypertension treatment: incident hypertension**

IF a person aged 50 or older remains hypertensive after non-pharmacological intervention, THEN pharmacological antihypertensive treatment should be initiated.

make w2\_basehyp2=0 if not missing(w2\_finstat)

replace w2\_basehyp2=1 if w2\_dim01\_d=1 & w1\_dim01\_d!=1 & w2\_hehbpb=0 & not missing(w2\_hehbpb)

make w2\_passhyp2=0 if w2\_basehyp2=1

replace w2\_passhyp2=1 if w2\_basehyp2=1 & w2\_hehbpb=1

**Indicator hypertension treatment: prevalent hypertension**

IF a person aged 50 or older remains hypertensive after non-pharmacological intervention, THEN pharmacological antihypertensive treatment should be initiated.

make w2\_basehyp2a=0 if not missing(w2\_finstat)

replace w2\_basehyp2a=1 if w2\_hibp\_d=1 & w2\_hehbpb=0 & not missing(w2\_hehbpb)

make w2\_passhyp2a=0 if w2\_basehyp2a=1

replace w2\_passhyp2a=1 if w2\_basehyp2a=1 & w2\_hehbpb=1

**Indicator ischaemic heart disease cholesterol (cholesterol first iteration) reported IDH and reported high cholesterol (previous variable: w2\_basechol1a & w2\_passchol1a)**

IF a person aged 50 or older has established CHD and LDL cholesterol 3 mmol/l, THEN he or she should be offered an intervention to lower cholesterol.

make w2\_baseihd1=0 if not missing(w2\_finstat)

replace w2\_baseihd1=1 if w2\_hichol\_d=1 & (w2\_angina\_d=1 or w2\_hrtattack\_d=1) & w2\_hechol=0 & not missing(w2\_hechol)

make w2\_passihd1=0 if w2\_baseihd1=1

replace w2\_passihd1=1 if w2\_baseihd1=1 & w2\_hechol=1

**Indicator ischaemic heart disease antiplatelets**

IF a person aged 50 or older has established CHD and is not on warfarin, THEN he or she should be offered antiplatelet therapy.

make w2\_baseihd2=0 if not missing(w2\_finstat)

replace w2\_baseihd2=1 if (w2\_angina\_d=1 or w2\_hrtattack\_d=1) & (w2\_hehrta=0 & not missing(w2\_hehrta)) & w2\_hehrtc!=1

make w2\_dkih2=0 if not missing(w2\_finstat)

replace w2\_dkihd2=1 if (w2\_angina\_d=1orw2\_hrtattack\_d=1) & w2\_hehrta=-8 & w2\_hehrtc!=1

make w2\_passihd2=0 if w2\_baseihd2=1

replace w2\_passihd2=1 if w2\_baseihd2=1 & w2\_hehrta=1

### Indicator ischaemic heart disease smoking

IF a person aged 50 or older with established CHD smokes, THEN he or she should be offered counselling for smoking cessation.

make w2\_baseihd3=0 if not missing(w2\_finstat)

replace w2\_baseihd3=1 if (w2\_angina\_d=1orw2\_hrtattack\_d=1) & not missing(w2\_hecgstp) & w2\_hecgstp=0

make w2\_dkihd3=0 if not missing(w2\_finstat)

replace w2\_dkihd3=1 if (w2\_angina\_d=1orw2\_hrtattack\_d=1) & w2\_hecgstp=-8

make w2\_passihd3=0 if w2\_baseihd3=1

replace w2\_passihd3=1 if w2\_baseihd3=1 & w2\_hecgstp=1

### Indicator myocardial infarction beta-blocker: incident myocardial infarction

IF a person aged 50 or older has had a recent MI, THEN he or she should be offered a beta-blocker.

make w2\_betab=0 if not missing(w2\_finstat)

replace w2\_betab=1 if w2\_hebeta=1orw2\_hebetb=1

replace w2\_betab= if (mi(w2\_hebeta)orw2\_hebeta<0) & (mi(w2\_hebetb)orw2\_hebetb<0)

make w2\_baseihd5=0 if not missing(w2\_finstat)

replace w2\_baseihd5=1 if w2\_dia03\_d=1 & w1\_dim03\_d!=1 & not missing(w2\_betab)

make w2\_dkihd5=0 if not missing(w2\_finstat)

replace w2\_dkihd5=1 if w2\_dia03\_d=1 & w1\_dim03\_d!=1 & (w2\_hebeta=-8 & w2\_hebetb=-8)

make w2\_passihd5=0 if w2\_baseihd5=1

replace w2\_passihd5=1 if w2\_baseihd5=1 & w2\_betab=1

### Indicator myocardial infarction beta-blocker: prevalent myocardial infarction

IF a person aged 50 or older has had a recent MI, THEN he or she should be offered a beta-blocker.

make w2\_baseihd5a=0 if not missing(w2\_finstat)

replace w2\_baseihd5a=1 if w2\_hrtattack\_d=1 & not missing(w2\_betab)

make w2\_dkihd5a=0 if not missing(w2\_finstat)

replace w2\_dkihd5a=1 if w2\_hrtattack\_d=1 & (w2\_hebeta=-8 & w2\_hebetb=-8)

make w2\_passihd5a=0 if w2\_baseihd5a=1

replace w2\_passihd5a=1 if w2\_baseihd5a=1 & w2\_betab=1

### Indicator international normalised ratio test

(IHD extra indicator – previously med3) limited to IHD (MI and angina) by questionnaire so aggregate as IHD variable.

IF a person aged 50 or older is prescribed warfarin, THEN an INR should be determined at least every 12 weeks.

make w2\_baseihd6=0 if not missing(w2\_finstat)

replace w2\_baseihd6=1 if w2\_hehrtc=1 & (w2\_hehrte=0 & not missing(w2\_hehrte))

make w2\_dkihd6=0 if not missing(w2\_finstat)

replace w2\_dkihd6=1 if w2\_hehrtc=1 & w2\_hehrtd=-8

make w2\_passihd6=0 if w2\_baseihd6=1

replace w2\_passihd6=1 if w2\_baseihd6=1 & w2\_hehrte=1

### Indicator osteoarthritis exercise

IF an ambulatory person aged 50 or older has had a diagnosis of symptomatic osteoarthritis of the knee for longer than 3 months and has no contraindications to exercise and is physically and mentally able to exercise, THEN a directed or supervised strengthening or aerobic exercise programme should have been prescribed at least once.

make w2\_baseoa2=0 if not missing(w2\_finstat)

replace w2\_baseoa2=1 if w2\_hekneb=0 & not missing(w2\_hekneb)

make w2\_passoa2=0 if w2\_baseoa2=1

replace w2\_passoa2=1 if w2\_baseoa2=1 & w2\_hekneb=1

### Indicator osteoarthritis education

IF an ambulatory person aged 50 or older has a diagnosis of symptomatic osteoarthritis, THEN education regarding the natural history, treatment and self-management of the disease should be offered at least once.

make w2\_alleduc=0 if not missing(w2\_finstat)

replace w2\_alleduc=1 if w2\_hearta=1 & w2\_heartb=1 & w2\_heartc=1

replace w2\_alleduc= if w2\_hearta<0 or w2\_heartb<0 or w2\_heartc<0 or mi(w2\_hearta, w2\_heartb, w2\_heartc)

make w2\_baseoa3=0 if not missing(w2\_finstat)

replace w2\_baseoa3=1 if w2\_heartoa=1 & not missing(w2\_alleduc)

make w2\_dkoa3=0 if not missing(w2\_finstat)

replace w2\_dkoa3=1 if w2\_heartoa=1 & (w2\_hearta=-8 or w2\_heartb=-8 or w2\_heartc=-8)

make w2\_passoa3=0 if w2\_baseoa3=1

replace w2\_passoa3=1 if w2\_baseoa3=1 & w2\_alleduc=1

### Indicator osteoarthritis paracetamol

IF oral pharmacological therapy is initiated to treat osteoarthritis among people aged 50 or older, THEN paracetamol should be the first drug used, unless there is a contraindication to use.

make w2\_baseoa4=0 if not missing(w2\_finstat)

replace w2\_baseoa4=1 if w2\_heartoa=1 & w2\_hearte=0 & not missing(w2\_hearte)

make w2\_dkoa4=0 if not missing(w2\_finstat)

replace w2\_dkoa4=1 if w2\_heartoa=1 & w2\_hearte=-8

make w2\_passoa4=0 if w2\_baseoa4=1

replace w2\_passoa4=1 if w2\_baseoa4=1 & w2\_hearte=1

### Indicator osteoarthritis referral

IF a person aged 50 or older with severe symptomatic osteoarthritis of the knee or hip has failed to respond to non-pharmacological and pharmacological therapy, THEN the patient should be offered referral to an orthopaedic surgeon to be evaluated for total joint replacement within 6 months unless surgery is contraindicated.

make w2\_baseoa6=0 if not missing(w2\_finstat)

replace w2\_baseoa6=1 if w2\_hepae=2 & w2\_hepaf=0 & not missing(w2\_hepaf)

make w2\_dkoa6=0 if not missing(w2\_finstat)

replace w2\_dkoa6=1 if w2\_hepae=2 & w2\_hepaf=-8

make w2\_passoa6=0 if w2\_baseoa6=1

replace w2\_passoa6=1 if w2\_baseoa6=1 & w2\_hepaf=1

## Patient-centered care

### Indicator diabetes training

Some people with diabetes receive training to help manage their diabetes themselves. Have you ever participated in a course or class about diabetes, or received special training on how you can live with your diabetes from day to day?

make w2\_basepat1=0 if not missing(w2\_finstat)

replace w2\_basepat1=1 if w2\_heacd=1 & not missing(w2\_heslfcf) & w2\_heslfcf=0

make w2\_passpat1=0 if w2\_basepat1=1)

replace w2\_passpat1=1 if w2\_basepat1=1 & w2\_heslfcf=1

### Indicator diabetes knowledge

How much do you think you know about managing your diabetes? ('just about everything you need to know' or 'most of what you need to know').

make w2\_basepat2=0 if not missing(w2\_finstat)

replace w2\_basepat2=1 if w2\_heacd=1 & not missing(w2\_heslfcf) & w2\_heslfcf=0

make w2\_dkpat2=0 if not missing(w2\_finstat)

replace w2\_dkpat2=1 if w2\_heacd=1 & w2\_heslfcf=-8

make w2\_passpat2=0 if w2\_basepat2=1

replace w2\_passpat2=1 if w2\_basepat2=1 & (w2\_heslfcf=1 or w2\_heslfcf=2)

### Indicator cholesterol explanation

Has a doctor or nurse explained high cholesterol in a way you could understand?

replace w2\_basepat3=1 if w2\_hecholb=1 or w2\_hecholb=2

make w2\_passpat3=0 if w2\_basepat3=1

replace w2\_passpat3=1 if w2\_basepat3=1 & w2\_hecholb=1

### Indicator cholesterol preferences

Have doctors or nurses taken your preferences into account when making treatment decisions about your high cholesterol?

make w2\_basepat4=0 if not missing(w2\_finstat)

replace w2\_basepat4=1 if w2\_hecholc=1 or w2\_hecholc=2

make w2\_passpat4=0 if w2\_basepat4=1

replace w2\_passpat4=1 if w2\_basepat4=1 & w2\_hecholc=1

### Indicator blood pressure explanation

Has a doctor or nurse explained high blood pressure in a way you could understand at any time since you were first told you had high blood pressure?

make w2\_basepat5=0 if not missing(w2\_finstat)

replace w2\_basepat5=1 if w2\_hehbp=1 or w2\_hehbp=2

make w2\_passpat5=0 if w2\_basepat5=1

replace w2\_passpat5=1 if w2\_basepat5=1 & w2\_hehbp=1

**Indicator blood pressure choice**

In general, have doctors or nurses given you any choice about how to treat your high blood pressure?

make w2\_basepat6=0 if not missing(w2\_finstat)

replace w2\_basepat6=1 if w2\_hehbpa=1 or w2\_hehbpa=2

make w2\_passpat6=0 if w2\_basepat6=1

replace w2\_passpat6=1 if w2\_basepat6=1 & w2\_hehbpa=1

**Indicator osteoarthritis treatment purpose**

Has any doctor or nurse ever talked to you about what the specific purpose of the treatment for your arthritis or joint pain is?

make w2\_basepat7=0 if not missing(w2\_finstat)

replace w2\_basepat7=1 if w2\_heartoa=1 & (w2\_heartd=1 or w2\_heartd=2)

make w2\_passpat7=0 if w2\_basepat7=1

replace w2\_passpat7=1 if w2\_basepat7=1 & w2\_heartd=1

**Subsequent waves**

Wave number is named X, one wave before is X-1, 2 waves before is X-2 and three waves before is X-3.

NB: not all indicators can be generated at every wave.

**Indicator stroke antihypertensives**

make wX\_bpmed=wX\_hehbpb

replace wX\_bpmed=wX\_hehbpb1 if (wX\_hehbpb=-1)

make wX\_basecvd4=0 if not missing(wX\_finstat)

replace wX\_basecvd4=1 if wX\_stroke\_d=1 & ((wX-3\_bpmed>0 & not missing(wX-3\_bpmed)) or (wX-2\_bpmed>0 & not missing(wX-2\_bpmed)) or (wX-1\_bpmed>0 & not missing(wX-1\_bpmed)) or (wX\_bpmed>0 & not missing(wX\_bpmed)))

make wX\_passcvd4=0 if wX\_basecvd4=1

replace wX\_passcvd4=1 if wX\_basecvd4=1 & (wX-3\_bpmed=1 or wX-2\_bpmed=1 or wX-1\_bpmed=1 or wX\_bpmed=1)

**Indicator depression suicide**

make wX\_basedep1=0 if not missing(wX\_finstat)

replace wX\_basedep1=1 if wX\_depres\_d=1 & wX\_hepsye>=0 & not missing(wX\_hepsye)

make wX\_passdep1=0 if wX\_basedep1=1

replace wX\_passdep1=1 if wX\_basedep1=1 & wX\_hepsye=1

**Indicator depression treatment**

make wX\_basedep2=0 if not missing(wX\_finstat)

replace wX\_basedep2=1 if wX\_depres\_d=1 & wX\_hepsya>=0 & not missing(wX\_hepsya)

make wX\_passdep2=0 if wX\_basedep2=1

replace wX\_passdep2=1 if wX\_basedep2=1 & wX\_hepsyb=1

**Indicator diabetes HbA<sub>1c</sub>**

make wX\_basediab1=0 if not missing(wX\_finstat)

replace wX\_basediab1=1 if wX\_hesug>=0 & wX\_hesuga>-8 & not missing(wX\_hesug, wX\_hesuga)

make wX\_passdiab1=0 if wX\_basediab1=1

replace wX\_passdiab1=1 if wX\_basediab1=1 & wX\_hesuga=1

**Indicator diabetes proteinuria**

make wX\_basediab2=0 if not missing(wX\_finstat)

replace wX\_basediab2=1 if wX\_hekidn!=1 & wX\_heacea=2 & wX\_hewee>=0 & not missing(wX\_hewee)

make wX\_passdiab2=0 if wX\_basediab2=1

replace wX\_passdiab2=1 if wX\_basediab2=1 & wX\_hewee=1

**Indicator diabetes cholesterol**

make wX\_basediab6=0 if not missing(wX\_finstat)

replace wX\_basediab6=1 if wX\_diab\_d=1 & wX\_hechol>=0 & not missing(wX\_hechol)

make wX\_passdiab6=0 if wX\_basediab6=1

replace wX\_passdiab6=1 if wX\_basediab6=1 & wX\_hechol=1

**Indicator diabetes ACE inhibitor**

make wX\_basediab8=0 if not missing(wX\_finstat)

replace wX\_basediab8=1 if wX\_diab\_d=1 &

(wX\_heska=1orwX\_hekidn=1orwX\_heweea=1orwX\_hichol\_d=1orwX\_hibp\_d=1) &

((wX\_heace>0 & not missing(wX\_heace)) or (wX\_heacea>=0 & not missing(wX\_heacea)))

make wX\_passdiab8=0 if wX\_basediab8=1

replace wX\_passdiab8=1 if wX\_basediab8=1 & (wX\_heace=1orwX\_heacea=1)



**Indicator diabetes foot check**

make wX\_basediab9=0 if not missing(wX\_finstat)

replace wX\_basediab9=1 if wX\_heftchk>=0 & not missing(wX\_heftchk)

make wX\_passdiab9=0 if wX\_basediab9=1

replace wX\_passdiab9=1 if wX\_basediab9=1 & wX\_heftchk=1

**Indicator hypertension treatment: incident hypertension**

make wX\_basehyp2=0 if not missing(wX\_finstat)

replace wX\_basehyp2=1 if (wX\_hedimbp=1 & wX\_hedasbp!=1) & wX\_hehbpb>=0 & not missing(wX\_hehbpb)

make wX\_passhyp2=0 if wX\_basehyp2=1

replace wX\_passhyp2=1 if wX\_basehyp2=1 & wX\_hehbpb=1

**Indicator hypertension treatment: prevalent hypertension**

make wX\_basehyp2a=0 if not missing(wX\_finstat)

replace wX\_basehyp2a=1 if wX\_hibp\_d=1 & wX\_hehbpb>=0 & not missing(wX\_hehbpb)

make wX\_passhyp2a=0 if wX\_basehyp2a=1

replace wX\_passhyp2a=1 if wX\_basehyp2a=1 & wX\_hehbpb=1

**Indicator ischaemic heart disease cholesterol**

make wX\_baseihd1=0 if not missing(wX\_finstat)

replace wX\_baseihd1=1 if wX\_chd\_d=1 & wX\_hechol>=0 & not missing(wX\_hechol)

make wX\_passihd1=0 if wX\_baseihd1=1

**Indicator ischaemic heart disease antiplatelets**

make wX\_baseihd2=0 if not missing(wX\_finstat)

replace wX\_baseihd2=1 if wX\_chd\_d=1 & (wX\_hehrta>=0 & not missing(wX\_hehrta)) & wX\_hehrtc!=1

make wX\_passihd2=0 if wX\_baseihd2=1

replace wX\_passihd2=1 if wX\_baseihd2=1 & wX\_hehrta=1

**Indicator ischaemic heart disease smoking**

make wX\_baseihd3=0 if not missing(wX\_finstat)

replace wX\_baseihd3=1 if wX\_chd\_d=1 & ((wX-3\_hecgstp>0 & not missing(wX-3\_hecgstp)) or (wX\_Hecgstp>0 & not missing(wX\_Hecgstp)))

make wX\_passihd3=0 if wX\_baseihd3=1

replace wX\_passihd3=1 if wX\_baseihd3=1 & (wX-3\_hecgstp=1 or wX\_Hecgstp=1)

**Indicator myocardial infarction beta-blocker: incident myocardial infarction**

make wX\_betab=0 if wX\_hebeta=2orwX\_hebetb=2

replace wX\_betab=1 if wX\_hebeta=1orwX\_hebetb=1

make wX\_baseihd5=0 if not missing(wX\_finstat)

replace wX\_baseihd5=1 if wX\_hedimmi=1 & wX-1\_hedimmi!=1 & not missing(wX\_betab)

make wX\_passihd5=0 if wX\_baseihd5=1

replace wX\_passihd5=1 if wX\_baseihd5=1 & wX\_betab=1

**Indicator myocardial infarction beta-blocker: prevalent myocardial infarction**

make wX\_baseihd5a=0 if not missing(wX\_finstat)

replace wX\_baseihd5a=1 if wX\_hrtattack\_d=1 & not missing(wX\_betab)

make wX\_passihd5a=0 if wX\_baseihd5a=1

replace wX\_passihd5a=1 if wX\_baseihd5a=1 & wX\_betab=1

**Indicator ischaemic heart disease international normalised ratio test**

make wX\_baseihd6=0 if not missing(wX\_finstat)

replace wX\_baseihd6=1 if wX\_hehrtc=1 & (wX\_hehrte>=0 & not missing(wX\_hehrte))

make wX\_passihd6=0 if wX\_baseihd6=1

replace wX\_passihd6=1 if wX\_baseihd6=1 & wX\_hehrte=1

**Indicator osteoarthritis exercise**

make wX\_baseoa2=0 if not missing(wX\_finstat)

replace wX\_baseoa2=1 if wX\_heartoa=1 & ( (wX-3\_hekneb>0 & not missing(wX-3\_hekneb))  
or(wX-2\_hekneb>0 & not missing(wX-2\_hekneb)) or (wX-1\_hekneb>0 & not missing(wX-1\_hekneb))  
or (wX\_hekneb>0 & not missing(wX\_hekneb)) )

make wX\_passoa2=0 if wX\_baseoa2=1

replace wX\_passoa2=1 if wX\_baseoa2=1 & (wX-3\_hekneb=1or wX-2\_hekneb=1or  
wX-1\_hekneb=1or wX\_hekneb=1)

**Indicator osteoarthritis education**

make wX\_alleduc=0 if wX\_hearta>0 & wX\_heartb>0 & wX\_heartc>0 & not missing(wX\_hearta,  
wX\_heartb, wX\_heartc)

replace wX\_alleduc=1 if wX\_hearta=1 & wX\_heartb=1 & wX\_heartc=1

make wX\_baseoa3=0 if not missing(wX\_finstat)

replace wX\_baseoa3=1 if wX\_heartoa=1 &

(not missing(wX-3\_alleduc)or not missing(wX-2\_alleduc)or not missing(wX-1\_alleduc)or not missing(wX\_alleduc))

make wX\_passoa3=0 if wX\_baseoa3=1

replace wX\_passoa3=1 if wX\_baseoa3=1 &

(wX-3\_alleduc=1orwX-2\_alleduc=1orwX-1\_alleduc=1or wX\_alleduc=1)

### Indicator osteoarthritis paracetamol

make wX\_baseoa4=0 if not missing(wX\_finstat)

replace wX\_baseoa4=1 if wX\_heartoa=1 & ((wX-3\_hearte>0 & not missing(wX-3\_hearte)) or

(wX-2\_hearte>0 & not missing (wX-2\_hearte)) or (wX-1\_hearte>0 & not missing (wX-1\_hearte)) or (wX\_hearte>0 & not missing(wX\_hearte)))

make wX\_passoa4=0 if wX\_baseoa4=1

replace wX\_passoa4=1 if wX\_baseoa4=1 & (wX-3\_hearte=1or wX-2\_hearte=1or wX-1\_hearte=1or wX\_hearte=1)

### Indicator osteoarthritis referral

make wX\_baseoa6=0 if not missing(wX\_finstat)

replace wX\_baseoa6=1 if wX\_heartoa=1 & wX\_hehipc=2 & wX\_hepsur>=0 & not missing(wX\_hepsur)

make wX\_passoa6=0 if wX\_baseoa6=1

replace wX\_passoa6=1 if wX\_baseoa6=1 & wX\_hepsur=1

### Indicator diabetes training

make wX\_basepat1=0 if not missing(wX\_finstat)

replace wX\_basepat1=1 if wX\_diab\_d=1 & ((w2\_heslfcf>0 & not missing(w2\_heslfcf)) or(w3\_heslfcf>0 & not missing(w3\_heslfcf)) or (wX\_heslfcf>0 & not missing(wX\_heslfcf)) )

make wX\_passpat1=0 if wX\_basepat1=1

replace wX\_passpat1=1 if wX\_basepat1=1 & (wX-2\_heslfcf=1or wX-1\_heslfcf=1or wX\_heslfcf=1)

### Indicator diabetes knowledge

make wX\_basepat2=0 if not missing(wX\_finstat)

replace wX\_basepat2=1 if wX\_diab\_d=1 & not missing(wX\_heslfcf) & wX\_heslfcf>=0

make wX\_passpat2=0 if wX\_basepat2=1

replace wX\_passpat2=1 if wX\_basepat2=1 & (wX\_heslfcf=1 or wX\_heslfcf=2)

**Indicator osteoarthritis treatment purpose**

make wX\_basepat7=0 if not missing(wX\_finstat)

replace wX\_basepat7=1 if wX\_heartoa=1 & ((wX-2\_heartd>0 & not missing(wX-2\_heartd)) or (wX-1\_heartd>0 & not missing(wX-1\_heartd)) or (wX\_heartd>0 & not missing(wX\_heartd)) )

make wX\_passpat7=0 if wX\_basepat7=1

replace wX\_passpat7=1 if wX\_basepat7=1 & (wX-2\_heartd=1 or wX-1\_heartd=1 or wX\_heartd=1)

## Appendix 3 Protocol: key changes

### The dynamics of quality: a national panel study of evidence-based standards

Primary outcome measures: owing to differences in the way questions were asked to the respondents, quality indicators are not available for all conditions at all four waves; the following table shows data availability.

Quality indicators for the four diseases	Availability of data
Cardiovascular disease	
Hypertension treatment	All
IHD cholesterol	2 and 5
IHD antiplatelets	2 and 5
INR test	2 and 5
IHD smoking	2 and 5
MI beta-blocker	2 and 5
OA	
OA exercise	All
OA education	All
OA paracetamol	All
OA referral	All
Receipt of hip or knee joint replacement if indicated, and whether received through NHS or non-NHS health care	All for receipt of joint replacement; 4 and 5 for payment
Diabetes	
Diabetes HbA <sub>1c</sub>	All
Diabetes proteinuria	All
Diabetes cholesterol	2 and 5
Diabetes ACE inhibitor	2, 4 and 5
Diabetes foot check	All
Depression	
Depression suicide	2 and 4
Depression treatment	2 and 4
Depression review	2

OA, osteoarthritis.

In addition to those indicators listed above, we can generate stroke antihypertensive use at all four waves.

### *Patient-centred care*

- Diabetes training: waves 2 and 4.
- Diabetes knowledge: waves 2 and 4.
- Cholesterol explanation: wave 2 only.
- Cholesterol preferences: wave 2 only.
- Blood pressure explanation: wave 2 only.
- Blood pressure choice: wave 2 only.
- Osteoarthritis treatment purpose: waves 2 and 4.

### **Effects of loss of quality indicator data**

Cardiovascular disease, osteoarthritis and diabetes have sufficient measurements for all the indicators for longitudinal analyses. Depression has two quality indicators available in waves 2 and 4 for longitudinal analyses. Unfortunately, one quality indicator was only asked at wave 2, so comparisons over time cannot be drawn for that indicator.

## Appendix 4 Public and Patient Involvement in Research report

The PPIRes project in Norfolk and Suffolk is a local initiative to enable and encourage volunteer members of the public to collaborate with researchers in local trusts and universities. Our study had two PPIRes steering committee members, Mrs Amander Wellings and Mr Dave Stott. They joined the study steering group meetings and usefully contributed to the research team discussions about factors that might be associated with quality of care. It is worth noting that it was difficult achieving meaningful patient involvement in this study which largely evaluated professional practice.

After the first meeting there was discussion about whether or not ELSA could be used to explore information regarding patient perceptions of their interactions with their clinician. There were also discussions regarding what biographical factors should be used to predict quality of care. With regard to patient perceptions, we used the patient-centred quality indicators. These are not ideal measures as they were primarily designed to measure the performance of the health-care system and so focus on the offer of effective care. The idea was to be able to give clinicians credit for offering/discussing good care, without penalty if their patients made an informed decision not to take a particular treatment. The biographical data discussion was based around availability and ethical considerations of using these data. Age, sex, ethnicity and sexual orientation were mentioned, and barring sexual orientation (which is being asked in wave 6 onwards and hence the data are not available for this work), these factors were included in the modelling process. Geography was discussed; however, this is not routinely released to protect patient confidentiality, and was not used in our analyses.

When we were amalgamating factors that might be associated with quality of care, a 'long-list' was sent to the PPIRes representatives as a base on which they could build further ideas for us to model. The following points were raised as ideas to follow up if possible:

- The proportion of patients: making use of telephone consultations or maybe using repeat prescriptions or non-attending pre-booked appointments or using home visits or using emergency after hours/ weekend locum call-outs or having referrals to hospital consultants or other non-practice-based specialist services?
- The proportion of patients: seeing multiple clinicians within a practice for the same or maybe different ailments.
- Some other biographical factors might include patients' mental health history (more than just the CES-D depression scale) or pattern of illegal drug or alcohol use – more than the 'days since having had an alcoholic drink' question. More 'left field', we wondered whether ELSA had any information on patients' religion.
- Geographical distance of patients' homes to GP surgery, or even mode of transport from home to surgery. In part this might tap in to the 'access' issue that remains a key strand of the national health-care agenda. It might also link with the availability/mobility of carers or other helpful family/neighbours?
- The proportion of patients who attend appointments accompanied by a carer, friend, family member or other more formal 'advocate' or representative? Probably not captured in patient records or ELSA but nonetheless interesting. Again quite easy to understand the additional pressures/encouragement for a clinician to do more or appear to do more/better when there is a third – though arguably relatively high status – independent presence in the consultation room.
- We also thought about the extent to which equity of health care might relate to the presentation of multiple ailments at the same consultation? One can easily imagine patients – ourselves included – saving up symptoms into a bundle that makes a surgery visit worthwhile/economical. Though similar, we guess, to the 'one more thing doctor before I leave' scenario, we do not feel it is entirely the same phenomena. It would be quite easy to see how some patients simultaneously

presenting with say three or four problems might inadvertently downplay or forget the most critical one – possibly due to consultation stress or issues of ‘cognition’. This could result in some GPs understandably focusing more upon on the first or least problematic of presented symptoms. (We are, however, well aware that GPs normally ask patients to focus on one problem per visit or invite them produce a hierarchy of problems but in reality. . .) Empathising somewhat with the plight of clinicians the phrase ‘hard to see the wood for the trees’ came to mind.

- One other variant of this phenomena could be patients with multiple problems, i.e. patients with a pre-existing problem, for which they are already being treated but who subsequently develop symptoms of other problems but about which they delay telling their GP, sometimes until its very or too late. Why? We are both aware of some patients who feel they have used up their NHS ‘entitlement’ to health care by having just one health problem and therefore defer going to their GP for fear of developing a practice reputation as a worrier or hypochondriac. How and when these patients alert their GP to these other/secondary issues is interesting but probably not for this project?
- We know that some clinicians, previously inclined so to do, no longer mark or otherwise signal on patients files their surgery reputation as being awkward, difficult, truculent, badly behaved – though anecdotally are aware locally of things like NfN (Normal for Norfolk). That said we could fully understand the temptation for clinicians not to be as thorough, sympathetic or caring towards certain types of patient – even down to ushering them out of the consultation door as quickly as possible. We cannot help but feel patient behaviour/reputation might well have a role in patients receipt of quality health care though can think of no way of getting access to or testing this, well at least not as part of this study. Whilst on this theme we wondered in that same ‘left field’ way, and howsoever broached whether criminal conviction or even a propensity among some patients for ‘crying wolf’ might be worth exploring.
- Finally we had an even wilder thought about whether a synergy between an individual patient’s profile with that of his/her GP might be an interesting avenue to explore. We are not really expecting a response to this one but believe we have read somewhere about evidence drawn from wider therapeutic encounters to suggest the greater the ‘fit’ – biographical/social/political/personal, etc. – between clinician and patient the more likely the patient is to feel they have received a better quality of care. We even had some momentary some fun with the notion that ELSA might have enquired about patients’ political affiliations!
- Patients being scared about going to their clinician – the ‘white coat syndrome’, e.g. how this syndrome could affect some patients say with obesity/BMI. The GP says ‘lose weight’ but the patient is not emotionally ready to take this advice on board at that point resulting in them not going back to the GP or at least not doing so for some considerable time or at a crisis, or looking for a different GP. Also possibly elongating the time between the onset of a health condition and the patient actually presenting themselves for a diagnosis and treatment. So link BMI with length of time from onset to presentation. Also possibly link with alcohol consumption/smoking and presentation.
- The potentially important role of patients’ spouses in their quality of health care.
- Comparing/contrasting the optimists and pessimists, i.e. feeling satisfied how life has turned out and feeling what has happened is out of their control. If one feels life is out of control it assumes cannot do anything about improving my own health.
- Carer support – (a) Importance of cognitive status. This could usefully link to the availability and importance to a patient having the support of a ‘carer’. With reference to ‘cognition’ there is an important ‘time’ variable between a patient gaining their educational qualifications – possibly many years ago – and their present cognitive state and therefore inability to actually use their education/knowledge/skills ‘now’ to help them more effectively problem solve and ask for or gain the quality of healthcare they so need. (b) Eyesight/hearing and linked it with the availability or otherwise and level of carer support. (c) You rightly identified ‘access to care’ as a big issue in primary care. In this context you began to explore the notion of ‘home visits and also a patient’s ability to walk to the surgery. Again the role of a carer could be key in such patients accessing high quality GP care. Look at last wave to see if cutbacks to care plays a part? Also could look at financial status e.g. total wealth amount of care from the 1st wave to the last. Is this carer a paid carer in the questionnaire?



These comments were mapped to the information that we could extract from the ELSA questionnaire, and the following table shows the result of this mapping.

Mapping PPIRes ideas to ELSA data	
Question/translation	Use ability?
Telephone consults, repeat prescriptions, non-attendance, home visits, locum call outs, number of hospital referrals, use of non-practice based services	Not available, may be examined if linkage with GPPS if it asks those questions
Multiple clinicians within a practice being seen by patient	N/A
Mental health history – more than CES-D	N/A
Pattern of illegal drug use	N/A
Religion	General question in self-completion asks if member of organisations/clubs/societies including church. Used in social detachment measure (scorg)
Distance from house to surgery	How easy is it for you to get to GP? In self-completion module, scale very easy to don't want to go
Transport from house to surgery (access issues)	
Attendance of carer/friend at GP visits	N/A
Presentation of multiple ailments at one visit – 'There's one more thing before I go doctor. ...'	Comorbidities measured no information on whether these are all identified at one visit or several. Do have time since diagnosis, perhaps could link together to see if diagnosed with several conditions very quickly?
Multiple problems i.e. if being treated for one condition and develop and second/third why do they not seek the doctor's advice earlier	Have a measure of comorbidities and also time since diagnosis for the 4 main diseases of interest. Can't measure why they do not seek advice earlier
'Normal for Norfolk' (NfN)/crying wolf/patient behaviour	If patient is 'badly behaved' or perceived as NfN do they get worse health care? Can't measure this
Synergy between GP and patient	General question in self-completion asks if member of organisations/clubs/societies including church. Used in social detachment measure (scorg)
Political affiliations	
Time since diagnosis and BMI/alcohol/smoking – tests for white coat syndrome – if I go to my GP she/he will tell me to lose weight, stop drinking/smoking therefore I won't go about my disease/illness	Can look at, time since diagnosis going into main regression model anyway. Also BMI/smoking/alcohol intakes
Role of spouses in quality of health care	Have marital status, carer availability and whether the care is useful or not
Sense of control and optimism/pessimism	Sense of control in model, can't really address the differences between optimists/pessimists
Carer support part 1	
Present cognition/knowledge i.e. there is a length of time between when a person gets their qualifications and present cognitive state. I take this to mean that some old people feel a lack of control over their environment e.g. using a computer, electronics etc. as this is very different from what they learnt about	Could use sense of control CASP-19 this is already in model Time between qualification to present day cannot do

## Mapping PPIRes ideas to ELSA data

Question/translation	Use ability?
Carer support part 2	
Eyesight/hearing. Do you have sufficient support from your carer due to these difficulties?	Sight and hearing in model. Also carer availability, see above
Carer support part 3	
Access to care	Question asked in self-completion module
Have there been cutbacks to care?	N/A
Role of carer in access to GP	

N/A, not applicable.

## Comments on the role of Public and Patient Involvement from Mrs Wellings

In my view the role of the public and patient involvement (PPI) member of the team often seemed vague especially due to the statistical nature of this piece of research and the reliance on analysis of secondary data. Much of what I thought as a lay member of the team ended up not being relevant within the confines of the data. Much of the statistical debate went on without me really understanding what was being discussed. There were none of the parts of research where PPI members can play an active role as this research was not recruiting patients. I felt like the team tried to include me but it was often difficult. I thought the study would be interesting as its policy and practical interventions seemed very good and I could see where it could make a real difference to patient outcomes. 'A clearer picture of who is at most risk from poor quality care would inform the design of targeted interventions to improve quality of care, and/or improve access for previously under-served groups. It would inform the further development and refinement of national quality of care surveys: with co-applicant JC there is a real opportunity to follow up results with targeted questions in the General Practice Patient Survey or similar surveys, to improve primary care quality. This proposal is limited to four conditions, and if successful this methodology can be extended to other common chronic conditions in primary care' (quote from the protocol). My interest being, how the health service seems to work better for some than others and why barriers exist and how we can remove them. As a life-long carer of people with mental health problems, learning disabilities, autism and stroke heart failure and head injury to name but a few of the conditions I have experience of, it is important for me to make a visit to the GP as easy as possible. I would be interested in future work in this area, but not a very large statistical study as I feel my strengths did not really reflect what was needed in this team.

## Appendix 5 Detailed breakdown of the whole English Longitudinal Study of Ageing sample

Detailed breakdown of the whole ELSA Sample by wave and covariate

Covariate	Wave 2, n (%)	Wave 3, n (%)	Wave 4, n (%)	Wave 5, n (%)
Sex				
Female	5307 (56)	5476 (56)	6125 (56)	5705 (56)
Male	4125 (44)	4295 (44)	4925 (44)	4569 (44)
Age (years)				
50–64	4424 (48)	4919 (53)	5571 (52)	4718 (47)
65–74	2643 (29)	2371 (25)	3047 (28)	3061 (30)
75+	2104 (23)	2053 (22)	2131 (20)	2316 (23)
NS-SEC				
Managerial/professional	2557 (28)	N/A	2769 (28)	3428 (35)
Intermediate	3612 (39)	N/A	3919 (39)	2543 (26)
Routine	2993 (33)	N/A	3258 (33)	3938 (40)
Highest educational qualification				
None	5008 (30)	N/A	N/A	2665 (16)
Intermediate	4335 (36)	N/A	N/A	3967 (24)
Degree or higher education below a degree	2721 (16)	N/A	N/A	3563 (21)
Eyesight				
Excellent/very good	8089 (86)	8301 (85)	9577 (87)	8881 (86)
Good/fair, poor, blind	1337 (14)	1463 (15)	1465 (13)	1381 (14)
General health				
Excellent/good	6711 (72)	8868 (93)	7819 (74)	7176 (74)
Fair/poor	2583 (28)	666 (7)	2775 (26)	2549 (26)
Hearing				
Good to excellent	7436 (79)	7689 (79)	8808 (80)	8121 (79)
Fair to poor	1992 (21)	2077 (21)	2233 (20)	2142 (21)
Chronic pain				
None	5786 (62)	5942 (62)	6413 (61)	5861 (60)
Mild	968 (10)	1091 (11)	1252 (12)	1176 (12)
Moderate	1822 (20)	1733 (19)	2102 (20)	1888 (19)
Severe	715 (8)	761 (8)	819 (8)	797 (8)
Has long-standing illness				
No	4103 (44)	4473 (46)	5057 (46)	4645 (45)
Yes	1982 (21)	2001 (20)	2208 (20)	2007 (20)
Yes: limiting	3341 (35)	3290 (34)	3776 (34)	3608 (35)

Covariate	Wave 2, n (%)	Wave 3, n (%)	Wave 4, n (%)	Wave 5, n (%)
ADL				
None/one	8586 (90)	8838 (90)	10,036 (91)	9309 (91)
Two or more	946 (10)	933 (10)	1014 (9)	965 (9)
IADL				
None/one	8368 (89)	8717 (89)	9945 (90)	9562 (93)
Two or more	1064 (11)	1054 (11)	1105 (10)	712 (7)
Cognitive impairment				
No	8063 (48)	8103 (48)	8495 (51)	8511 (51)
Yes	896 (5)	901 (5)	944 (6)	950 (6)
Health literacy				
Low	1108 (7)	N/A	N/A	915 (5)
Medium	1805 (11)	N/A	N/A	1506 (9)
High	5989 (36)	N/A	N/A	6868 (41)
Alcohol consumption				
1–2 times/week or less	5256 (31)	5099 (30)	5757 (34)	5725 (34)
3–4 times/week or more	2888 (17)	2818 (17)	3346 (20)	3137 (19)
Physical activity level				
Sedentary	556 (6)	686 (7)	835 (8)	801 (8)
Low	2309 (25)	2263 (23)	2562 (23)	2452 (24)
Medium	4688 (50)	4884 (50)	5388 (49)	4996 (49)
High	1744 (19)	1972 (20)	2254 (20)	2014 (20)
Smoking status				
Never	3472 (37)	3770 (39)	4336 (40)	3827 (38)
In past	4482 (48)	3485 (46)	5001 (46)	5000 (49)
Current smoker	1475 (16)	1510 (15)	1545 (14)	1312 (13)
Diet				
Eats '5-a-day'	N/A	2592 (15)	3869 (23)	4972 (30)
Does not eat '5-a-day'	N/A	2142 (13)	3089 (18)	3791 (23)
Access to GP				
Very/quite easy	7663 (46)	N/A	8625 (51)	8258 (49)
Difficult/unable to attend	378 (2)	N/A	515 (3)	518 (3)
Social detachment				
Not detached	5956 (36)	5954 (35)	7024 (42)	6704 (40)
Detached	1089 (6)	996 (6)	1265 (19)	1260 (8)
Locus of control				
Internal	1874 (11)	1811 (11)	2100 (13)	2154 (13)
External	6264 (37)	6287 (37)	6995 (42)	6658 (40)

Covariate	Wave 2, n (%)	Wave 3, n (%)	Wave 4, n (%)	Wave 5, n (%)
Lives alone				
No	3452 (21)	3584 (21)	4062 (24)	3754 (22)
Yes	5740 (34)	5855 (35)	6584 (39)	6038 (58)
Married/civil partnership				
No	3162 (34)	3232 (33)	N/A	3341 (33)
Yes	6269 (66)	6538 (67)	N/A	6927 (67)
N/A, not applicable.				



## Appendix 6 Complete breakdown of longitudinal quality of care modelling results

### Diabetes

Characteristic	OR	95% CI
Age (years)		
50–64	1.0	–
65–74	1.1	0.8 to 1.4
75 +	0.9	0.7 to 1.2
Sex		
Female	1.0	–
Male	1.0	0.8 to 1.1
NS-SEC		
Routine	1.0	–
Intermediate/managerial and professional	1.2	0.9 to 1.5
Education		
None	1.0	–
Up to degree level	1.2	0.9 to 1.5
Wealth		
Quartile 1	1.0	–
Quartile 2	1.2	0.9 to 1.7
Quartile 3	1.3	0.9 to 1.8
Quartile 4	1.1	0.8 to 1.6
Quartile 5	1.5	1.0 to 2.2
Eyesight		
Less than excellent	1.0	–
Excellent	1.0	0.8 to 1.4
Hearing		
Less than excellent	1.0	–
Excellent	1.2	0.8 to 1.6
Chronic pain		
None	1.0	–
Mild/moderate	0.8	0.5 to 1.2
Severe	1.2	0.8 to 1.6
General health		
Less than excellent	1.0	–
Excellent	1.0	0.6 to 1.5

Characteristic	OR	95% CI
Limiting illness		
None	1.0	–
Has limiting long-standing illness	1.0	0.8 to 1.3
ADL		
None/one	1.0	–
Two or more	1.0	0.9 to 1.1
IADL		
None/one	1.0	–
Two or more	0.9	0.8 to 1.0
Access to GP		
Very easy	1.0	–
Quite easy	0.9	0.7 to 1.2
Difficult/can't go	1.1	0.6 to 1.8
Cognitive impairment		
No	1.0	–
Yes	0.5	0.4 to 0.7
BMI (kg/m <sup>2</sup> )		
Under-/normal weight	1.0	–
Overweight	1.1	0.7 to 1.7
Obese	1.3	0.8 to 2.0
Alcohol		
Infrequently	1.0	–
Daily	0.9	0.7 to 1.3
Marital status		
Lives with partner	1.0	–
Lives alone	1.7	1.3 to 2.0
HbA <sub>1c</sub>		
< 7.5% DCCT	1.0	–
≥ 7.5% DCCT	1.1	0.8 to 1.4
Smoking		
Never	1.0	–
Past or present	0.9	0.7 to 1.1
Physical activity		
Sedentary	1.0	–
Low	1.6	0.9 to 2.6
Medium	1.4	0.9 to 2.2
High	1.8	1.0 to 3.3



Characteristic	OR	95% CI
CASP-19		
Low	1.0	–
Medium	1.1	0.8 to 1.5
High	1.2	0.9 to 1.6
Rose angina		
No	1.0	–
Yes	1.1	0.7 to 1.7
MAP		
< 110 mmHg	1.0	–
≥ 110 mmHg	0.9	0.6 to 1.3
CES-D depression		
Not depressed	1.0	–
Depressed	0.8	0.6 to 1.1
Social detachment		
Not detached	1.0	–
Detached	1.3	0.9 to 2.0

MAP, mean arterial pressure.

## Cerebrovascular disease

Characteristic	OR	95% CI
Age (years)		
50–64	1.0	–
65–74	1.0	0.5 to 2.1
75+	0.9	0.4 to 1.9
Sex		
Female	1.0	–
Male	0.8	0.4 to 1.5
NS-SEC		
Routine	1.0	–
Intermediate/managerial and professional	0.9	0.5 to 1.6
Education		
None	1.0	–
Up to degree level	0.9	0.5 to 1.7

Characteristic	OR	95% CI
Wealth		
Quartile 1	1.0	–
Quartile 2	0.4	0.1 to 1.1
Quartile 3	0.4	0.1 to 1.0
Quartile 4	0.2	0.1 to 0.5
Quartile 5	0.5	0.2 to 1.3
Eyesight		
Less than excellent	1.0	–
Excellent	0.9	0.3 to 2.5
Hearing		
Less than excellent	1.0	–
Excellent	0.6	0.3 to 1.2
Chronic pain		
None	1.0	–
Mild/moderate	0.6	0.2 to 1.4
Severe	0.9	0.4 to 2.1
General health		
Less than excellent	1.0	–
Excellent	0.5	0.2 to 1.6
Limiting illness		
None	1.0	–
Has limiting long-standing illness	1.2	0.6 to 2.1
ADL		
None/one	1.0	–
Two or more	1.3	1.0 to 1.7
IADL		
None/one	1.0	–
Two or more	1.1	0.8 to 1.3
Access to GP		
Very easy	1.0	–
Quite easy	1.3	0.6 to 2.7
Difficult/can't go	1.2	0.3 to 5.1
Cognitive impairment		
No	1.0	–
Yes	1.0	0.4 to 2.6
BMI (kg/m <sup>2</sup> )		
Under-/normal weight	1.0	–
Overweight	1.4	0.6 to 3.5
Obese	1.9	0.6 to 6.3

Characteristic	OR	95% CI
Alcohol		
Infrequently	1.0	–
Daily	0.6	0.3 to 1.1
Marital status		
Lives with partner	1.0	–
Lives alone	1.3	0.7 to 2.6
HbA <sub>1c</sub>		
< 7.5% DCCT	1.0	–
≥ 7.5% DCCT	0.8	0.3 to 2.1
Smoking		
Never	1.0	–
Past or present	0.6	0.3 to 1.1
Physical activity		
Sedentary	1.0	–
Low	2.8	0.7 to 12.1
Medium	1.6	0.4 to 6.2
High	1.4	0.3 to 7.2
CASP-19		
Low	1.0	–
Medium	0.3	0.1 to 0.8
High	0.3	0.1 to 0.9
Rose angina		
No	1.0	–
Yes	1.3	0.4 to 4.1
MAP		
< 110 mmHg	1.0	–
≥ 110 mmHg	2.0	0.4 to 11.1
CES-D depression		
Not depressed	1.0	–
Depressed	1.6	0.7 to 3.6
Social detachment		
Not detached	1.0	–
Detached	2.5	0.7 to 8.3

MAP, mean arterial pressure.

## Hypertension

Characteristic	OR	95% CI
Age (years)		
50–64	1.0	–
65–74	2.2	1.6 to 3.1
75+	3.2	2.0 to 5.3
Sex		
Female	1.0	–
Male	0.9	0.6 to 1.1
NS-SEC		
Routine	1.0	–
Intermediate/managerial and professional	0.9	0.6 to 1.2
Education		
None	1.0	–
Up to degree level	0.9	0.7 to 1.2
Wealth		
Quartile 1	1.0	–
Quartile 2	0.9	0.6 to 1.5
Quartile 3	1.2	0.8 to 1.9
Quartile 4	0.7	0.5 to 1.1
Quartile 5	1.0	0.6 to 1.5
Eyesight		
Less than excellent	1.0	–
Excellent	1.4	0.9 to 2.2
Hearing		
Less than excellent	1.0	–
Excellent	1.1	0.7 to 1.5
Chronic pain		
None	1.0	–
Mild/moderate	0.9	0.6 to 1.3
Severe	0.8	0.5 to 1.5
General health		
Less than excellent	1.0	–
Excellent	0.9	0.6 to 1.4
Limiting illness		
None	1.0	–
Has limiting long-standing illness	1.1	0.8 to 1.5
ADL		
None/one	1.0	–
Two or more	1.0	0.9 to 1.2

Characteristic	OR	95% CI
IADL		
None/one	1.0	–
Two or more	1.0	0.8 to 1.2
Access to GP		
Very easy	1.0	–
Quite easy	1.0	0.7 to 1.4
Difficult/cannot go	1.6	0.6 to 4.1
Cognitive impairment		
No	1.0	–
Yes	1.1	0.5 to 2.4
BMI (kg/m <sup>2</sup> )		
Under-/normal weight	1.0	–
Overweight	1.3	0.8 to 1.9
Obese	1.0	0.7 to 1.6
Alcohol		
Infrequently	1.0	–
Daily	0.9	0.7 to 1.2
Marital status		
Lives with partner	1.0	–
Lives alone	1.0	0.7 to 1.4
HbA <sub>1c</sub>		
< 7.5% DCCT	1.0	–
≥ 7.5% DCCT	2.6	0.5 to 12.7
Smoking		
Never	1.0	–
Past or present	0.9	0.7 to 1.2
Physical activity		
Sedentary	1.0	–
Low	1.1	0.5 to 2.5
Medium	0.9	0.4 to 1.9
High	0.7	0.3 to 1.6
CASP-19		
Low	1.0	–
Medium	1.0	0.7 to 1.4
High	0.9	0.6 to 1.4
Rose angina		
No	1.0	–
Yes	1.3	0.6 to 2.9

Characteristic	OR	95% CI
MAP		
< 110 mmHg	1.0	–
≥ 110 mmHg	1.4	0.9 to 2.1
CES-D depression		
Not depressed	1.0	–
Depressed	0.8	0.5 to 1.2
Social detachment		
Not detached	1.0	–
Detached	1.3	0.8 to 2.1

MAP, mean arterial pressure.

## Ischaemic heart disease

Characteristic	OR	95% CI
Age (years)		
50–64	1.0	–
65–74	1.0	0.6 to 1.6
75+	0.5	0.3 to 0.8
Sex		
Female	1.0	–
Male	1.0	0.7 to 1.3
NS-SEC		
Routine	1.0	–
Intermediate/managerial and professional	1.0	0.7 to 1.6
Education		
None	1.0	–
Up to degree level	1.3	0.9 to 1.9
Wealth		
Quartile 1	1.0	–
Quartile 2	0.8	0.5 to 1.4
Quartile 3	0.7	0.4 to 1.2
Quartile 4	0.9	0.5 to 1.6
Quartile 5	0.8	0.5 to 1.5
Eyesight		
Less than excellent	1.0	–
Excellent	0.8	0.4 to 1.3

Characteristic	OR	95% CI
Hearing		
Less than excellent	1.0	–
Excellent	0.9	0.5 to 1.5
Chronic pain		
None	1.0	–
Mild/moderate	1.6	0.7 to 3.6
Severe	0.8	0.5 to 1.2
General health		
Less than excellent	1.0	–
Excellent	2.3	0.5 to 9.7
Limiting illness		
None	1.0	–
Has limiting long-standing illness	0.8	0.5 to 1.1
ADL		
None/one	1.0	–
Two or more	1.0	0.8 to 1.1
IADL		
None/one	1.0	–
Two or more	1.0	0.8 to 1.1
Access to GP		
Very easy	1.0	–
Quite easy	0.8	0.5 to 1.2
Difficult/can't go	0.8	0.4 to 1.6
Cognitive impairment		
No	1.0	–
Yes	1.1	0.5 to 2.4
BMI (kg/m <sup>2</sup> )		
Under-/normal weight	1.0	–
Overweight	1.1	0.7 to 1.9
Obese	0.9	0.5 to 1.5
Alcohol		
Infrequently	1.0	–
Daily	1.1	0.7 to 1.7
Marital status		
Lives with partner	1.0	–
Lives alone	1.6	1.1 to 2.5
HbA <sub>1c</sub>		
< 7.5% DCCT	1.0	–
≥ 7.5% DCCT	0.6	0.3 to 1.2

Characteristic	OR	95% CI
Smoking		
Never	1.0	–
Past or present	1.2	0.8 to 1.7
Physical activity		
Sedentary	1.0	–
Low	1.8	1.0 to 3.4
Medium	1.6	0.8 to 2.9
High	2.0	0.9 to 4.5
CASP-19		
Low	1.0	–
Medium	1.3	0.9 to 2.1
High	1.5	0.9 to 2.4
Rose angina		
No	1.0	–
Yes	1.3	0.8 to 2.1
MAP		
< 110 mmHg	1.0	–
≥ 110 mmHg	1.1	0.5 to 2.4
CES-D depression		
Not depressed	1.0	–
Depressed	1.1	0.7 to 1.7
Social detachment		
Not detached	1.0	–
Detached	1.0	0.6 to 1.3

MAP, mean arterial pressure.

## Osteoarthritis

Characteristic	OR	95% CI
Age (years)		
50–64	1.0	–
65–74	0.8	0.6 to 1.0
75+	1.1	0.8 to 1.4
Sex		
Female	1.0	–
Male	0.9	0.8 to 1.1
NS-SEC		
Routine	1.0	–
Intermediate/managerial and professional	1.0	0.9 to 1.2



Characteristic	OR	95% CI
Education		
None	1.0	–
Up to degree level	1.0	0.8 to 1.2
Wealth		
Quartile 1	1.0	–
Quartile 2	0.8	0.6 to 1.0
Quartile 3	0.8	0.6 to 1.0
Quartile 4	0.9	0.7 to 1.2
Quartile 5	0.8	0.6 to 1.0
Eyesight		
Less than excellent	1.0	–
Excellent	1.0	0.8 to 1.3
Hearing		
Less than excellent	1.0	–
Excellent	1.0	0.8 to 1.3
Chronic pain		
None	1.0	–
Mild/moderate	1.0	0.8 to 1.2
Severe	1.8	1.4 to 2.2
General health		
Less than excellent	1.0	–
Excellent	0.8	0.5 to 1.0
Limiting illness		
None	1.0	–
Has limiting long-standing illness	1.8	1.5 to 2.1
ADL		
None/one	1.0	–
Two or more	1.0	0.9 to 1.2
IADL		
None/one	1.0	–
Two or more	1.0	0.9 to 1.2
Access to GP		
Very easy	1.0	–
Quite easy	1.2	1.0 to 1.4
Difficult/cannot go	1.0	0.8 to 1.5
Cognitive impairment		
No	1.0	–
Yes	1.2	0.8 to 1.8

Characteristic	OR	95% CI
BMI (kg/m <sup>2</sup> )		
Under-/normal weight	1.0	–
Overweight	1.2	0.9 to 1.5
Obese	1.6	1.2 to 2.0
Alcohol		
Infrequently	1.0	–
Daily	1.0	0.8 to 1.3
Marital status		
Lives with partner	1.0	–
Lives alone	1.2	0.9 to 1.4
HbA <sub>1c</sub>		
< 7.5% DCCT	1.0	–
≥ 7.5% DCCT	0.9	0.5 to 1.6
Smoking		
Never	1.0	–
Past or present	1.0	0.9 to 1.2
Physical activity		
Sedentary	1.0	–
Low	0.9	0.6 to 1.3
Medium	1.0	0.7 to 1.6
High	0.9	0.6 to 1.5
CASP-19		
Low	1.0	–
Medium	1.1	0.9 to 1.4
High	1.0	0.8 to 1.3
MAP		
< 110 mmHg	1.0	–
≥ 110 mmHg	1.0	0.8 to 1.4
CES-D depression		
Not depressed	1.0	–
Depressed	1.1	0.9 to 1.4
Social detachment		
Not detached	1.0	–
Detached	1.1	0.9 to 1.5

MAP, mean arterial pressure.



A decorative graphic consisting of numerous thin, parallel green lines that curve from the left side of the page towards the right, creating a sense of movement and depth.

**EME  
HS&DR  
HTA  
PGfAR  
PHR**

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