

Impact of the 2004 General Practitioner Contract on health improvement and inequalities in cardiovascular disease and diabetes: findings from a systematic review and national and local quantitative studies

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Project 08/1716/209

Contents

Contents 3

List of tables..... 6

List of figures..... 8

Glossary of terms/abbreviations..... 9

Acknowledgements..... 10

Executive Summary..... 11

Background 11

Aims..... 11

Methods..... 12

Results..... 12

Conclusions 13

1 Introduction 14

 1.1 Background to QOF 14

 1.2 Rationale for examining the impact of QOF on inequalities in health care
 15

2 Systematic review on the impacts of pay for performance incentives on
health care inequalities 18

 2.1 Methods..... 18

 2.1.1 Search Strategy 18

 2.1.2 Study Selection 18

 2.2 Results 19

 2.2.1 Socioeconomic inequality (18 studies)..... 20

 2.2.2 Age and Gender Inequalities (4 studies) 21

 2.2.3 Ethnic Inequalities (6 studies) 22

 2.2.4 Longer term impacts of pay for performance on inequalities..... 23

 2.2.5 Pay for performance impacts on inequalities in the US..... 23

 2.3 Discussion..... 23

3	Observational studies on the impact of QOF on inequalities in cardiovascular disease and diabetes management	25
3.1	Methods.....	25
3.1.1	Data sources.....	25
3.1.2	Study Design and Outcome Measures.....	26
3.1.3	Omissions from the longitudinal data analyses	26
3.2	Impact of QOF on inequalities in Diabetes management between age, sex and ethnic groups.....	27
3.2.1	Analysis plan.....	27
3.2.2	Results – process of care and prescribing	28
3.2.3	Results – achievement of treatment targets	33
3.3	Impact of QOF on inequalities in diabetes management between small and large practices (GPRD)	37
3.3.1	Analysis plan.....	37
3.3.2	Results.....	37
3.4	Impact of QOF on inequalities in diabetes management in patients with and without comorbid medical conditions.....	45
3.4.1	Analysis plan.....	45
3.4.2	Results.....	45
3.5	Impact of QOF on inequalities in cardiovascular disease and diabetes management between different ethnic groups (Wandsworth)	53
3.5.1	Analysis plan.....	53
3.5.2	Results.....	54
3.6	Impact of QOF on inequalities in diabetes management between different ethnic groups (Brent).....	72
3.6.1	Analysis plan.....	72
3.6.2	Results.....	73
	Process of care measures.....	74
	Intermediate clinical outcomes	74
	Prescribing	78
3.7	Association of patient and practice characteristics with exception reporting in Diabetes (Brent)	80

3.7.1	Analysis plan.....	80
3.7.2	Results.....	81
3.8	Trends in smoking status ascertainment, provision of smoking cessation advice and smoking prevalence	89
3.8.1	Analysis plan.....	89
3.8.2	Results.....	89
3.9	Trends in recording and prevalence of obesity	95
3.9.1	Analysis.....	95
3.9.2	Results.....	96
4	Discussion	101
4.1	Key findings	101
4.1.1	Key findings – systematic review	101
4.1.2	Key findings - Observational studies on the impact of QOF on inequalities in cardiovascular disease and diabetes management	101
4.1.3	Key findings – exception reporting	102
4.2	Previous Research	102
4.3	Strengths and limitations of studies.....	105
4.4	Implications for future research	107
	References	111
	Appendix - List of published outputs from this project.....	120

List of tables

Table 1: Process measures of care and prescribing (as % of group) by age, gender and deprivation 30

Table 2: Performance (as % achieving the target) for 2005 compared with predicted by age, gender and deprivation..... 31

Table 3: Percentage achievement of treatment targets (with adjusted odds ratios) in 1997 and 2005 by age, sex and deprivation 32

Table 4: Characteristics of the sample, process of care and prescribing by practice size (quintiles) 40

Table 5: Performance (as mean % achieving the target) for 2004 and 2005 compared with predicted by practice size 41

Table 6: Characteristics of the sample by number of comorbidities 47

Table 7: Performance (as % achieving the target) for 2004 and 2005 compared with predicted by number of co-morbidities 48

Table 8: Characteristics of Diabetes, CHD, Stroke and Hypertension cohorts in 2007..... 54

Table 9: Variation in processes of care and prescribing by ethnic group (CHD group) 57

Table 10: Variation in processes of care and prescribing by ethnic group (Stroke group) 57

Table 11: Variation in processes of care and prescribing by ethnic group (Hypertension group)..... 58

Table 12: Variation in processes of care and prescribing by ethnic group (diabetes group) 58

Table 13: Results for blood pressure measured/ blood pressure controlled 59

Table 14: Result for HbA1c measured/ HbA1c controlled for diabetes..... 60

Table 15: Result for cholesterol measured/ cholesterol controlled 61

Table 16: Results for systolic blood pressure, cholesterol and HbA1c level 62

Table 17: Ethnic Disparities by patients’ disease cohorts for each indicator..... 63

Table 18: Characteristics of the study participants in Brent 2006..... 73

Table 19: BP, cholesterol and glycaemic control monitoring among ethnic groups in 1997 and 2006	76
Table 20: BP, cholesterol and glycaemic control target achievement among ethnic groups in 1997 and 2006	77
Table 21: Prescribing of medications by ethnic group in 1997 and 2006	79
Table 22: Characteristics of the sample 2006-07	83
Table 23: Percentage of exception reported and non exception reported patients achieving treatment targets, 2004/5 -2006/7	84
Table 24: Exception reporting percentages by patient and practice characteristics (% and unadjusted findings), 2004-2006	85
Table 25: Exception reporting by patient and practice characteristics (adjusted findings) 2004/5 – 2006/7.....	87
Table 26: Characteristics of patients with CHD, hypertension and Diabetes with valid data for smoking status in Wandsworth 2007	89
Table 27: Ascertainment of smoking status in general population and those with CHD, diabetes or hypertension 1998 - 2007 Wandsworth*	90
Table 28: Prevalence of smoking among those with CHD, diabetes or hypertension (number and %)	91
Table 29: Provision of smoking cessation advice to smokers with CHD, diabetes or stroke by year (%)	92
Table 30: Provision of interventions to stop smoking among smokers with CHD, diabetes or hypertension. (%)	94
Table 31: Ascertainment of BMI among patients registered with general practices in Wandsworth 1998 - 2007	96
Table 32: Prevalence of overweight and obesity among patients registered with general practices in Wandsworth 1998 - 2007.....	97
Table 33: Patterns in overweight and obesity by age group, pooling data from 1998 - 2007	98
Table 34: Patterns in overweight and obesity by ethnicity, pooling data from 1998 - 2007	99

List of figures

Figure 1: Flow Diagram for articles selected..... 19

Figure 2: Proportion of patients who achieved the blood pressure target in 2005 compared to that predicted by trend by A) age group B) sex and C) deprivation quintile 35

Figure 3: Predicted and actual achievement of Blood pressure (<140/80 mmHg) targets by practice size. 42

Figure 4: Predicted and actual achievement of cholesterol (< 5 mmol/L) target by practice size 43

Figure 5: Predicted and actual achievement of HbA1c (< 7.0%) target by practice size 44

Figure 6: Projected and actual achievement of blood pressure target (<140/80 mmHg) by number of co-morbid conditions 50

Figure 7: Projected and actual achievement of HbA1c target ($\leq 7.0\%$) by number of co-morbid conditions..... 51

Figure 8: Projected and actual achievement of cholesterol target (≤ 5 mmol/L) by number of co-morbid conditions 52

Figure 9: Percentage achievement of indicators in patients with coronary heart disease 55

Figure 10: Percentage achievement of indicators in patients with stroke 55

Figure 11: Percentage achievement of indicators in patients with hypertension 55

Figure 12: Mean systolic/diastolic blood pressure by years for CHD, Stroke and hypertension cohorts 56

Figure 13: Mean cholesterol value by years for stroke/CHD cohorts 56

Figure 14: Percentage achievement of process and outcome indicators among diabetes patients..... 57

Figure 15: Prevalence of smoking among those with CHD, Diabetes or hypertension, 1998 - 2007 92

Glossary of terms/abbreviations

AHA – Antihypertensive Agents
AMI - acute myocardial infarction
AOR – Adjusted Odds Ratio
BMI – Body Mass Index
BP – Blood pressure
CAP - community acquired pneumonia
CHD – Coronary Heart Disease
CI – Confidence Interval
CVD – Cardiovascular Disease
GEE – Generalised Estimating Equation
GP – General Practice
GPRD - General Practice Research Database
HbA_{1c} - Glycosylated haemoglobin
HF – Heart Failure
MeSH - Medical Subject Heading
NSF – National Service framework
OHA – Oral hypoglycaemic agents
QMAS- Quality Management and Analysis System
QOF – Quality and Outcomes Framework
SES – Socio-economic status

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Executive Summary

Background

Despite overall improvements in morbidity and mortality levels, health inequalities remain pervasive in the United Kingdom. For example, inequalities in the prevalence and outcomes of cardiovascular disease between socio-economic and ethnic groups have been well documented.

Inequalities in cardiovascular disease outcomes may result from inequitable access to high quality health care. A number of recent studies suggest that inequalities in chronic disease management have persisted despite publication of the National Service Frameworks for Older People, Coronary Heart Disease, Diabetes and Long Term Conditions.

The Quality and Outcomes Framework within the 2004 General Practitioner contract ties about one quarter of general practice income to the achievement of quality standards. The framework aims to raise and standardise the health care being delivered to all patients with selected chronic diseases. The contract therefore provides an important opportunity to address existing inequalities in chronic disease management and related health outcomes.

This report presents the methods and results from a 30 month project funded by the National Institute of Health Research Service Delivery and Organisation programme on the impact of the Quality and Outcomes Framework on inequalities in the management of cardiovascular disease and diabetes.

Aims

- Examine the impact of the Quality and Outcomes Framework (QOF) on trends in diabetes management and inequalities in care and outcomes at patient and general practice level using a nationally representative dataset
- Examine the impact of QOF on trends in CVD and diabetes management and inequalities in care and outcomes at patient group and general practice level in multi-ethnic, deprived inner city areas
- Explore associations between exception reporting for diabetes care and patient and practice characteristics in a multi-ethnic, deprived inner city area
- Examine the impact of QOF on inequalities in the prevalence and management of smoking and obesity in primary care

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Project 08/1716/209

Methods

- A systematic review of the research literature on the impact of pay for performance programmes on health care inequalities
- Longitudinal studies on the impact of QOF on inequalities in diabetes management using the General Practice Research Database (GPRD)
- Longitudinal studies examining the impact of QOF on inequalities in CVD and diabetes management using electronic patient extracted from general practices in inner London Primary Care Trusts serving multi-ethnic populations with considerable health needs
- A serial cross sectional study in Brent to examine associations between patient and practice level characteristics and exception reporting for diabetes quality indicators

Results

Our observational studies were designed to investigate the impact of QOF on inequalities in chronic disease management. Our findings suggest that the introduction of QOF was associated with accelerated overall improvements in the control of blood pressure in patients with diabetes, hypertension and stroke but not CHD in the initial post introduction period. These improvements continued between 2005 and 2007 for systolic but not diastolic blood pressure (i.e. greater than those predicted by the underlying trend). The introduction of QOF was associated with accelerated improvements in the control of cholesterol in patients with diabetes and stroke but not CHD in the initial post introduction period. These improvements were not sustained between 2005 and 2007. The introduction of QOF was not associated with any additional improvement in HbA_{1c} control in patients with diabetes and mean HbA_{1c} actually increased significantly during the period between 2005 and 2007.

The initial improvements in intermediate outcome control associated with QOF identified in our studies are likely to confer important clinical and public health benefits in the different age, gender, ethnic and socio-economic status groups that we studied. However, the magnitude of the improvements seen were greater among women than men in diabetes, thus narrowing existing sex inequalities in the management of these risk factors. Conversely, younger patients with diabetes appear to have benefited less from QOF than older patients, resulting in some widening of existing age group inequalities in the management of HbA_{1c} and cholesterol. Older patients (75+ years) with diabetes appear to have derived a similar level of benefit as other groups from QOF thus

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leaving existing inequalities in blood pressure control largely intact. Patients living in affluent and deprived areas appear to have had similar levels of risk factor control before QOF and derived a similar level of benefits from this financial incentive.

Our findings suggest that the impacts of QOF on inequalities in chronic disease management between ethnic groups are mixed. This pay for performance programme appeared to reduce some inequalities in risk factor control (white-black differences in systolic blood pressure in patients with diabetes) while increasing others (white-black differences in cholesterol in patients CHD). A number of other inequalities in risk factor control largely persisted after the introduction of QOF (white-black-south Asian differences in HbA1c control).

Conclusions

QOF could be developed in a number of ways to better address inequalities in health care. These include raising treatment thresholds, rewarding improvement as well as absolute achievement, developing and expanding quality indicators where inequitable care has been identified and directly rewarding reductions in health care inequalities.

Assessing the impact of QOF on health care inequalities is currently hampered by an absence of patient level data within the QMAS (Quality Management and Analysis System) national reporting system and continued poor recording of ethnicity and of individual measures of socio-economic status within primary care information systems. QMAS should be modified to allow patient level analyses of quality of care, in addition to the practice level measures of performance that are currently available. Where possible this assessment should include both local and national analyses of patient level data, consider different dimensions of inequality including age, gender, ethnicity, socioeconomic status, take into account underlying trends in inequality and involve longer term follow up of impacts.

1 Introduction

1.1 Background to QOF

In an effort to hasten improvements in health care quality and increase efficiency in health systems, policymakers and purchasers of healthcare have increasingly aligned financial incentives to quality of care. Pay for performance schemes reward health care providers by paying them more if they succeed in meeting performance targets set by the government and other purchasers of healthcare. Pay for performance programmes are now an established part of the healthcare policy in the USA and UK and are being developed in a growing number of other countries, including Germany, the Netherlands, New Zealand, Australia, Canada and Rwanda. (1-5)

The Quality and Outcomes Framework (QOF) was introduced into UK primary care as part of a new General Practitioner contract in April 2004. QOF represents a major and innovative investment to strengthen secondary prevention in primary care (6). It has been described as the most radical shift towards pay for performance seen in any health care setting (7) involving £1.8 billion additional funding for primary care annually which links approximately one quarter of general practice income to the achievement of quality standards. QOF aims to both raise and standardise the quality of care being delivered to patients with selected chronic diseases.

The framework contains a large number of evidence-based quality indicators and targets agreed between the government and general practitioners. Each quality indicator is assigned a number of points with each point worth £125 to the average practice. A total of 1050 points were available in the initial iteration of QOF (there have been some minor changes in subsequent years, with new indicators introduced, and now only 1000 points to be gained) for meeting these standards. The indicators related initially to quality of care for 10 chronic conditions (this increased to 19 conditions in 2006), organisation of care and patient experience. Indicators in the clinical domain largely relate to process and intermediate outcomes of care. Most standards have a lower and upper payment threshold with a sliding payment scale. For example, CHD5 (measurement of blood pressure in patients with CHD) has a lower payment threshold of 40% and an upper payment threshold of 90%. Maximum thresholds were set to reflect the maximum level of reasonable achievement, although there have been some concern that practices can achieve maximum points while still neglecting many patients. (8)

There are two key safeguards in QOF to ensure that it does not result in patients receiving inappropriate care. First, maximum thresholds for indicators are set below 100%. Second, GPs are permitted to remove or "exception report" patients from the denominator for individual indicators. Patients may be exception reported because they have refused to come for review; due to clinical inappropriateness of a review or medication; are on the maximum tolerated dose

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of a drug; intolerance to medication; they have dissented to treatment; or when services are unavailable. (9) Previous work suggests that overall rates of exception reporting in QOF are low, (10-11) but indicate much higher rates for intermediate outcome indicators and considerable variations between family practices, with larger practices excluding at higher rates. (10) There is concern that exception reporting may be exploited by some practices for financial gain by excluding patients missing various targets, and also that this may have a disproportionately negative impact on more vulnerable patient groups. (12)

While there is a growing literature examining QOF, most studies have used national QOF data which is available at only practice level and which provide little information about its impacts at a patient level. (13) Furthermore, national QOF data is only available for the period after the general practitioner contract was introduced in April 2004, thus making it difficult to disentangle the impact of QOF from other quality initiatives. This is important as substantial quality improvements occurred in the years immediately predating the introduction of QOF, and some of the improvement occurring since April 2004 is likely to be due to other, non-financial quality initiatives. (14-15) Only a small number of studies have been designed to isolate the impact of QOF from underlying trends of improved quality. These suggest that the introduction of QOF was associated with accelerated improvements in the management of selected conditions in primary care during the first two years of this incentive (14), but this does not appear to have been sustained in subsequent years. (16-17) This may be because most practices have reached the upper payment threshold for quality indicators and will not benefit financially from further improvements in care. Less is known about the distribution of this improvement between population subgroups and, more broadly, the impact of QOF on inequalities in the quality of chronic disease management (18-19).

1.2 Rationale for examining the impact of QOF on inequalities in health care

The rationale for examining the impact of QOF on inequalities in health care include:-

- Despite health improvements in morbidity and mortality levels overall, health inequalities remain pervasive in the United Kingdom. (20-21) A number of recent studies suggest that inequalities in chronic disease management have persisted between age, gender, ethnic and socio-economic groups despite dedicated national efforts to reduce inequalities and the publication of the National Service Frameworks (NSF) for Older People, Coronary Heart Disease (CHD), Diabetes and Long Term Conditions. (22)
- UK health policy and research evidence summarised in the recently published Marmot review has reaffirmed the importance of primary care in reducing health inequalities. (23)

- QOF aims to both improve and standardise the quality of general practice. If it achieves this aim inequalities in care will be reduced. Both the previous UK government and the British Medical Association have explicitly stated that the scheme will likely reduce inequalities in health care. (24-25)
- At the same time, concerns have also been raised, particularly in the US, about potential unintended consequences of pay for performance incentives, including their impact of health inequalities. Casalino & Elster (26) have highlighted a number of ways in which pay for performance schemes in the United States could worsen health inequalities, including through a reduction in the income of physicians treating underserved populations, through physicians avoiding patients perceived to lower quality scores and lower use of public quality reports in disadvantaged groups due to lower health literacy. Several of these concerns may be salient within the UK context. For example, concerns have been raised that lower QOF performance, resulting in reduced funding, would perpetuate the inverse care law whereby the poorest communities with the highest health needs receive the lowest provision of health care. The recently published Marmot review suggested that QOF may not address health care inequalities because full achievement of available points is possible without covering the entirety of any particular practice population. (27)
- The Acheson *Independent Inquiry into Inequalities in Health Report* in 1998, the WHO Commission on the Social Determinants of Health and more recently published Marmot *Strategic Review of Health Inequalities in England post 2010*, emphasise that all policies likely to have a direct or indirect effect on health should be evaluated for their impact on health inequalities, and implemented in such a way that they will favour the less well off wherever possible. This work fits into this theme by examining the effect that QOF, which has both direct and indirect effects on health, has been having on health inequalities, both in chronic disease management and the control of CVD risk factors. Little is still known about the distribution of the quality of care improvements from QOF between population subgroups, and also more broadly on the impact which QOF has had on chronic disease management. (28-29)

This report examines the impact of QOF on inequalities in chronic disease management in relation to age, gender, ethnicity and deprivation.

Our studies focus on cardiovascular disease and diabetes for a number of reasons. First, they are the commonest cause of death in the United Kingdom, and are responsible for a significant proportion of NHS spending (30). Second, reducing the burden of cardiovascular disease has been a key government priority for some time (31) and secondary prevention interventions have an important role in achieving this (30, 32) Third, cardiovascular disease contributes substantially to overall health inequalities and the government has set high level

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targets to address inequalities in cardiovascular outcomes. (23, 33) Fourth, inequalities in the quality of care for cardiovascular conditions appear to have persisted in the UK despite dedicated efforts to reduce variations in care over the past decade. Fifth, QOF places considerable emphasis on improving and standardising the quality of care for cardiovascular conditions (356 of the 550 points available in the clinical domain are assigned to CHD, diabetes, stroke and hypertension).

2 Systematic review on the impacts of pay for performance incentives on health care inequalities

2.1 Methods

2.1.1 Search Strategy

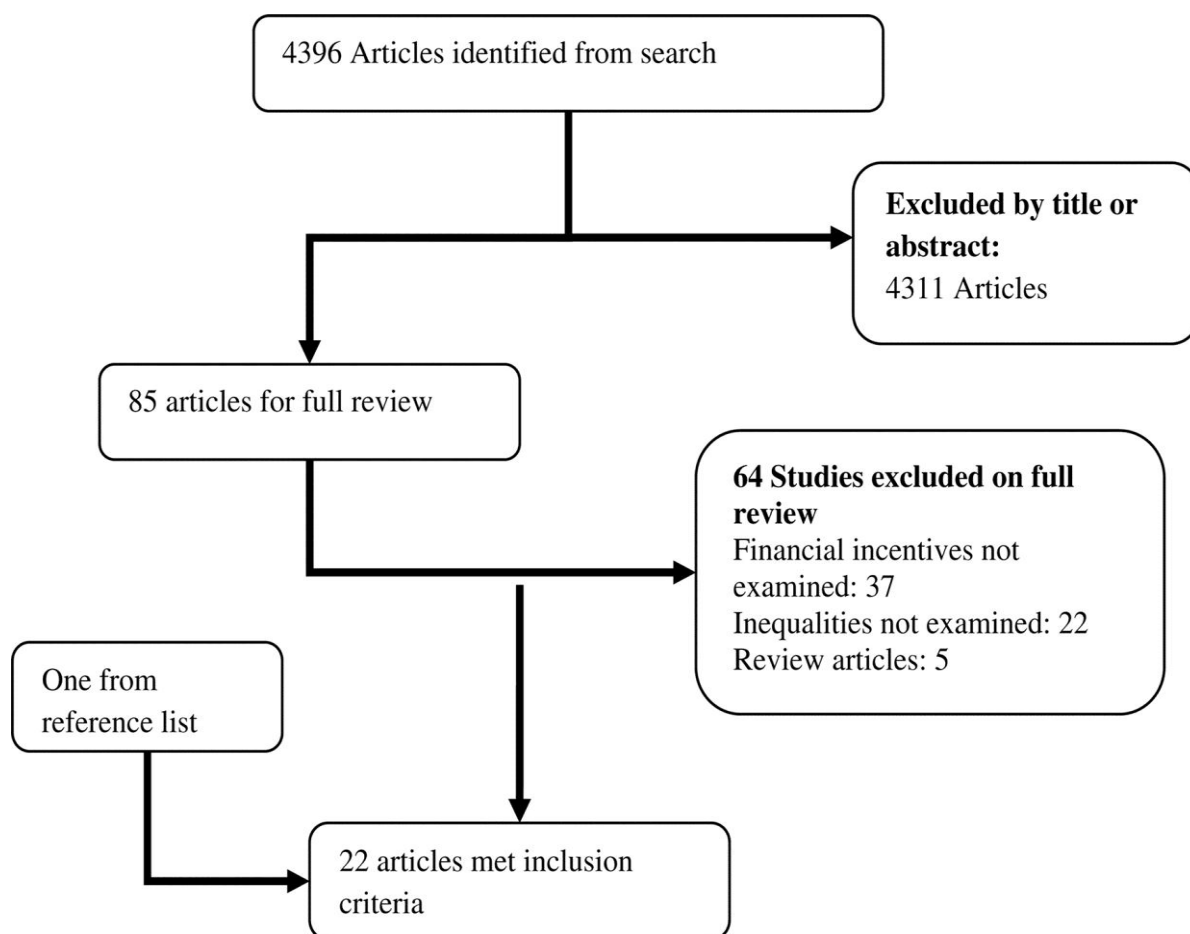
Papers published between 1st January 1980 and 1st November 2008, were identified through a systematic search of published English language literature in MEDLINE, EMBASE, PsycINFO and the Cochrane Library. We examined papers that assessed quantitatively the impact of pay for performance on health care inequalities. In MEDLINE, our search included Medical Subject Heading (MeSH) terms and text words. MeSH terms used were: physician incentive plans; reimbursement, incentive; reimbursement mechanisms; insurance, health, reimbursement; quality indicators, health care; ethnic groups; minority groups; minority health; healthcare disparities; health care inequalities, health status disparities; and socioeconomic factors. Text words used were: pay for performance and P4P. In EMBASE, we used the following Emtree heading terms: reimbursement, health care quality, prospective payment, performance measurement system, minority group, ethnic group, ethnic difference, race difference, and social status. Text word included pay for performance, P4P, pay for quality, physician incentive and deprivation. In PsycINFO terms used includes: incentive, monetary incentive, quality of care, racial and ethnic groups, minority groups, racial and ethnic differences, social deprivation, social justice, socioeconomic status, and health disparities. The following text words were also used: pay for performance, physician incentive, incentive payment, and performance measurement. Where the title or abstract of the paper were not clear, the full text of the article was retrieved and reviewed.

2.1.2 Study Selection

Pay for performance incentives were defined as the use of monetary incentives to reward health care providers' achievements in predetermined quality standards. Quantitative studies were included if they examined the relationship between the use of an explicit financial incentive and healthcare inequalities. Dimensions of health care inequality examined included: age, gender, ethnicity, and socioeconomic status. We included both experimental and observational studies. We excluded papers that examined the use of non monetary rewards, such as public report cards. Two assessors independently used the Downs and Black critical appraisal tool to assess the methodological quality of the retrieved studies. (34) We used a similar approach used by Petersen et al,(35) to assign studies into a quality scale from 1 to 4. Studies considered to be of poor methodological quality were scored as "1+" and studies considered to be of

excellent methodological quality were scored as "4+". Whenever there was conflict in the score of the retrieved articles, a third scorer (AM) was consulted.

Figure 1: Flow Diagram for articles selected



2.2 Results

Our search yielded 4396 articles. Based on the title of the articles, we identified 85 papers for further review; from these, 21 relevant articles were identified. One additional article was retrieved through the reference list search of the retrieved articles. Figure 1 shows the selection process for the articles included.

Most of the studies retrieved were observational studies conducted in the UK assessing the impact of the introduction of the Quality and Outcomes Framework (QOF) in April 2004. Some studies examined more than one aspect of inequality.

2.2.1 Socioeconomic inequality (18 studies)

Socioeconomic status was the most frequently examined inequality in the retrieved studies. (6, 36-52) Most studies used a cross-sectional design and examined associations between quality of care and an area deprivation score after the implementation of the QOF. Only one study, which was conducted in a largely rural and relatively deprived part of Scotland, found that deprivation was positively associated with higher quality in the first year of the QOF. (47) The remaining studies identified significantly lower quality of care in deprived areas compared with affluent areas. However, the magnitudes of the differences were generally small and appear to have been attenuated in the second and third year of this pay for performance programme. For example, Ashworth et al (52), found a difference in the achievements between least and most deprived practices of 64.5 QOF points (a difference of 6.1 percent) in the first year of the QOF, but this figure decreased to 30.4 QOF points (a difference of 2.9 percent) in the second year. Doran and colleagues,(40) undertook a similar analysis and found a further narrowing of quality during the third year of QOF. Median achievement increased by 4.4 percent in the least deprived quintile of practices and by 7.6 percent in the most deprived quintile of practices. Consequently, the gap in median achievement narrowed from 4.0 percent to 0.8 percent during this period and was no longer associated with deprivation ($P=0.062$). Furthermore, the researcher found a significant association between scores in the previous year and increases in achievement. The lower the score in the previous year, the better were the achievements in the following year ($p<0.01$).

In a methodologically similar paper,(37) data were collected from over 97 percent of practices in England to examine the values of blood pressure monitoring and control in five chronic diseases in relation to deprivation over a period of three years after QOF introduction. Differences between affluent and deprived areas seen in the first year after the QOF had almost disappeared by the third year. For example, 79.2 percent of diabetes patients attending practices in affluent areas achieved the desired blood pressure targets compared to 78.6 percent of diabetes patients attending practices in deprived areas. By the third year deprivation had a weak positive effect on blood pressure monitoring ($P<0.001$).

A study by Ashworth et al (38) found higher levels of statin prescribing in deprived areas when compared to affluent areas in the first year of the QOF after adjusting for differences in cardiovascular disease prevalence. Saxena et al (44), examined associations between deprivation and quality of care for Coronary Heart Disease (CHD), hypertension and stroke in the first year of this pay for performance programme. Achievement was very similar in practices working in deprived and affluent areas. However, affluent practices achieved better scores for some indicators associated with initial diagnosis and management, such as referral for exercise testing ($p<0.0001$). Using a comparable study design, Millett et al, (43) found broadly similar achievement of quality indicators for diabetes in practices working in deprived and affluent

areas. Sigfrid and colleagues, (45) examined associations between deprivation and 'exception reporting' for 15 diabetes indicators in the QOF, whereby patients can be excluded from the data used to calculate the achievement of a target. They found that practices working in deprived areas were more likely to report 'exceptions' for process of care indicators ($p < 0.05$), although the relationship appeared to be reversed for intermediate clinical outcome indicators, which raised the concern that reported achievements in the QOF could mask wider inequalities.

Three studies evaluated the impact of this pay for performance programme using a before and after study design. McGovern et al, (49) found that patients with coronary heart disease living in deprived areas were less likely than patients living in affluent areas to have their smoking status recorded (Pre-QOF: Adjusted Odds Ratio [AOR] 1.04; 95% C.I: 0.86-1.26, Post QOF: AOR 0.78; 95% C.I: 0.62-0.99), blood pressure recorded (Pre-QOF: AOR 0.95; 95% C.I: 0.74-1.20, Post-QOF: AOR: 0.59; 95% C.I: 0.45-0.78), or have beta blocker therapy (Pre-QOF: AOR 0.87; 95% C.I: 0.77-0.97, Post-QOF: AOR 0.84; 95% C.I: 0.76-0.92) after the implementation of the QOF. These differences were not evident before the introduction of the QOF. However, deprived patients were more likely than affluent patients to have antiplatelet or anticoagulant therapy (Pre-QOF: AOR 1.11; 95% C.I: 0.95-1.28, Post-QOF AOR 1.14; 95% C.I: 1.00-1.22). Using a similar study design, Simpson and colleagues, (51) found significant difference between stroke patients living in most and least deprived areas after QOF introduction. Patients in the highest deprivation group were less likely to have a recording of blood pressure (Pre-QOF: AOR 0.98 95% C.I: 0.88-1.09, Post-QOF: AOR 0.66; 95% C.I: 0.54-0.80) and a record of smoking status (Pre-QOF: AOR 1.16; 95% C.I 1.05-1.29, Post-QOF: AOR: 0.81; 95% C.I: 0.71-0.94) after the implementation of the QOF. Millett et al, (50) found no significant variation in ascertainment of smoking status and provision of smoking cessation advice in patients with diabetes living in deprived and affluent areas before and after the introduction of QOF.

2.2.2 Age and Gender Inequalities (4 studies)

Four studies explored the impact of the QOF on age and gender inequalities. In Scotland, a serial cross sectional study found large improvements in quality indicators for stroke patients. However, inequalities present before the introduction of QOF did not narrow. For instance, patients aged >75 years were less likely than young patients to have their smoking status recorded (AOR: 0.69; 95% C.I: 0.62-0.76), have a smoking advice given (Pre-QOF: AOR 0.92; 95% C.I: 0.76-1.12, Post-QOF AOR 0.75; 95% C.I: 0.60-0.93) and have their cholesterol level recorded (Pre-QOF: AOR 0.35; 95% C.I: 0.32-0.38, Post-QOF: AOR 0.71; 95% C.I: 0.66-0.77). Older patients were more likely to receive antiplatelet or anticoagulant therapy after the QOF introduction (Pre-QOF: AOR 0.68; 95% C.I: 0.64-0.74, Post QOF: AOR 1.75; 95% C.I: 1.60-1.91). Women were less likely than men to have a recording of smoking status

(Pre-QOF: AOR 0.92; 95% C.I: 0.76-0.98, Post-QOF: AOR 0.87; 95% C.I 0.81-0.95), or receive antiplatelet or anticoagulant therapy (Pre-QOF: AOR 0.95; 95% C.I 0.89-1.00, Post-QOF: AOR 0.93; 95% C.I: 0.86-0.99). Further, Women were less likely to have a controlled blood pressure (Pre-QOF: AOR 0.90; 95% C.I 0.84-0.98, Post-QOF: AOR 0.86; 95% C.I: 0.81-0.91) or controlled cholesterol levels (Pre-QOF: AOR 0.59; 95% C.I 0.51-0.68, Post-QOF: AOR 0.56; 95% C.I: 0.52-0.60) after QOF compared to men.(51) In a similar study pay for performance did not improve the age and gender inequalities for coronary heart disease patients seen before introduction of the QOF. For example, females were less likely than males to have a recording of blood pressure (Pre QOF: AOR 0.92; 95% C.I 0.87-0.97, Post-QOF: AOR: 0.89; 95% C.I: 0.82-0.97) or having their blood pressure controlled (Pre-QOF: AOR 0.84; 95% C.I: 0.79-0.89, Post-QOF: AOR 0.84; 95% C.I: 0.80-0.87), or have a recording of beta blocker therapy (Pre-QOF: AOR 0.85; 95% C.I 0.81-0.88; Post-QOF: AOR 0.81; 95% C.I 0.79-0.84). Older patients were less likely than younger patients to have a recording of beta blocker therapy (Pre-QOF: AOR 0.39; 95% C.I: 0.36-0.42, Post-QOF: AOR 0.53; 95% C.I: 0.51-0.56).(38) In a cross sectional study for all general practices in England, practices with a high proportion of patients aged ≥ 75 years were less likely to prescribe statins. (38) Using a serial cross sectional study, Millett et al found that the introduction of QOF was associated with an attenuation of differences in ascertainment of smoking status and provision of cessation advice in people with diabetes from different age groups. For instance, patients aged ≥ 75 years had an AOR of 0.92 (95% C.I 0.26-3.31). Ascertainment of smoking status remained significantly higher in women with diabetes than in men (AOR: 2.01; 95% C.I 1.59-2.54) after introduction of the QOF, however reduction in smoking prevalence were lower in women than men (AOR: 0.71; 95% C.I 0.53-0.95).(50)

2.2.3 Ethnic Inequalities (6 studies)

In an analysis undertaken during the first year of pay for performance, Ashworth et al, found lower statin prescribing in areas with high proportions of residents with African-Caribbean or south Asian ethnicity. (38) A cross-sectional survey of 32 general practices in London, identified significant ethnic group inequalities in diabetes management, with black and South Asian patients less likely to achieve all three intermediate clinical outcome targets (for blood pressure; glycosylated haemoglobin (HbA_{1c}); cholesterol) when compared to the white group. (53) Using a serial cross sectional design, Millett et al, (12) examined inequalities in prescribing and intermediate outcomes for diabetes management before and after the introduction of the QOF. The study found that percentage achievement of treatment targets for blood pressure, HbA_{1c} and total cholesterol increased in all ethnic groups after the implementation of pay for performance. However, the magnitude of the improvement in HbA_{1c} control (AOR: 0.75; 95% C.I: 0.57-0.97) and blood pressure control (AOR: 0.65; 95% C.I: 0.53-0.81) was lower in the black Caribbean group than the White British group which meant that inequalities in HbA_{1c} and blood pressure control persisted. Variations in prescribing were also documented in the study, with

lower prescribing of insulin in the Black African group (AOR: 0.69; 95% C.I: 0.51-0.93), Indian group (AOR: 0.51; 95% C.I: 0.38-0.70), Pakistani group (AOR: 0.56; 95% C.I: 0.40-0.78) and Bangladeshi group (AOR: 0.49; 95% C.I: 0.25-0.98) relative to the white British group, differences which persisted after introduction of the QOF. Furthermore, prescribing of oral hypoglycaemic agents increased significantly after QOF introduction, however these changes were largely seen more in the black African and South Asian groups more than the White British ($P < 0.001$). In a similar study, Millett and colleagues, found no variation between different ethnic groups in the recording of smoking status and smoking cessation advice. (50) In another study evaluating QOF, (54) achievements of incentivised quality indicators were evaluated before and after the QOF introduction. Overall attainment of CHD management and intermediate clinical outcome improved significantly after the QOF introduction and were similar across ethnic groups.

2.2.4 Longer term impacts of pay for performance on inequalities

We identified an additional UK study which examined the impact of a more limited pay for performance scheme introduced as part of the 1990 General Practitioner contract. (39) This scheme provided financial incentives for reaching fixed targets for cervical cancer screening coverage. The study findings suggest that whilst these incentives were initially associated with widening of inequalities in cervical screening coverage between deprived and affluent areas, these were largely attenuated at five years follow up. The inequality ratio (equality represented as a ratio of 1) in 1991 was 0.46 however it increased towards equality when the affluent areas maintained maximum levels and by 1999 the inequality ratio was 0.77.

2.2.5 Pay for performance impacts on inequalities in the US

We identified only one study which examined the impact of pay for performance on inequalities in a US health care setting. Karve et al, (55) used data from 3449 hospitals to examine the impact of pay for performance on process measures for acute myocardial infarction (AMI), community acquired pneumonia (CAP) and heart failure (HF). The study shows that hospitals with more than 20 percent of African American patients were less likely to improve on the scores for AMI and CAP compared to hospital that served a lower proportion of non-minority patients.

2.3 Discussion

We identified 22 studies that assessed the impact of pay for performance programmes on health care inequalities. Eighteen studies examined the impact on socio-economic inequalities, four examined age and gender inequalities, and six studies examined ethnic group inequalities. Virtually all studies were UK primary care based and examined the impacts of the QOF. The introduction of QOF was associated with reductions in inequalities in chronic disease

management between affluent and deprived areas. However, it is unclear if these reductions are attributable to QOF or part of underlying trend that pre-dates QOF and other quality improvement initiatives such as the National Service Frameworks. (56-57) Other important inequalities in quality of care between age, gender and ethnic groups present before the introduction of this programme appear to have persisted. Specifically women, older patients and those from some minority ethnic groups continued to receive lower quality of care after the introduction of QOF.

The studies included in this review have a number of important limitations. This partly reflects the way that pay for performance programmes have been introduced into health care systems, generally precluding evaluation using an experimental design or a non-intervention comparison group. For example, the QOF was introduced nationally in the UK during April 2004 as part of a new contract for general practitioners. The data for most studies included in this review was derived from the financial administration system for QOF, the Quality Management and Analysis System (QMAS), and its usefulness for evaluating impacts on inequalities in health care is limited for a number of reasons. Firstly, the QMAS does not hold patient level information on characteristics such as age, gender, ethnicity and socioeconomic status. Hence, most of the QOF evaluations reported here used practice level data and may underestimate the relationship between deprivation and quality of care. This has been further compounded by poor recording of patient based measures of ethnicity and of socioeconomic status within primary care information systems in the UK. Secondly, the ability of practices to exclude patients from performance reporting for the contract means that this data may underestimate the extent of inequalities in care. However, exception reporting rates have been published since the second year of the contract. Finally, studies which use QMAS data are unable to examine underlying trends in quality, making it difficult to attribute reductions in socioeconomic inequalities to QOF. This is an important limitation given that the UK government has instituted a policy agenda to reduce health inequalities since the late 1990s (23) and the important role primary care plays in achieving such objectives.

3 Observational studies on the impact of QOF on inequalities in cardiovascular disease and diabetes management

3.1 Methods

3.1.1 Data sources

Data for the observational studies were drawn from one national (General Practice Research Database) and two local datasets (Wandsworth and Brent). We examined the impact of QOF on quality of care in diabetes using all three datasets; and examined impacts on quality of care for coronary heart disease, stroke and hypertension in Wandsworth. We were able to examine the impact of QOF on quality of care by ethnic group in Wandsworth and Brent due to the high proportion of ethnic minorities living in these communities and the good quality coding on ethnicity in local general practice information systems.

3.1.1.1 General Practice Research Database

We obtained an extract from the General Practice Research Database (GPRD) containing the medical records of all adult patients (18 years of age and above) with a diagnosis of Type 1 or Type 2 diabetes and who had an episode of care in participating practices between 1990 and 2005. The GPRD contains anonymised, longitudinal primary care records on approximately 5% of the population registered with a general practice in the UK. The data recorded is accepted as representative, accurate and complete and is used extensively for health service and epidemiological research. Patients were identified using both diagnostic (C10) and management (66A) Read and OXMIS codes for diabetes. Ethical approval for these studies was received from the Independent Scientific Advisory Committee (ISAC) of GPRD.

3.1.1.2 Wandsworth Primary Care Trust

Wandsworth, south west London has a younger, more deprived and more culturally diverse population than is typical for England. (58-59) 29 of the 34 general practices in the study area participated in the study. We used established methods to identify patients with coronary heart disease, stroke, diabetes and hypertension. (60-61) These use combinations of Read codes for diabetes, CHD and hypertension, procedure codes and prescribing records (i.e. use of drugs for CHD and diabetes). Patient level data were extracted for the 10 years 1998 – 2007 on all patients registered with general practices in on 31st December 2007. Patients did not have to be registered within Wandsworth PCT for this entire period, and the data extraction included those joining from other areas. A unique aspect of this dataset is the completeness of ethnicity coding (> 90%) using the 2001 census classification. Ethical approval for these studies was obtained from the Wandsworth Local Research Ethics Committee.

3.1.1.3 Brent Primary Care Trust

The Brent Clinical information Management System (CIMS) project aimed to examine the quality and outcomes of care in an ethnically diverse population. The CIMS project extracts information from the electronic medical records of patients in the borough of Brent, including age, sex, area of residence, clinical consultations (coded using Read classification system), prescribing records, physical measurements such as BP, height and weight, and lab tests including serum cholesterol and HbA1c.

Twenty-six out of 72 general practices in Brent volunteered to participate in the Brent CIMS project. The registered population of these 26 practices was 106 691 patients. The population of Brent is younger and has higher levels of unemployment than the rest of England. Brent is the most ethnically diverse area in the UK and non-white ethnic groups in Brent now make up the majority (55%) of the population. Over the 10-year period covered here, from 1997 – 2006, there were notable changes in the ethnic proportions in Brent, with a reduction in the white population from 55% in 1997 to 45% in 2006. This contrasts with the South Asian and black populations which increased by about 3% each during the same period. (62-63) Ethical approval was obtained from the Brent Local Research Ethics Committee.

3.1.2 Study Design and Outcome Measures

We used an open cohort study to examine the impact of QOF on quality of care in diabetes using the GPRD data. This allowed us to include data on patients who died or moved away during the study period (1997-2005). We employed a retrospective cohort design for the Wandsworth studies because we only had access to data on those patients registered with practices at the end of the study period (December 2007). The study design for the Brent diabetes study involved comparison of cross sectional findings over the 10 year period (1997-2006).

Our main outcome measures were mean blood pressure, cholesterol, HbA1c levels and achievement of national treatment targets. We used more stringent targets than those set in QOF in line with clinical guidance (64-65). Secondary outcome measures include process of care measures, i.e. whether blood pressure has been measured, and prescribing on secondary prevention medications.

3.1.3 Omissions from the longitudinal data analyses

1. We were only able to present findings for diabetes from Brent in this report because this was a newly established dataset and there were some major

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Project 08/1716/209

quality issues with the data for CHD and hypertension. However, we also present data for stroke patients using the Wandsworth data which was not part of the original proposal

2. We were unable to examine associations between improved quality associated with the introduction of QOF and secondary outcome measures such as inpatient procedures (CABG, PACT) major complications (including myocardial infarction, stroke, amputations) using patient level data as planned. This is because the then Patient Information Advisory Group did not grant permission for us to extract patient identifiers, which would have permitted data linkage to hospital data, without individual patient consent.

3.2 Impact of QOF on inequalities in Diabetes management between age, sex and ethnic groups

3.2.1 Analysis plan

The analysis here was limited to the data from those patients with diabetes registered with participating practices between 1997 and 2005 in the GPRD dataset.

Our main outcome measures were the achievement of national targets for HbA_{1c} ($\leq 7.0\%$), blood pressure ($<140/80$ mm Hg), and total cholesterol (≤ 5 mmol/L or 193 mg/dl). We used mean annual values if patients had more than one measurement in a year. Secondary outcome measures were process of care indicators (whether blood pressure, cholesterol and HbA_{1c} were measured) and prescription of oral hypoglycaemic agents (OHAs), antihypertensive agents (AHAs) and lipid lowering medications.

Our predictor variables were age, sex and socio-economic status. We assigned socioeconomic status to patients using the Index of Multiple Deprivation (IMD) 2004 based on their general practice postcode and then generated deprivation quintiles (1 = least deprived, 5 = most deprived) (52). The Index of Multiple Deprivation is the most commonly used method of measuring neighbourhood socioeconomic status in the UK and is compiled from a variety of sources, including the 2001 UK census, unemployment, and social security benefits records. Covariates in our analysis included duration of diabetes, number of the comorbid medical conditions (including hypertension, atrial fibrillation, stroke, heart failure, CHD, asthma, depression, osteoporosis and COPD) and body mass index.

The data have a two-level structure, with patients "clustered" within practices (because patients treated by the same general practice are expected to be more similar in their outcomes than patients treated by different general practices) and multiple practices. This was managed by constructing marginal models using Generalised Estimating Equations (GEEs) in SASTM version 9.1. The first set of models used records for 1997-2003 to estimate the underlying time trends and enable us to predict the achievement rates for the post-QOF years. 'Year' was fitted as a linear term. For HbA_{1c}, only the years 2000-2003 were used for extrapolation as it was only during this period that the linear

trend was valid. Actual mean 2005 target achievement was then compared with the predicted rates using t-tests.

A second set of GEE models was developed to examine whether achievement of targets in 1997 and 2005 differed depending on the age, sex and socio-economic status of patients with diabetes. All covariates were entered at the same time (i.e. with no stepwise selection).

3.2.2 Results – process of care and prescribing

We identified 154,945 adult patients with diabetes registered with 422 participating practices during the study period. The number of people registered on the GPRD with diabetes increased from 49,970 in 1997 to 105,065 in 2005.

There were large improvements in process measure recording and prescribing of secondary prevention medications during the study period. A number of important between-group differences were identified (Table 1).

Age

There was a strikingly low rate of recording for the over-75s for HbA_{1c} and cholesterol. Only 10% of over-75s had their HbA_{1c} recorded in 1997, compared with, for example, 50% for the 55-64 age group. Only 5% of over-75s had their cholesterol level recorded in 1997 compared with 30% in the 55-64 age group. Although the recording improved for all groups by 2005, the over-75s remained disadvantaged with 42% having their HbA_{1c} recorded in 2005 compared with 82% of 18-44s and 89% of 55-64s.

Prescribing of OHAs and lipid-lowering medications was very low among the over-75s in 1997 and 2005. For OHAs the rate was 12% for over-75s in 1997, rising to 25% in 2005, compared with 29% and 48% respectively for 18-44s, and 57% and 65% respectively for 55-64s. Similarly, only 1% of over-75s were prescribed lipid-lowering medication in 1997, rising to 40% in 2005, compared with 8% and 53% respectively for 18-44s and 12% and 74% for 55-64s in the two years examined. However, for AHAs, the oldest three age groups received more treatment than the youngest two age groups in both years.

Sex

In 1997 there was no significant difference in the recording of blood pressure between men and women with diabetes. By 2005, differences in blood pressure recording between men and women were statistically significant, but the absolute difference was very small (90.6% v 89.9%, $p < 0.001$). Men were more likely than women to have their HbA_{1c} and cholesterol recorded in 1997 and 2005 ($p < 0.001$) and men were also more likely to be prescribed OHAs and lipid lowering medication than women in 1997 and 2005 ($p < 0.001$). Women were more likely to be prescribed AHAs than men in both years ($p < 0.001$) but the difference was largely attenuated in 2005.

Deprivation

There were statistically significant variations in the recording of risk factors and prescribing of secondary prevention medications between deprivation quintiles, but the magnitude of the differences found were generally very small.

Table 1: Process measures of care and prescribing (as % of group) by age, gender and deprivation

	Process of care (measurement)								Prescribing					
	BP		HbA _{1c}		Cholesterol		All three		OHAs		Lipid lowering		AHAs	
	1997	2005	1997	2005	1997	2005	1997	2005	1997	2005	1997	2005	1997	2005
Age (years)														
18-44	56.6	87.1	39.0	81.5	22.9	79.0	17.1	72.9	29.3	48.2	7.8	53.2	29.1	50.9
45-54	69.5	92.5	47.4	87.0	30.7	86.8	23.6	81.0	54.9	66.8	12.6	69.3	49.3	71.1
55-64	71.5	93.7	49.9	88.5	29.7	88.9	22.3	83.0	57.0	64.5	11.9	73.7	59.0	78.5
65-74	70.5	94.2	46.8	87.0	24.8	88.1	19.1	81.4	52.7	58.4	6.4	71.9	64.7	84.4
75+	63.2	84.0	10.2	42.0	4.9	60.6	2.8	37.8	12.2	24.9	1.0	39.5	58.8	77.4
p value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Gender														
Male	66.0	90.6	37.3	79.3	22.2	82.8	16.6	73.6	39.2	54.0	7.3	63.7	49.9	73.2
Female	65.8	89.9	30.1	71.6	16.7	77.1	12.3	65.7	33.5	48.9	6.1	58.5	57.9	75.1
p value	0.68	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Deprivation (quintiles)														
1	64.8	91.1	35.2	77.2	20.5	81.4	13.8	69.4	38.1	51.2	7.1	61.0	53.4	73.9
2	64.4	91.7	34.8	79.4	20.6	82.8	14.2	74.2	40.9	52.8	8.2	64.4	53.4	75.2
3	65.4	88.8	31.9	72.9	15.3	77.0	12.6	67.4	34.8	51.1	5.4	58.9	53.3	73.5
4	66.6	89.3	33.6	72.4	19.6	79.1	15.6	67.7	32.1	48.2	6.0	59.1	54.2	73.8
5	67.8	90.4	33.0	75.6	21.1	79.7	15.6	70.3	36.8	54.2	7.0	62.4	55.5	74.0
p value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.02	<0.001

Neighbourhood socioeconomic status (SES) based on the Index of Multiple Deprivation 2004; 1= least deprived, 5 = most deprived. OHAs = oral hypoglycemic agents; AHA = antihypertensive agent; BMI = body mass index. P values were derived using the Chi-squared test

Table 2: Performance (as % achieving the target) for 2005 compared with predicted by age, gender and deprivation

	Age					Gender		Deprivation (quintiles)				
Blood pressure \leq 140/80 mm Hg	18-44	45-54	55-64	65-74	75+	Male	Female	1	2	3	4	5
Actual mean % achievement	40.8	33.4	36.0	38.1	34.7	37.4	35.2	34.6	36.7	36.2	37.7	37.3
Predicted mean % achievement	44.2	31.7	32.5	32.9	31.1	35.7	31.7	32.2	33.1	33.0	35.1	36.1
Difference (actual - predicted)	-3.4	1.6	3.5	5.2	3.6	1.7	3.5	2.5	3.3	3.2	2.5	1.3
95% CI for difference	-4.6 to - 2.2	0.6 to 2.7	2.7 to 4.4	4.2 to 6.1	2.7 to 4.5	1.1 to 2.3	2.9 to 4.2	1.6 to 3.4	2.4 to 4.3	2.2 to 4.2	1.5 to 3.6	0.3 to 2.3
P value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
HbA1c \leq 7.0%	18-44	45-54	55-64	65-74	75+	Male	Female	1	2	3	4	5
Actual mean % achievement	25.9	36.3	46.4	55.7	63.6	44.7	46.9	46.8	45.6	44.6	44.6	46.5
Predicted mean % achievement	30.5	40.4	48.7	55.8	63.2	47.8	47.8	48.0	49.0	46.8	47.9	47.1
Difference (actual - predicted)	-4.6	-4.1	-2.3	-0.1	0.4	-3.1	-0.9	-1.2	-3.4	-2.3	-3.2	-0.6
95% CI for difference	-5.7 to - 3.5	-5.1 to -2.4	-3.3 to -1.4	-1.1 to 0.9	-0.9 to 1.7	-3.8 to -2.4	-1.7 to -0.2	-2.3 to -0.1	-4.5 to -2.3	-3.4 to -1.2	-4.4 to -2.0	-1.7 to 0.5
P value	<0.001	<0.001	<0.001	0.456	0.259	<0.001	0.007	0.013	<0.001	<0.001	<0.001	0.148
Total cholesterol \leq 5 mmol/L	18-44	45-54	55-64	65-74	75+	Male	Female	1	2	3	4	5
Actual mean % achievement	67.9	71.6	74.8	76.9	66.2	77.6	65.7	72.1	73.0	70.9	71.0	73.4
Predicted mean % achievement	67.6	66.7	68.5	69.6	61.8	73.9	59.1	67.2	67.6	65.5	66.5	68.5
Difference (actual - predicted)	0.3	4.8	6.4	7.3	4.5	3.7	6.7	4.9	5.5	5.3	4.5	5.0
95% CI for difference	-0.9 to 1.4	3.8 to 5.9	5.5 to 7.2	6.4 to 8.2	3.4 to 5.6	3.1 to 4.2	6.0 to 7.4	3.9 to 5.9	4.5 to 6.4	4.3 to 6.4	3.5 to 5.6	4.0 to 6.0
P value	0.328	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Neighbourhood socioeconomic status (SES) based on the Index of Multiple Deprivation 2004, 1= least deprived, 5 = most deprived

HbA1c predicted figures were based on extrapolations from the period 2000–2003 only

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Project 08/1716/209

Table 3: Percentage achievement of treatment targets (with adjusted odds ratios) in 1997 and 2005 by age, sex and deprivation

	Blood pressure \leq 140/80 mm Hg				Cholesterol \leq 5 mmol/L				HbA _{1c} \leq 7.0%			
	1997		2005		1997		2005		1997		2005	
	%	AOR (95% CI)	%	AOR (95% CI)	%	AOR (95% CI)	%	AOR (95% CI)	%	AOR (95% CI)	%	AOR (95% CI)
Age												
18-44	28.9	1	40.8	1	25.6	1	67.9	1	25.4	1	25.9	1
45-54	16.9	0.89 (0.88-0.91)*	33.4	0.95 (0.94-0.96)*	21.5	0.95 (0.97-0.98)\$\$	71.6	1.33 (1.26-1.41)*	34.9	1.06 (1.04-1.08)*	36.3	1.37 (1.30-1.45)*
55-64	15.8	0.88(0.87-0.89)*	36.0	0.98 (0.97-0.99)**	20.3	0.95 (0.92-0.98)\$\$	74.8	1.69 (1.59-1.79)*	40.1	1.10 (1.07-1.13)*	46.4	1.90 (1.80-2.00)*
65-74	15.0	0.88 (0.86-0.89)*	38.1	1.02 (1.00-1.03)**	18.2	0.98 (0.94-1.01)	76.9	2.07 (1.95-2.19)*	48.1	1.18 (1.14-1.21)*	55.7	2.51 (2.36-2.66)*
75+	14.5	0.87 (0.85-0.89)*	34.7	0.98 (0.96-0.99)**	15.9	0.99 (0.95-0.98)	70.7	1.26 (1.16-1.35)*	51.7	1.21 (1.16-1.25)*	63.6	3.17 (2.96-3.40)
Sex												
Men	19.0	1	37.4	1	26.5	1	77.6	1	40.4	1	44.7	1
Women	15.4	0.97 (0.96-0.97)*	35.2	0.98 (0.97-0.98)*	14.5	0.86 (0.85-0.88)*	65.7	0.52 (0.50-0.54)*	38.0	0.96 (0.95-0.98)*	46.9	1.04 (1.00-1.07)**
Deprivation												
1	15.4	1	34.7	1	21.4	1	72.1	1	44.5	1	46.8	1
2	14.2	0.99 (0.97-1.02)	36.4	1.02 (0.99-1.04)	21.4	1.00 (0.97-1.04)	73.0	1.09 (0.97-1.27)	41.8	0.99 (0.93-1.06)	45.6	0.94 (0.83-1.07)
3	17.2	1.02 (0.99-1.04)	36.2	1.02 (0.99-1.05)	19.4	0.97 (0.93-1.00)	70.9	1.01 (0.90-1.14)	30.1	0.95 (0.88-1.01)	44.5	0.93 (0.82-1.05)
4	19.6	1.04 (1.02-1.06)*	37.7	1.01 (0.98-1.04)	18.8	0.98 (0.95-1.02)	71.0	0.98 (0.87-1.11)	37.4	0.96 (0.89-1.03)	44.6	0.91 (0.82-1.05)
5	18.3	1.03 (1.01-1.05)\$	37.3	1.03 (0.99-1.06)	23.7	1.03 (0.99-1.07)	73.4	1.14 (1.02-1.28)*	42.4	0.96(0.90-1.01)	46.5	1.06 (0.94-1.21)
Total	17.2		36.4		19.8		72.9		39.3		45.6	

Neighbourhood socioeconomic status (SES) based on the Index of Multiple Deprivation 2004, 1= least deprived, 5 = most deprived

* p<0.001
 \$ p=0.001
 \$\$ p<0.01
 ** p<0.05

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Project 08/1716/209

3.2.3 Results – achievement of treatment targets

Achievement of treatment targets

Table 2 shows the performance (as a mean percentage of patients achieving the target) for 2005 compared with that predicted by the underlying trend for different age groups, for men and women and by area deprivation quintiles. Figures 2a - c are graphs of actual achievement of performance targets for blood pressure against predicted trend lines. Table 3 shows the results of the GEE model, accounting for practice-level clustering.

Age

There was an improved achievement of the target for blood pressure in 2005 which was significantly greater ($p < 0.001$) than that predicted by the underlying trend based on 1997-2003 data. This was true for all age groups except the youngest (18-44), where performance was significantly below that predicted ($p < 0.001$). However, that this group had the highest predicted values of all groups and the actual attainment was the best of all the groups.

Findings from the model (accounting for practice-level clustering) conducted on the 1997 data suggest that patients aged 45 years and over were significantly less likely to achieve the blood pressure target than those aged 18-44 years (Table 3). Adjusted odds ratios varied from 0.89 for age group 45-54 (CI 0.88 to 0.91, $p < 0.001$) to 0.87 for the over-75s (CI 0.85 to 0.89, $p < 0.001$). These differences had largely been attenuated by 2005, when the adjusted odds ratio relative to the youngest group was between 0.95 (CI 0.94 to 0.96, $p < 0.001$) among 45-54 year olds, 1.19 (1.13 to 1.26, $p < 0.001$) and 0.98 (CI 0.96 to 0.99, $p < 0.05$) for the over-75s.

Achievement of the target for HbA_{1c} was significant below that predicted by the underlying trend in 2005 among patients 18-64 years ($p < 0.001$). There was no statistically significant differences in actual and predicted achievement of the target for HbA_{1c} among patients 65 years and older. Findings from the GEE model conducted on the 1997 data suggest glycaemic control was worse among the youngest age group, with adjusted odds ratios ranging from 1.06 (CI 1.04 to 1.08, $p < 0.001$) among 45-54 year olds to 1.21 (CI 1.16 to 1.25, $p < 0.001$) among those 75 years and older. These differences had widened in 2005, with the greatest difference being for the over-75s, with an odds ratio of 3.17 compared with the youngest age group (CI 2.96 to 3.40, $p < 0.001$).

For the cholesterol target, achievement was higher in 2005 than predicted by the underlying trend among all age groups except for those aged 18-44 years, where performance was not significantly different in 2005 from the expected value. The oldest age group (75+ years) appeared to benefit most from the introduction of QOF as the difference between predicted and actual cholesterol control values in 2005 was significantly larger than that found in all other groups. Findings from

the GEE model conducted on the 1997 data suggest that cholesterol control among the youngest age group was similar or better than all of the older age groups. In 2005, this trend had completely reversed, with all the older age groups having a greater chance of achieving the target than the youngest. For example, the adjusted odds ratio among 65-74 year olds was 2.07 (CI 1.95 to 2.19, $p < 0.001$).

Sex

Blood pressure control was better than predicted for both men and women in 2005, but the magnitude of the difference was significantly greater among women than men. Findings from the GEE model suggest that women had poorer blood pressure control than men in both 1997 (AOR 0.97, CI 0.96 to 0.97, $p < 0.001$) and 2005 (AOR 0.98, CI 0.97 to 0.98, $p < 0.001$). Both sexes had lower attainment of the HbA_{1c} target in 2005 than predicted by trend with the magnitude of the difference was significantly greater among men than women. The GEE model showed that women were significantly less likely to achieve the target than men in 1997 (AOR 0.96, 95% CI 0.95 to 0.98, $p < 0.001$) but significantly more likely to do so in 2005 (AOR 1.04, 95% CI 1.00-1.07, $p < 0.05$).

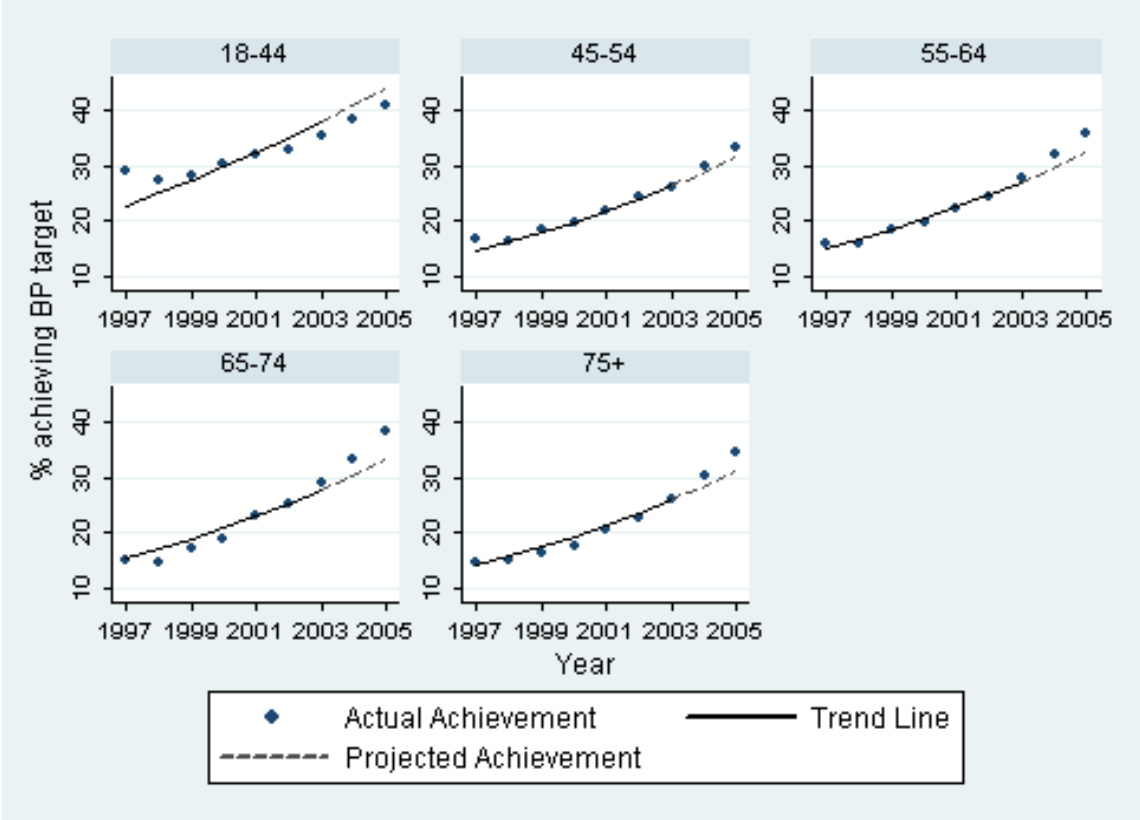
For the cholesterol target, both sexes had a better achievement in 2005 than predicted, with women improving significantly more than men (achievement was 6.7% greater than predicted in 2005 among women compared with 3.7% for men, $p < 0.001$), findings from the model accounting for practice-level clustering suggest that despite this more rapid improvement women remained significantly less likely to achieve the treatment target for cholesterol in 2005 (OR 0.52, CI 0.50 to 0.54, $p < 0.001$).

Deprivation

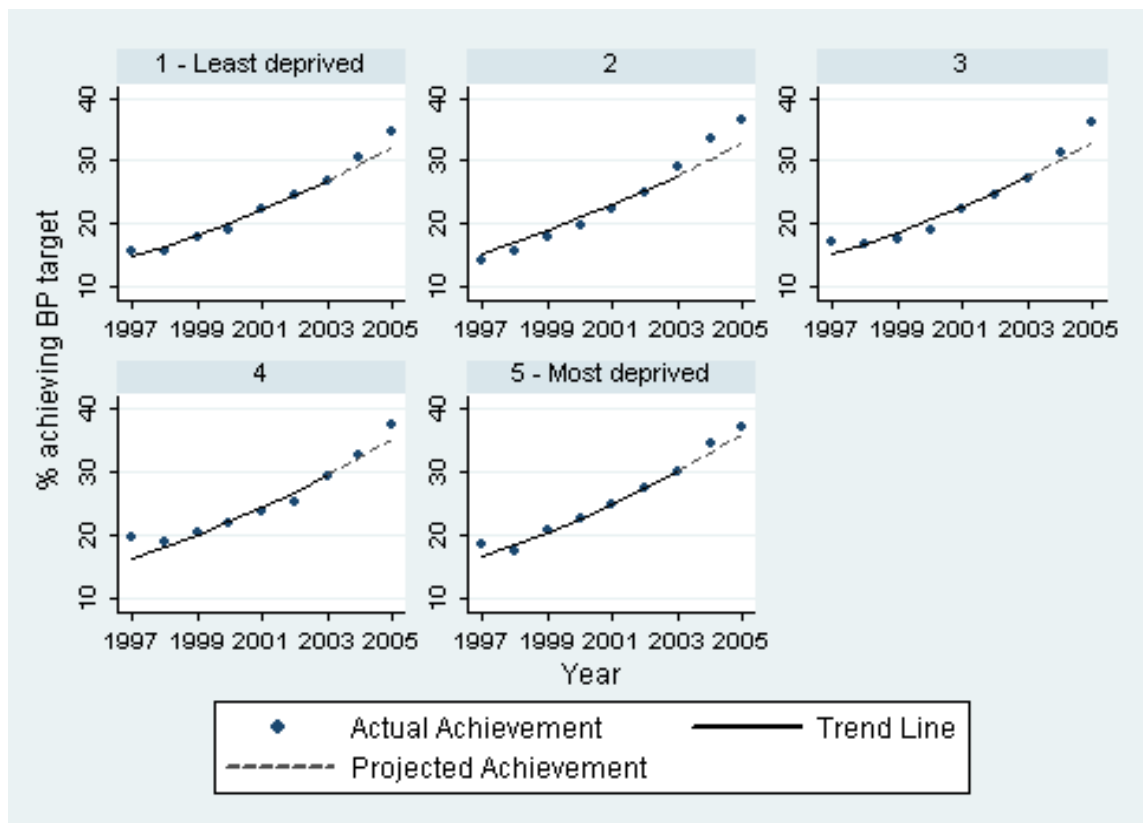
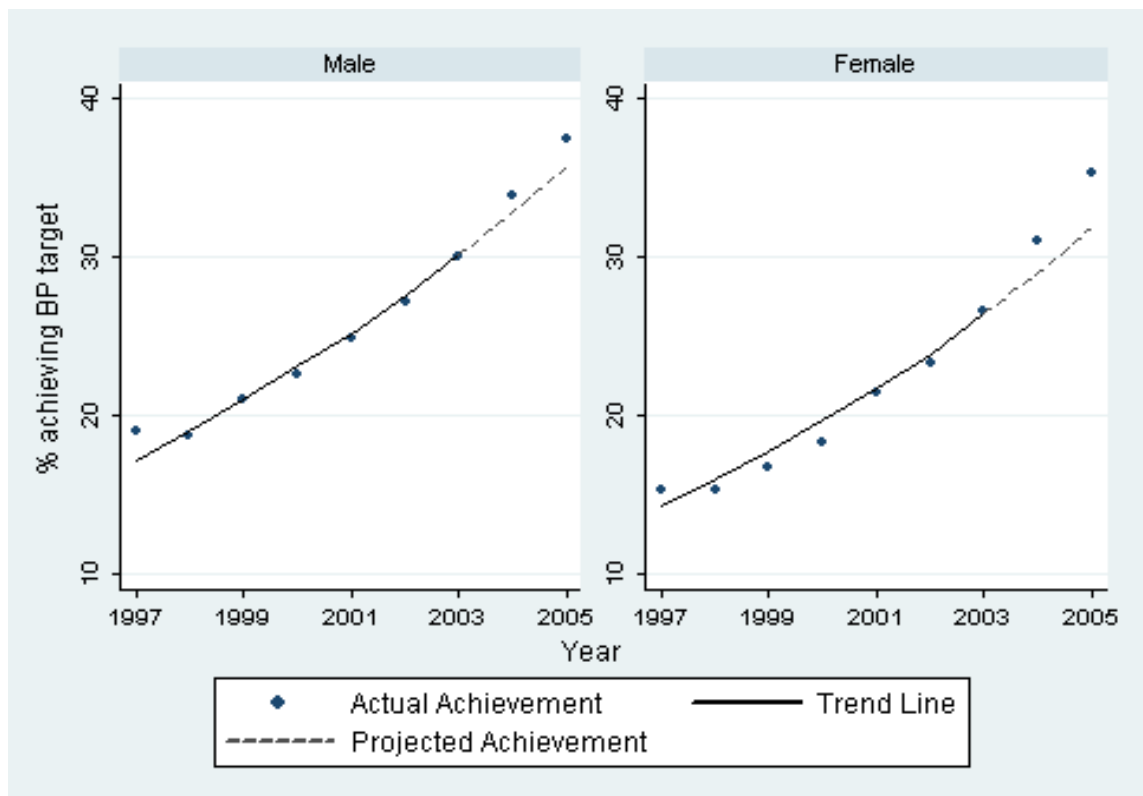
Achievement of the blood pressure target was greater than that predicted by the underlying trends among all deprivation groups with the magnitude of improvement being similar in the most and least deprived quintiles. Findings from the multivariate model accounting for practice-level clustering conducted on the 1997 data showed that patients in the most deprived quintile were significantly more likely to achieve the blood pressure target than patients in the least deprived (adjusted odds ratio 1.03 95% CI 1.01 to 1.05, $p = 0.001$). There were no significant differences in achievement of the blood pressure target between the least and most deprived quintiles in 2005. Achievement of the treatment target for HbA_{1c} was lower than that predicted by the underlying trend in all but the most deprived area quintile. No significant differences in HbA_{1c} control were identified between patients living in the most and least deprived areas in either 1997 or 2005. Achievement of the treatment target for cholesterol was significantly higher than that predicted by the underlying trend in all deprivation area groups. No significant differences in cholesterol control were identified between patients living in the most and least deprived areas in 1997.

Patients living in the most deprived areas were significantly more likely to achieve the treatment target than those in the least deprived areas in 2005 (AOR 1.14, CI 1.02 to 1.28).

Figure 2: Proportion of patients who achieved the blood pressure target in 2005 compared to that predicted by trend by A) age group B) sex and C) deprivation quintile



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3.3 Impact of QOF on inequalities in diabetes management between small and large practices (GPRD)

3.3.1 Analysis plan

Practice size was defined as the total number of patients registered in each practice and was assigned to quintiles where 1= smallest and 5=largest. Additional covariates in our analysis aside from those mentioned above were diabetes caseload (the number of adult patients with diabetes in each practice), duration of diabetes, number of co-morbid conditions and body mass index (BMI).

The first set of models used records for 1997 and 2005 data to examine differences in target attainment between different patient volume groups. The second set of models used records for 1997-2003 (before the implementation of the Quality & Outcomes Framework) to estimate the underlying time trends and thereby predict the achievement rates for the post-QOF years. Year was fitted as a linear term. For HbA_{1c}, only 2000-2003 data were used to calculate predicted values, as this was the only period when a linear trend was observed. Actual mean post-QOF (2004 and 2005) target achievement was then compared with these mean predicted rates using t tests.

We also examined whether QOF attenuated or widened differences in achievement of targets by practice size. Records for 2003-2005 were used for these models, with 2003 taken as the baseline and year this time fitted as a categorical variable. All covariates were entered at once in both sets of models with none removed. Two-way interactions were examined.

3.3.2 Results

The mean prevalence of diabetes was higher in smaller practices in 1997 and this difference further increased by 2005 (Table 4). Furthermore, smaller practices had a higher mean deprivation score than larger practices in 2005. Other characteristics of patients registered with small and large practices were broadly similar in 1997 and 2005.

Process of care and prescribing

There were large improvements in process measure recording and prescription of secondary prevention medications during the study period. Practice volume was associated with significant differences in compliance with measures and prescription of medications in 1997 and 2005. However, with the exception of cholesterol measurement in 1997 with largest practices having a higher recording rate than the smallest volume group (23.3 % vs. 17.1%), the absolute differences between smallest and large practices were modest (<5%).

Blood pressure target achievement

Improved achievement of the target for blood pressure was shown in all practice size groups between 1997 and 2005 (Table 5). There were no statistically significant variations in the blood pressure target attainment between small and large practices in 1997 and 2005 after adjusting for covariates in the GEE models

Table 5 shows the performance (as a mean percentage of patients achieving the target) for 2004 and 2005 compared with that predicted by the underlying trend for different practice size quintiles. There was an improved achievement of established treatment targets for blood pressure after the introduction of the incentives in 2004 and 2005 in all practice size quintiles, which was significantly greater than that predicted by the underlying trends based on 1997 to 2003 data (except for the 4th quintile group, where the difference was not statistically significant in 2004) (Table 5, Figure 3). There was no consistent trend seen in the magnitude of improvement from the low (quintile 1) to high (quintile 5) volume groups. The magnitude of improvement in smallest practices was slightly higher compared to largest practices in both years.

In 2005, the marginal model accounting for practice-level clustering showed no statistically significant difference between smaller practices and any other list size quintiles.

In the analyses examining the effect of the pay-for-performance program on target achievement in different list size groups using the 2003-2005 data, the interaction between year and list size quintile was not significant reflecting that there was no significant change in volume-outcome relations over the three year period between 2003 and 2005 ($p=0.37$).

Cholesterol target achievement

Achievement of the target for cholesterol improved in all practice size groups during the study period. There were no statistically significant variations in the cholesterol target attainment between small and large practices in 1997 after adjusting for covariates in the GEE model. In 2005, patients in the largest volume group had significantly higher target achievement compared with smallest practices (OR = 1.17, 95% CI 1.01 to 1.3, $p=0.04$) (Table 4).

After the introduction of the pay-for performance program, cholesterol target attainment was significantly greater than that predicted by the underlying trends based on 1997 to 2003 data in all list size groups both in 2004 and 2005 (Table 5, Figure 4).

The interaction between year and list size quintile was not significant reflecting that this relation did not significantly change over the three year period between 2003 and 2005 ($p=0.18$).

HbA_{1c} target achievement

Achievement of the target for HbA_{1c} improved in all practice size groups during the study period but at a lower rate than for blood pressure and cholesterol.

Patients treated in the largest practices had considerably lower HbA_{1c} target achievement than those registered with smaller practices in 1997 (30.7% vs. 40.7%, $p < 0.001$) but these differences were not significant after adjusting for covariates in the GEE model. In 2005, there was no difference between smallest and any other list size groups in performance.

After the introduction of pay for performance, only largest practices in 2004 showed higher improvement in HbA_{1c} target achievement than that predicted by the underlying trend based on 2000 to 2003 data (Table 5, Figure 5). In the medium and small practice size groups (1st to 4th quintiles), the achievement was significantly lower than predicted for both years. The shortfall was the greatest in patients treated in the high volume 4th quintile in 2004 and in smallest practices in 2005.

The interaction between year and list size quintile did not reach statistical significance ($p = 0.08$)

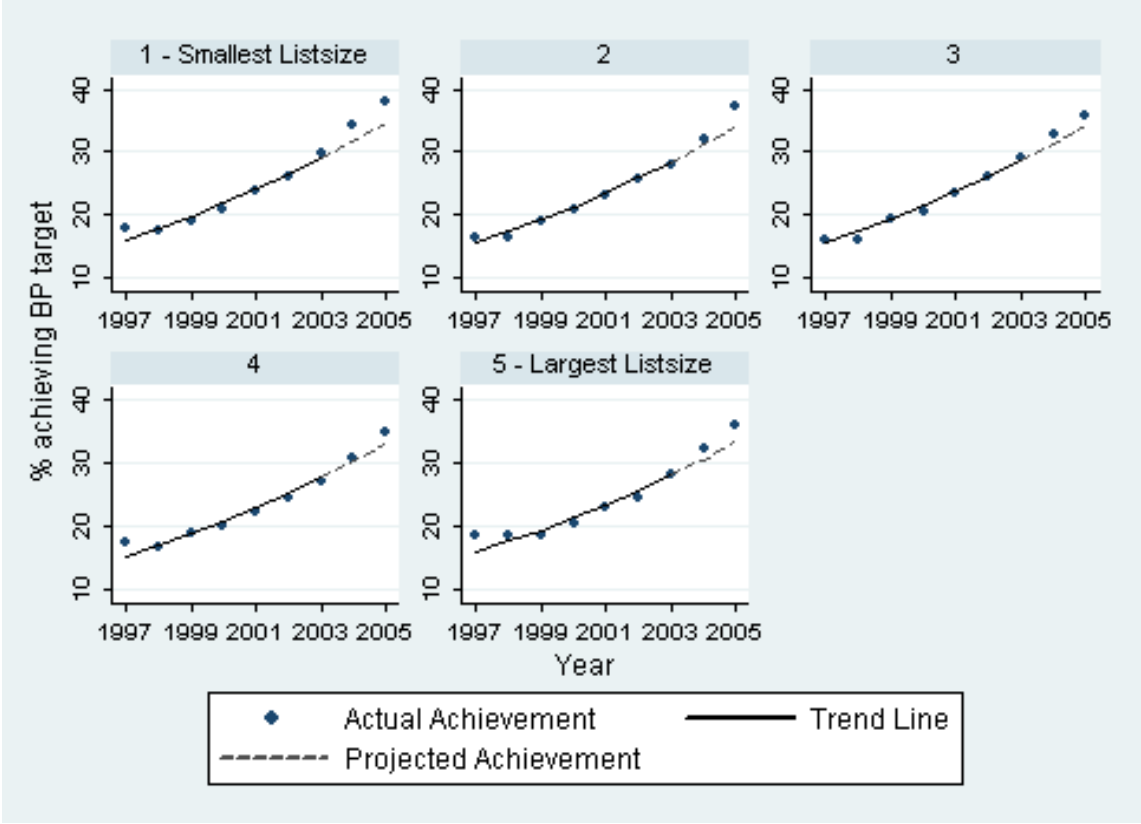
Table 4: Characteristics of the sample, process of care and prescribing by practice size (quintiles)

	1997 (n=49,970)						2005 (n=105,065)						
	Smallest	2	3	4	Largest		Smallest	2	3	4	Largest		
Practice list size (n)	1,395 to 6,708	6,750 to 8,643	8,649 to 10,519	10,557 to 12,629	12,630 to 27,563		1,506 to 6,833	6,846 to 9,209	9,242 to 11,258	11,284 to 13,358	13,429 to 27,094		
Patient characteristics													
% male	48.6	47.0	50.3	49.0	50.0		52.0	51.9	51.4	52.1	52.7		
Mean age	68.8	71.3	67.7	69.9	69.3		67.4	67.6	67.2	68.3	66.9		
Mean BMI (kg/m ²)	27.4	27.2	27.7	27.2	27.3		29.3	29.4	29.4	29.2	29.4		
Mean Neighbourhood SES*	24.3	28.2	23.6	26.3	24.3		25.4	25.9	24.9	22.6	21.1		
Process of care (%)						p value							p value
Blood pressure measured	67.3	64.8	64.3	66.2	67.1	<0.001	90.2	90.3	91.0	90.0	90.0	0.004	
HbA _{1c} measured	32.8	31.2	34.6	32.2	37.7	<0.001	74.0	76.4	77.3	73.9	76.2	<0.001	
Cholesterol measured	17.1	22.3	17.2	17.5	23.3	<0.001	78.8	80.9	78.9	77.8	78.8	<0.001	
All three measured	13.6	15.8	12.8	12.9	17.2	<0.001	68.6	71.4	71.0	68.3	69.9	<0.001	
Medications prescribed (%)													
OHAs	36.7	33.2	39.3	35.8	36.4	<0.001	51.2	52.5	53.1	49.2	51.8	<0.001	
Insulin	21.8	19.0	25.0	22.7	22.3	<0.001	16.3	17.0	17.9	17.0	17.0	0.001	
Lipid Lowering	7.4	6.2	7.5	5.7	6.6	<0.001	60.4	61.7	62.3	60.5	61.1	<0.001	
AHT	54.7	55.8	52.4	54.2	52.8	<0.001	74.0	74.2	74.7	73.8	73.7	0.002	
Intermediate outcomes, mean													
Systolic blood pressure (mm Hg)	148.1	148.4	149.1	148.6	149.1	0.01	138.6	139.0	139.5	139.9	139.3	0.001	
Diastolic blood pressure (mm Hg)	81.7	81.7	82.0	82.0	81.4	0.001	77.5	77.7	77.9	77.7	77.8	0.001	
HbA _{1c} (%)	7.6	7.6	7.7	7.5	8.2	<0.001	7.5	7.4	7.4	7.5	7.4	<0.001	
Cholesterol (mmol/l)	5.8	5.8	6.2	6.1	5.8	<0.001	4.6	4.6	4.6	4.6	4.6	0.328	
Target achievement (%)													
Blood pressure < 140/80 mm Hg	17.9	16.4	16.1	17.2	18.4	<0.001	38.0	37.2	35.9	35.0	36.0	<0.001	
HbA _{1c} ≤ 7.0%	40.7	40.7	40.3	44.5	30.7	<0.001	44.2	46.8	46.4	44.2	46.6	<0.001	
Total cholesterol ≤ 5 mmol/L	23.0	20.0	22.2	18.2	22.2	<0.001	72.1	73.2	72.2	72.3	73.9	0.004	

Table 5: Performance (as mean % achieving the target) for 2004 and 2005 compared with predicted by practice size

Year	Blood pressure < 140/80 mm Hg	Practice size (quintiles)				
		Smallest	2	3	4	Largest
2004	Actual mean % achievement	34.4	32	32.7	31	32.4
	Predicted mean % achievement	31.7	31.1	31.3	30.3	30.6
	Difference (actual - predicted)	2.7	0.9	1.4	0.6	1.8
	95% CI for difference	1.7 to 3.7	0.1 to 1.9	0.4 to 2.4	-0.3 to 1.6	0.8 to 2.8
	P value	< 0.001	< 0.05	< 0.01	0.103	< 0.001
2005	Actual mean % achievement	38	37.2	35.9	35	36
	Predicted mean % achievement	34.6	33.9	34.2	33.2	33.4
	Difference (actual - predicted)	3.4	3.2	1.6	1.8	2.6
	95% CI for difference	2.4 to 4.4	2.2 to 4.2	0.7 to 2.6	0.9 to 2.8	1.6 to 3.5
	P value	< 0.001	< 0.001	< 0.01	< 0.001	< 0.001
	HbA1c < 7.0%	Smallest	2	3	4	Largest
2004	Actual mean % achievement	44.5	44.8	43.4	41.4	44.8
	Predicted mean % achievement	46.3	46.8	45.4	44.7	43.7
	Difference (actual - predicted)	-1.9	-2	-2	-3.2	1.1
	95% CI for difference	-3 to -0.7	-3.2 to -0.9	-3.1 to -0.9	-4.4 to -2.1	0 to 2.3
	P value	0.001	< 0.001	< 0.001	< 0.001	0.028
2005	Actual mean % achievement	44.2	46.8	46.4	44.2	46.6
	Predicted mean % achievement	48.8	49.5	48.1	47.7	46.1
	Difference (actual - predicted)	-4.5	-2.7	-1.7	-3.5	0.5
	95% CI for difference	-5.6 to -3.4	-3.8 to -1.6	-2.8 to -0.6	-4.6 to -2.4	-0.6 to 1.6
	P value	< 0.001	< 0.001	0.001	< 0.001	0.185
	Total cholesterol < 5 mmol/L	Smallest	2	3	4	Largest
2004	Actual mean % achievement	63.5	64.7	63.2	65.3	65.7
	Predicted mean % achievement	60.9	61.3	61.5	61.8	62
	Difference (actual - predicted)	2.6	3.4	1.8	3.4	3.7
	95% CI for difference	1.3 to 3.8	2.2 to 4.6	0.5 to 3	2.2 to 4.7	2.5 to 4.9
	P value	< 0.001	< 0.001	< 0.01	< 0.001	< 0.001
2005	Actual mean % achievement	72.1	73.2	72.2	72.3	73.9
	Predicted mean % achievement	67.4	67.8	67.8	68	68.4
	Difference (actual - predicted)	4.6	5.5	4.4	4.3	5.5
	95% CI for difference	3.5 to 5.8	4.4 to 6.6	3.3 to 5.5	3.2 to 5.4	4.4 to 6.6
	P value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

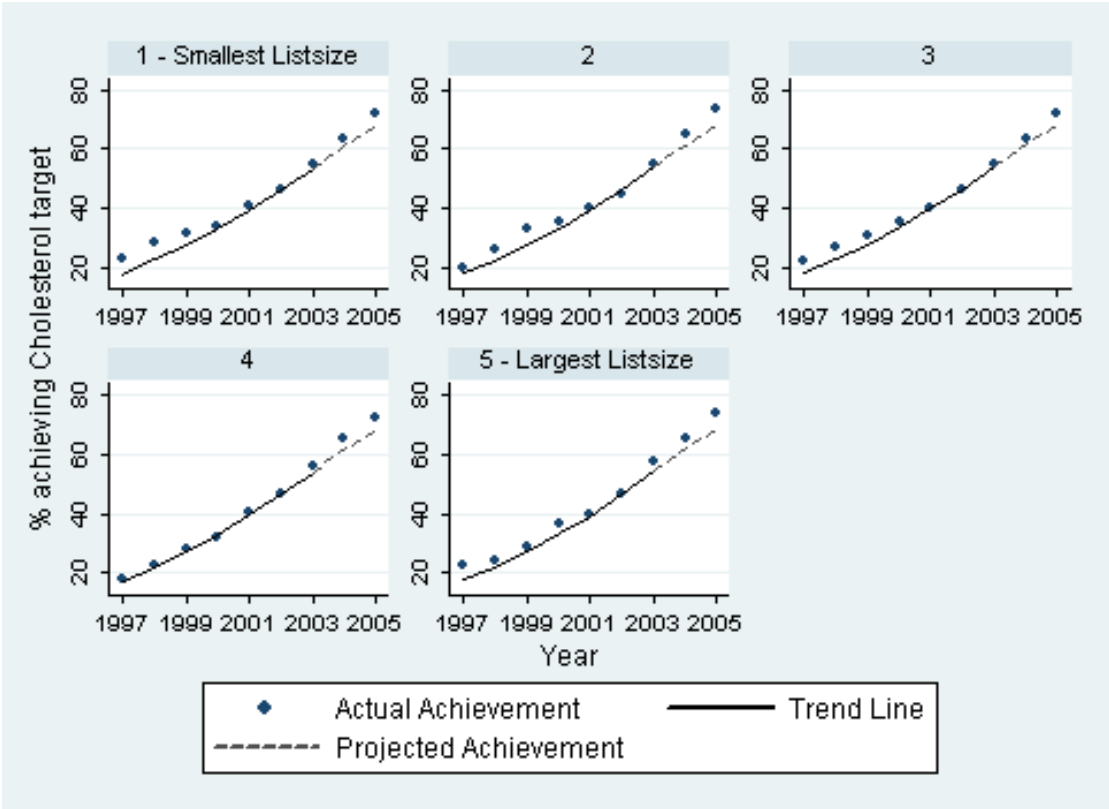
Figure 3: Predicted and actual achievement of Blood pressure (<140/80 mmHg) targets by practice size.



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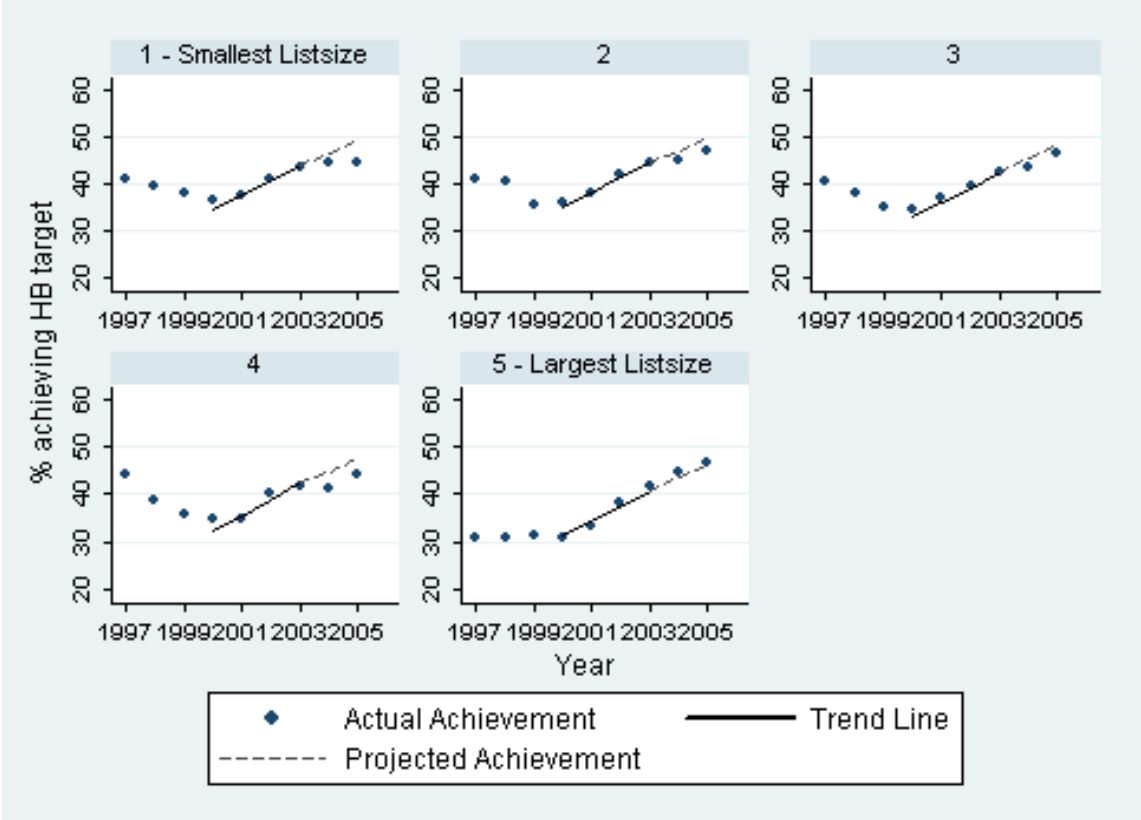
Figure 4: Predicted and actual achievement of cholesterol (< 5 mmol/L) target by practice size



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Figure 5: Predicted and actual achievement of HbA1c (< 7.0%) target by practice size



3.4 Impact of QOF on inequalities in diabetes management in patients with and without comorbid medical conditions

3.4.1 Analysis plan

Analysis of the same data with the same variables and categories was used to assess for possible inequalities between those with and without diabetic comorbidities. As well as the variables listed above, these analyses also used practice size, practice diabetes caseload and number of medications prescribed (0–3 or more antihypertensives for BP target; no diabetes medications, oral hypoglycaemic agent(s), insulin, oral hypoglycaemic agent(s) plus insulin for HbA1c target; any lipid lowering medication for cholesterol target).

3.4.2 Results

We identified 154,945 adult patients with diabetes registered with 422 participating practices during the study period. The number of people with diabetes registered with participating practices increased from 49,970 in 1997 to 105,065 in 2005. In 2005, 17.3% of patients had no co-morbidities with 32.4%, 21.9%, 14.8%, 8.4% and 5.2% having one, two, three, four and five or more co-morbidities, respectively. Patients with co-morbid conditions were older than those without any co-morbid conditions, and women were more likely to have three or more co-morbid conditions than men (Table 6).

Process of care and prescribing

Measurement of blood pressure, blood glucose and cholesterol increased during the study period but varied significantly ($p < 0.001$) with number of co-morbidities present in 1997 and 2005 (Table 6). Patients with one co-morbidity were most likely to have all three risk factors measured in both years. Prescribing of medications for secondary prevention increased during the study period. Antihypertensive and lipid lowering medications were significantly ($p < 0.001$) more likely to be prescribed in patients with one or more co-morbidities than in those without any co-morbidities in both 1997 and 2005.

Achievement of treatment targets – Blood pressure

The introduction of pay for performance was associated with improved achievement of an established treatment target for blood pressure in 2004 and 2005 which was significantly greater ($p < 0.001$) than that predicted by the underlying trend based on 1997 to 2003 data (Table 7, Figure 6). The magnitude of improvement was similar in patients with and without co-morbidities in both years.

For the analysis using the 2003–2005 data, blood pressure target attainment and co-morbidity showed a J-shaped relation, with patients with 1–3 comorbidities having significantly lower attainment (OR compared with no co-morbidity = 0.72, CI 0.69–0.74 for one, 0.87, CI 0.84–0.91 for two, 0.92, CI

0.89–0.96 for three co-morbidities) and five or more co-morbidities having the highest attainment (OR compared with no co-morbidity = 1.36, CI 1.28–1.44). There was no significant change in these relations over the three years (p value for interaction with year = 0.126).

HbA1c

The introduction of pay for performance was associated with improved achievement of an established treatment target for HbA1c in 2004 and 2005, but overall these improvements were significantly lower ($p < 0.001$) than that predicted by the underlying trend based on 2000–2003 data (Table 7, Figure 7). The shortfall was greatest in patients with no co-morbidities (3.8% less than predicted in 2005) but the difference was not statistically significant in patients with 4 and 5 or more co-morbidities in 2004 and 2005 (except for the 5 or more co-morbidity group in 2005, for whom the achievement was 2.5% less than predicted, $p=0.015$). For the analysis using the 2003–2005 data, attainment of the HbA1c target increased steadily with increasing co-morbidity up to 5 or more co-morbidities. There was a significant interaction between year and co-morbidity ($p = 0.0053$), with performance at each co-morbidity level rising in both 2004 and 2005 compared with the previous year. Compared with the no co-morbidity group in 2003, the biggest improvement was seen in 2005 in people with 5 or more co-morbidities (OR 3.71, 95% CI 3.39–4.07).

Total cholesterol

The introduction of pay for performance was associated with improved achievement of an established treatment target for total cholesterol in 2004 and 2005 (Table 7, Figure 8). These improvements were significantly greater than that predicted by the underlying trend based on 1997 to 2003 data in patients with co-morbidities. The improvement in cholesterol control did not exceed achievement predicted by the underlying trend in patients without any co-morbidity in 2004 ($p=0.42$) but did so by 1.4% in 2005 ($p=0.029$). For the analysis using the 2003–2005 data, in each year, cholesterol target attainment increased steadily with increasing co-morbidity. There was a significant interaction between year and co-morbidity ($p = 0.0001$), although the gap between 0 and 5 or more co-morbidities did not change across the three years: in 2003, the odds ratio for 5 or more co-morbidities compared with none was 1.87 (95% CI 1.69–2.08); in 2004, this was 1.96 (CI 1.78–2.16) and in 2005 it was 1.84 (CI 1.66–2.03).

Table 6: Characteristics of the sample by number of comorbidities

	1997 (n=49,970)							2005 (n=105,065)						
	0	1	2	3	4	5+		0	1	2	3	4	5+	
Patient characteristics														
% Men	53.5	48.2	49.2	44.1	41.8	39.9		60.9	53.5	51.2	48.0	43.9	41.3	
Mean age	64.7	69.4	70.9	72.1	73.7	75.9		60.7	66.5	69.0	70.2	71.8	75.4	
Mean BMI (kg/m ²)	28.5	28.7	28.3	28.7	28.5	27.9		27.4	29.5	29.4	29.6	29.9	29.3	
Mean neighbourhood SES*	23.6	24.7	25.6	25.7	26.0	26.2		24.5	23.3	24.0	24.6	25.2	26.0	
Process of care							P value							
Blood pressure measured	58.9	69.9	68.3	68.4	67.7	65.6	<0.001	80.8	92.3	91.9	92.3	93.1	92.2	<0.001
Blood glucose measured	32.8	36.1	33.8	32.3	31.9	29.6	<0.001	71.6	78.4	76.2	75.1	74.9	70.9	<0.001
Cholesterol measured	18.0	21.3	20.1	19.0	18.2	16.3	<0.001	70.7	80.8	80.5	80.9	81.0	80.7	<0.001
All 3 measured	13.7	16.1	14.9	13.5	13.1	11.6	<0.001	64.0	72.9	70.7	70.3	69.5	65.6	<0.001
Medications prescribed (%)														
OHAs	32.2	38.3	37.4	37.5	37.9	39.0	<0.001	48.7	53.0	51.7	52.0	52.1	49.2	<0.001
Lipid Lowering	2.9	7.1	8.7	8.3	9.3	10.5	<0.001	44.3	61.3	66.6	65.3	68.8	70.2	<0.001
AHT	16.3	64.6	62.2	73.9	83.6	90.9	<0.001	27.2	80.7	82.3	84.5	92.3	85.2	<0.001

Table 7: Performance (as % achieving the target) for 2004 and 2005 compared with predicted by number of co-morbidities

Year	Blood pressure < 140/80mm Hg	0	1	2	3	4	5+	All patients
2004	Actual mean % achievement	40.3	27.3	32.0	32.7	33.6	40.8	32.5
	Predicted mean % achievement	38.4	26.2	30.0	31.0	33.2	39.1	31.0
	Difference (actual – predicted)	1.9	1.1	1.9	1.7	0.4	1.7	1.5
	95% CI for difference	0.8 to 3.1	0.3 to 1.8	1.0 to 2.9	0.6 to 2.8	-1.1 to 2.0	-0.3 to 3.7	1.0 to 1.9
	P value	<0.01	<0.01	<0.001	<0.01	0.29	P<0.05	<0.001
2005	Actual mean % achievement	43.4	31.3	35.7	37.1	38.5	45.4	36.4
	Predicted mean % achievement	41.5	29.0	32.9	34.0	36.3	42.3	33.9
	Difference (actual – predicted)	1.9	2.3	2.8	3.1	2.2	3.1	2.5
	95% CI for difference	0.8 to 3.1	1.6 to 3.1	1.9 to 3.7	2.0 to 4.2	0.7 to 3.7	1.1 to 5.1	2.1 to 3.0
	P value	<0.01	<0.001	<0.001	<0.001	<0.01	<0.01	<0.001
	HbA1c ≤7.0%	0	1	2	3	4	5+	All patients
2004	Actual mean % achievement	36.5	44.9	45.5	45.6	45.3	46	43.8
	Predicted mean % achievement	39.4	46.3	46.7	47.3	46.3	46.5	45.4
	Difference (actual – predicted)	-2.9	-1.4	-1.2	-1.8	-0.9	-0.5	-1.6
	95% CI for difference	-4.1 to -1.7	-2.3 to -0.5	-2.3 to -0.1	-3.1 to -0.4	-2.7 to 0.9	-2.9 to 1.8	-2.1 to -1.1
	P value	<0.001	0.001	0.019	<0.01	0.161	0.33	<0.001
2005	Actual mean % achievement	37.9	46.8	47.7	47	48.2	46.7	45.7
	Predicted mean % achievement	41.7	49	49.5	49.8	48.8	49.2	48
	Difference (actual – predicted)	-3.8	-2.2	-1.8	-2.8	-0.6	-2.5	-2.4

	95% CI for difference	-5 to -2.6	-3 to -1.3	-2.9 to -0.8	-4.1 to -1.5	-2.3 to 1.1	-4.8 to -0.3	-2.9 to -1.9
	P value	<0.001	<0.001	<0.001	<0.001	0.243	0.015	<0.001
	Total cholesterol ≤5 mmol/L	0	1	2	3	4	5+	All patients
2004	Actual mean % achievement	54.6	62.6	67.5	67.6	68.7	72.8	64.5
	Predicted mean % achievement	54.7	59.0	64.2	64.0	65.2	69.5	61.5
	Difference (actual – predicted)	-0.2	3.6	3.3	3.7	3.5	3.3	3
	95% CI for difference	-1.7 to 1.4	2.6 to 4.6	2.2 to 4.4	2.3 to 5.0	1.7 to 5.3	1.1 to 5.5	2.4 to 3.5
	P value	0.42	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001
2005	Actual mean % achievement	63.3	71.7	75.2	75.4	75.9	78.8	72.8
	Predicted mean % achievement	61.9	65.7	70.1	70.1	71.0	74.7	67.9
	Difference (actual – predicted)	1.4	6.0	5.1	5.4	5.0	4.1	4.9
	95% CI for difference	0.0 to 2.8	5.2 to 6.9	4.1 to 6.1	4.1 to 6.6	3.4 to 6.6	2.2 to 6.0	4.4 to 5.4
	P value	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

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Project 08/1716/209

Figure 6: Projected and actual achievement of blood pressure target (<140/80 mmHg) by number of co-morbid conditions

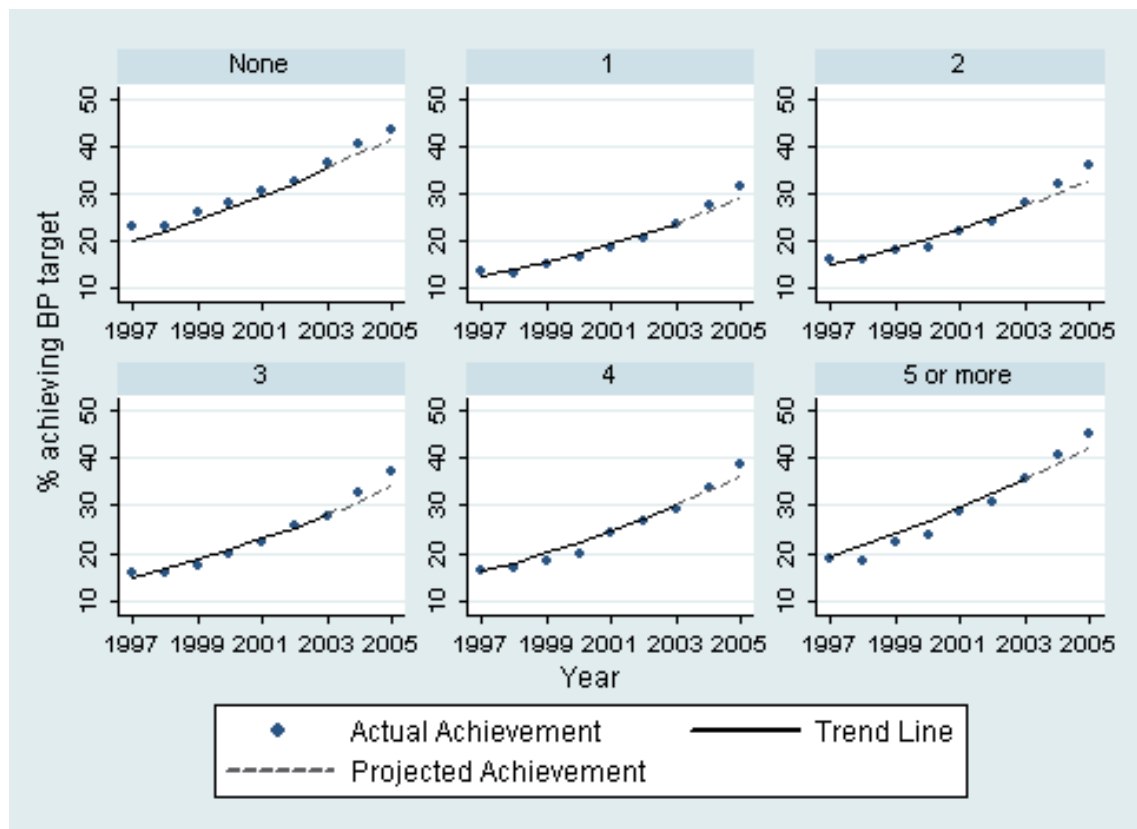


Figure 7: Projected and actual achievement of HbA1c target ($\leq 7.0\%$) by number of co-morbid conditions

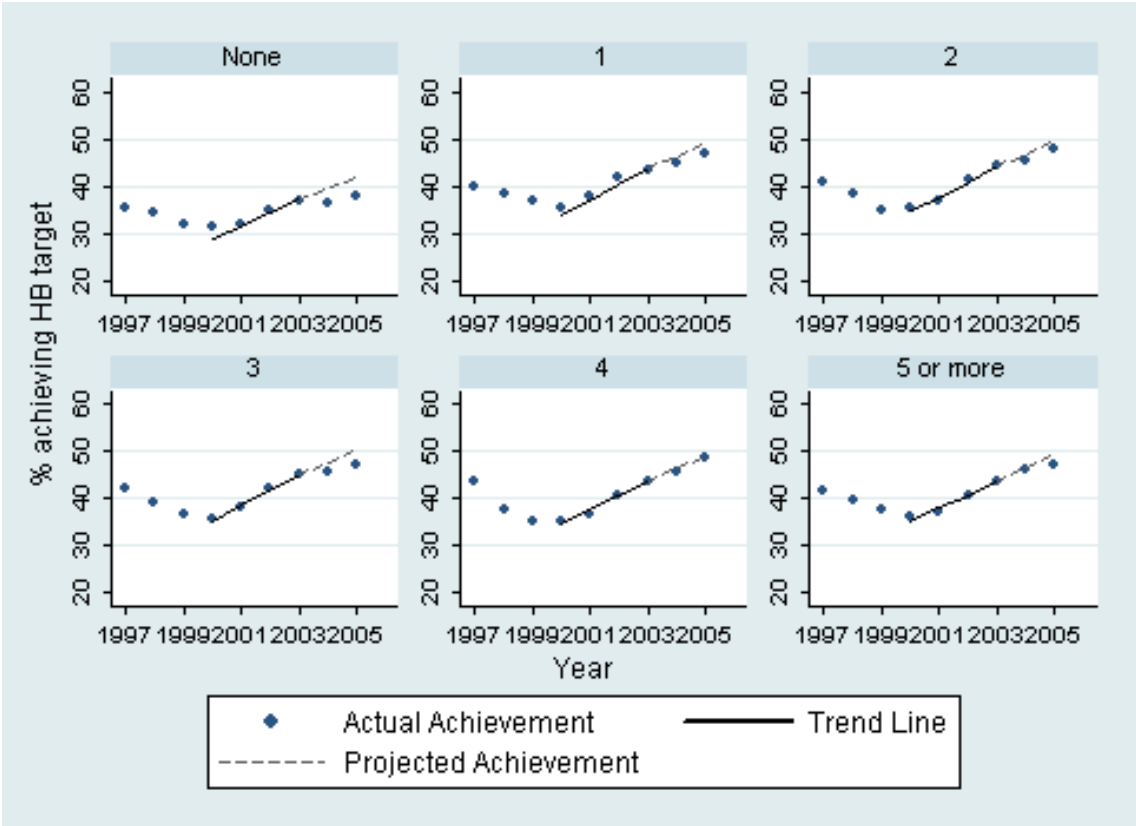
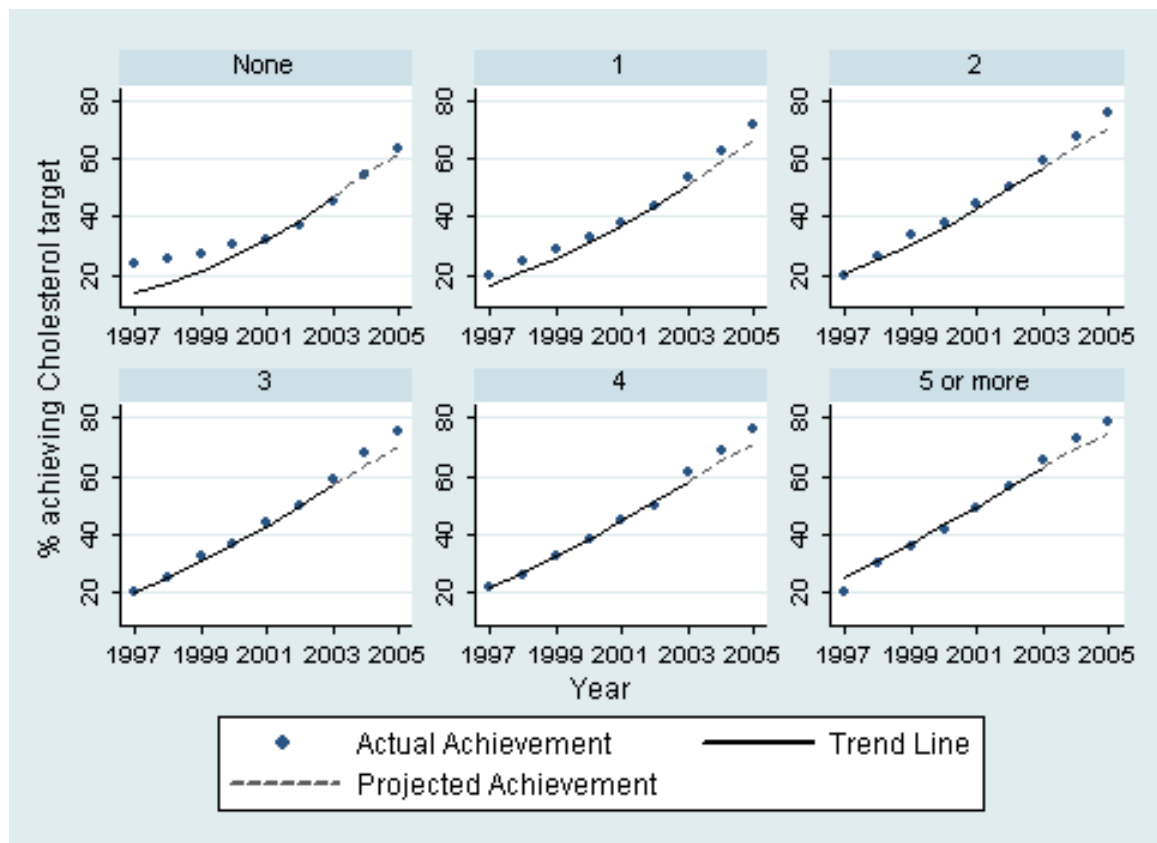


Figure 8: Projected and actual achievement of cholesterol target (≤ 5 mmol/L) by number of co-morbid conditions



3.5 Impact of QOF on inequalities in cardiovascular disease and diabetes management between different ethnic groups (Wandsworth)

3.5.1 Analysis plan

For these analyses, data were used from 2000-2007, due to small numbers in previous years. In 2007, there were a total of 220,743 patients registered with the 29 participating practices.

The primary outcome measures were mean systolic and diastolic blood pressure (all conditions), cholesterol (diabetes, stroke, CHD) and HbA1c (diabetes only) and achievement of QOF treatment targets.

As previous literature indicates that the quality of care for these conditions was improving before the introduction of QOF (15), segmented regression analysis of interrupted time series was adopted in order to take into account of the previous time trend. This method has been widely used in health policy evaluation. (66-68)

Taking into account the multilevel model nature of the data (patients being observed many times in the panel, and patients nested in the practice level), the random effect multilevel model with two random intercepts was adopted. The model Specification is the following:

$$Y_{ijt} = B_{ijt} + B_1 \times Time_{ijt} + B_2 \times policy_{ijt} + B_3 \times years\ after\ the\ policy_{ijt} + B_4 X_{ijt} + V_i + U_j + e_{ijt}$$

where V_i , U_j are random intercept for practice level and patient level and are assumed to be independently distributed from the residual error e_{ijt} . B_1 estimates the change in the outcome measures that occur each year before the implementation of QOF. B_2 estimates the level change in outcome measures after policy. B_3 estimates the change in the trend of outcome measures after QOF. B_4 are the covariates that are used to control for patients' heterogeneity. Such control variables including patients' age, age squared, gender, ethnicity. We assign socioeconomic status to individual patients based on their postcode using the Index of Multiple Deprivation 2004. We also include both the number of co-morbidities of patient and the duration of their illness in 2007.

For the continuous variables, linear regression model was used. For binary variables, the logit model was adopted which can be presented as: $\ln\left(\frac{p}{1-p}\right) = x'B$, therefore the log-odds ratio is linear in the regressors. For this reason, we report logit coefficient after exponentiation, i.e. $\exp(b)$ rather than b , and the coefficient after transportation reported is the change in the odds ratio. In this way, we can calculate the effect of this policy on the prevalence rate.

Logistic regression with patients' ethnicity as dummy variables was used to look at whether QOF reduce health disparity among ethnic groups. We compare the results for each indicator in year 2003 and year 2007. The effect of ethnic groups was calculated with robust standard error and adjusted for age, gender, deprivation, duration of illness, number of co-morbidities and clustering at practice level. By doing this, we can investigate whether QOF has reduced the effect of ethnicity on patients' health.

3.5.2 Results

During the study period, 90 percent of patients had their ethnicity coded. In 2007, the mean age of patients in the CHD cohort is 68.3 years old, 66.9 years for the stroke patients, 65.8 years in the hypertension cohort and 61.1 years in the diabetes cohort. The average number of co-morbidities for patients with the CHD is 1.23, 1.68 for patients with stroke, and 0.95 for the hypertension cohort. The average period since diagnosis for CHD is 11.0 years, 9.8 years for stroke, and 9.9 for hypertension.

Table 8: Characteristics of Diabetes, CHD, Stroke and Hypertension cohorts in 2007

		Diabetes		CHD		Stroke		Hypertension	
		Number	%	Number	%	Number	%	Number	%
Gender	Male	3,749	50.4	1860	63.0	884	50.4	6796	45.2
	Female	3,685	49.6	1092	37.0	869	49.6	8239	54.8
Age group	18-44	1,329	17.9	37	1.3	114	6.5	1152	7.7
	45-54	1,151	15.5	181	6.1	103	5.9	1967	13.1
	55-64	1,645	22.1	550	18.6	289	16.5	3423	22.8
	65-74	1,945	26.2	995	33.7	485	27.7	4255	28.3
	>=75	1,364	18.3	1189	40.3	762	43.5	4240	28.2
Ethnicity	White	3,181	42.8	289	9.8	324	18.5	3894	25.9
	Black	1,811	24.4	629	21.3	209	11.9	2045	13.6
	S Asian	1,653	22.2	2007	68.0	1206	68.8	8961	59.6
	Other	39	0.5	15	0.5	5	0.3	98	0.7
	Missing	750	10.1	6	0.2	6	0.3	39	0.3
Total		7,434		2952		1753		15035	

The hypertension cohort was significantly larger than the other cohorts, with 15,035 patients compared to the next biggest cohort of 7,434 diabetes patients. Among the CHD, stroke and diabetes cohorts there was a clear trend with more patients in the older age categories, while the diabetes cohort was more evenly spread out between the age groups. Black and south Asian patients accounted for the majority of the diabetes cohort, while white patients accounted for 47.5%

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Project 08/1716/209

of this cohort. South Asian patients also made up the majority of the CHD, stroke and hypertension cohorts with 68.0%, 68.8% and 59.6% respectively. Figures 9 - 14 present the descriptive findings for overall measurement and control of blood pressure, cholesterol and HbA1c in the different disease groups.

Figure 9: Percentage achievement of indicators in patients with coronary heart disease

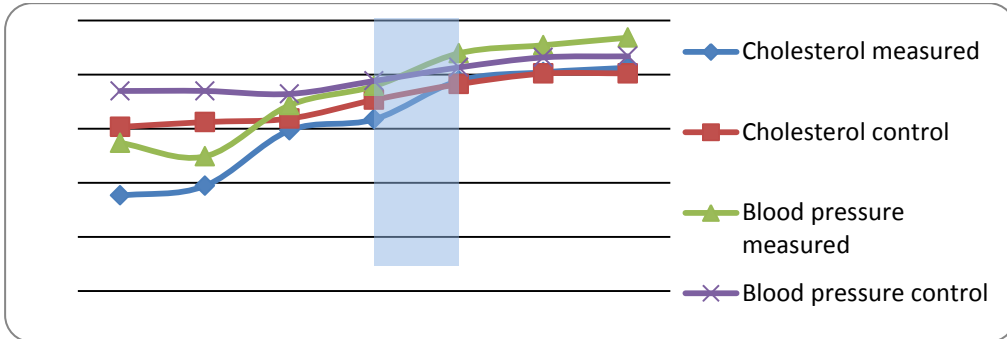


Figure 10: Percentage achievement of indicators in patients with stroke

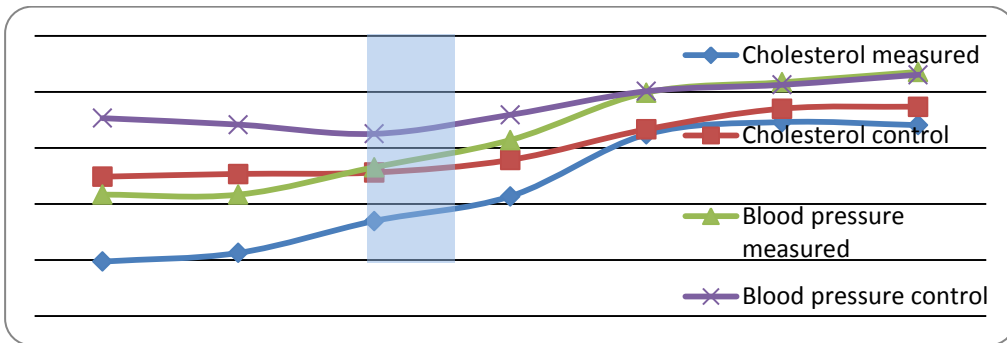


Figure 11: Percentage achievement of indicators in patients with hypertension

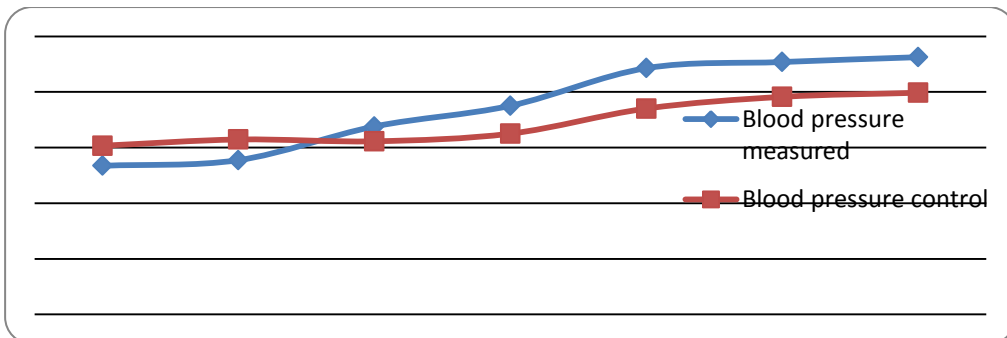


Figure 12: Mean systolic/diastolic blood pressure by years for CHD, Stroke and hypertension cohorts

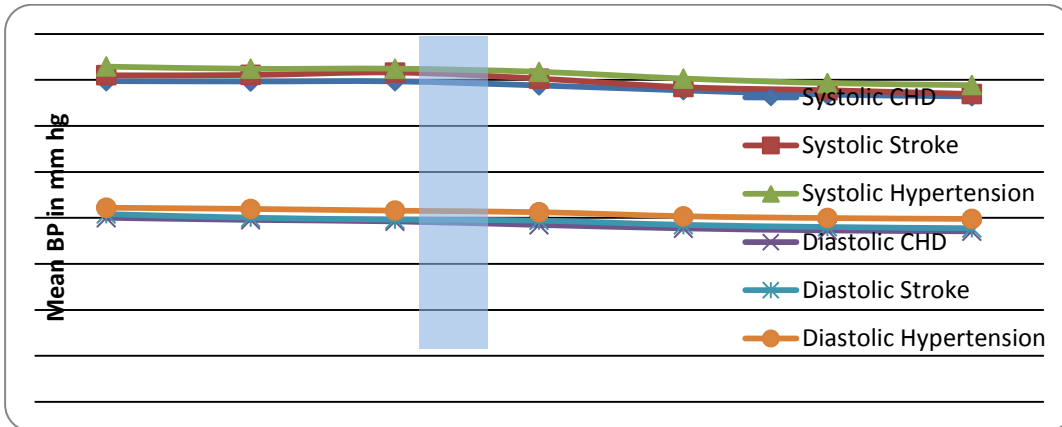


Figure 13: Mean cholesterol value by years for stroke/CHD cohorts

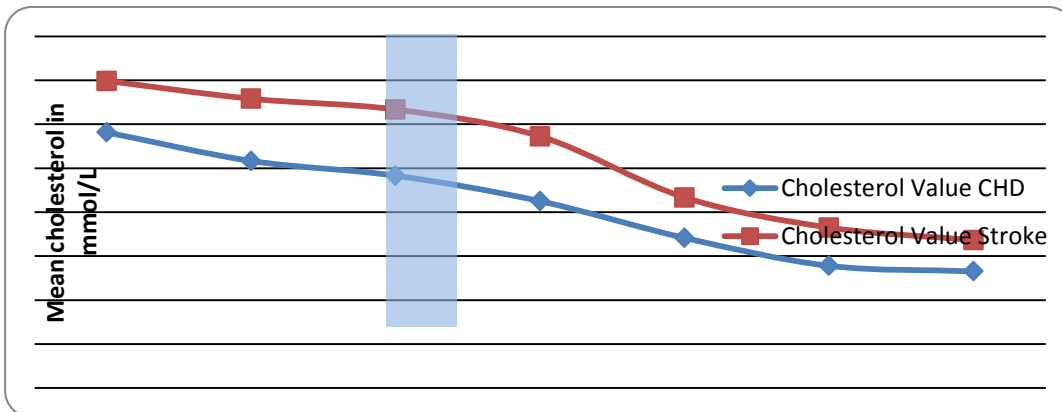
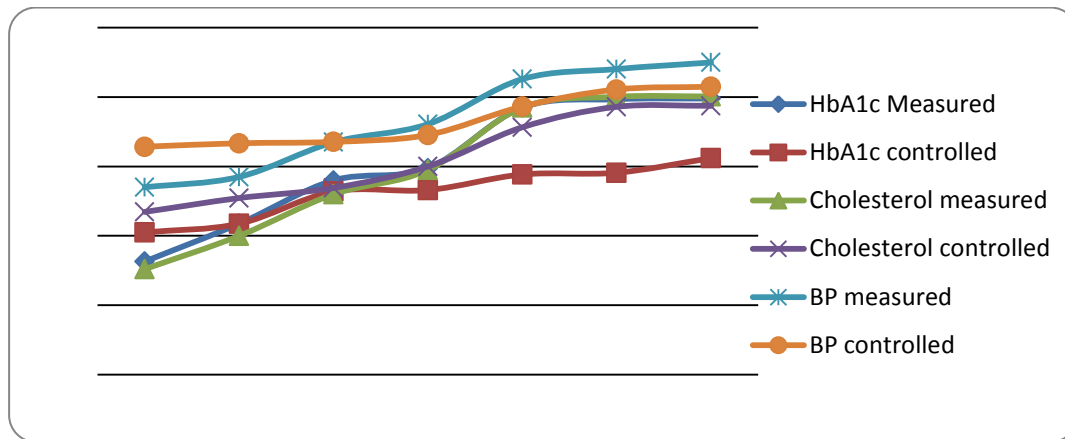


Figure 14: Percentage achievement of process and outcome indicators among diabetes patients



CHD

Table 9: Variation in processes of care and prescribing by ethnic group (CHD group)

		2000	2001	2002	2003	2004	2005	2006	2007
Antihypertensives	White	67.1	71.6	74.7	77.9	82.8	84.8	87.6	89.6
	Black	71.0	78.8	78.8	81.5	88.1	88.5	92.0	90.6
	South Asian	55.7	64.2	67.9	72.0	77.4	82.9	87.2	89.1
Lipid lowering	White	46.1	52.8	63.2	66.8	73.6	77.8	80.7	82.9
	Black	34.8	46.3	50.8	56.6	62.8	69.3	77.1	76.4
	South Asian	43.3	53.1	58.3	65.8	71.8	78.5	84.0	87.1

Chi-squared results –Antihypertensives (2000; $p < 0.05$, 2007; $p=0.77$), Lipid lowering (2000; $p < 0.05$, 2007; $p < 0.05$)

Stroke

Table 10: Variation in processes of care and prescribing by ethnic group (Stroke group)

		2000	2001	2002	2003	2004	2005	2006	2007
Antihypertensives	White	50.5	52.7	56.6	60.4	63.9	67.2	68.6	71.3
	Black	56.3	61.2	62.9	61.6	74.3	76.9	76.6	79.0
	South Asian	50.6	64.3	56.9	53.3	64.9	71.9	77.5	79.0
Lipid lowering	White	18.1	22.2	33.2	38.3	46.3	53.5	59.7	63.6
	Black	16.2	19.4	26.3	24.1	42.6	50.2	55.3	63.8
	South Asian	20.0	37.8	38.8	34.8	55.2	62.0	66.5	72.3

Chi-squared results –Antihypertensives (2000; $p < 0.46$, 2007; $p < 0.05$), Lipid lowering (2000; $p=0.76$, 2007; $p = 0.05$)

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Project 08/1716/209

Hypertension

Table 11: Variation in processes of care and prescribing by ethnic group (Hypertension group)

	2000	2001	2002	2003	2004	2005	2006	2007
Antihypertensives								
White	71.6	73.4	74.7	77.1	81	82.5	84.4	86.2
Black	69.9	73.2	75.9	77.9	81.6	83.3	85.5	86.5
South Asian	64.4	71.3	71.5	74.8	78.9	82.9	85.5	87.6

Chi-squared results –Antihypertensives (2000; $p < 0.05$, 2007; $p=0.85$)

Diabetes

Table 12: Variation in processes of care and prescribing by ethnic group (diabetes group)

	2000	2001	2002	2003	2004	2005	2006	2007
Antihypertensives								
White	44.5	48.1	51.4	56.9	61.6	65.3	67.1	69.3
Black	51.3	55.9	59.2	61.6	66.9	69.4	72.3	73.5
South Asian	36.1	43.8	48.8	51.5	56.7	62.6	67.5	70.3
OHAs (%)								
White	26.8	32.3	35.5	40.0	44.9	49.2	51.6	52.4
Black	37.5	42.9	46.7	49.5	56.0	60.5	64.5	65.9
South Asian	29.3	38.3	41.7	46.8	52.2	59.8	64.0	67.5
Insulin (%)								
White	18.7	18.9	17.9	17.9	18.1	18.8	20.1	22.5
Black	16.1	16.8	16.8	18.2	18.3	18.9	19.7	20.1
South Asian	10.3	11.7	11.9	13.1	14.4	15.5	15.8	16.2
Lipid lowering (%)								
White	18.1	23.6	31.3	40.0	50.9	60.2	66.4	68.8
Black	11.2	14.8	22.3	30.0	42.1	53.8	62.1	66.7
South Asian	16.2	22.1	30.3	37.4	50.9	61.5	68.1	71.3

Chi-square findings: All medications (2000; $p < 0.05$, 2007; $p < 0.05$)

Table 13: Results for blood pressure measured/ blood pressure controlled

		Blood Pressure Measured				Blood Pressure Controlled			
		Whole population	Black	White	South Asian	Whole population	Black	White	South Asian
Stroke	Baseline Trend	1.648***	1.575***	1.684***	1.573***	1.011	0.981	1.022	0.992
	Level Change	1.732***	1.794	1.816***	1.321	1.475**	2.129**	1.344	1.276
	Trend Change	0.954	1.207	0.859*	1.328	1.251***	1.134	1.302***	1.190
<i>CHD</i>	Baseline Trend	1.799***	1.825***	1.907***	1.519***	1.080**	1.027	1.119***	0.969
	Level Change	1.234	3.260**	1.001	1.826**	1.322**	1.327	1.384**	1.197
	Trend Change	0.894*	0.582**	0.814***	1.301*	1.116*	1.257	1.022	1.403**
Diabetes	Baseline Trend	1.720***	1.664***	1.844***	1.584***	1.044*	1.013	1.133***	0.921
	Level Change	1.707***	2.160***	1.207	2.624***	1.392***	1.251	1.358**	1.665***
	Trend Change	0.871***	0.815**	0.857**	0.908	1.170***	1.322***	1.023	1.291***
Hypertension	Baseline Trend	1.713***	1.617***	1.805***	1.542***	1.092***	1.023	1.131***	1.066
	Level Change	1.857***	2.586***	1.375***	3.582***	1.382***	1.490***	1.377***	1.237
	Trend Change	0.795***	0.750***	0.794***	0.869*	1.145***	1.255***	1.088***	1.180**

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*indicates significance at 10% level, ** at the 5% level and *** at the 1% level

*Wald test was used to test the significance of coefficients

	HbA1c Measured				HbA1c Controlled			
	Whole population	White	Black	South Asian	Whole population	White	Black	South Asian
Baseline trend	1.895***	1.775***	1.882***	1.952***	1.404***	1.524***	1.295***	1.325***
Level change after QOF	1.429***	1.478***	1.861***	1.865***	1.035	0.911	1.232	1.034
Trend change after QOF	0.724***	0.657***	0.643***	0.643***	0.767***	0.658***	0.836**	0.927

Table 14: Result for HbA1c measured/ HbA1c controlled for diabetes

*indicates significance at 10% level, ** at the 5% level and *** at the 1% level

Table 15: Result for cholesterol measured/ cholesterol controlled

		Cholesterol Measured				Cholesterol Controlled			
		Whole population	Black	White	South Asian	Whole population	Black	White	South Asian
Stroke	Baseline Trend	1.833***	1.902***	1.823***	1.752***	1.321***	1.368*	1.354***	1.125
	Level Change	1.892***	1.587	1.810***	3.603***	1.529*	1.209	1.606*	1.562
	Trend Change	0.629***	0.654***	0.611***	0.726*	1.059	0.954	1.044	1.304
CHD	Baseline Trend	1.809***	1.522***	1.954***	1.531***	1.322***	1.591***	1.281***	1.423***
	Level Change	1.029	2.694***	0.749**	1.992***	1.171	1.210	1.316	0.633
	Trend Change	0.686***	0.737*	0.614***	0.940	0.931	0.650**	0.949	1.006
Diabetes	Baseline Trend	1.874***	1.770***	1.958***	1.838***	1.413***	1.435***	1.461***	1.332***
	Level Change	1.676***	2.094***	1.150	2.453***	1.449***	1.252	1.686***	1.148
	Trend Change	0.659***	0.685***	0.605***	0.732***	0.957	0.866*	0.925	1.109

*indicates significance at 10% level, ** at the 5% level and *** at the 1% level

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*Wald test was used to test the significance of coefficients

Table 16: Results for systolic blood pressure, cholesterol and HbA1c level

		Systolic				Cholesterol Value				HbA1c value			
		Whole population	Black	White	South Asian	Whole population	Black	White	South Asian	Whole population	Black	White	South Asian
Stroke	Baseline												
	Trend	-0.500	-0.383	-0.408	-1.266	-0.110***	-0.086*	-	0.116***	-0.132*	-	-	-
	Level												
	Change	-1.917*	-3.594	-1.943	1.144	-0.106*	-0.092	-0.118	-0.011	-	-	-	-
CHD	Trend												
	Level												
	Change	-0.790*	-0.142	-1.089**	-0.278	0.010	0.045	0.004	0.012	-	-	-	-
	Change	-0.662***	-1.121*	0.824***	0.2581	-0.102***	0.158***	0.095***	0.111***	-	-	-	-
CHD	Baseline												
	Trend												
	Level												
	Change	-0.805	-1.234	-0.673	-1.385	-0.010	-0.066	-0.044	0.163**	-	-	-	-
CHD	Trend												
	Level												
	Change	-0.534*	0.628	-0.363	1.774***	0.0222	0.144***	0.013	0.009	-	-	-	-

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Project 08/1716/209

Diabetes	Baseline												
	Trend	-0.0315	0.316	-0.509**	0.429	-0.133***	0.115***	0.151***	0.132***	-0.210***	0.214***	0.209***	0.209***
	Level												
	Change	-1.950***	2.325***	2.127***	-1.081	-0.122***	-0.105**	0.135***	-0.0794	0.0421	-0.124	0.0716	0.185**
Hypertension	Trend												
	Level												
	Change	-1.182***	1.951***	1.171***	0.049								
	Trend												
Diabetes	Change	-1.040***	1.686***	-0.215	1.792***	0.0317**	0.0342	0.0459**	0.0170	0.191***	0.218***	0.213***	0.115***
	Baseline												
	Trend	-0.678***	-0.139	0.943***	-0.637**								
	Level												
Hypertension	Change												
	Trend												
	Change	-0.833***	1.402***	0.446***	1.286***								
	Trend												

*indicates significance at 10% level, ** at the 5% level and *** at the 1% level

*Wald test was used to test the significance of coefficients

Table 17: Ethnic Disparities by patients' disease cohorts for each indicator

Stroke Patients														
Patient Ethnicity	Blood Pressure Measured		Blood Pressure Controlled		Cholesterol Measured		Cholesterol Controlled		Systolic Blood Pressure		Diastolic Blood Pressure		Cholesterol Value	
	2003	2007	2003	2007	2003	2007	2003	2007	2003	2007	2003	2007	2003	2007
White	0.66	0.88	0.72	0.87	0.45	0.68	0.51	0.73	140.70	133.53	78.54	75.07	5.07	4.55
Black	0.70	(0.91)	0.67	(0.83)	0.50	(0.72)	(0.63)	0.76	141.73	(135.36)	(81.21)	(77.35)	(4.74)	4.43
South Asian	0.61	0.90	0.79	0.86	0.40	(0.77)	0.69	(0.84)	138.02	133.10	(75.96)	74.87	4.51	(4.16)
All Group	0.66	0.89	0.72	0.86	0.45	0.70	0.55	0.75	140.55	133.86	78.79	75.49	4.95	4.47
CHD Patients														

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Project 08/1716/209

Patient Ethnicity	Blood Pressure Measured		Blood Pressure Controlled		Cholesterol Measured		Cholesterol Controlled		Systolic Blood Pressure		Diastolic Blood Pressure		Cholesterol Value	
	2003	2007	2003	2007	2003	2007	2003	2007	2003	2007	2003	2007	2003	2007
White	0.79	0.94	0.79	0.87	0.67	0.82	0.69	0.79	137.58	132.81	77.10	74.16	4.73	4.38
Black	0.81	0.95	(0.68)	0.84	0.60	0.86	0.72	0.77	140.36	(136.97)	(79.01)	(75.65)	4.69	4.45
South Asian	(0.68)	0.94	0.81	0.88	-0.56	(0.86)	(0.81)	(0.86)	136.09	130.90	(75.08)	(73.35)	(4.31)	(4.14)
All Group	0.77	0.94	0.78	0.87	0.64	0.83	0.71	0.80	137.60	132.83	76.93	74.15	4.65	4.33
Diabetes Patients														
Patient Ethnicity	Blood Pressure Measured		Blood Pressure Controlled		Cholesterol Measured		Cholesterol Controlled		Systolic Blood Pressure		Diastolic Blood Pressure		Cholesterol Value	
	2003	2007	2003	2007	2003	2007	2003	2007	2003	2007	2003	2007	2003	2007
White	0.75	0.91	0.49	0.57	0.64	0.79	0.58	0.77	138.30	132.80	78.60	76.00	4.90	4.40
Black	0.78	0.92	(0.39)	(0.52)	0.64	(0.85)	(0.62)	0.76	(141.30)	(135.10)	(80.40)	(77.50)	(4.80)	(4.40)
South Asian	0.66	0.90	0.54	0.62	0.51	(0.84)	(0.63)	(0.80)	136.60	(131.00)	78.50	75.60	(4.70)	4.20
All Group	0.72	0.90	0.76	0.83	0.590	0.80	0.60	0.78	138.50	132.90	79.10	76.50	4.80	4.40
Hypertension Patients														
Patient Ethnicity	Blood Pressure Measured		Blood Pressure Controlled		Systolic Blood Pressure		Diastolic Blood Pressure							
	2003	2007	2003	2007	2003	2007	2003	2007						
White	0.77	0.93	0.66	0.80	143.72	138.08	81.93	79.14						
Black	0.76	0.92	(0.61)	0.78	(144.28)	138.22	(84.34)	81.07						
South Asian	(0.66)	0.93	0.70	0.82	140.80	(135.12)	81.08	(78.34)						
All Group	0.75	0.93	0.65	0.80	143.51	137.70	82.48	79.53						

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Project 08/1716/209

*figures with bracket indicates significantly different to white group after adjustment for age, gender, deprivation, duration of illness, number of co-morbidities and practice level clustering at 5% level of significance

Trends and variations in prescribing

Findings from our analyses examining trends in prescribing in Wandsworth between 2000 and 2007 are presented in Tables 9-12 above. We tested whether differences in prescribing between ethnic groups were statistically significant using the Chi-squared test in 2000 and 2007. For CHD, black patients were significantly more likely to be prescribed an antihypertensive medication in 2000 but there was no significant difference in AHT prescribing between ethnic groups in 2007. Black patients were significantly less likely to be prescribed a lipid lowering medication in 2000 and this persisted in 2007.

For stroke, there were no significant differences in AHT prescribing between ethnic groups in 2000 but south Asian and black patients were more likely to be prescribed AHTs than whites in 2007. There were no significant differences in lipid lowering prescribing between ethnic groups in 2000 but south Asian patients were more likely to be prescribed lipid lowering drugs than black and white patients in 2007.

For hypertension, south Asians were significantly less likely to be prescribed an AHT medication in 2000 but there were no significant differences between ethnic groups in 2007.

For diabetes, black patients were significantly more likely to be prescribed AHTs than south Asian or white patients in 2000 and in 2007. Black and south Asian patients were significantly more likely to be prescribed OHAs than whites in 2000 and 2007. South Asian patients were significantly less likely to be prescribed insulin in both years. Black patients were significantly less likely to be prescribed a lipid lowering medication in both years.

Interpretation of interrupted time series analyses

The findings of our interrupted time series analyses of Wandsworth data is presented in Tables 13-16 above. The interrupted time series produces three results for each outcome measure; baseline trend, level change and trend change. The baseline trend represents the change in the outcome measures before QOF due to time and factors not included in our models. The level change represents the shift in this trend due to QOF. This can be considered as the point estimate of the effect size of QOF in the year of its implementation. The trend change refers to the change in baseline trend in the post QOF years. It is an indication how the effect of QOF is maintained longitudinally

Findings for blood pressure measurement and target achievement

Table 13 present findings from the interrupted time series analyses for the two binary measures for blood pressure (measurement and achievement of treatment target).

Stroke

The odds ratio for the baseline trend was 1.65 per year ($p < 0.01$) for measuring blood pressure in the whole stroke group, which suggests that the proportion getting their blood pressure measured in this group was increasing every year during the period of this study. There was a significant positive shift in the level change for the whole stroke group (OR per year 1.73, $P > 0.01$ in year 2005). The odds ratio for the trend change after 2004 for the whole stroke group was not significant. This suggests that with time the effect of QOF flattens out. For all three ethnic groups the baseline trend of BP measurement was similar and significantly positive. The level change was similar in white and black patients but only reached statistical significance in the former. The trend change was not significant in black or south Asian patients and suggestive of significant downward trend in white patients. For BP control, there was no significant change in the baseline trend in any ethnic group. There was a significant positive shift in the level change overall (OR: 1.25, $P < 0.01$). The level change was significant in the black patients but not in the south Asian or white patients. The trend change was significant overall. The trend change was significantly positive in white patients only (OR per year: 1.30, $P < 0.01$).

CHD

The odds ratio for the baseline trend was 1.80 per year ($p < 0.01$) for measuring blood pressure in the whole CHD group, which suggests that the proportion getting their blood pressure measured in this group was increasing every year during the period of this study. The level change for the whole CHD group, there was a non-significant positive shift (OR: 1.23, $P > 0.1$). The odds ratio for the trend change after the policy for the whole CHD group was less than one (OR per year: 0.89, $p < 0.1$). This suggests that with time the effect of QOF reduces (declining trend). Thus it would seem that, even before QOF, the level of blood pressure measurement in the whole population was high and increasing so that QOF did not produce any noticeable improvement. For all three groups the baseline trend of BP measurement, as expected, was positive with the SA showing a slightly lower trend than others. The level change for the black patients was very large (OR 3.26, $p < 0.05$) while the SA showed a relatively modest change (OR 1.83, $p < 0.05$). The white group had no change in the level. Both black and white groups showed significant declining trend post QOF while SA had an increasing trend (OR per year 1.3, $p < 0.1$). The picture with BP control was different. For the whole population, there was small positive baseline trend, a significant positive shift with QOF and significant positive post-QOF trend. Different ethnic groups had similar trends but only few of the values reached statistical significance. The white group had baseline trend and level change significant while SA had only the post QOF trend significant. None of the values were significant for black patients.

Diabetes

The odds ratio for the baseline trend was 1.72 per year ($p < 0.01$) for measuring blood pressure in the whole diabetes group, which suggests that the proportion

getting their blood pressure measured in this group was increasing every year during the pre-QOF period of this study. There was a significant positive shift in the level change for the whole diabetes group (OR: 1.71, $P > 0.01$). The odds ratio for the trend change for the whole hypertension group was less than one (OR: 0.87, $p < 0.01$). This suggests that with time the effect of QOF reduces (declining trend). For all ethnic three groups the baseline trend of BP measurement was similar and significantly positive. The level change was statistically significant in black and south patients but not white patients. The trend change was significant and suggestive of significant downward trend in black and white patients but not south Asian patients. For BP control, there was a significant change in the baseline trend overall (OR per trend: 1.04, $P < 0.1$) and in the white group only. There was a significant positive shift in the level change in the white and south Asian patients but not in the black patients. The trend change was significant in the black and south Asian patients but not in the white patients.

Hypertension

The odds ratio for the baseline trend was 1.71 per year ($p < 0.01$) for measuring blood pressure in the whole hypertension group, which suggests that the proportion getting their blood pressure measured in this group was increasing every year during the pre-QOF period of this study. There was a significant positive shift in the level change for the whole hypertension group (OR: 1.86, $P > 0.01$). The odds ratio for the trend change for the whole hypertension group was less than one (OR per year: 0.80, $p < 0.01$). This suggests that with time the effect of QOF reduces (declining trend). For all ethnic three groups the baseline trend of BP measurement was similar and significantly positive. The level change in 2005 was statistically significant in all three ethnic groups, but the magnitude was lower in white patients than black or south Asian patients. The trend change was significant and suggestive of significant downward trend in all three groups. For BP control, there was a significant change in the baseline trend overall (OR per year: 1.09, $P < 0.01$) and in the white group only. There was a significant positive shift in the level change in the black and white patients but not in the south Asian patients. The trend change was significant in all ethnic groups.

Findings for HbA1c measurement and target achievement

Table 14 presents findings from the interrupted time series analyses for the two binary measures for HbA1c (measurement and achievement of treatment target). The odds ratio for the baseline trend was 1.90 per year ($p < 0.01$) for measuring HbA1c in the whole diabetes group, which suggests that the proportion getting their blood glucose measured in this group was increasing every year during the period of this study. There was a significant positive shift in the level change for the whole diabetes group (OR: 1.43, $P > 0.01$). The odds ratio for the trend change for the whole diabetes group was less than one (OR: 0.87, $p < 0.01$). This suggests that with time the effect of QOF reduces

(declining trend). Baseline trend, level change and trend change findings for measurement of HbA1c were similar in all ethnic three groups. For HbA1c control, there was a significant positive baseline trend in all ethnic groups, suggesting that HbA1c control was improving prior to QOF. There was no significant shift in the level change in any ethnic group and the trend was less than one in all ethnic groups.

Findings for cholesterol measurement and target achievement

Table 15 presents findings from the interrupted time series analyses for the two binary measures for cholesterol (measurement and achievement of treatment target).

Stroke

The odds ratio for the baseline trend was 1.83 per year ($p < 0.01$) for measuring cholesterol in the whole stroke group, which suggests that the proportion getting their cholesterol measured in this group was increasing in the pre-QOF period of this study. There was a significant positive shift in the level change for the whole group. The level change was significantly positive in white and south Asian but not black patients. The odds ratio for the trend change for the whole stroke group was less than one (OR: 0.63, $p < 0.01$). This suggests that with time the effect of QOF reduces (declining trend). For cholesterol control, there was a significant positive baseline trend overall (OR: 1.32, $P < 0.01$). The baseline trend was significantly positive in black and white but not south Asian patients. The overall level change was significantly positive (OR: 1.53, $P < 0.1$) but this was only significant in the white group. The trend change was not significant overall or in any ethnic group.

CHD

The odds ratio for the baseline trend was 1.81 per year ($p < 0.01$) for measuring cholesterol in the whole CHD group, which suggests that the proportion getting their cholesterol measured in this group was increasing in the pre-QOF period of this study. There was a no significant positive shift in the level change for the whole group. The level change was significantly negative among white patients but significantly positive in black and south Asian patients. The odds ratio for the trend change for the whole CHD group was less than one (OR: 0.87, $p < 0.01$). This suggests that with time the effect of QOF reduces (declining trend). For cholesterol control, there was a significant positive baseline trend overall and in all ethnic groups suggesting that cholesterol control was improving prior to QOF. There was no significant shift in the level change or the trend change, with the exception of a significant reduction in the trend change black group.

Diabetes

The odds ratio for the baseline trend was 1.87 per year ($p < 0.01$) for measuring cholesterol in the whole diabetes group, which suggests that the proportion getting their cholesterol measured in this group was increasing in the

pre-QOF period of this study. There was a significant positive shift in the level change for the whole group. The level change was significantly positive in black and south Asian but not white patients. The odds ratio for the trend change for the whole diabetes group was less than one (OR: 0.63, $p < 0.01$). This suggests that with time the effect of QOF reduces (declining trend). For cholesterol control, there was a significant positive baseline trend overall (OR per year: 1.32, $P < 0.01$). The baseline trend was significantly positive overall and in each ethnic group. The overall level change was significantly positive (OR: 1.45, $P < 0.01$) but this was only significant in the white group. The trend change was not significant overall but reduced significantly in black patients.

Findings for continuous measures (mean values)

The findings for the interrupted time series analyses for continuous outcome measures are presented in Table 16.

Stroke patient systolic blood pressure

The baseline trend suggests that systolic blood pressure was not decreasing in any group prior to the introduction of QOF. The level change suggested a significant overall reduction in systolic blood pressure (1.9 mm Hg) associated with the introduction of QOF but the findings in each ethnic group did not reach statistical significance. The trend change for systolic blood pressure suggested a significant overall decrease during the post-QOF period (0.8 mm Hg per year). The trend change for systolic blood pressure suggested a significant reduction among white patients (1.1 mm Hg per year) but no change in black or south Asian patients.

CHD patient systolic blood pressure

The baseline trend suggests that systolic blood pressure was decreasing significantly in black (1.1 mm Hg per year) and white patients (0.8 mm Hg per year), but not in south Asian patients with CHD prior to the introduction of QOF. There was no significant level change in systolic blood pressure suggesting that the introduction of QOF did not have an immediate beneficial impact on mean blood pressure control. The trend change for systolic blood pressure suggested a significant reduction during the post-QOF period which exceeded the pre-QOF period among south Asian (1.8 mm Hg per year) but not white or black patients. There was no significant change in white or black patients.

Diabetes patient systolic blood pressure

The baseline trend suggests that systolic blood pressure was decreasing significantly in white (0.5 mm Hg per year), but not in black or south Asian patients, prior to the introduction of QOF. The level change suggested a significant reduction in systolic blood pressure in white (2.1 mm Hg) and black patients (2.3 mm Hg), but not south Asian patients, associated with the introduction of QOF. The trend change suggested that there were significant reductions in systolic blood pressure in black (1.7 mm Hg per year) and south

Asian patients (1.8 mm Hg per year), but not white patients, in the post-QOF period when compared to the pre-QOF period.

Hypertension patient systolic blood pressure

The baseline trend suggests that systolic blood pressure was decreasing significantly in white (0.9 mm Hg per year) and south Asian (0.6 mm Hg per year) patients, but not black patients, prior to the introduction of QOF. The level change suggested a significant reduction in systolic blood pressure in white and black patients, but not south Asian patients, associated with the introduction of QOF. The trend change suggested that there were significant reductions in systolic blood pressure in all three ethnic groups in the post-QOF period when compared to the pre-QOF period.

Stroke patient total cholesterol

The baseline trend suggests that total cholesterol was decreasing significantly in all ethnic groups prior to the introduction of QOF (0.1 mmol/L per year). The level change suggested a significant overall decrease in mean total cholesterol associated with the introduction of QOF. However, the reductions seen were not statistically significant in any ethnic group. The trend change for total cholesterol was not statistically significant overall or in any ethnic group.

CHD patient total cholesterol

The baseline trend suggests that total cholesterol was decreasing significantly in all ethnic groups prior to the introduction of QOF (0.1 mmol/L per year). The level change suggested a significant increase in total cholesterol in south Asian patients (0.2 mm Hg) but no change among white or black patients associated with the introduction of QOF. The trend change for total cholesterol suggested a significant decrease among black patients (0.1 mmol/L per year) but no change in south Asian or white patients during the post-QOF period.

Diabetes patient total cholesterol

The baseline trend suggests that total cholesterol was decreasing significantly in all ethnic groups prior to the introduction of QOF (0.1 mmol/L per year). The level change suggested a significant overall decrease in mean total cholesterol associated with the introduction of QOF in white (0.1 mmol/L) and black patients (0.1 mmol/L) but not south Asian patients. The trend change suggested a significant increase in total cholesterol during the post-QOF period compared to pre-QOF period in white but not black or south Asian patients.

Diabetes patient HbA1c

The baseline trend suggests that HbA1c was decreasing significantly in all ethnic groups prior to the introduction of QOF (0.2% per year). The level change suggested that the introduction of was associated with a significant increase in HbA1c in south Asian patients but no change in black or white patients. The trend change suggested a significant increase in total HbA1c

during the post-QOF period compared to pre-QOF period in all three ethnic groups.

Inequalities in risk factor control in Wandsworth (2007)

Table 17 presents the results of linear and logistic regression analyses which examined whether there were significant differences in risk factor control between ethnic groups at the end of our study period after adjustment for differences in age, sex, deprivation, number of comorbid medical conditions and duration of illness.

Stroke inequalities in risk factor control

In 2007, black patients were significantly more likely to have their blood pressure and cholesterol measured than white patients. South Asian patients were more likely to have their cholesterol measured than white patients.

Black patients had significantly higher systolic and diastolic blood pressure and were less likely to meet the QOF target than white patients. South Asian patients had significantly lower mean cholesterol levels and were more likely to achieve the QOF target than white patients.

CHD inequalities in risk factor control

In 2007, south Asian patients were more likely to have their cholesterol measured than white patients.

Black patients had significantly higher systolic and diastolic blood pressure than white patients but were as likely to achieve the QOF treatment target. South Asian patients had significantly lower mean cholesterol levels and were more likely to achieve the QOF target for cholesterol than white patients. South Asian patients had significantly lower diastolic blood pressure than white patients.

Hypertension inequalities in risk factor control

In 2007, there were no significant differences in blood pressure measurement between ethnic groups.

South Asian patients had significantly lower systolic and diastolic blood pressure than white patients. There were no significant differences in blood pressure control between white and black patients.

3.6 Impact of QOF on inequalities in diabetes management between different ethnic groups (Brent)

3.6.1 Analysis plan

We conducted a population based repeated cross sectional study of quality of diabetes care in 26 practices in Brent. Outcomes measures were the proportion of patients having their blood pressure (BP), cholesterol and HbA1c measured, proportions achieving targets for these, and prescribing of antihypertensives,

lipid lowering, oral hypoglycaemic and insulin medication. For the purposes of analysis, patients were grouped into four ethnic categories: white, black, south Asian and Other/Unknown. The majority of the Other/Unknown category consisted of patients with conflicting ethnicity codes in their notes, white and Black Caribbean patients, and Chinese census categories.

In Brent, 4986 patients aged over 18 years were identified with diabetes, although 677 had to be excluded because they lacked ethnicity coding. Of the remaining 4309 patients, 2393 (55.5%) were men, 1871 (43.4%) were women and sex was not coded in 45 (1.0%). Data on age were missing for 1.1% of the patients. Of the 4309 patients, 13.7% were white British, 16.1% black, 51.2% South Asian and 18.3% belonged to Other/Unknown ethnic groups.

We calculated percentage achievement and age-sex adjusted odds ratios (AORs) with 95% confidence intervals (CIs) for each quality indicator in each ethnic category using the Mantel-Haenszel technique. Statistical analysis was performed using Stata 10.0 (Stata Corporation, TX, USA).

3.6.2 Results

Brent

We identified 4986 patients ≥ 18 years with diabetes in the 26 participating practices. [69] A total of 677 (15.7%) patients were subsequently excluded because they lacked ethnicity coding. Of the 4309 remaining patients, 2393 (55.5%) were men, 1871 (43.4%) were women and sex was not coded in 45 (1.0%). Data on age were missing for 1.1% of the patients. Of the 4309 patients, 13.7% were white British, 16.1% black, 51.2% South Asian and 18.3% belonged to Other/Unknown ethnic groups (Table 18).

Table 18: Characteristics of the study participants in Brent 2006

<i>Total number of patients with diabetes ≥ 18 years (n=4039)</i>				
<i>All</i>	<i>White</i>	<i>Black</i>	<i>South Asian</i>	<i>Other/Unknown</i>
<i>n (%)</i>	<i>n (%)</i>	<i>n (%)</i>	<i>n (%)</i>	<i>n (%)</i>
4309 (100)	590 (13.7)	694 (16.1)	2236 (51.2)	789 (18.3)
<i>Sex</i>				

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Male	2393 (55.5)	346 (58.6)	340 (49.0)	1267 (56.7)	440 (55.8)
Female	1871 (43.4)	240 (40.7)	353 (50.9)	934 (41.8)	344 (43.6)
Missing ^a	45 (1.0)	4 (0.7)	1 (0.1)	35 (1.6)	5 (0.6)
Age group (years)					
18–44	849 (19.7)	80 (13.6)	107 (15.4)	516 (23.1)	146 (18.5)
45–54	994 (23.1)	91 (15.4)	110 (15.9)	636 (28.4)	157 (19.9)
55–64	1194 (27.7)	160 (27.1)	235 (33.9)	592 (26.5)	207 (26.2)
65–74	924 (21.4)	165 (28.0)	202 (29.1)	371 (16.6)	186 (23.6)
≥ 75	302 (7.0)	90 (15.3)	39 (5.6)	86 (3.9)	87 (11.0)
Missing ^b	46 (1.1)	4 (0.7)	1 (0.1)	35 (1.6)	6 (0.8)
Mean age (95% CI)	61.3 (60.8– 61.7)	63.3 (62.5– 64.1)	56.7 (55.2– 58.1)	59.4 (58.8– 59.9)	66.3 (65.2– 67.4)

n, number of patients

^a 1.0% of patients had missing ethnicity codes for gender

^b 1.1% of patients had missing ethnicity codes for age

Process of care measures

The absolute proportion of all patients with diabetes with annual BP, cholesterol and HbA1c measurements increased between 1997 and 2006 [50.6–87.0% ($P < 0.0001$), 17.0–76.7% ($P < 0.0001$) and 32.9–74.1% ($P < 0.0001$), respectively. There was no evidence of difference in the recording of these processes of care between the white, black, South Asian and Other/Unknown groups during 1997. By 2006, the Other/Unknown group showed fewer recordings of all three processes of care compared with the white group (age-sex AOR, 0.59; CI, 0.47–0.75). This difference was not evident in the black and South Asian groups.

Intermediate clinical outcomes

The proportion of patients with diabetes meeting national treatment targets for BP, cholesterol and HbA1c control increased from 1997 to 2006. Although the

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Project 08/1716/209

percentage of black patients achieving target BP doubled over the 10-year period, they remained less likely to achieve this target in 2006 compared with the white group in 2006 (AOR, 0.65; CI, 0.51–0.83). They were also less likely to achieve all three targets than white patients (AOR, 0.66; CI, 0.44–0.99). There was an almost 2-fold increase in the proportion of South Asian patients achieving the cholesterol target over the 10-year period. By 2006, the South Asian group was more likely to achieve this target than the white group (AOR, 1.57; CI, 1.23–2.0).

Table 19: BP, cholesterol and glycaemic control monitoring among ethnic groups in 1997 and 2006

Year	Measurement	Ethnic group								
		White		Black		South Asian		Other		All
		n (%)	n (%)	AOR (95% CI) ^a	n (%)	AOR (95% CI) ^a	n (%)	AOR (95% CI) ^a	n (%)	
1997	Blood pressure	71 (59.2)	89 (57.4)	0.81 (0.46– 1.43)	257 (50.7)	0.71 (0.46– 1.09)	60 (37.3)	0.40 (0.24– 0.69)	477 (50.6)	
	Cholesterol	16 (13.3)	18 (11.6)	0.79 (0.35– 1.78)	102 (20.1)	1.66 (0.92– 2.98)	24 (14.9)	1.23 (0.61– 2.49)	160 (17.0)	
	HbA _{1c}	39 (32.5)	52 (33.6)	0.96 (0.55– 1.69)	173 (34.1)	1.08 (0.69– 1.69)	46 (28.6)	0.85 (0.50– 1.44)	310 (32.9)	
	All three targets	13 (10.8)	15 (9.7)	0.85 (0.45– 2.07)	76 (15.0)	1.55 (0.81– 2.97)	19 (11.8)	1.23 (0.57– 2.66)	123 (13.0)	
2006	Blood pressure	527 (89.3)	617 (89.0)	0.92 (0.64– 1.31)	1991 (89.0)	1.25 (0.92– 1.70)	613 (77.8)	0.43 (0.32– 0.60)	3748 (87.0***)	
	Cholesterol	484 (82.0)	555 (80.0)	0.84 (0.63– 1.12)	1727 (77.2)	0.81 (0.64– 1.03)	540 (68.5)	0.48 (0.37– 0.63)	3306 (76.7***)	
	HbA _{1c}	456 (77.3)	539 (77.7)	0.95 (0.73– 1.25)	1687 (75.5)	0.96 (0.77– 1.21)	508 (64.5)	0.54 (0.42– 0.69)	3190 (74.1***)	
	All three targets	424 (71.9)	510 (73.5)	1.05 (0.81– 1.35)	1564 (70.0)	0.99 (0.80– 1.22)	471 (59.8)	0.59 (0.47– 0.75)	2969 (68.9)	

AOR, adjusted odds ratio; CI, confidence interval; *n*, number of patients.

^aAge and gender adjusted odds ratios, reference group = white.

***P<0.0001 on comparison of measurements in all ethnic groups combined between 1997 and 2006

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Project 08/1716/209

Table 20: BP, cholesterol and glycaemic control target achievement among ethnic groups in 1997 and 2006

Year	Target	Ethnic group							
		White		Black	South Asian		Other		All
		<i>n</i> (%)	<i>n</i> (%)	AOR (95% CI) ^a	<i>n</i> (%)	AOR (95% CI) ^a	<i>n</i> (%)	AOR (95% CI) ^a	<i>n</i> (%)
1997	Blood pressure (<140/80 mmHg)	20 (28.2)	14 (15.7)	0.42 (0.18–0.97)	75 (29.2)	0.96 (0.52–1.78)	16 (26.7)	0.74 (0.31–1.79)	125 (26.2)
	Cholesterol (<5.0 mmol/l)	5 (31.3)	7 (38.9)	0.97 (0.17–5.43)	41 (43.2)	2.00 (0.53–7.63)	12 (52.2)	1.61 (0.35–7.51)	65 (42.8)
	HbA1c (<7.0%)	0	-3.9	^b	-4.1	^b	-2.2	^b	10 (3.23)
	All three targets met	0	0	^b	1.4 (1.4)	^b	0	^b	1 (0.84)
2006	Blood pressure (<140/80 mmHg)	229 (43.5)	211 (34.3)	0.65 (0.51–0.83)	896 (45.0)	1.14 (0.93–1.39)	251 (41.2)	0.94 (0.74–1.20)	1587 (42.4)
	Cholesterol (<5.0 mmol/l)	342 (72.6)	389 (71.9)	1.08 (0.81–1.44)	1340 (79.2)	1.57 (1.23–2.00)	388 (77.6)	1.40 (1.04–1.87)	2459 (76.7)
	HbA1c (<7.0%)	185 (40.6)	210 (39.0)	0.96 (0.74–1.24)	602 (35.7)	0.94 (0.76–1.18)	198 (39.0)	1.03 (0.79–1.34)	1195 (37.5)
	All three targets met	67 (16.0)	55 (11.0)	0.66 (0.44–0.99)	221 (14.3)	1.03 (0.75–1.43)	64 (14.3)	0.94 (0.64–1.37)	407 (14.0)

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Project 08/1716/209

AOR, adjusted odds ratio; CI, confidence interval; *n*, number of patients. ^aAge and gender adjusted odds ratios, reference group = white.

^b Values for 1997 are too small for ORs to be calculated.

Prescribing

There were marked increases in prescribing lipid-lowering, oral hypoglycaemic agents (OHAs), insulin and antihypertensive medications since 1997 across all ethnic groups. The proportion of patients in the black group receiving prescriptions for three or more antihypertensive medications increased by a factor of 2.8. The proportion of lipid-lowering medications issued in this group increased by a factor of 10. However, there was some evidence that the proportion of patients in the black group on lipid-lowering medications remained lower than that of white patients in 2006 (AOR, 0.79; CI, 0.63–1.00). Black patients were more likely to be on OHAs than white patients (AOR, 1.14; CI, 1.07–1.87) in 2006.

In the South Asian group, there was a 31.5% increase in the proportion of patients on three or more antihypertensive agents and a 5-fold increase in the proportion of those on lipid-lowering medication and insulin over the study period. In 2006, South Asian patients were more likely to receive lipid-lowering medication than white patients, more likely to be on OHAs (AOR, 2.27; CI, 1.79–2.86), but less likely to be prescribed insulin (AOR, 0.54; CI, 0.42–0.69).

Between 1997 and 2006, there was nearly a 7-fold increase in the proportion of patients in the Other/Unknown ethnic group receiving lipid-lowering medication and a 2-fold increase in the proportion receiving insulin. However, they were less likely to be prescribed insulin (AOR, 0.56; CI, 0.41–0.76) and lipid-lowering medication (AOR, 0.68; CI, 0.54–0.85) compared with white patients in 2006. In 2006, a very small proportion of each ethnic group (<10%) did not receive OHAs or insulin, unlike in 1997 when the proportions not receiving medication for diabetes were almost 50%.

Table 21: Prescribing of medications by ethnic group in 1997 and 2006

Year	Medication	Ethnic group						
		White n (%)	Black n (%)	AOR (95% CI) ^a	South Asian n (%)	AOR (95% CI) ^a	Other n (%)	AOR (95% CI) ^a
1997	Lipid lowering	18 (15.0)	7 (4.5)	0.26 (0.09–0.74)	56 (11.0)	0.69 (0.39–1.24)	10 (6.2)	0.36 (0.15–0.85)
	OHAs	56 (46.7)	84 (54.2)	1.11 (0.65–1.88)	256 (50.5)	1.28 (0.84–1.96)	74 (46.0)	1.11 (0.66–1.87)
	Insulin	5 (4.2)	8 (5.2)	0.80 (0.25–2.56)	10 (2.0)	0.30 (0.10–0.95)	8 (5.0)	0.93 (0.28–3.11)
	AHTs							
	0	77 (64.2)	87 (56.1)	0.73 (0.42–1.26)	364 (71.8)	1.23 (0.79–1.92)	117 (72.7)	1.27 (0.74–2.18)
	1	3 (2.5)	13 (8.4)	2.96 (0.72–12.11)	18 (3.6)	1.23 (0.37–4.12)	4 (2.5)	0.98 (0.22–4.37)
	2	17 (14.2)	23 (14.8)	0.98 (0.48–2.03)	64 (12.6)	1.02 (0.57–1.83)	20 (12.4)	1.05 (0.53–2.11)
	3 or more	23 (19.2)	32 (20.7)	1.18 (0.61–2.28)	61 (12.0)	0.67 (0.38–1.17)	20 (12.4)	0.65 (0.32–1.30)
2006	Lipid lowering	306 (51.9)	322 (46.4)	0.79 (0.63–1.00)	1234 (55.1)	1.29 (1.07–1.56)	327 (41.5)	0.68 (0.54–0.85)
	OHAs	448 (75.9)	566 (81.6)	1.14 (1.07–1.87)	1961 (87.7)	2.27 (1.79–2.86)	617 (78.3)	1.17 (0.90–1.51)
	Insulin	107 (18.1)	117 (16.9)	0.92 (0.68–1.24)	252 (11.3)	0.54 (0.42–0.69)	94 (11.9)	0.56 (0.41–0.76)
	AHTs							
	0	129 (21.9)	155 (23.3)	0.99 (0.74–1.34)	685 (30.6)	1.17 (0.92–1.48)	220 (27.9)	1.20 (0.92–1.58)
	1	26 (4.4)	30 (4.3)	0.91 (0.53–1.56)	131 (5.9)	1.22 (0.79–1.88)	40 (5.1)	1.05 (0.63–1.75)
	2	114 (19.3)	108 (15.6)	0.76 (0.57–1.02)	447 (20.0)	1.04 (0.82–1.32)	145 (18.4)	0.93 (0.71–1.23)
	3 or more	321 (54.4)	401 (57.8)	1.22 (0.96–1.55)	973 (43.5)	0.84 (0.69–1.02)	383 (48.6)	0.91 (0.72–1.14)

AOR, adjusted odds ratio; CI, confidence interval; n, number of patients.

^aAge and gender adjusted odds ratios, reference group = white.

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Project 08/1716/209

3.7 Association of patient and practice characteristics with exception reporting in Diabetes (Brent)

3.7.1 Analysis plan

Using the data from Brent, three cross sections from 2004/05, 2005/06 and 2006/07 were used to examine patterns of exclusions for three intermediate outcome indicators among patients with diabetes. These analyses were conducted using data extracted from the electronic medical records in 23 general practices in the borough of Brent. Here, we examined exception reporting rates for three intermediate outcomes for diabetes, concerning HbA1c (DM6/20), blood pressure (DM12) and cholesterol (DM17). We focused on intermediate outcome measures, rather than process of care indicators, because these are clinically more important and have higher levels of exception reporting in this pay for performance program. We used the General Medical Services Contract- QOF Business Rule set for diabetes (69), which defines the Read Codes used for exception reporting in the three indicators. Read codes are the clinical classification system used by family practices in the UK. Data on exception report coding was extracted for all patients identified with diabetes. The Read Code was valid if present within the 15 months before the end of each year, i.e. exception codes for 2004-5 were valid if recorded between 1st January 2004 and 31st March 2005. We generated binary variables to indicate exception reporting in each indicator.

Patients were excluded from our study if they were not eligible for inclusion in the QOF according to the Rule set. (69) A patient was excluded if: - 1. registered at the general practice within 9 months of the QOF data collection day (March 31st) 2. diagnosed with diabetes within 9 months of data collection day 3. coded as having had diabetes resolved 4. on the maximum tolerated therapy (for HbA1c and blood pressure control indicators).

In addition to data on exception reporting, we extracted data on each patient's last HbA1c, blood pressure and total cholesterol measurement in each year to assess achievement in each intermediate outcome indicator. The physiological reading had to have been recorded within 15 months of the data collection date to be valid. (69)

Setting and patients

The study was conducted using data extracted from the electronic medical records in 23 general practices in the borough of Brent, north London. Brent is the most ethnically heterogeneous borough in the UK with high levels of material deprivation. Data were extracted on all adult patients (> 17 years)

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Project 08/1716/209

with diagnosed diabetes registered with practices between April 2004 and March 2007. Quality indicators for diabetes in QOF do not apply to children or adolescents. These data were split into three one year periods, April 2004-March 2005, April 2005-March 2006, April 2006-March 2007, for analysis which is consistent with the performance assessment schedule in QOF.

Explanatory variables

We obtained data on patient and practice level explanatory variables. These included the patient's age, sex, ethnicity, duration of illness and the number of chronic co-morbidities. Practice level variables included list size, number of full time equivalent family practitioners and area level deprivation. We constructed a practice deprivation score based on the 2007 indices of multiple deprivation scores of the resident population, a method more robust than one based solely on practice postcode (70). We constructed categorical variables based on all continuous data; hence had no concern over the normality of variables.

Analysis

We tested whether QOF achievement was lower in patients who were exception reported compared to those not using a two sample Z-test for proportions. We calculated the level of exception reporting for each indicator by patient and practice characteristics separately in 2004/05, 2005/06 and 2006/07. We compared the proportions exception reported between each group and the baseline using Z- tests.

We built logistic regression models to describe patterns in exception reporting in each year, for each indicator. We built the models using backward stepwise selection, with the Akaike Information Criterion (AIC) (71) used to gauge the variables included in the models- a reduction in AIC showing superior fit. We included interaction terms between the number of co-morbidities and ethnicity, age and duration of illness, testing these using the Wald Test. The goodness of fit of the models was tested using the Hosmer- Lemeshow Chi² test (using 10 groups), with a p-value of <0.05 showing poor fit. Poor fitting models were examined using standardised Pearson, deviance and Pregibon leverage residuals. (72) We used STATA version 10.1 IC to carry out data analysis.

3.7.2 Results

There were 3294, 3786 and 4202 patients registered with diabetes in the 23 practices during 2004/5, 2005/6 and 2006/7 respectively. A breakdown of the patient characteristics from 2006/7 is shown in Table 22. The mean age of the sample was 61 years with 56% male. The population was largely deprived, with all practices lying within the three most deprived national quintiles; 14% were from white, 16% from black and 51% from south Asian ethnic groups.

Exception reported patients were significantly less likely to achieve treatment targets for HbA1c (2004/05, 2006/07), blood pressure (2005/06, 2006/07) and cholesterol (2005/06) (Table 23).

Levels of exception reporting were highest for the HbA1c control indicator (DM6/ 20) (Table 23). In 2006-7, 14.2% of eligible patients were exception reported (practice median = 5.8% [interquartile range = 1.5-22.7]). Exception reporting for the cholesterol control indicator was 7.7% (practice median= 5.7% [IQR= 2.2- 9.6]) and 4.7% for blood pressure control (practice median = 2.9 [IQR= 1.0- 5.2]). The increase in minimum thresholds for payment in 2006-7 did not increase aggregate levels of exception reporting. There were large levels of practice variation in exception reporting for HbA1c (0 to 65.9% in 2006/07), cholesterol (0 to 38.1%) and blood pressure (0 to 25.8%) in all three years.

Table 24 displays the levels of exception reporting and univariate findings by patient and practice characteristics. There were no differences in the levels of exception reporting by age group in 2004/5 or 2005/6 but older patients (> 60 years) were significantly more likely to be exception reported for the blood pressure and cholesterol indicators in 2006/7. South Asian patients experienced higher exception reporting than white patients in the HbA1c indicator in each of the three years. Black patients were more likely to be exception reported for the HbA1c indicator in both 2004/05 and 2005/06. Larger practices showed increased exception reporting for the HbA1c indicator in the first two years, but not in 2006/7. In 2006/7 we found higher exception reporting in patients with diabetes for ≥ 10 years in all three indicators, this difference was present in two of the indicators in each of the previous two years but with a smaller effect size. Patients with co morbidities were more likely to be exception reported from the blood pressure and cholesterol indicators. We found higher levels of exception reporting in more deprived practices.

All variables were included in the final models of the multi-variate analyses except the number of FTE GPs. None of the three interaction terms tested reached significance and were excluded. All models showed a satisfactory goodness of fit, thus no residual analysis was required. The adjusted odds ratios and confidence intervals for the regression analysis of patients exception reported in the three indicators are displayed in table 25.

In both 2005/6 and 2006/7, patients diagnosed with diabetes for ≥ 10 years were more likely to be exception reported in all three indicators (AOR = 2.01 [1.65-2.45] for HbA1c in 2006-7). In 2004-5, patients with ≥ 3 co morbidities were exception reported more than those without co-morbidity on all three indicators (AOR= 2.97 [1.54-5.71] for blood pressure). In 2006/7, older patients had higher exception reporting on the blood pressure and cholesterol indicators (AOR= 2.52 [1.21-5.28] ≥ 75 compared to 18-44 in blood pressure and 2.79 [1.55-4.99] for cholesterol). In both 2005-6 and 2006-7, patients of south Asian origin were exception reported more than white patients on the

HbA1c indicator (AOR = 1.52 [1.12-2.06] in 2006/7). Black patients were significantly more likely to be exception reported from HbA1c indicator in 2005/06. There was a higher level of exception reporting for the HbA1c indicator in practices with larger list sizes, though the effect size decreased over the three years (AOR for practice $\geq 7,000$ compared to $< 3,000$ was 6.56 [95% CI= 3.92- 10.99] in 2004-5, 3.52 [2.35- 5.27] in 2005-6 and 1.43 [1.05- 1.95] in 2006-7). Finally, patients from the more deprived practices were more likely to be exception reporting on all indicators in all three years, although the effect size decreased over the study period.

Table 22: Characteristics of the sample 2006-07

		N (%)
Age	18-44	523 (11.88)
	45-59	1371 (31.14)
	60-74	1762 (40.03)
	≥ 75	746 (16.95)
Gender	Male	2473 (56.18)
	Female	1929 (43.82)
Ethnicity	White	616 (13.99)
	South Asian	2265 (51.45)
	Black	711 (16.15)
	Other	118 (2.68)
	Missing	692 (15.72)
Co-morbidity	0	1224 (28.83)
	1	1611 (37.94)
	2	901 (21.22)
	≥ 3	510 (12.01)
Duration of Illness	< 10 years	3518 (79.92)
	≥ 10 years	884 (20.08)
List size tertile	< 3000	584 (13.27)
	3000-6999	2892 (65.7)
	≥ 7000	926 (21.04)
Practice Deprivation (local IMD 2007 tertile- 1 is most deprived)	1	1161 (26.37)
	2	2219 (50.41)
	3	1022 (23.22)
		4,402

Table 23: Percentage of exception reported and non exception reported patients achieving treatment targets, 2004/5 -2006/7

		HbA1c < 7.4/ 7.5%	BP < 145/85	Cholesterol <5mmol/l
2004/5	Not exception reported	50.0%	68.2%	84.5%
	Exception reported	39.4%	66.3%	82.1%
	Difference (p value)	10.6 (p<0.001)	1.9 (p=0.692)	2.4 (p=0.421)
2005/6	Not exception reported	42.8%	73.3%	88.6%
	Exception reported	39.2%	64.4%	81.9%
	Difference (p value)	3.6 (p=0.177)	8.9 (p=0.032)	6.7 (p=0.006)
2006/7	Not exception reported	61.7%	74.3%	89.2%
	Exception reported	55.9%	55.9%	89.3%
Difference (p value)		5.8 (p=0.018)	18.4 (p<0.001)	-0.1 (p=0.956)

Table 24: Exception reporting percentages by patient and practice characteristics (% and unadjusted findings), 2004-2006, * indicates a significant difference in the proportion exception reported compared to the reference group (indicated by †) p< 0.05; ** p<0.01

		2004/5			2005/6			2006/7		
		HbA1c	BP	Cholesterol	HbA1c	BP	Cholesterol	HbA1c	BP	Cholesterol
Age	18-44†	12.0	4.5	6.9	13.3	3.8	5.8	11.3	2.3	3.6
	45-59	14.6	3.7	6.7	14.0	2.9	6.8	14.9*	3.6	6.3*
	60-74	15.3	5.7	7.4	14.6	4.7	7.6	14.6	5.3**	8.4**
	≥75	14.2	5.1	7.2	13.0	6.2	9.3*	13.6	6.7**	11.4**
Gender	Male†	14.0	4.8	7.2	13.6	4.5	7.4	13.3	4.3	7.3
	Female	15.4	5.0	6.9	14.5	4.3	7.6	15.3*	5.1	8.4
Ethnicity	White†	14.0	4.2	6.1	10.5	5.4	7.0	11.0	5.2	9.2
	South Asian	14.7*	4.2	6.9	14.1*	3.7	7.1	16.1**	3.8	7.0**
	Black	17.4**	6.4	7.7	17.2*	4.1	7.5	14.7	5.0	9.3
	Other	15.4	7.8	10.4	12.9	6.5	9.7	16.5	7.8	7.8
	Missing	10.9	5.3	7.6	13.3	5.9	8.9	9.4	6.2	7.5
Co-morbidity	0†	13.1	4.2	5.8	13.4	4.5	7.5	14.2	3.5	6.0
	1	16.1	5.4	8.3*	14.3	3.8	7.0	14.2	4.5	7.8
	2	14.3	3.7	6.0	13.4	3.5	6.6	13.7	4.7	7.8
	≥3	16.6	7.6	8.8*	15.4	7.5†	10.5*	14.7	7.7**	11.5**
Duration of illness	<10 years†	14.5	4.6	6.9	12.6	4.0	6.7	11.9	4.0	6.7
	≥10 years	15.7**	7.8*	9.7	19.2	5.8†	10.1**	22.1*	6.9**	11.3**
List size	< 3000†	5.5	4.3	4.9	7.7	4.2	5.9	14.8	5.1	6.9
	3000-7000	15.0**	5.8	9.3*	14.1**	4.3	8.8*	13.3	3.9	8.1
	≥7000	19.0**	2.6	2.4*	17.4**	4.8	4.3	16.3*	6.9	7.0
Deprivation	1†	26.7	11.1	14.0	20.6	7.7	11.8	15.8	7.0	10.4
	2	13.5**	2.0**	4.2**	13.0**	2.3**	5.9**	15.4	3.4**	7.2**

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Project 08/1716/209

	3	6.7**	3.2**	4.7**	8.0**	4.6*	5.4**	9.6**	4.7*	5.9**
Total		14.6	4.9	7.1	14.0	4.4	7.5	14.1	4.7	7.7

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Project 08/1716/209

Table 25: Exception reporting by patient and practice characteristics (adjusted findings) 2004/5 – 2006/7, †* indicates the reference group. *indicates a significant difference in the proportion exception reported compared to the reference group (indicated by †) p< 0.05; ** p<0.01

		2004/5			2005/6			2006/7		
		HBA1c	Blood pressure	Cholesterol	HBA1c	Blood pressure	Cholesterol	HBA1c	Blood pressure	Cholesterol
Age	18-44†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	45-59	0.92	1.31	1.23	1.09	0.84	1.16	1.42*	1.64	1.74*
	60-74	0.95	1.47	1.03	1.05	1.26	1.23	1.33	2.15*	2.09*
	≥75	0.95	1.34	1.03	0.95	1.66	1.51	1.24	2.52*	2.79*
Gender	Male†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Female	1.06	0.98	0.91	1.05	0.92	0.99	1.18	1.14	1.10
Ethnicity	White†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	South Asian	1.24	1.41	1.48	1.64*	1.10	1.28	1.52*	0.97	0.89
	Black	1.04	1.09	1.00	1.55*	0.66	0.99	1.30	0.86	0.98
	Other	0.96	1.46	1.72	1.27	1.08	1.5	1.52	1.35	0.86
	Missing	0.64*	1.10	1.21	1.21	1.10	1.32	0.81	1.34	0.85
Co-morbidity	0†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	1	1.37*	1.44	1.64*	1.06	0.83	0.89	0.95	1.13	1.10
	2	1.31	1.12	1.37	1.08	0.74	0.91	0.93	1.08	1.09
	≥3	1.90*	2.97*	2.49*	1.29	1.58	1.55*	1.02	1.68*	1.59*
Duration of Illness	<10 years†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	≥ 10 years	1.12	1.87*	1.53	1.77*	1.62*	1.57*	2.01*	1.73*	1.57*
Practice Size	< 3000†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	3000-7000	2.86*	0.67	1.45	1.98*	0.63	1.41	1.03	0.52*	1.11
	≥7000	6.56*	0.65	0.56	3.52*	1.21	0.83	1.43*	1.35	1.10
Deprivation	1†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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Project 08/1716/209

2	0.31*	0.13*	0.29*	0.45*	0.19*	0.48*	0.83	0.34*	0.68*
3	0.13*	0.23*	0.31*	0.26*	0.44*	0.42*	0.53*	0.51*	0.52

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Project 08/1716/209

3.8 Trends in smoking status ascertainment, provision of smoking cessation advice and smoking prevalence

3.8.1 Analysis plan

Rates of smoking, and the provision of smoking cessation services among those with CHD, diabetes or hypertension were examined also using the data from Wandsworth 1998 – 2007. The indicator used for smoking cessation prescription refers to any prescription for cessation therapy during the year, and so those receiving more than one prescription are treated the same as those receiving only one prescription.

3.8.2 Results

Table 26: Characteristics of patients with CHD, hypertension and Diabetes with valid data for smoking status in Wandsworth 2007

Age group in years	Number with Diabetes (%)	Number with Hypertension (%)	Number with CHD (%)	Number with any of these 3 (%)
18 - 44	511 (14.1)	1115 (10.2)	44 (2.1)	1580 (11.6)
45 – 54	622 (17.1)	1898 (17.4)	218 (10.2)	2402 (17.8)
55 – 64	978 (27.0)	2785 (25.6)	529 (24.7)	3453 (25.6)
65 – 74	1008 (27.8)	2943 (27.0)	716 (33.4)	3555 (26.4)
75+	507 (14.0)	2156 (19.8)	634 (29.6)	2505 (18.6)
Gender				
Female	1709 (47.1)	6230 (57.2)	792 (37.0)	7263 (53.9)
Male	1917 (52.9)	4667 (42.8)	1349 (63.0)	6222 (46.1)
Deprivation group, by practice level IMD				
1 (least deprived)	1282 (35.3)	3719 (34.1)	710 (33.2)	4609 (34.2)
2	1239 (34.2)	3855 (35.4)	760 (35.5)	4799 (35.6)
3 (most deprived)	1105 (30.5)	3323 (30.5)	671 (31.3)	4077 (30.2)
Ethnic background				
White	1494 (41.2)	5759 (52.9)	1401 (65.4)	7099 (52.6)
Black	914 (25.2)	2539 (23.3)	188 (8.8)	2921 (21.7)
South Asian	846 (22.3)	1223 (11.2)	404 (18.9)	1809 (13.4)
Unknown / Other / Missing	372 (10.3)	1376 (12.6)	148 (6.9)	1656 (12.3)
Total	3626 (100)	10897 (100)	2141 (100)	13485 (100)

The numbers of patients used in the analysis of smoking are slightly different to those used in the interrupted time series work. This is due to slightly different data cleaning, based on the completeness of data on smoking status.

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Project 08/1716/209

Table 27: Ascertainment of smoking status in general population and those with CHD, diabetes or hypertension 1998 - 2007 Wandsworth*

		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
CHD, diabetes, hypertension group	Status ascertained Number	776	1,848	3,468	5,121	6,917	8,401	10,639	11,842	12,740	13,371
	Status ascertained %	9.4	21.3	36.3	49.2	63.6	74.4	91.4	96.3	98.5	99.2
General population	Status ascertained Number	2,347	7,566	14,799	23,055	32,120	42,820	63,120	81,784	103,253	124,484
	Status ascertained %	4.8	14.0	24.1	33.2	42.1	50.6	66.4	75.6	83.1	87.1

*Ascertainment of smoking status defined as a valid code against a person's smoking status in the general practice records.

There have been large improvements in the ascertainment of smoking status among the general population, and this improvement has been even more marked among those diagnosed with CHD, diabetes or hypertension. This picture was similar across deprivation groups, age groups and gender. (Table 28)

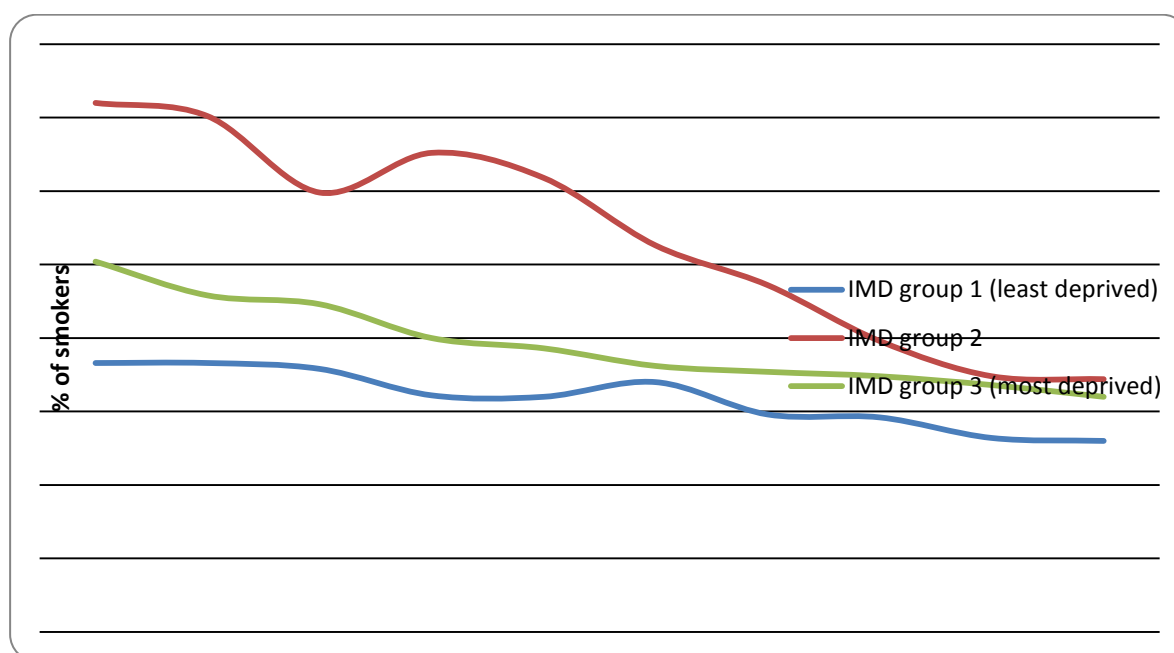
Table 28: Prevalence of smoking among those with CHD, diabetes or hypertension (number and %)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
18 - 44	13 (26.5)	55 (37.4)	86 (30.1)	143 (34.5)	172 (30.2)	215 (28.4)	246 (25.4)	292 (24.2)	317 (22.7)	333 (21.6)
45 - 54	43 (33.8)	76 (26.5)	161 (28.4)	255 (29.3)	313 (28.8)	359 (26.9)	403 (22.7)	437 (21.3)	424 (19.6)	444 (18.7)
55 - 64	57 (29.4)	133 (27.0)	245 (27.0)	338 (25.4)	445 (24.3)	504 (22.7)	568 (20.2)	566 (18.4)	577 (17.2)	565 (16.5)
65 - 74	66 (27.6)	145 (27.1)	231 (23.2)	310 (21.7)	399 (20.3)	440 (18.3)	508 (17.4)	497 (15.3)	460 (13.5)	492 (13.9)
75+	23 (13.8)	69 (17.9)	105 (14.9)	146 (13.6)	214 (14.7)	218 (13.0)	276 (12.8)	255 (11.3)	228 (9.5)	224 (9.0)
Female	104 (23.6)	234 (22.7)	397 (20.8)	554 (19.8)	710 (19.0)	781 (17.2)	894 (15.4)	902 (14.0)	846 (12.4)	864 (12)
Male	98 (29.3)	244 (29.9)	431 (27.8)	638 (27.5)	833 (26.2)	955 (24.7)	1107 (22.8)	1145 (21.2)	1160 (19.7)	1194 (19.4)
White	138 (31.1)	303 (28.7)	507 (26.9)	730 (26.1)	949 (24.5)	1103 (23.5)	1312 (22.9)	1364 (21.5)	1342 (19.7)	1384 (19.6)
Black	34 (20.9)	83 (20.2)	142 (17.2)	184 (16.3)	247 (16.9)	286 (16.2)	292 (12.7)	302 (11.7)	280 (10.3)	284 (9.8)
S Asian	14 (13.9)	36 (18.4)	66 (16.5)	101 (15.1)	117 (13.4)	125 (11.7)	136 (9.7)	136 (8.8)	133 (7.9)	136 (7.6)
Missing/ Unknown / Other	16 (23.2)	56 (30.6)	113 (32.4)	177 (34.0)	230 (32.8)	222 (25.3)	261 (22.0)	245 (17.9)	251 (16.6)	254 (16.0)
IMD group 1 (least deprived)	52 (18.3)	90 (18.3)	163 (17.9)	241 (16.1)	339 (16.0)	445 (17.0)	530 (14.8)	588 (14.6)	578 (13.2)	592 (13.0)
IMD group 2	87 (36.0)	223 (35.1)	381 (29.9)	588 (32.6)	745 (30.9)	791 (26.3)	883 (23.6)	833 (19.8)	785 (17.4)	818 (17.2)
IMD group 3 (Most deprived)	63 (25.2)	165 (22.9)	284 (22.3)	363 (20.0)	459 (19.3)	500 (18.1)	588 (17.7)	626 (17.4)	643 (16.8)	648 (16.0)
Total Smoker Number	202	478	828	1,192	1,543	1,736	2,001	2,047	2,006	2,058
Total Smoker %	26.0	25.8	23.9	23.3	22.3	20.7	18.8	17.3	15.8	15.4
Total patient numbers	776	1,847	3,461	5,115	6,909	8,401	10,635	11,836	12,739	13,368

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Project 08/1716/209

Figure 15: Prevalence of smoking among those with CHD, Diabetes or hypertension, 1998 - 2007



The prevalence of smoking among patients with CHD, diabetes or hypertension has shown a steady decline from 26.0% in 1998 to 15.4% in 2007. Those in the 18-44 age group were most likely to smoke, while those over 75 were less likely to smoke. White patients were more likely to smoke than their black or south Asian counterparts. (Table 28, Figure 15). Patients from the most deprived areas had higher smoking rates than those from the least deprived areas. However, these figures may underestimate inequalities in smoking prevalence between socio-economic status groups because they are based on an area based measure of deprivation assigned to practice (rather than patient) postcode.

Table 29: Provision of smoking cessation advice to smokers with CHD, diabetes or stroke by year (%)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
18 - 44	30.8	10.9	15.1	15.4	30.2	47.9	68.3	67.8	75.4	73.3
45 - 54	23.3	21.1	20.5	20.0	35.1	48.8	75.9	73.7	81.6	78.8
55 - 64	24.6	16.5	17.1	18.1	42.3	46.6	78.9	77.2	83.5	80.9
65 - 74	18.2	15.9	14.7	23.6	37.6	53.4	83.3	80.1	89.8	85.2
75+	26.1	21.7	11.4	22.6	34.6	48.6	80.4	80.8	86.8	81.3
Female	22.1	15.0	18.1	19.3	33.1	45.3	77.6	77.1	82.0	81.9
Male	23.5	19.3	14.4	20.9	40.7	52.4	78.9	75.6	84.8	79.1
White	21.0	17.8	18.7	23.4	42.5	54.5	83.5	78.5	86.0	81.7
Black	32.4	22.9	16.2	17.9	37.7	51.8	78.1	74.8	83.9	81.3

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Project 08/1716/209

S Asian	0.0	5.6	9.1	20.8	35.0	45.6	79.4	81.6	85.0	80.2
Missing/ Unknown / Other	37.5	12.5	8.9	8.5	16.1	21.6	52.1	62.9	70.1	71.7
IMD group 1 (least deprived)	25.0	15.6	15.3	22.4	48.1	51.2	78.1	74.3	82.0	76.0
IMD group 2	20.7	18.8	13.7	16.7	25.9	42.4	76.6	74.9	83.8	81.3
IMD group 3 (Most deprived)	23.8	15.8	20.1	24.2	47.5	58.2	81.1	79.9	84.9	82.9
Total	23.0	15.6	14.5	19.5	36.8	49.3	79.3	75.5	83.2	80.6

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Project 08/1716/209

Table 30: Provision of interventions to stop smoking among smokers with CHD, diabetes or hypertension. (%)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
18 - 44	0	0	4.65	2.8	4.65	5.58	5.69	7.53	9.78	11.71
45 - 54	2.3	0	3.73	5.1	6.07	7.52	8.19	9.15	9.67	9.01
55 - 64	0	0	2.86	5.62	5.84	4.37	9.15	8.66	7.97	10.27
65 - 74	0	0	3.03	6.45	4.01	6.14	8.46	7.24	11.3	8.94
75+	0	0	0	0	2.34	2.75	3.62	3.53	2.63	4.02
Female	1.0	0	2.52	5.05	4.79	6.79	6.6	8.2	10.87	10.53
Male	0	0	3.25	4.39	4.8	4.29	8.4	7.16	7.24	8.29
White	0.7	0	3.75	5.75	5.37	6.62	7.62	7.4	9.84	9.68
Black	0	0	0	2.72	3.64	3.85	8.56	7.62	7.14	9.15
S Asian	0	0	4.55	2.97	4.27	4.1	8.82	13.24	7.52	11.03
Missing/ Unknown / Other	0	0	1.77	3.39	3.91	2.25	5.75	5.71	5.58	5.91
IMD group 1 (least deprived)	0	0	4.29	4.98	5.6	4.72	9.25	7.31	9.52	9.8
IMD group 2	1.15	0	2.36	3.74	3.49	4.93	6.12	8.64	7.64	7.33
IMD group 3 (Most deprived)	0	0	2.82	6.06	6.32	6.8	8.33	6.55	9.49	11.11
Total	0.5	0.0	2.9	4.6	4.4	5.6	7.7	7.0	7.9	9.2

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Project 08/1716/209

Provision of smoking cessation advice among those with CHD, diabetes or stroke has increased from 23.0% in 1998 to 80.6% in 2007, although this represents a slight fall from the 2006 figure of 83.2%. Those patients registered with general practices in the most deprived areas were more likely to be offered advice (82.9% versus 76.0% among the least deprived group in 2007)

Interventions to stop smoking included prescribed NRT, drugs, patches and chewing gum. Despite some increase, provision of stop smoking interventions to smokers with CHD, diabetes or hypertension has remained low over the 10 years examined here, peaking at an overall 9.2% in 2007 (table 30).

3.9 Trends in recording and prevalence of obesity

3.9.1 Analysis

Using the same data as we reported on smoking prevalence from, we also looked at recording and prevalence of obesity in Wandsworth from 1998 – 2007.

Due to slightly different data cleaning, total numbers of patients per year were different to those in the smoking data, and are detailed in the tables.

The indicator used for this was Body Mass Index (BMI), and the definition of BMI recording was having a valid number in the patient record for BMI.

Due to high levels of missing data for BMI, we examined differences between age, sex and ethnicity groups by pooling data across all years from 1998 – 2007.

3.9.2 Results

Table 31: Ascertainment of BMI among patients registered with general practices in Wandsworth 1998 - 2007

BMI	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Not measured	214,498	213,159	210,313	208,732	204,965	200,262	190,508	185,876	178,992	171,264
	97.17	96.57	95.28	94.56	92.85	90.72	86.30	84.21	81.09	77.59
Measured	6,243	7,582	10,428	12,009	15,776	20,479	30,233	34,865	41,749	49,477
	2.83	3.43	4.72	5.44	7.15	9.28	13.70	15.79	18.91	22.41

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Project 08/1716/209

Table 32: Prevalence of overweight and obesity among patients registered with general practices in Wandsworth 1998 - 2007

BMI Category	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Underweight (<18.5)	301 4.83	341 4.51	493 4.73	552 4.60	676 4.29	919 4.49	1,490 4.94	1,890 5.43	2,061 4.95	2,400 5.03
Normal Weight (>=18.5 to <25)	3,014 48.34	3,574 47.23	4,751 45.62	5,516 46.00	6,993 44.43	9,182 44.90	13,494 44.70	15,814 45.44	18,950 45.48	22,621 47.39
Overweight (<=25 to <30)	1,878 30.12	2,299 30.38	3,261 31.31	3,619 30.18	4,922 31.27	6,354 31.07	9,233 30.58	10,305 29.61	12,311 29.55	14,032 29.40
Obese I (<=30 to <35)	694 11.13	898 11.87	1,271 12.20	1,456 12.14	2,025 12.87	2,579 12.61	3,808 12.61	4,354 12.51	5,317 12.76	5,555 11.64
Obese II (<=35 to <40)	242 3.88	292 3.86	413 3.97	539 4.49	737 4.68	916 4.48	1,403 4.65	1,572 4.52	1,939 4.65	2,045 4.28
Obese III (<=40 to <50)	87 1.40	141 1.86	188 1.81	281 2.34	338 2.15	420 2.05	657 2.18	747 2.15	953 2.29	936 1.96
Obese III (<=50 to <60)	17 0.27	19 0.25	32 0.31	25 0.21	38 0.24	64 0.31	78 0.26	97 0.28	103 0.25	113 0.24
Obese III (>=60)	2 0.03	4 0.05	6 0.06	4 0.03	11 0.07	16 0.08	28 0.09	21 0.06	31 0.07	29 0.06
Total (N/%)	6,235 100.00	7,568 100.00	10,415 100.00	11,992 100.00	15,740 100.00	20,450 100.00	30,191 100.00	34,800 100.00	41,665 100.00	47,731 100.00

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Project 08/1716/209

Table 33: Patterns in overweight and obesity by age group, pooling data from 1998 - 2007

Age group	BMI Category								Total N/%
	Underweight	Normal weight	Overweight	Obese I	Obese II	Obese III*	Obese III**	Obese III***	
<18	4,558	3,614	865	247	105	77	15	11	9,492
	41.13	3.51	1.29	0.90	1.06	1.66	2.64	7.48	4.24
>=18 to <44	4,909	72,192	32,296	9,793	3,301	1,756	261	62	124,570
	44.29	70.15	48.06	35.65	33.34	37.93	45.95	42.18	55.63
<=45 to <55	384	8,109	9,513	5,058	2,109	1,155	138	21	26,487
	3.46	7.88	14.16	18.41	21.30	24.95	24.30	14.29	11.83
<=55 to <65	377	7,196	9,690	5,316	2,187	909	92	27	25,794
	3.4	6.99	14.42	19.35	22.09	19.63	16.20	18.37	11.52
<=65 to <75	349	6,307	9,270	4,649	1,582	599	51	16	22,823
	3.15	6.13	13.8	16.92	15.98	12.94	8.98	10.88	10.19
>=75	506	5,497	5,563	2,410	617	134	11	10	14,748
	4.57	5.34	8.28	8.77	6.23	2.89	1.94	6.80	6.59

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Project 08/1716/209

Table 344: Patterns in overweight and obesity by ethnicity, pooling data from 1998 - 2007

BMI Category	Female	Male
Underweight (<18.5)	7,190	3,933
	64.64	35.36
	5.63	3.97
Normal weight (>=18.5 to <25)	62,513	41,396
	60.16	39.84
	48.98	41.74
Overweight (<=25 to <30)	30,938	37,275
	45.35	54.65
	24.24	37.59
Obese I (<=30 to <35)	15,946	12,011
	57.04	42.96
	12.49	12.11
Obese II (<=35 to <40)	6,966	3,132
	68.98	31.02
	5.46	3.16
Obese III (<=40 to <50)	3,562	1,186
	75.02	24.98
	2.79	1.20
Obese III (<=50 to <60)	415	171
	70.82	29.18
	0.33	0.17
Obese III (>=60)	90	62
	59.21	40.79
	0.07	0.06
Total (N/%)	127,620	99,166
	56.27	43.73
	100.00	100.00

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The proportion of BMI measured has increased nearly 10 fold over the 10 years from 2.8% in 1998 to 22.4% in 2007. Nevertheless, although the recording of BMI has increased it still remains low, with 77.59% of patients lacking a BMI value in 2007. (Table 31)

The prevalence of overweight remains fairly constant over the 10 years, from 30.12% in 1998 to 29.40% in 2007. There is a similar picture for obesity (level 1), which was 11.13% in 1998 and 11.64% in 2007. These trends remain constant despite the increase in patients registered with these practices over the study period. (Table 32)

We can see in table 33 that the 18 – 44 age group constitutes a large portion of patients who are overweight or obese (level 1). They make up 48.06% of overweight patients, and 35.65% of all obese level 1 patients. From table 34 we can see that prevalence of overweight is higher amongst men (54.6%) than among women (45.4%). In contrast, prevalence of obesity (level I) is higher in female patients (57%) than male patients (43%). Women also had over double the rates of obesity level 2 to that seen among men (69.98% vs. 31.02%)

4 Discussion

4.1 Key findings

4.1.1 Key findings – systematic review

Findings from our systematic review suggest that the introduction of QOF was associated with reductions in inequalities in chronic disease management between affluent and deprived areas. However, limitations in the design of included studies means that it is generally not possible to determine whether these reductions are attributable to QOF or part of underlying trend reflecting the impacts of other quality improvement initiatives (56-57). Other important inequalities in quality of care between age, gender and ethnic groups present before the introduction of this programme appear to have persisted in the short term. Specifically women, older patients and those from some minority ethnic groups continued to receive lower quality of care after the introduction of QOF.

4.1.2 Key findings - Observational studies on the impact of QOF on inequalities in cardiovascular disease and diabetes management

Our observational studies were designed to isolate the impact of QOF on inequalities in chronic disease management. Our findings suggest that the introduction of QOF was associated with accelerated overall improvements in the control of blood pressure in patients with diabetes, hypertension and stroke but not CHD in the initial post introduction period. These improvements continued between 2005 and 2007 for systolic but not diastolic blood pressure (i.e. greater than those predicted by the underlying trend). The introduction of QOF was associated with accelerated improvements in the control of cholesterol in patients with diabetes and stroke but not CHD in the initial post introduction period. These improvements were not sustained between 2005 and 2007. The introduction of QOF was not associated with any additional improvement in HbA_{1c} control in patients with diabetes and mean HbA_{1c} actually increased significantly during the period between 2005 and 2007.

The initial improvements in intermediate outcome control associated with QOF identified in our studies are likely to confer important clinical and public health benefits in the different age, gender, ethnic and socio-economic status groups that we studied. However, the magnitude of the improvements seen was greater among women than men in diabetes, thus narrowing existing sex inequalities in the management of these risk factors. Conversely, younger patients with diabetes appear to have benefited less from QOF than older patients, resulting in some widening of existing age group inequalities in the management of HbA_{1c} and cholesterol. Older patients (75+ years) with diabetes

appear to have derived a similar level of benefit as other groups from QOF thus leaving existing inequalities in blood pressure control largely intact. Patients with diabetes living in affluent and deprived areas appear to have had similar levels of risk factor control before QOF and derived a similar level of benefits from this financial incentive.

Our findings suggest that the impacts of QOF on inequalities in chronic disease management between ethnic groups are mixed. This pay for performance programme appeared to reduce some inequalities in risk factor control (white-black differences in systolic blood pressure in patients with diabetes) while increasing others (white-black differences in cholesterol in patients CHD). A number of other inequalities in risk factor control largely persisted after the introduction of QOF (white-black-south Asian differences in HbA1c control). White patients performed worse on a number of quality indicators than black or south Asian patients, including cholesterol control and smoking prevalence. South Asian patients with hypertension had superior blood pressure control than white or black patients. The reasons for these persisting inequalities in risk factor control between groups are likely to be complex but are likely due to organisational, provider and patients factors. For example, we identified lower prescribing rates of lipid lowering medications in black patients and lower insulin prescribing to south Asian patients with diabetes. These findings could reflect therapeutic inertia by general practitioners and / or between group differences in attitudes towards initiation and adherence to medications. [114 – 115]

4.1.3 Key findings – exception reporting

Exception reporting levels in people with diabetes remained stable over between 2004/05 and 2006/07 but were higher for the HbA1c control indicator than the cholesterol and blood pressure control indicators. Exception reported patients were significantly less likely to achieve treatment targets for HbA1c (2004/05, 2006/07), blood pressure (2005/06, 2006/07) and cholesterol (2005/06). There was considerable variation in exception reporting by patient (age, ethnicity, co-morbidity, duration of illness) and practice characteristics (list size, deprivation), with higher rates among already disadvantaged groups.

4.2 Previous Research

As demonstrated by the findings of our systematic review, there is little international literature on pay for performance and inequalities; and previous UK studies have generally not isolated the impact of QOF on inequalities in chronic disease management. (26) (73)

Whilst non-financial quality improvement initiatives have been associated with reductions in ethnic disparities in process measures in chronic disease management, variations in prescribing and intermediate clinical outcomes have generally not been attenuated in studies conducted in the United States (74). For example, Sequist et al examined the impact of a series of quality improvement initiatives for diabetes undertaken by Harvard Vanguard Medical

Associates, including the use of information systems to facilitate focused patient outreach and to deliver clinical reminders to physicians within an electronic medical record system (75). They found that between 1997 and 2001, rates of annual cholesterol level testing increased from 39% to 64% and the white-black disparity decreased from 14% to 4%. There were no disparities in annual Hb1Ac level testing (76%) at the beginning or end of the study period. Whilst statin therapy rates increased from 20% to 37% overall, black patients remained less likely than white patients to receive therapy. In addition, inequalities in HbA1c control between white and black patients remained constant at 10%. Trivedi et al examined the quality of care for elderly white and black beneficiaries enrolled in 183 Medicare managed-care plans from 1997 to 2003. Reductions in disparities between white and black groups were achieved for frequency of eye examination and testing of cholesterol and HbA1c. Whilst disparities were attenuated for LDL cholesterol control, these widened for HbA1c control from 4% in 1999 to 7% in 2002 (76). The findings from these studies concur with those from other US research which has examined general trends in inequalities in intermediate outcomes in diabetes using national health survey. Using the National Health and Nutrition Examination Survey (NHANES), Saydah et al found that poorer glycaemic control evident in black and Mexican American participants relative to whites in the 1988-1994 survey had not been attenuated in 1999-2000, despite publication of national clinical guidance and other quality initiatives in the interim period (77). These differences were found to persist in a more recent analysis of NHANES data by the same research group (78).

Few studies have examined the impact of quality improvement initiatives on inequalities in chronic disease management in the United Kingdom. We found lower recording of process of care measures among south Asian patients from 2000 to 2003 but these differences were largely attenuated after the introduction of QOF in 2004. Soljak et al found no significant differences in recording of blood pressure and HbA1c between white, black and south Asians registered with 173 general practices in north-west London in 2002. However, the study found significantly lower levels of cholesterol recording among south Asians patients. McElduff et al found only small differences in the provision of care on process of care measures in 820 South Asian and 2070 European people with Type 2 diabetes mellitus in Blackburn between 1995 and 2001, after adjusting for age and sex. Our findings confirm those of previous community based studies which have found important variations in prescribing between ethnic groups. For example, our finding of lower prescribing of insulin to south Asian patients with diabetes is consistent with data from the Health Survey for England (79) and an earlier study by Soljak et al conducted in north-west London. Few UK studies have examined variations in access to lipid-lowering treatments by ethnic group. Existing studies have mainly been ecological and have identified lower prescribing of statins in geographical areas with high proportions of "non-white" or south Asian ethnic groups. These findings have been confirmed by a study which used individual level data from the Health Survey for England.(79) Previous US studies have found lower statin

use among black patients and this may be partly due to financial barriers (80-81).

Patients aged 75 years and older were least likely to have HbA_{1c} and cholesterol recorded, or to be prescribed OHAs and lipid lowering medication, both before and after QOF. This could be explained by ageism, or by prescriber concerns about risks of medication outweighing benefits, and because this age group had usually been excluded from randomised controlled trials of the medications (82). It is likely that if GPs were not planning to prescribe for this group, there would be little rationale for measuring the indicators (80-81). The introduction of QOF appeared to narrow existing inequalities in the control of BP, HbA_{1c} and cholesterol between men and women. However, small but significant sex differences in the recording of process measures and in prescribing persisted at the end of the study period. For instance, by 2005, more men with diabetes had their blood pressure and HbA_{1c} recorded than women, and men were more likely to be prescribed OHAs and lipid lowering medication than women, who were more likely to be prescribed AHAs. This might be explained by a lack of consensus as to whether women benefit from treatment to the same extent as men, particularly for lipid lowering drugs (83). These findings are similar to those of other studies. For example, Raine et al found that males with cardiovascular disease in Scotland were more likely to be prescribed secondary prevention treatments than females (84). Simpson et al demonstrated that women were less likely to have a controlled blood pressure or controlled cholesterol levels compared to men (51). Patients living in affluent and deprived areas appeared to have derived a similar level of benefit from QOF and there were only very modest differences in the quality of diabetes management by socio-economic status in 2005. These findings are consistent with previous studies (36-39, 41, 43-44, 46, 48-50, 85-92).

Our findings on aggregate levels and variations in exception reporting are consistent with previous studies and published national data. Doran et al. (93) found a practice median of 10.6%, 6.9% and 9.9% for the HbA_{1c}, blood pressure and cholesterol intermediate outcomes respectively, within the range of 4.4- 14.6% found here. They did however find a large amount of variation between practices (0-51%). An earlier paper (6) estimated a median level of 4.7% (IQR= 3.3-7.0) for selected indicators, though these included process of care indicators, where exception reporting is lower. Large practices exception reported more frequently than the smallest practices, especially for the HbA_{1c} indicator, a finding previously shown (93). Patients consider smaller practices more accessible and achieve higher levels of satisfaction than in larger practices (94). Hence, the more personalised care offered by small practices may lead to lower rates of exception reporting. Patients with greater chronic co-morbidity were excluded more, a finding also seen previously for stroke indicators (95). Patients with multiple morbidities have more chance of fulfilling exception reporting criteria, for instance one of their co-morbid conditions can make treatment inappropriate or increase the likelihood of drug contraindication. Patients diagnosed with diabetes for longer than ten years were exception reported more. Longer duration of diabetes is associated with poorer glycaemic

control (96) and more diabetic complications (97), and like patients with co-morbid conditions, this may give valid reasons for exclusion. Black and south Asian patients were more likely to be exception reported for the HbA1c indicator. Patients registered with practices in deprived areas were exception reported at higher levels. This finding mirrors those of Sigfrid et al. in an ecological study of diabetes exception reporting (45). There is some limited evidence that minority patients and lower SES patients are more likely to default from diabetes care in general practice (98), a valid reason for exclusion. An alternative explanation is that these groups of patients are being excluded more frequently to improve performance because they have worse glycaemic control (99-100) or are perceived by physicians as being more difficult to treat (101).

4.3 Strengths and limitations of studies

Our observational studies have a number of strengths when compared with previous research in this area. Most of the previous studies identified in our systematic review were unable to isolate the impact of QOF on health care inequalities and did not use patient level data. This is because they used data derived from the financial administration system for QOF, the Quality Management and Analysis System (QMAS), and its usefulness for evaluating impacts on inequalities in health care is limited. Firstly, the QMAS does not hold patient level information on characteristics such as age, gender, ethnicity and socioeconomic status. Hence, most of the QOF evaluations reported here used practice level data and may underestimate the relationship between deprivation and quality of care. This has been further compounded by poor recording of patient based measures of ethnicity and of socioeconomic status within primary care information systems in the UK. Secondly, the ability of practices to exclude patients from performance reporting for the contract means that this data may underestimate the extent of inequalities in care. However, exception reporting rates have been published since the second year of the contract. Finally, studies which use QMAS data are unable to examine underlying trends in quality, making it difficult to attribute reductions in socioeconomic inequalities to QOF. This is an important limitation given that the UK government has instituted a policy agenda to reduce health inequalities since the late 1990s (45) and the important role primary care plays in achieving such objectives.

The structure of primary care in the UK enables large scale research on healthcare delivery as almost all the population is registered with a general practitioner and use of electronic medical records in primary care is very high (102). Our findings are based on an analysis of data obtained several primary care datasets which are subject to careful quality checks. The GPRD contains anonymised, longitudinal primary care records on approximately 5% of the population registered with a general practice in the UK. The data recorded is accepted as representative, accurate and complete and is extensively accessed for health service and epidemiological research (103). We had high participation (29 out of 34) among general practices in Wandsworth which means that our findings provide a comprehensive picture of the primary care provided to

patients with chronic disease in this urban, ethnically diverse location. In contrast, only 26 of the 72 general practices in Brent volunteered to participate.

A major strength and unique aspect of the Wandsworth studies has been the high levels of ethnicity coding, which exceeded 90% in patients with cardiovascular disease and diabetes. In Brent, this figure was 85% among patients with diabetes. Nonetheless, as the numbers in some individual ethnic groups were small, we combined the ethnic categories into larger groups based on the 2001 UK census categories to give overall white, black and south Asian groups. (79) The limitations of combining individuals from heterogeneous populations into a single ethnic category, such as "south Asians", have been well documented (104) and we may have subsequently missed important differences in the quality of chronic disease management between sub-groups. Some of the comparisons made may not have reached statistical significance due to small numbers in certain ethnic groups. In addition, there were insufficient numbers in our study to examine quality of diabetes care in smaller ethnic minority groups, including long established communities such as the Chinese and communities who have migrated more recently, including those from Eastern Europe.

We obtained data on *all* patients with cardiovascular disease and diabetes in our datasets and hence exception reporting will not affect our findings. We adjusted for important covariates, such as duration of diabetes and presence of co-morbidities, which may be confounders in the relationship between ethnicity and diabetes management.

Our studies have a number of limitations. We may have under-estimated the effect of QOF by assuming a linear trend. This is because there may be ceiling effect for some indicators, meaning that additional improvements become harder to achieve when quality standards are high. Differences in the accuracy and completeness of coding by individual GPs or practices may have led to some variability in the data used for the study. Coding before QOF also may have been less accurate due to a lack of financial incentive at the time. In an effort to address this, we identified patients using both diagnostic and management Read codes. Use of routine data limits interpretation of some findings. For example, we were unable to determine the reasons for the differential prescribing patterns found. Such patterns may be due to a number of factors, including patient preferences, provider factors or wider organisational factors given that patients from minority ethnic groups identify numerous barriers to quality diabetes care (105-106). In addition, we were unable to examine adherence to medications or self-monitoring behaviour, which may systematically differ between the groups studied (107). Some of the improvements identified, particularly in relation to process measures of care, may be due to improved recording rather than changes in actual care provided. Similarly, some of the variations in quality identified in our studies may be due to systematic differences in recording practice rather than actual differences in care. However, improved recording is unlikely to be a major explanatory factor for changes seen in intermediate clinical outcomes (HBA1c and cholesterol), as

these measures are increasingly downloaded electronically from the laboratory directly into patient records.

We assigned a deprivation score to individual patients using the Index of Multiple Deprivation based on their practice postcode. Practice level IMD score was the best indicator available as individual level IMD score was not available in the database, and person level measures of socio-economic status are not routinely recorded in UK general practice. This approach has limitations because patients attending the same general practice are likely to be from different socio-economic groups, particularly in urban areas and within practices with large catchment areas. The "ecological fallacy" may occur if results obtained by interpreting data from practices are then assumed to apply to individuals, although postcode-linked IMD scores are generally accepted as good proxies for patient-level deprivation (108) (38). It has been suggested that a lower threshold may be appropriate for defining overweight and obesity in Asian populations. However, this remains subject to debate and we have used the same cut points for ease of comparison(109).

The results from the studies we conducted using data from Wandsworth may be influenced by attrition bias as we were only able to use retrospectively collected data from patients who were registered in 2007. Patients who died, de-registered or moved practices before 2007 are not captured in the sample and so the data are biased towards healthier patients who have survived over the time studied. However, results from sensitivity analyses that we conducted (not presented) suggest that this limitation did not have a major bearing on our findings. Further, additional studies are required to determine whether our findings reflect the impacts of QOF on the quality of care being delivered to minority ethnic patients in other settings.

4.4 Implications for future research

a) QOF has resulted in a step change in quality improvement

The initial improvements in intermediate outcome control associated with QOF identified in our studies are likely to confer important clinical and public health benefits in the different age, gender, ethnic and socio-economic status groups that we studied. However, most of these improvements do not appear to be sustained beyond 2005 and given some of the differential impacts on intermediate outcomes seen, these improvements may not address known inequalities in health outcomes.

b) The importance of ongoing monitoring and assessment

Evaluations of pay for performance programmes should include an assessment of impacts on health care inequalities. (110) Where possible this assessment should include both local and national analyses of patient level data, consider different dimensions of inequality including age, gender, ethnicity, socioeconomic status, take into account underlying trends in inequality and

involve longer term follow up of impacts. This final point will permit examination of the inverse equity hypothesis, (73) which asserts that whilst new policy initiatives may initially widen inequality, these tend to be attenuated over time. However, assessing the impact of QOF on health care inequalities is currently hampered by an absence of patient level data within the QMAS (Quality Management and Analysis System) national reporting system and continued poor recording of ethnicity and of individual measures of socio-economic status within primary care information systems. QMAS should be modified to allow patient level analyses of quality of care, in addition to the practice level measures of performance that are currently available.

We identified considerable variation in exception reporting levels by patient and practice characteristics. Exception reporting rates were higher among older patients, ethnic minorities and among patients with longer duration of illness. This is of concern given that these groups of patients have been shown to experience poor risk factor control. Whether exception reporting is valid or misused, the unequal levels presented here may worsen health care inequalities. These findings highlight the importance of closely monitoring exclusions from QOF. This monitoring should examine exclusions from process and outcome indicators separately and should include an ongoing assessment of the characteristics of patients excluded and the quality of care they receive.

c) Potential modifications to QOF

Our findings suggest that while QOF was associated with reductions in inequalities in chronic disease management between men and women, age and ethnic group inequalities largely persisted or worsened since the GP contract was introduced in April 2004. QOF could be developed to ensure that it better addresses inequalities in health care in a number of ways:-

1) raising payment thresholds. Inequalities in care are more likely to be attenuated where thresholds for quality indicators are set high, hence these should continue to be increased over time. This is because low thresholds permit practices to earn maximum income without achieving adequate control of intermediate clinical outcomes in a large minority of their patients. For example, to achieve maximum QOF points for glycaemic control in diabetes, practices must ensure that 50% of their patients achieve HbA1c $\leq 7.5\%$. Moreover, the denominator for this target does not include those patients exception reported for this indicator (in 2008/09 the median exception reporting rate for this indicator in England was 9.2%; IQR= 5.3- 12.1%). The recently published Marmot review recommended that QOF may not address health care inequalities because full achievement of available points is possible without covering the entirety of any particular practice population. (27) GP negotiators recently rejected a recommendation by the National Institute for Health and Clinical Excellence (NICE) to raise treatment thresholds for intermediate outcomes from 2010/11.(111) This rejection was despite evidence that practice achievement is considerably higher than existing treatment

thresholds (27) and that improvement on many QOF indicators appears to have stalled after 2005.(66)

The transfer of responsibility for QOF indicator development and refinement to NICE in 2009 may increase pressure to align treatment targets in QOF with those in their own clinical guidance. Any shift toward tighter treatment targets would inevitably reduce support for increasing payment thresholds among GPs further and limit the scope of QOF to reduce health care inequalities.

2) rewarding improvement as well as absolute achievements. As some practices may find it difficult to meet higher absolute payment thresholds, additional incentives which reward improvement may need to be considered. Research conducted in the United States suggests that designers of P4P programs believe that programs that only reward the achievement of absolute benchmarks (e.g. > 85% of diabetes patients with a cholesterol less than 5 mmol/L) are more likely to have an adverse impact on inequalities than those that reward improvements in care (e.g. the percentage of patients with controlled cholesterol increasing from 50% to 70%) (112)

3) developing and expanding quality indicators in clinical areas where suboptimal and inequitable care has been identified. For example, there is a case for further shifting the emphasis of quality assessment from process of care measures, where achievement is high and generally equitable, to quality indicators for prescribing and intermediate outcomes, where inequalities have persisted

4) directly rewarding reductions in inequalities. (112) For example, the Massachusetts Medicaid programme has recently developed a pay for performance programme aimed at reducing inequalities in the quality of hospital care between ethnic groups. (113)

The abolition of the 'square root transformation' of prevalence in 2009 may have had a positive impact on health care inequalities as, under the old system, practices with high disease caseload being rewarded less per patient than those with smaller caseloads. (114) This meant that practices serving deprived and ethnically diverse populations were financially disadvantaged because they tend to have high disease caseloads due to the higher prevalence of cardiovascular disease and diabetes among patients on their lists.

d) Further research

Future research should involve longer term follow up of patients to better evaluate the impact of pay for performance on inequalities in access to high quality chronic disease management. Longer term follow-up is particularly important to permit examination of the "inverse equity hypothesis" which has been proposed by Victora et al. This suggests that new public-health interventions and programmes initially reach those of higher socioeconomic

status and only later affect the poor resulting in early increases in inequity ratios for coverage, morbidity, and mortality indicators. Inequities only improve later when the rich have achieved new minimum achievable levels for morbidity and mortality and the poor gain greater access to the interventions. Further research should also examine the impact of proposed changes to QOF i.e. raising payment thresholds, devolving part of the QOF budget to local areas, on health care inequalities.

Conclusions

Our findings confirm previous work that suggests that the introduction of QOF was associated with a step change improvement in the quality of cardiovascular disease and diabetes management. The initial improvements in intermediate outcome control associated with QOF identified in our studies are likely to confer important clinical and public health benefits in the different age, gender, ethnic and socio-economic status groups that we studied. While QOF was associated with reductions in inequalities in chronic disease management between men and women, age and ethnic group inequalities largely persisted since the GP contract was introduced in April 2004. We identified considerable variation in exception reporting by patient (age, ethnicity, co-morbidity, duration of illness) and practice characteristics (list size, deprivation), with higher rates among already disadvantaged groups. QOF could be developed in a number of ways to better address inequalities in health care. These include raising treatment thresholds, rewarding improvement as well as absolute achievement, developing and expanding quality indicators where inequitable care has been identified and directly rewarding reductions in health care inequalities.

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Project 08/1716/209

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Appendix - List of published outputs from this project

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Addendum:

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Although NETSCC, SDO has managed the project and conducted the editorial review of this document, we had no involvement in the commissioning, and therefore may not be able to comment on the background of this document. Should you have any queries please contact sdo@southampton.ac.uk.