OPEN ACCESS

Associations between exemption and survival outcomes in the UK's primary care pay-for-performance programme: a retrospective cohort study

Evangelos Kontopantelis,[1,2] David A Springate,[1,3] Darren M Ashcroft,[4] Jose M Valderas,[5] Sabine N van der Veer,[2] David Reeves,[1,3] Bruce Guthrie,[6] Tim Doran[7]

▸ Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/bmjqs-2015-004602).

For numbered affiliations see end of article.

Correspondence to
Dr Evangelos Kontopantelis, Institute of Population Health, University of Manchester, 5th Floor, Williamson Building, Manchester M13 9PL, UK; e.kontopantelis@manchester.ac.uk

Received 14 July 2015
Revised 20 October 2015
Accepted 1 November 2015
Published Online First 1 December 2015

Linked

▸ http://dx.doi.org/10.1136/bmjqs-2015-005003

CrossMark

To cite: Kontopantelis E, Springate DA, Ashcroft DM, *et al*. *BMJ Qual Saf* 2016;**25**:657–670.

ABSTRACT

Objectives The UK's Quality and Outcomes Framework permits practices to exempt patients from financially-incentivised performance targets. To better understand the determinants and consequences of being exempted from the framework, we investigated the associations between exception reporting, patient characteristics and mortality. We also quantified the proportion of exempted patients that met quality targets for a tracer condition (diabetes).

Design Retrospective longitudinal study, using individual patient data from the Clinical Practice Research Datalink.

Setting 644 general practices, 2006/7 to 2011/12.

Participants Patients registered with study practices for at least one year over the study period, with at least one condition of interest (2 460 341 in total).

Main outcome measures Exception reporting rates by reason (clinical contraindication, patient dissent); all-cause mortality in year following exemption. Analyses with logistic and Cox proportional-hazards regressions, respectively.

Results The odds of being exempted increased with age, deprivation and multimorbidity. Men were more likely to be exempted but this was largely attributable to higher prevalence of conditions with high exemption rates. Modest associations remained, with women more likely to be exempted due to clinical contraindication (OR 0.90, 99% CI 0.88 to 0.92) and men more likely to be exempted due to informed dissent (OR 1.08, 99% CI 1.06 to 1.10). More deprived areas (both for practice location and patient residence) were non-linearly associated with higher exception rates, after controlling for comorbidities and other covariates, with stronger associations for clinical contraindication. Compared with patients with a single condition, odds ratios for patients with two, three, or four or more conditions were respectively 4.28 (99% CI 4.18 to 4.38), 16.32 (99% CI 15.82 to 16.83) and 68.69 (99% CI 66.12 to 71.37) for contraindication, and 2.68 (99% CI 2.63 to 2.74), 4.02 (99% CI 3.91 to 4.13) and 5.17 (99% CI 5.00 to 5.35) for informed dissent. Exempted patients had a higher adjusted risk of death in the following year than non-exempted patients, regardless of whether this exemption was for contraindication (hazard ratio 1.37, 99% CI 1.33 to 1.40) or for informed dissent (1.20, 99% CI 1.17 to 1.24). On average, quality standards were met for 48% of exempted patients in the diabetes domain, but there was wide variation across indicators (ranging from 8 to 80%).

Conclusions Older, multimorbid and more deprived patients are more likely to be exempted from the scheme. Exception reported patients are more likely to die in the following year, whether they are exempted by the practice for a contraindication or by themselves through informed dissent. Further research is needed to understand the relationship between exception reporting and patient outcomes.

INTRODUCTION

Pay-for-performance programmes aim to improve patient care by providing financial incentives to providers for meeting quality targets. Major national schemes have been introduced in several countries over the past decade, including the

Quality and Outcomes Framework (QOF) in the UK,[1] the Hospital Value-Based Purchasing Program[2] and the Medicare Physician Quality Reporting System[3] in the USA, and the Practice Incentives Program in Australia.[4] Schemes implemented to date have had mixed success in improving processes of care[5–7] and there is conflicting evidence for their impact on patient outcomes.[8–13] Optimal programme designs remain elusive. One of the main challenges is to ensure that targets applied to whole populations are appropriate for individual patients, so that patient autonomy is respected and unnecessary investigations and treatments are avoided for those who will not benefit.

The UK's QOF programme provides incentives to family practices for meeting a wide range of clinical, organisational and patient experience targets.[1] Data on performance are extracted from practices' clinical computing systems and are collated in a national database (QMAS) and assessed at the end of each financial year. The scheme includes provisions for practices to exempt (or 'exception report') patients they deem inappropriate from single, multiple or all incentivised targets (box 1). Patients who refuse investigations and treatments can also be exempted, provided that the practice has discussed the reasons directly with the patient. Practices are not financially penalised if they miss quality targets for exempted patients, since these patients are not included in the annual calculation of quality achievement. The most common reasons for exception reporting are logistical (recent registration or diagnosis—41%), followed by informed dissent (30%) and clinical contraindication or unsuitability (26%).[14]

If used appropriately, exception reporting is a potentially effective tool for introducing some flexibility into national indicator sets. It allows doctors to exercise clinical judgement in the pursuit of quality targets and to tailor care according to individual circumstances. However, inappropriate use of exception reporting can undermine pay-for-performance programmes, potentially enabling practices to claim large financial rewards without providing the recommended level of care.[15 16] Initially, practices exempted relatively few patients (median 5.3%, IQR 4.0%–6.9% in 2005/2006),[17] but exemption rates have increased as quality targets have been made more challenging,[18 19] which might reflect more accurate recording of genuine exemptions or gaming to maximise income.[16 20]

Studies of exception reporting have been limited in two respects.[15 17] First, the levels of exception reporting are routinely reported at the practice level, and it is therefore not possible to examine the relationships between exception reporting, patient characteristics (such as age, sex and multimorbidity) and outcomes. Previous investigations have found that overall rates of exceptions under the QOF have been low, but there is wide variation between quality indicators (ranging from zero to 24%) and between practices.[14] This has raised concerns that particular groups of patients—for example, those living in more deprived areas, with particular conditions, or with multimorbidity—are more likely to be exception reported and, as a result, may have poorer health outcomes. Understanding these issues requires patient-level analysis. To date, patient-level analyses have been restricted to local areas and specific conditions, and have found that patients living in deprived areas, from ethnic minorities and with multimorbidity are more likely to be exception reported and are subsequently less likely to achieve treatment goals.[21]

Second, if a patient who has been exception reported subsequently meets the target (eg, if they initially refuse to have their blood pressure measured but later attend for monitoring or have blood pressure measured as part of other care) the exception report is overridden. Although a record of the original exception report remains on the practice's clinical computing system, the patient is not counted as an exception on the national QMAS database. This creates two classes of exempted patients: (1) those for whom the quality standards were *not* met, the numbers of which can be derived and are routinely reported on the QMAS database[22] and (2) those for whom the standards *were* met, the numbers of which cannot be derived from national data. Thus, the total percentage of patients who receive an exception code is higher than the nationally reported rate, which does not include patients for whom the exception report was subsequently overridden. However, the levels of both types of exemption are informative. For example, a high ratio of 'met' to 'unmet' clinical contraindication exemptions might suggest that the exception reporting provision is being applied too liberally in the first instance. For informed dissent, a high rate of 'met' exception reports might reflect dissenting patients reconsidering their original decision, either autonomously or under pressure from practices.

In this study, we used individual patient-level data to investigate: (1) patterns of exception reporting; (2) patient and practice predictors of exception reporting; (3) the associations between different types of exception reporting and mortality and (4) rates of both 'met' and 'unmet' exceptions for patients with a tracer condition (diabetes).

METHODS

Guidance for exception reporting is produced annually by NHE Employers,[23] and details of the recording of exceptions by practices have been previously described.[14] Exemptions are applied on an individual-patient basis using one of nine permitted reasons (box 1). However, practice clinical computing systems use a limited set of exception codes, and some reasons are conflated in the electronic patient record. For the

Box 1 Permissible reasons for exception reporting patients

Logistical
- The patient is newly diagnosed or recently registered with the practice*
- The investigative or secondary care service is unavailable to the practice

Clinical contraindication or unsuitability
- The patient has an allergy, another contraindication or has experienced an adverse reaction to the specified medication
- The patient has not tolerated medication
- The patient is on the maximum tolerated dose of medication, but levels remain suboptimal
- The patient has a supervening condition that makes treatment clinically inappropriate
- The patient is not appropriate due to particular circumstances, for example terminal illness or extreme frailty†

Informed dissent
- The patient refuses to attend†
- The patient does not agree to investigation or treatment‡

*Within 3 months in the case of measurement indicators (eg, measurement of blood pressure) and 9 months in the case of treatment and outcomes indicators (eg, control of blood pressure within target levels). The patient is excluded from all relevant indicators.
†Patient is excluded for the whole clinical domain (eg, all diabetes indicators).
‡Patient is excluded for this activity across all clinical domains (eg, measurement of blood pressure).

purposes of this study, exception reports were categorised under broad categories as: (1) logistical; (2) clinical contraindication or unsuitability; (3) informed dissent and (4) unknown reason. The latter group consists of patients who have been exempted from whole clinical domains, where the specific reason is not recorded. We did not examine logistical exemptions in our analyses, as these mainly relate to patients registered or diagnosed towards the end of each year.

Data sources

We extracted data from the Clinical Practice Research Datalink (CPRD), a database of individual patient records drawn from family practices in the UK using the Vision clinical computer system (used in approximately a fifth of all practices[24]). Available data include patient diagnoses, management and deaths. In July 2012, data were available for 645 practices and 13 772 992 patients. Data were linked to Office of National Statistics (ONS) data, allowing measurement of area deprivation (using the Index of Deprivation[25]) at the practice location. More detailed information on area deprivation measured at the patient's location[26] and on deaths verified by ONS were only available for a subgroup of 357 practices that had agreed to the additional linkages (covering approximately 60% of patients).

Study design: retrospective cohort

There was a major revision of the QOF scheme in 2006, therefore to ensure consistency in our longitudinal analyses we limited the study period to years 3–8 of the scheme (1 April 2006 to 31 March 2012). Practice performance on the QOF is measured across financial years and we divided the study period into six financial years (1 April to 31 March the following year). Within each year, we identified practices that reliably contributed data for the whole year.[27] Within each practice and study year, we selected patients registered with the practice for the full year and from these we identified patients with at least one condition of interest, at any point in time up to the end of the respective year.

Conditions of interest were those incentivised in the QOF from 2006 onwards: atrial fibrillation, asthma, hypertension, cancer, coronary heart disease, heart failure, chronic kidney disease, chronic obstructive pulmonary disease, dementia, depression, diabetes, epilepsy, learning disability, severe mental health, stroke and hypothyroidism. We excluded clinical domains that were not a condition (eg, palliative care), were concerned only with maintenance of a register (eg, obesity) or that were introduced in later years (eg, osteoporosis). All codes used in the study are available at http://www.clinicalcodes.org.[28]

Datasets

Using R V.3.1.1,[29] we generated three datasets with which we aimed to answer our main research questions. Dataset #1 included yearly aggregated exception reporting information for patients with at least one of the conditions of interest. Dataset #2 contained all recorded exception information for patients in dataset #1: Read exception code, type of exception, exception date and QOF indicators to which the exception applied. Dataset #3 focused on patients with diabetes aged 18 or over: diabetes diagnosis date, information on eligibility, achievement and exceptions for 15 clinical indicators that were included in the QOF diabetes domain for most or all of the study period. Full details are provided in the online supplementary appendix.

Analyses

Analyses were undertaken in Stata V.13.1, and an α level of 1% was used throughout.[30] However, statistical significance is not very informative in analyses of datasets of this size and we focus on the clinical significance of the effect sizes rather than p values.[31]

Using dataset #1, we descriptively examined the characteristics of patients who are exception reported and used regression modelling of practices with linked ONS data to investigate predictors of exception reporting and examined whether exemption is associated with mortality. Longitudinal random-effects logistic regression models were used to assess the effect of year, gender, age, the presence of each of the 16 conditions of interest (as binary variables), practice list size, region and deprivation on the presence of at least one relevant exception code. Alternative models included the number of relevant conditions (one, two, three, four or more) as predictors, in place of the individual conditions.

Proportional-hazards survival models with yearly time-windows were used to examine the associations between patient mortality and age, gender, smoking status (current, ex, never smoked, missing), area deprivation at the patient's location, each of the 16 conditions of interest, practice list size, area deprivation at the practice location and exception reports. Recorded information in each year was used to model survival or death in the subsequent year; that is, 2007/2008 deaths were predicted using 2006/2007 data, etc, up until 2011/2012 deaths predicted by 2010/2011 data. We introduced time-varying covariates, when needed, to ensure the proportional-hazard assumption stood. The relationship between exception reporting and mortality was investigated in two separate survival models. In the first, types of exception reporting (clinical contraindication, informed dissent and reason unknown) were included as separate predictors. In the second, all three reasons were aggregated into a single predictor. As sensitivity analyses, we calculated propensity scores (for all reasons, contraindication and informed dissent) as an alternative means of controlling for the role of the covariates on the probability of being exception reported.

We used dataset #2 to investigate the frequency of all relevant exception codes used over time. We aggregated the data at the practice level to calculate the number of exception codes per 1000 patients in each practice. Dataset #3 was used to descriptively provide insight on exception reported patients for which the relevant quality indicator (or indicators) was met, for all indicators in the diabetes domain and each financial year. Due to the complexity of fully mapping a QOF clinical domain in a primary care database, we were only able to perform this analysis for one condition. We selected diabetes as it has high prevalence and the greatest range of QOF indicators.

RESULTS

Between 2006/2007 and 2011/2012, 644 of the 645 CPRD practices were active, and a total of 2 460 341 patients were identified with at least one of the 16 conditions of interest (the respective figures for the ONS linked data were 1 470 461 patients and 357 practices). In 2006/2007, 569 practices were active (ie, provided data) with a total registered population of 5 321 351 patients, of which 1 602 366 patients (30.1%) had at least one of the examined QOF conditions. In 2011/2012, 499 practices were active with a total population of 5 069 748 patients, of whom 1 486 578 (29.3%) had at least one of the conditions.

Exemption rates over time are provided in table 1. Additional information on the characteristics of non-exempted and exempted patients, by exception reporting category, is provided in online supplementary appendix table A1. Prevalence rates for the modelled conditions are provided in online supplementary appendix table A2. The percentage of patients with an examined condition who had at least one exception reporting code remained relatively stable over the study period at 18.8%–19.9%. In 2011/2012, 12.4% of patients received at least one clinical contraindication code and 9.0% received an informed dissent code (figure 1). In 2011/2012, exception reporting rates for any reason (excluding logistical exceptions) ranged from 17.1% in South-Central England to 25.5% in Scotland. Rates increased with increasing area deprivation, both for practice location (18.1% in the least deprived quintile in 2011/2012 and 21.4% in the most deprived) and patient location (17.3% and 19.8%, respectively). On average, exempted patients were older than non-exempted patients (mean age 61.6 and 54.5, respectively, in 2011/2012) and men were exception reported more often than women (21.2% compared with 18.8%). Patients who died were more likely to have been exception reported in the previous year (41.4% for 2010/2011) than those who remained alive (19.5%). Percentages of patients receiving at least one exception code varied across conditions from 16.5% (in 2011/2012) for depression and learning disability to 46.2% for heart failure.

The most commonly reported specific reason for exception reporting was 'influenza vaccination declined', making up approximately 15% of all non-logistical exceptions within a year (see online supplementary appendix table A4). Other common reasons were 'asthma resolved' (5.4%), 'informed dissent for asthma indicators' (4.2%) and 'depression resolved' (3.5%).

Predictors of exception reporting

Use of exception reporting increased over time, especially for informed dissent (table 2). In our regression models, the odds of being exception reported increased with age. Men were more likely to be exempted than women for informed dissent (OR=1.08, 99% CI 1.06 to 1.10), but less likely for contraindications (OR=0.90, 99% CI 0.88 to 0.92). The odds of being exempted varied across clinical domains, at least partly reflecting opportunities to be exempted (odds of exception reporting for any reason

Table 1 Rates of exception reporting and characteristics of included patients, 2006/2007 to 2011/2012

	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012
Populations—all practices						
No of practices	569	566	565	556	534	499
Total list size	5 321 351	5 370 801	5 449 547	5 432 224	5 301 520	5 069 748
Patients with at least one of the 16 conditions (%)	30.1	30.0	30.1	30.0	29.8	29.3
Populations—ONS linkage						
No of practices	333	336	335	332	313	289
Total list size	3 257 681	3 362 641	3 408 043	3 415 997	3 271 321	3 157 801
Patients with at least one of the 16 conditions (%)	29.5	29.3	29.3	29.1	29.0	28.4
Exceptions: clinical contraindication						
Patients with one or more (%)	12.6	12.3	11.9	12.3	12.4	12.4
Patients with more than one (%)	3.7	3.8	3.4	3.3	3.2	3.2
Exceptions: informed dissent						
Patients with one or more (%)	8.0	8.6	8.3	8.6	9.2	9.0
Patients with more than one (%)	1.7	2.1	2.0	1.9	2.0	2.0
Exceptions: reason unknown (general)						
Patients with one or more (%)	0.2	0.2	0.2	0.1	0.1	0.1
Patients with more than one (%)	0.0	0.0	0.0	0.0	0.0	0.0
Exceptions: all reasons*						
Patients with one or more (%)	19.1	19.3	18.8	19.3	19.9	19.8
Patients with more than one (%)	6.1	6.5	5.9	5.8	6.0	5.8
Exceptions: clinical contraindication AND informed dissent						
Patients with one or more (%)	1.6	1.7	1.6	1.6	1.7	1.6
Patients with more than one (%)	0.2	0.2	0.2	0.2	0.2	0.2
By region: percentage of patients with one or more exception (all reasons)*						
English regions						
North East	18.2	19.0	17.3	19.0	19.0	18.7
North West	19.6	19.7	19.1	19.6	20.0	19.5
Yorkshire and Humber	17.8	18.6	18.1	18.3	18.7	20.5
East Midlands	21.9	19.6	22.2	20.1	20.5	20.7
West Midlands	15.8	16.6	16.3	16.8	18.4	18.6
East England	17.8	18.7	18.3	18.8	19.3	18.6
South West	19.6	20.8	20.7	21.3	22.5	23.3
South Central	17.0	16.8	16.7	17.4	18.0	17.1
London	18.8	17.8	16.4	17.1	17.8	16.8
South East	16.9	16.4	15.4	17.0	17.6	17.1
Country aggregates						
England	18.2	18.3	17.8	18.4	19.1	18.7
Northern Ireland	19.3	20.8	20.0	18.9	17.3	18.4
Scotland	22.2	21.8	22.0	23.3	24.3	25.5
Wales	23.5	24.3	22.7	22.7	23.1	22.7
By practice area deprivation quintile: percentage of patients with one or more exception (all reasons)*						
1 (least deprived)	18.0	18.0	17.3	17.3	18.3	18.1
2	18.0	19.0	18.6	18.9	19.6	20.1
3	19.9	19.7	18.8	19.5	20.4	20.4
4	19.9	19.6	19.4	19.9	20.1	19.1
5	19.6	20.0	19.5	20.8	21.4	21.4
By patient area deprivation quintile: percentage of patients with one or more exception (all reasons)†*						
1 (least deprived)	16.6	16.8	16.2	16.6	17.8	17.3
2	18.0	18.1	17.8	18.1	19.1	18.9
3	18.5	18.6	18.3	18.8	19.9	19.8
4	19.0	18.9	18.4	18.9	19.6	19.1
5	19.2	19.1	18.8	19.9	20.1	19.7

Continued

Table 1 Continued

	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012
By sex: percentage of patients with one or more exception (all reasons)*						
Female	17.9	18.0	17.6	18.0	18.7	18.8
Male	20.7	20.9	20.3	21.0	21.5	21.2
By smoking status: percentage of patients with one or more exception (all reasons)*						
Never	17.3	17.4	16.8	17.1	17.8	17.6
Ex-smoker	21.3	21.6	20.9	21.4	21.9	21.6
Smoker	17.8	17.4	17.1	18.0	18.7	19.1
Missing	11.2	10.5	9.8	9.8	10.2	10.0
By death in next year: percentage of patients with one or more exception (all reasons)*						
Alive	18.6	18.7	18.3	18.9	19.5	.
Dead	41.8	42.0	40.5	41.0	41.4	.
By condition: percentage prevalence rates in patients with one or more exception (all reasons)*						
Atrial fibrillation	40.5	42.4	41.0	41.3	41.4	40.7
Asthma	26.5	25.7	25.4	25.9	26.7	26.8
Hypertension	23.8	24.7	23.9	24.5	25.0	24.5
Cancer	19.8	20.3	19.6	19.9	20.4	19.8
Coronary heart disease	47.2	47.8	45.6	45.8	45.7	44.3
Heart failure	47.8	47.9	47.0	49.7	48.4	46.2
Chronic kidney disease	35.8	37.0	34.4	34.5	34.4	33.3
COPD	45.7	46.0	44.8	46.6	45.8	43.5
Dementia	38.5	38.8	36.8	37.5	38.3	36.7
Depression	14.3	14.1	14.0	14.9	16.0	16.5
Diabetes mellitus	36.7	38.3	36.8	38.6	38.6	36.7
Epilepsy	28.9	28.8	28.4	27.8	28.5	30.2
Learning disability	15.7	15.9	15.4	14.9	15.8	16.4
Severe mental illness	26.3	26.9	25.7	26.9	27.2	28.9
Stroke	42.0	42.1	40.1	40.1	40.6	39.1
Hypothyroidism	19.3	19.7	18.9	19.2	19.7	19.4
Means (SDs) for patients with one or more exceptions (all reasons*)						
Age‡	61.4 (20.4)	62.1 (19.9)	61.9 (19.8)	61.8 (19.6)	61.9 (19.5)	61.6 (19.3)
No of morbidities‡	2.3 (1.4)	2.3 (1.4)	2.3 (1.4)	2.3 (1.4)	2.3 (1.4)	2.3 (1.4)
BMI§	28.4 (6.4)	28.6 (6.6)	28.7 (6.7)	28.9 (6.8)	28.9 (6.6)	29.0 (6.7)
BMI missing (%)	50.0	51.2	50.9	50.8	50.7	50.2
Means (SDs) for patients without an exception						
Age‡	52.9 (19.7)	53.0 (19.5)	53.4 (19.5)	53.6 (19.4)	54.0 (19.2)	54.5 (19.1)
No of morbidities‡	1.5 (0.9)	1.5 (0.9)	1.5 (0.9)	1.5 (0.9)	1.6 (0.9)	1.6 (0.9)
BMI§	28.4 (6.4)	28.5 (6.5)	28.7 (6.6)	28.8 (6.7)	28.9 (6.6)	28.9 (6.6)
BMI missing (%)	60.6	62.7	61.3	61.2	60.6	59.5

*Clinical contraindication, informed dissent or reason unknown. Logistical exceptions were not included in analyses.
†Available for ONS linked patients only.
‡Data were complete for age and number of morbidities.
§Partially imputed using the *mibmi* algorithm.
BMI, body mass index; COPD, chronic obstructive pulmonary disease; ONS, Office of National Statistics.

was positively correlated with the number of indicators in the domain, Spearman's rho=0.73 for 2011/2012). The highest odds of a contraindication exception was observed for patients with coronary heart disease (OR=23.71, 99% CI 22.87 to 24.58) and the highest informed dissent odds for patients with diabetes (OR=5.38, 99% CI 5.25 to 5.52), compared with patients without each of the conditions, respectively (but with one of the investigated QOF conditions, in order for exceptions to be relevant). The odds of being exception reported for a contraindication increased with deprivation in the area the patient lived in, with the largest difference between the most and least affluent areas (OR=1.29, 99% CI 1.24 to 1.35). For informed dissent, however, the biggest differences were observed between the third and fourth quintile and the first (most affluent) quintile. When area deprivation was measured at the practice location, the odds of being exempted for a contraindication were highest for the third quintile (OR=1.84, 99% CI 1.76 to 1.92) and the odds of being exception reported for informed dissent were

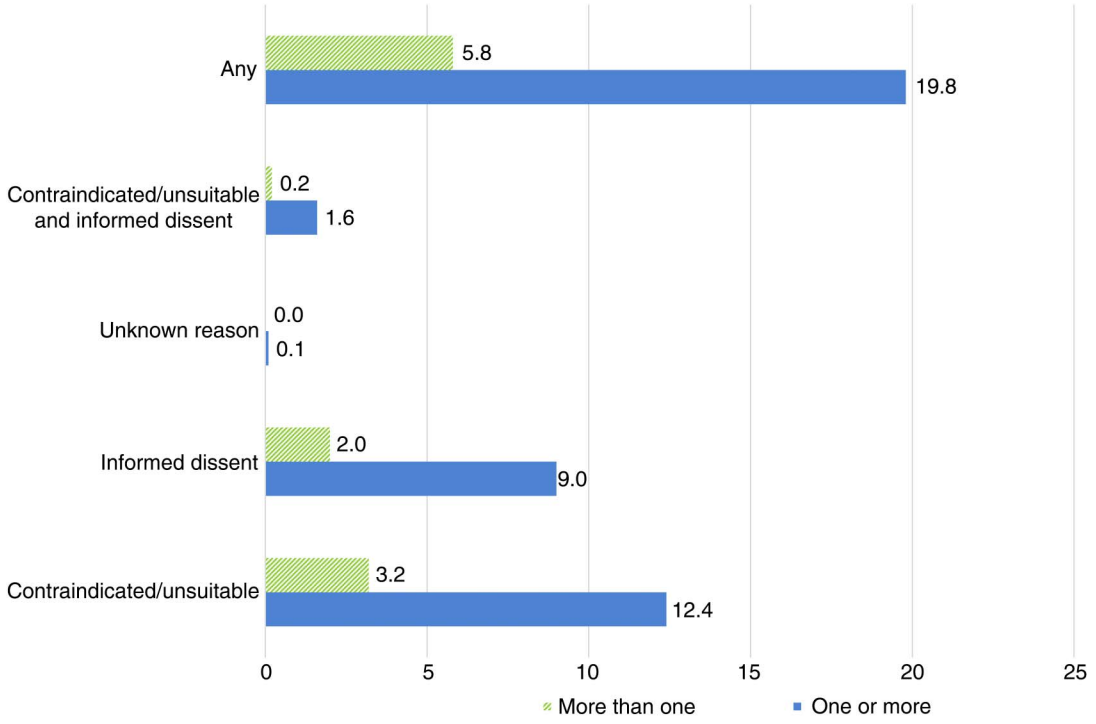


Figure 1 Exception reporting rates by reason for 2011/2012, the last year of the study.
*Unknown relates to global exceptions applied to the entire domain, where a specific reason for exclusion has not been recorded.

highest for the 5th (most deprived) quintile (OR=1.19, 99% CI 1.15 to 1.24).

In the models where we used the number of morbidities as predictor, rather than the individual conditions, the number of morbidities was a very strong predictor of both clinical contraindication and informed dissent exemptions (see online supplementary appendix table A5). Compared with patients with a single condition, ORs for patients with two, three or four or more conditions were, respectively 4.28 (99% CI 4.18 to 4.38), 16.32 (99% CI 15.82 to 16.83) and 68.69 (99% CI 66.12 to 71.37) for contraindication, and 2.68 (99% CI 2.63 to 2.74), 4.02 (99% CI 3.91 to 4.13) and 5.17 (99% CI 5.00 to 5.35) for informed dissent. Results for each QOF year and deprivation—both at practice and patient level—broadly agreed with models using individual conditions. However, we observed higher exception reporting odds for men on both contraindication (OR=1.40, 99% CI 1.37 to 1.44) and informed dissent exemptions (OR=1.53, 99% CI 1.49 to 1.56).

Exception reporting and survival in the following year

Findings were broadly similar across analyses of CPRD or ONS verified deaths, so, we discuss the results for the latter only. Patients with one or more informed dissent codes recorded had a 20% higher risk of death in the following year, compared with patients who were not exception reported (HR 1.20, 99% CI 1.17 to 1.24). The risk was higher for clinical contraindication and for patients exempted from the whole domain (for whom a specific reason for exemption is not available), with HRs of 1.37 (99% CI 1.33 to 1.40) and 1.39 (99% CI 1.22 to 1.58), respectively (table 3). Men (HR=1.28, 99% CI 1.25 to 1.31) and smokers (HR=1.61, 99% CI 1.55 to 1.66) had higher hazards of death. Area deprivation measured at the practice location did not predict mortality but deprivation at the patient location did; patients living in the most deprived quintile of areas had a higher risk of death (HR=1.32, 99% CI 1.27 to 1.37), compared with patients living in the most affluent quintile of areas. Interpretation of the condition coefficients is not straightforward due to potential collinearity and the inclusion of time-varying covariates.

In alternative models where we pooled all types of exception reports into a single predictor, patients with at least one exception code had a 38% higher risk of death in the following year (HR=1.38, 99% CI 1.35 to 1.41), compared with patients without a recorded exception report (see online supplementary appendix table A6). Under the propensity score controlled sensitivity analyses, the associations were even stronger. The HR was 1.63 (99% CI 1.59 to 1.66) for any exemption, 1.67 (99% CI: 1.63 to 1.71) for at least one clinical contraindication exemption and 1.35 (99% CI 1.31 to 1.39) for at least one informed dissent exemption.

Rates of met and unmet exemptions

Rates of 'met' exemptions in the diabetes domain varied from 1.0% for treatment of microalbuminuria (ie, 1.0% of patients with diabetes with

Table 2 Predictors of exception reporting (at least one exception code within each year and patient); logistic regression analyses on ONS linked data from 357 practices

	OR (99% CI)		
	All reasons*†	Clinical contraindication‡	Informed dissent§
QOF year			
2006/2007	Reference	Reference	Reference
2007/2008	1.03 (1.02 to 1.05)	0.93 (0.91 to 0.95)	1.14 (1.12 to 1.16)
2008/2009	0.99 (0.97 to 1.00)	0.91 (0.90 to 0.93)	1.08 (1.06 to 1.10)
2009/2010	1.09 (1.08 to 1.11)	1.021 (1.00 to 1.04)	1.18 (1.16 to 1.21)
2010/2011	1.30 (1.28 to 1.32)	1.15 (1.12 to 1.17)	1.44 (1.41 to 1.47)
2011/2012	1.27 (1.24 to 1.29)	1.15 (1.13 to 1.18)	1.34 (1.32 to 1.37)
List size			
Per 1000 increase	1.01 (1.01 to 1.01)	1.00 (0.99 to 1.00)	1.02 (1.02 to 1.03)
English region			
North East	Reference	Reference	Reference
North West	1.01 (0.95 to 1.08)	1.58 (1.45 to 1.72)	0.70 (0.65 to 0.74)
Yorkshire and The Humber	0.62 (0.58 to 0.67)	0.93 (0.85 to 1.03)	0.51 (0.47 to 0.55)
East Midlands	1.10 (1.02 to 1.19)	1.55 (1.40 to 1.72)	0.87 (0.81 to 0.95)
West Midlands	0.66 (0.62 to 0.70)	1.04 (0.95 to 1.13)	0.47 (0.44 to 0.50)
East of England	1.06 (0.99 to 1.13)	1.95 (1.79 to 2.13)	0.61 (0.57 to 0.65)
South West	1.07 (1.00 to 1.14)	1.88 (1.72 to 2.05)	0.65 (0.61 to 0.69)
South Central	0.84 (0.78 to 0.89)	1.27 (1.16 to 1.39)	0.62 (0.57 to 0.66)
London	0.64 (0.60 to 0.68)	0.94 (0.86 to 1.03)	0.52 (0.48 to 0.55)
South East Coast	0.68 (0.63 to 0.73)	0.96 (0.88 to 1.05)	0.57 (0.54 to 0.61)
Practice deprivation quintile			
1 (least deprived)	Reference	Reference	Reference
2	1.31 (1.27 to 1.36)	1.62 (1.56 to 1.69)	1.04 (1.00 to 1.07)
3	1.55 (1.50 to 1.61)	1.84 (1.76 to 1.92)	1.17 (1.13 to 1.22)
4	1.28 (1.24 to 1.33)	1.51 (1.44 to 1.57)	1.04 (1.01 to 1.08)
5	1.33 (1.28 to 1.38)	1.40 (1.34 to 1.47)	1.19 (1.15 to 1.24)
Gender			
Female	Reference	Reference	Reference
Male	1.01 (0.99 to 1.03)	0.90 (0.88 to 0.92)	1.08 (1.06 to 1.10)
Age			
Per 1-year increase	1.02 (1.02 to 1.03)	1.04 (1.03 to 1.04)	1.02 (1.01 to 1.02)
Patient deprivation quintile			
1 (least deprived)	Reference	Reference	Reference
2	1.06 (1.03 to 1.09)	1.12 (1.08 to 1.16)	1.00 (0.97 to 1.03)
3	1.10 (1.07 to 1.13)	1.10 (1.06 to 1.15)	1.10 (1.06 to 1.13)
4	1.15 (1.11 to 1.19)	1.14 (1.10 to 1.19)	1.16 (1.12 to 1.20)
5	1.16 (1.12 to 1.20)	1.29 (1.24 to 1.35)	1.07 (1.03 to 1.12)
Conditions¶			
Atrial fibrillation	3.11 (3.00 to 3.22)	5.33 (5.11 to 5.56)	1.06 (1.02 to 1.11)
Asthma	4.97 (4.86 to 5.09)	2.85 (2.77 to 2.93)	4.58 (4.47 to 4.69)
Hypertension	1.47 (1.44 to 1.50)	1.71 (1.67 to 1.76)	1.15 (1.13 to 1.18)
Cancer	0.96 (0.93 to 0.99)	1.18 (1.14 to 1.22)	0.80 (0.78 to 0.83)
Coronary heart disease	9.82 (9.54 to 10.11)	23.71 (22.87 to 24.58)	2.20 (2.14 to 2.27)
Heart failure	1.83 (1.74 to 1.92)	2.54 (2.40 to 2.70)	0.98 (0.93 to 1.03)
Chronic kidney disease	1.82 (1.78 to 1.87)	2.43 (2.36 to 2.51)	1.08 (1.05 to 1.11)
COPD	5.84 (5.63 to 6.07)	9.20 (8.78 to 9.64)	2.24 (2.15 to 2.33)
Dementia	2.24 (2.13 to 2.37)	3.25 (3.04 to 3.46)	1.02 (0.96 to 1.09)
Depression	0.94 (0.92 to 0.96)	1.81 (1.76 to 1.85)	0.52 (0.51 to 0.53)
Diabetes mellitus	6.35 (6.20 to 6.51)	5.06 (4.91 to 5.22)	5.38 (5.25 to 5.52)
Epilepsy	5.30 (5.01 to 5.60)	11.76 (11.00 to 12.59)	1.37 (1.29 to 1.47)

Continued

Table 2 Continued

	OR (99% CI)		
	All reasons*†	Clinical contraindication‡	Informed dissent§
Learning disability	1.10 (1.00 to 1.22)	1.75 (1.54 to 1.99)	0.66 (0.58 to 0.75)
Severe mental illness	4.38 (4.17 to 4.60)	4.42 (4.15 to 4.70)	2.83 (2.68 to 2.98)
Stroke	3.61 (3.48 to 3.73)	3.84 (3.68 to 4.01)	2.44 (2.35 to 2.53)
Hypothyroidism	0.87 (0.84 to 0.90)	0.93 (0.89 to 0.96)	0.84 (0.81 to 0.87)

*Clinical contraindication, informed dissent or reason unknown. Logistical exceptions were not included in analyses.
†No of observations=5 787 456, No of subjects=1 414 897, Log likelihood=−1 869 483, Wald χ^2=224 393.
‡No of observations=5 787 456, No of subjects=1 414 897, Log likelihood=−1 211 443, Wald χ^2=223 723.
§No of observations=5 787 456, No of subjects=1 414 897, Log likelihood=−1 249 265, Wald χ^2=87 458.
¶Reference: patients without the specific condition, but with one or more other study conditions.
COPD, chronic obstructive pulmonary disease; ONS, Office of National Statistics; QOF, Quality and Outcomes Framework.

microalbuminuria were both exempted for this indicator *and* received treatment) to 7.1% for control of HbA1c ≤10% (figure 2 and appendix figure A1). On average across the whole study period, quality standards were met for 48% of exempted patients, but this varied across indicators from 8% for the treatment of microalbuminuria (ie, 8% of patients exempted for this indicator were nevertheless treated) to 80% for the measurement of blood pressure (details on the indicators are provided in online supplementary appendix table A3). For simple processes such as blood pressure measurement or blood tests, the majority of exempted patients eventually received the incentivised care. Conversely, for more complex processes such as retinal screening and for treatments, only a minority received the incentivised care.

For the intermediate outcomes indicators, targets were achieved for the majority of exempted patients, with the exception of the indicator relating to tight glycaemic control (HbA1c ≤7.0/7.5%), for which only 29% of exceptions were met, compared with 60% for moderate glycaemic control (HbA1c ≤9.0/10.0%). Since the intermediate outcome indicators cannot be met without first meeting the respective process indicator (eg, the patient automatically fails the blood pressure control indicator if blood pressure is not measured), a proportion of patients who are eventually measured will therefore meet the intermediate outcome indicator without the practice changing their treatment.

DISCUSSION

Tailoring population-based guidelines to the needs and preferences of individual patients can be challenging, both for designers of guidelines and for clinicians applying them in practice. This challenge is further complicated in the context of pay-for-performance programmes: when clinicians are financially incentivised to apply guidelines, the risk of inappropriate care increases. The provision for practices to exception report patients under the UK's QOF is intended to obviate this risk and ensure shared decision making in the consultation process,[32–34] at a relatively low cost.[14] However, it may in turn result in patients who would benefit from inclusion in the quality scheme being inappropriately excluded. National guidance on exception reporting states that exempted patients should 'still be the recipients of best clinical care and practice'.[23] We found that quality standards are subsequently met for almost half of exempted patients. We also found that certain patient groups are more likely to be exempted, and that exempted patients have poorer outcomes. However, patients who are already in poor health are more likely to be exempted or to refuse treatments, and the complex relationships between exception reporting, health status and patient outcomes will require further investigation.

Limitations

First, this is an analysis of observational data and it is difficult to demonstrate causality, or even directionality in some cases. For example, while non-provision of recommended care may lead to poorer health outcomes and increase the risk of mortality, patients who are already in very poor health may also be more likely to refuse treatment and investigations. Even so, the relationship between informed dissent and mortality persisted after controlling for morbidities and other types of exceptions. Second, although our modelling approach attempted to replicate as closely as possible the processes by which exceptions are applied by practices, we cannot directly compare rates reported under the national QOF scheme and those we calculated using CPRD data. We used more inclusive code lists than what are used under the QOF rules, to better account for changes in recording practice and in the rules themselves over time.[7 27] Levels of exception reporting also varied across geographical areas. Although our CPRD sample was broadly nationally representative, some regions were over-represented and others were under-represented.[27] Third, CPRD collects data from practices that use a single computer system (Vision) and differences in recording routines might exist across clinical computer systems.[24] Fourth, reasons for exception reporting are not mutually exclusive, and we cannot assume that

Table 3 Exception reporting, by reason,* as a predictor of survival in the subsequent year; proportional-hazards survival analyses on ONS linked data from 357 practices

	HR (95% CI)†
Exception reported‡	
Clinical contraindication	1.37 (1.33 to 1.40)
Informed dissent	1.20 (1.17 to 1.24)
Unknown reason	1.39 (1.22 to 1.58)
Age§	1.07 (1.05 to 1.09)
Gender	
Female	Reference
Male	1.28 (1.25 to 1.31)
Smoking status	
Never smoked	Reference
Ex-smoker	0.97 (0.95 to 0.995)
Current smoker	1.61 (1.55 to 1.66)
Missing§	8.71 (1.23 to 61.63)
Patient deprivation quintile	
1 (least deprived)	Reference
2	1.06 (1.03 to 1.10)
3	1.12 (1.09 to 1.16)
4	1.20 (1.17 to 1.25)
5	1.32 (1.27 to 1.37)
Practice list size (1000 s)	1.000 (0.999 to 1.002)
Practice deprivation quintile	
1 (least deprived)	Reference
2	0.99 (0.96 to 1.02)
3	0.98 (0.94 to 1.01)
4	0.99 (0.95 to 1.02)
5	1.03 (0.99 to 1.07)
Conditions	
Atrial fibrillation	1.32 (1.29 to 1.36)
Asthma	0.91 (0.88 to 0.94)
Hypertension	0.90 (0.88 to 0.92)
Cancer§	1.60 (1.11 to 2.31)
Coronary heart disease	0.97 (0.95 to 0.997)
Heart failure	1.68 (1.62 to 1.73)
Chronic kidney disease§	1.60 (1.13 to 2.27)
Chronic obstructive pulmonary disease	1.72 (1.67 to 1.77)
Dementia§	3.07 (1.85 to 5.11)
Depression	1.06 (1.03 to 1.08)
Diabetes mellitus§	1.39 (0.94 to 2.06)
Epilepsy	1.68 (1.58 to 1.80)
Learning disability§	8.85 (0.33 to 234.09)
Severe mental illness	1.43 (1.35 to 1.51)
Stroke	1.32 (1.29 to 1.36)
Hypothyroidism	0.99 (0.96 to 1.02)
Time-varying (× log(_t))	
Age	1.01 (1.00 to 1.01)
Smoking status: missing	0.34 (0.13 to 0.88)
Cancer	1.21 (1.01 to 1.43)
Chronic kidney disease	0.87 (0.74 to 1.03)
Dementia	0.89 (0.70 to 1.14)
Diabetes mellitus	0.94 (0.78 to 1.13)
Learning disability	0.53 (0.11 to 2.67)

Based on ONS deaths. Number of observations / time at risk=4416374, Number of subjects=1194389 (excluding data for 2011/12 since survival information for the following year was not available), Number of failures=68756, Log pseudolikelihood=−869469, Wald Chi2=120783.
*Clinical contraindication, informed dissent or reason unknown. Logistical exceptions were not included in analyses.
†Based on ONS deaths. No of observations/time at risk=4 416 374, No of subjects=1 194 389, No of failures=68 756, Log pseudolikelihood=−869 469, Wald χ^2=120 783.
‡At least one code within each category.
§Interpretation of the HRs for these covariates is not straightforward because of the inclusion of the time-varying components.
ONS, Office of National Statistics.

patients giving informed dissent do not also have a contraindication, although a practice would not need to obtain a reason for dissent if a contraindication was recorded. Fifth, analyses of primary care databases rest on the assumption that GPs accurately record consultations in their clinical computer systems, and for the purposes of this study that, for example, informed dissent exemptions are recorded as such. Although we cannot be certain this is the case, the very low usage of generic codes is an indication that practices have sought to record the reason for exception reporting. Sixth, overall mortality may not be a sensitive enough measure and cause-specific mortality for each condition of interest linked to exceptions from specific relevant indicators, although answering a slightly different research question, could potentially provide a more informative clinical picture. Finally, although we used all QOF conditions to define our cohort (which include all major conditions), most conditions are not included in QOF and our analyses therefore investigate the relationship between QOF-specific multimorbidity and outcomes.

Findings

The likelihood of being exception reported under the pay-for-performance scheme varied with patient characteristics. In the regression models, older people, women and patients in less affluent areas were more likely to be exception reported for a clinical contraindication. This broadly agrees with previous findings for patients with diabetes in North West London.[21] Patterns were similar for informed dissent, but men were more likely to be exception reported than women. The higher overall raw rates of exception reporting in men are largely attributable to higher prevalence of conditions such as coronary heart disease and diabetes.[35 36] Patients with these conditions were more likely to have one or more exception reports, as were patients with chronic obstructive pulmonary disease or epilepsy. The probability of being exempted increased sharply with the number of chronic conditions: compared with patients with a single condition, patients with two conditions were four times more likely to be exempted for a contraindication and patients with four or more conditions were almost 70 times more likely. This finding was expected, as the presence of a supervening condition or extreme frailty are the criteria for exemption. However, we also found that multimorbid patients were more likely to refuse monitoring and treatment under the scheme. This raises questions about the appropriateness of incentive frameworks and guidelines based on single conditions.[37]

Greater area deprivation was also associated with higher exception rates. In our results, this is mainly driven by clinical contraindication exemptions and to a smaller extent by refusal of treatment. It seems

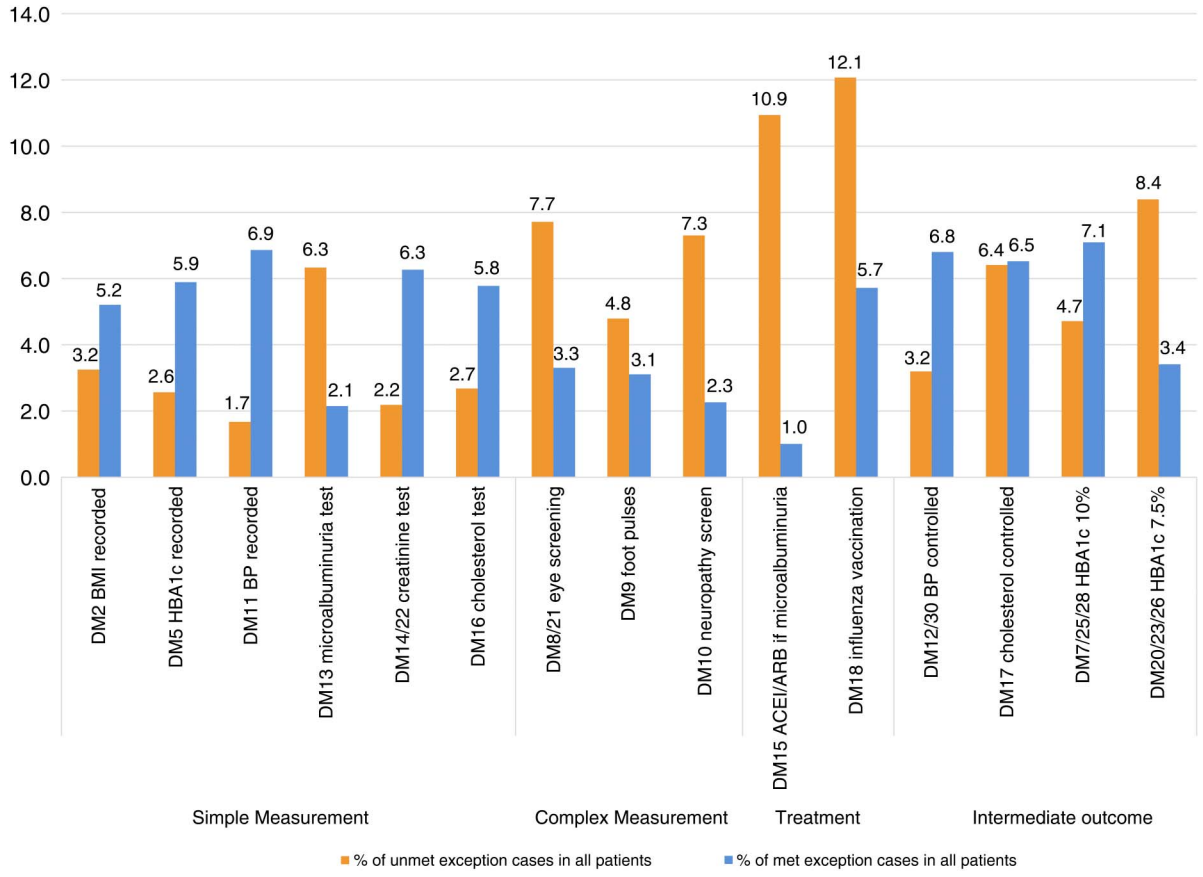


Figure 2 Exception reporting rates in the diabetes domain of the Quality and Outcomes Framework (QOF), aggregated over time. *Details on the indicators are provided in online supplementary appendix table A3. †DM9 changes significantly in 2011/2012 so calculations for that indicator are limited to 2006/2007–2010/2011. ‡Patients with documented proteinuria are exempted for indicator DM13.

likely that the poorer health of patients residing in more deprived areas leads to more contraindication exceptions, although refusal is also a factor, possibly driven by health experiences, education or other aspects of deprivation that are captured in the index of multiple deprivation. However, we observed a stronger (and a non-linear) relationship between exception reporting and area deprivation measured at the practice location than at the patient location, especially for contraindications, with the highest rates observed for the middle deprivation quintile. This suggests that exception reporting usage varies with practice location deprivation, above what would be expected from the average deprivation of the practice population. A possible explanation for the non-linear nature of the effect is that patients are more likely to be undiagnosed in the most deprived practices, and hence less likely to be exception reported due to contraindication. Alternatively, practices in the most deprived areas might be performing well in terms of case finding, but might not use contraindication exception reports as much as practices in more affluent areas. In either case, it is possible that recording of exceptions is less complete in practices located in the most deprived areas.

With respect to mortality, we observed several well-known relationships: men, smokers, patients residing in more deprived areas and multimorbid patients had a higher probability of dying. Controlling for these factors, we found that patients receiving one or more exception codes, of any type, were more likely to die the following year. Compared with patients with no exceptions, mortality rates were the highest for contraindication exceptions (≈37% higher) and also significantly higher for informed dissent exceptions (≈20% higher). For contraindication exception reporting, we can reasonably assume that the relationship with mortality is confounded by multimorbidity and overall health: less healthy patients are more likely to have a contraindication, intolerance or terminal illness.

Similar confounding is also likely to occur for informed dissent, but the strength of the confounding is likely to be weaker (multimorbidity, a reasonable proxy for overall health, was a weaker predictor of informed dissent than of contraindications). However, in the survival analyses we controlled for all major conditions and also used propensity scores as an alternative way to control for confounders of the effect of informed dissent on mortality and the effect persisted. Although there is a risk of unmeasured confounding

(eg, multimorbidity not captured by the QOF conditions), it does appear that refusal of QOF investigations and treatments is linked to poorer outcomes. However, previous investigations have questioned the effectiveness of some QOF indicators[36] and have failed to identify a link between performance on QOF indicators and mortality.[12] Therefore, although informed dissent under the QOF might have no direct effect on survival, it might be a proxy for non-adherence with the advice and recommendations of health professionals generally, or of other risk-prone or unhealthy behaviours.[38] Informed dissent potentially identifies a group of patients for whom it would be appropriate to design and evaluate more tailored interventions to optimise care according to their preferences.

Finally, within the diabetes indicator set, we saw that the levels of 'met' exception reporting are not negligible and are high for some indicators, indicating that the exception reporting provision is used more often than previously reported under the QOF scheme. For example, for indicators relating to blood pressure measurement and control, 'met' exemption rates were higher than the 'unmet' rates reported under the QOF. This finding is in agreement with previous work that reported high met exemption rates for influenza immunisation.[27] The high observed met exception reporting rates for most indicators suggests that health professionals are often successful in delivering incentivised care to patients who were initially exempted, whether for reasons of contraindication or informed dissent. This appears to be more likely to occur for more straightforward measurement activities (eg, blood pressure measurement), which are easier to deliver if the patient attends for routine care, compared with more complex activities and interventions (eg, diabetic eye screening). Similarly, there were more met exceptions for the less challenging of the two glycaemic control targets.

CONCLUSIONS

Older, male, more multimorbid and more socioeconomically deprived patients are more likely to be exempted from the UK's QOF. Furthermore, patients who are exception reported are more likely to die in the following year, whether they were exempted by the practice for a contraindication or by themselves through informed dissent. In most cases, this may be entirely appropriate, as an exemption will often be an indication of the practice recognising the limitations imposed by existing poor health or respecting the wishes of frail patients in a shared decision-making process.[14 34] It appears that the exception reporting provisions in the scheme are generally being used properly by practices to tailor national guidelines to individual patients' circumstances and preferences.[39] However, the greater use of exception reporting in particular patient groups raises questions about whether the QOF is contributing to healthcare inequalities, with practices serving such patients using exception reporting, legitimately or otherwise, in response to difficulties in engaging patients who are less able or willing to attend routine chronic disease clinics.[20] The QOF payment system makes no allowance for differences in the work required to deliver care to different patient groups. Similarly, the association between informed dissent exception reporting and higher mortality again highlights that there may be opportunities for more tailored approaches for groups of patients for whom the one-size-fits-all approach of QOF sits uncomfortably. There are lessons here for designers of other incentive schemes, who must balance the requirement for consistent targets with the need to include mechanisms that allow for the exercise of discretion by clinicians and autonomy by patients. Further explorations of the relationships between the exact reasons for exception reporting and cause-specific mortality are needed to ensure that patients are receiving the optimum benefit from incentivisation interventions.

Author affiliations
[1]NIHR School for Primary Care Research, Centre for Primary Care, Institute of Population Health, University of Manchester, Manchester, UK
[2]Centre for Health Informatics, Institute of Population Health, University of Manchester, Manchester, UK
[3]Centre for Biostatistics, Institute of Population Health, University of Manchester, Manchester, UK
[4]Centre for Pharmacoepidemiology and Drug Safety, Manchester Pharmacy School, University of Manchester, Manchester, Uk
[5]Patient Centred Care, APEx Collaboration for Academic Primary Care, Medical School, University of Exeter, Exeter, UK
[6]Population Health Sciences Division, Medical Research Institute, University of Dundee, Dundee, Uk
[7]Department of Health Sciences, University of York, York, UK

Twitter Follow Tim Doran at @narodmit and Evangelos Kontopantelis at @dataevan

Contributors EK and TD designed the study. DAS extracted the data. EK performed the statistical analyses. EK and TD wrote the manuscript. DR, DAS, DMA, BG, JMV and SNvdV were involved in interpreting the findings and editing the manuscript. EK is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Funding NIHR School for Primary Care Research (Project #141); Medical Research Council; Health eResearch Centre grant MR/K006665/1.

Competing interests EK was partly supported by a NIHR School for Primary Care Research fellowship in primary healthcare; TD was supported by a NIHR Career Development Fellowship.

Ethics approval ISAC approval, protocol 12_147Ra.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement Clinical Practice Research Datalink data cannot be shared due to licensing restrictions.

REFERENCES

1 Roland M. Linking physicians' pay to the quality of care—a major experiment in the United Kingdom. *N Engl J Med* 2004;351:1448–54.
2 Centers for Medicare & Medicaid Services (CMS), HHS. Medicare program; hospital inpatient value-based purchasing program. Final rule. *Fed Regist* 2011;76:26490–547.
3 Centers for Medicare & Medicaid Services (CMS), HHS. Medicare program; hospital inpatient prospective payment systems for acute care hospitals and the long-term care hospital prospective payment system and fiscal year 2015 rates; quality reporting requirements for specific providers; reasonable compensation equivalents for physician services in excluded hospitals and certain teaching hospitals; provider administrative appeals and judicial review; enforcement provisions for organ transplant centers; and electronic health record (EHR) incentive program. Final rule. *Fed Regist* 2014;79:49853–50536.
4 Australia M. Practice incentives program. Sydney: Australian Government, 2011.
5 Campbell SM, Reeves D, Kontopantelis E, *et al*. Effects of pay for performance on the quality of primary care in England. *N Engl J Med* 2009;361:368–78.
6 Doran T, Kontopantelis E, Valderas JM, *et al*. Effect of financial incentives on incentivised and non-incentivised clinical activities: longitudinal analysis of data from the UK Quality and Outcomes Framework. *BMJ* 2011;342:d3590.
7 Kontopantelis E, Reeves D, Valderas JM, *et al*. Recorded quality of primary care for patients with diabetes in England before and after the introduction of a financial incentive scheme: a longitudinal observational study. *BMJ Qual Saf* 2013;22:53–64.
8 Dusheiko M, Doran T, Gravelle H, *et al*. Does higher quality of diabetes management in family practice reduce unplanned hospital admissions? *Health Serv Res* 2011;46:27–46.
9 Purdy S, Griffin T, Salisbury C, *et al*. Emergency respiratory admissions: influence of practice, population and hospital factors. *J Health Serv Res Policy* 2011;16:133–40.
10 Bottle A, Gnani S, Saxena S, *et al*. Association between quality of primary care and hospitalization for coronary heart disease in England: national cross-sectional study. *J Gen Intern Med* 2008;23:135–41.
11 Harrison MJ, Dusheiko M, Sutton M, *et al*. Effect of a national primary care pay for performance scheme on emergency hospital admissions for ambulatory care sensitive conditions: controlled longitudinal study. *BMJ* 2014;349:g6423.
12 Kontopantelis E, Springate DA, Ashworth M, *et al*. Investigating the relationship between quality of primary care and premature mortality in England: a spatial whole-population study. *BMJ* 2015;350:h904.
13 Flodgren G, Eccles MP, Shepperd S, *et al*. An overview of reviews evaluating the effectiveness of financial incentives in changing healthcare professional behaviours and patient outcomes. *Cochrane Database Syst Rev* 2011;(7):CD009255.
14 Doran T, Kontopantelis E, Fullwood C, *et al*. Exempting dissenting patients from pay for performance schemes: retrospective analysis of exception reporting in the UK Quality and Outcomes Framework. *BMJ* 2012;344:e2405.
15 Doran T, Fullwood C, Gravelle H, *et al*. Pay-for-performance programs in family practices in the United Kingdom. *N Engl J Med* 2006;355:375–84.
16 Gravelle H, Sutton M, Ma A. Doctor behaviour under a pay for performance contract: treating, cheating and case finding? *Econ J* 2010;120:F129–56.
17 Doran T, Fullwood C, Reeves D, *et al*. Exclusion of patients from pay-for-performance targets by English physicians. *N Engl J Med* 2008;359:274–84.
18 Kontopantelis E, Doran T, Gravelle H, *et al*. Family doctor responses to changes in incentives for influenza immunization under the U.K. Quality and Outcomes Framework pay-for-performance scheme. *Health Serv Res* 2012;47:1117–36.
19 Pape U, Huckvale K, Car J, *et al*. Impact of 'stretch' targets for cardiovascular disease management within a local pay-for-performance programme. *PLoS One* 2015;10:e0119185.
20 Campbell S, Hannon K, Lester H. Exception reporting in the Quality and Outcomes Framework: views of practice staff—a qualitative study. *Br J Gen Pract* 2011;61:183–9.
21 Dalton AR, Alshamsan R, Majeed A, *et al*. Exclusion of patients from quality measurement of diabetes care in the UK pay-for-performance programme. *Diabet Med* 2011;28:525–31.
22 Prescribing and Primary Care Services HSCIC. Quality and Outcomes Framework—Prevalence, Achievements and Exceptions Report: England, 2013–14. Health & Social Care Information Centre, 2014:63. http://www.hscic.gov.uk/catalogue/PUB15751/qof-1314-report.pdf
23 NHS Employers. *Quality and Outcomes Framework guidance for GMS contract 2013/14*. NHS Employers, 2013. http://bma.org.uk/-/media/files/pdfs/practical%20advice%20at%20work/contracts/gpqofguidance20132014.pdf
24 Kontopantelis E, Buchan I, Reeves D, *et al*. Relationship between quality of care and choice of clinical computing system: retrospective analysis of family practice performance under the UK's quality and outcomes framework. *BMJ Open* 2013;3:e003190.
25 Communities and Local Government. The English indices of deprivation 2010. Technical Report. Government DfCaL, 2011. http://www.communities.gov.uk/documents/statistics/pdf/1870718.pdf
26 McLean G, Guthrie B, Watt G, *et al*. Practice postcode versus patient population: a comparison of data sources in England and Scotland. *Int J Health Geogr* 2008;7:37.
27 Kontopantelis E, Springate D, Reeves D, *et al*. Withdrawing performance indicators: retrospective analysis of general practice performance under UK Quality and Outcomes Framework. *BMJ* 2014;348:g330.
28 Springate DA, Kontopantelis E, Ashcroft DM, *et al*. ClinicalCodes: an online clinical codes repository to improve the validity and reproducibility of research using electronic medical records. *PLoS One* 2014;9:e99825.
29 R: a language and environment for statistical computing [program]. 3.1.1 version. R Foundation for Statistical Computing, 2013.
30 Stata Statistical software for Windows [program]. 13.1 version, 2013.
31 Lin MF, Lucas HC, Shmueli G. Too big to fail: large samples and the p-value problem. *Inform Syst Res* 2013;24:906–17.

32 Elwyn G, Edwards A, Kinnersley P, *et al*. Shared decision making and the concept of equipoise: the competences of involving patients in healthcare choices. *Br J Gen Pract* 2000;50:892–9.

33 Stiggelbout AM, Van der Weijden T, De Wit MP, *et al*. Shared decision making: really putting patients at the centre of healthcare. *BMJ* 2012;344:e256.

34 Elwyn G, Frosch D, Thomson R, *et al*. Shared decision making: a model for clinical practice. *J Gen Intern Med* 2012; 27:1361–7.

35 O'Flaherty M, Ford E, Allender S, *et al*. Coronary heart disease trends in England and Wales from 1984 to 2004: concealed levelling of mortality rates among young adults. *Heart* 2008;94:178–81.

36 Kontopantelis E, Springate DA, Reeves D, *et al*. Glucose, blood pressure and cholesterol levels and their relationships to clinical outcomes in type 2 diabetes: a retrospective cohort study. *Diabetologia* 2015;58:505–18.

37 Hughes LD, McMurdo MET, Guthrie B. Guidelines for people not for diseases: the challenges of applying UK clinical guidelines to people with multimorbidity. *Age Ageing* 2013;42:62–9.

38 Curtis JR, Larson JC, Delzell E, *et al*. Placebo adherence, clinical outcomes, and mortality in the women's health initiative randomized hormone therapy trials. *Med Care* 2011;49:427–35.

39 Hopayian K. Exception reporting as a quality marker. *Br J Gen Pract* 2013;63:315–5.

Online appendix for "Investigating the characteristics and outcomes of patients excluded from the UK's primary care pay-for-performance programme: a retrospective cohort study"

Methods

Recording of exception reporting

Family practices record diagnoses, referrals, processes of care (including QOF-related activities) and exception reporting of patients on their clinical computing systems using a hierarchical coding set ('Read' codes). Practice level data are collated in the national Quality and Management Analysis System (QMAS) and practice performance against QOF targets is assessed annually. For each clinical indicator, achievement is calculated as the number of patients for whom the target was met divided by the number of eligible patients. For example, for indicator DM11, eligible patients are those with a diagnosis of diabetes (the denominator) and the target is met if they have a recording of blood pressure within 15 months of the end of the financial year (the numerator). Patients who are exception reported are excluded from the denominator. However, if a patient who has been exception reported also meets the target in the assessment period, the exception report is overridden and they are included in both the numerator and denominator.

Data source

National exception reporting data are only available at the practice level through QMAS, and the individual characteristics of exception reported patients cannot be directly assessed. We therefore extracted data from the Clinical Practice Research Datalink (CPRD), a database of individual patient records drawn from family practices using the Vision clinical computer system (installed in approximately a fifth of practices[1]). In July 2012, data were available for 645 practices and 13,772,992 patients. Anonymised electronic patient data were linked to Office of National Statistics (ONS) mortality data and to area deprivation quintile, as measured by the 2010 Index of Multiple Deprivation (IMD) in England.[2] However, patient deprivation quintile[3] and verified deaths were only available for a subgroup of English practices that have agreed to the linkages.

Study design: retrospective cohort

The Quality and Outcomes Framework was introduced on 1 April 2004 and is reviewed annually. In a major revision in 2006: new clinical domains were introduced (for example, dementia, depression, learning disability, palliative care), several indicators were re-structured (for example, condition specific smoking indicators were amalgamated into a single smoking domain) and payment thresholds were changed.[4] To ensure consistency in our longitudinal analyses we limited the study period to years 3 to 8 of the scheme (1 April 2006 to 31 March 2012), after the major revision. Practice performance on the QOF is measured across financial years and we therefore divided the study period into six financial years (1 April to 31 March the following year). Within each year we identified practices that reliably contributed data for the whole year, the characteristics of which have been described elsewhere.[5] Within each practice and study year, we selected patients registered with the practice for the full year and from these we identified patients with at least one condition of interest, at any point in time up to the end of the respective year.

Conditions of interest were those incentivised in the QOF from 2006 onwards: atrial fibrillation, asthma, hypertension, cancer, coronary heart disease, heart failure, chronic kidney disease, chronic obstructive pulmonary disease, dementia, depression, diabetes, epilepsy, learning disability, severe mental health, stroke and hypothyroidism. We excluded clinical domains that were not a condition (e.g. palliative care), were concerned only with maintenance of a register (e.g. obesity), or that were introduced in later years (e.g. osteoporosis). We used an inclusive approach in our case finding, to better account for changes in code usage over time. In addition to the QOF business rule code sets (the algorithms used for the identification of patients in the incentive scheme) we also used clinician-identified relevant keywords to generate unrefined, inclusive lists of Read and other clinical activity codes. Two clinicians independently reviewed these lists and reached consensus on a conservative list of codes (indicating the presence of the respective condition with a high degree of certainty). All codes used in the study are available from www.clinicalcodes.org.[6] All conditions, with the exception of asthma, depression and epilepsy, were treated as chronic and unresolvable. Patients with one of the three resolvable conditions were considered condition-free if a code denoting resolution was observed, from that time onwards.

Datasets

Using R version 3.1.1,[7] we generated three datasets with which we aimed to answer our main research questions. Dataset #1 included yearly aggregated exception reporting information for patients with at least one of the conditions of interest (one record per patient, in each year). Exceptions were categorised as: i) clinical contraindication or unsuitability; ii) informed dissent; iii) unknown (where the precise reason for exclusion is not available). We did not examine logistical exceptions, as these mainly relate to patients registered or diagnosed towards the end of each year and we did not expect exclusion on the basis of registration date to be associated with mortality, given that the exception only applies in the index year. Patient data included age, sex, smoking status, Body Mass Index (BMI), patient location deprivation quintile, first diagnosis date for each study condition (if applicable), practice list size, region and practice deprivation quintile. We used the *mibmi* algorithm in Stata to interpolate BMI values over time, allowing us to make use of a more complete dataset.[8] Dataset #2 contained all recorded exception information for patients in dataset #1 (i.e. patients with at least one of the conditions of interest): Read exception code, type of exception, exception date and QOF indicators to which the exception applied. Dataset #3 focused on patients with diabetes aged 18 or over (one record per patient, in each year): diabetes diagnosis date, information on eligibility, achievement and exception for 15 clinical indicators that were included in the QOF diabetes domain for most (if not all) of the study period. Included indicators were modelled using diagnostic codes, but we also used codes relating to medications, tests undertaken and test results where appropriate.[9] In addition, some indicators have undergone small or moderate changes over time and we aimed to model these within each year. Details for the indicators are provided in appendix table A3.

Analyses

All analyses were undertaken in Stata v13.1 and an alpha level of 1% was used throughout.[10] However, statistical significance is not very informative in analyses of datasets of this size (even very small absolute differences will usually be statistically significant) and we focus on the clinical significance of the effect sizes rather than p-values.

Using dataset #1 we descriptively examined the characteristics of patients who are exception reported and through regression modelling, focusing only on practices with linked ONS data,

we investigated predictors of exception reporting and examined whether exception reporting is associated with mortality. Longitudinal random-effects logistic regression models with the *xtlogit* command and the patient identifier as the panel variable were used to assess the effect of year, gender, age, number of relevant conditions (one, two, three, four or more), practice list size, region and deprivation on presence of at least one relevant exception code. Alternative models included each of the 16 conditions of interest as predictors, rather than an overall measure of multimorbidity.

Proportional-hazards survival models with the *stcox* command and yearly time-windows were used to examine the associations of age, gender, smoking status (current, ex, never smoked, missing), patient deprivation, each of the 16 conditions of interest, practice list size, practice deprivation quintile and exceptions on CPRD and ONS mortality. Since recorded clinical information, including exceptions, was more likely to be missing in the year of a patient's death (less time for events to be recorded in), and to avoid introducing a form of 'reverse' censorship bias, we introduced a 1-year lag into the analysis model. Therefore, recorded information in each year was used to model survival or death in the subsequent year; i.e. 2006/7 predictor data were linked to 2007/8 deaths, et cetera, up until 2010/11 predictors linked to 2011/12 deaths. We introduced time-varying covariates for age, smoking status, cancer, coronary heart disease, dementia, diabetes and learning disability, modelling a logarithmic increase in risk, to ensure the proportional-hazard assumption stood (tested using Schoenfeld residuals and command *estat phtest*). The relationship between being exception reported and mortality was investigated in two separate survival models: in the first, types of exception reporting (clinical contraindication, informed dissent and reason unknown) were coded and analysed separately, and in the second by type all reasons were aggregated into a single predictor. As sensitivity analyses, we calculated propensity scores (for all reasons, contraindication and informed dissent) which we used to better control for the role of the covariates (all we included in the main model) on the probability of being exception reported.

We used dataset #2 to investigate the frequency of all relevant exception codes used over time and to visualise the seasonality of exception reporting. We aggregated the data at the practice level to calculate the number of exception codes per 1000 patients in each practice. We then used a random-effects negative binomial regression model with the *xtnbreg* command (practice identifier used as panel variable) to quantify the monthly seasonality of

these overall exception rates, controlling for practice list size, year and deprivation quintile. Negative binomial regression was selected over Poisson, since initial findings indicated considerable over-dispersion of the count data.

Dataset #3 was used to descriptively provide insight on exception reported patients for which the relevant quality indicator (or indicators) was met, for all indicators in the diabetes domain and each financial year. Since only exceptions for which the relevant indicators are not met are reported under the QMAS, we calculated the 'met' and 'unmet' levels of exception reporting for the diabetes domain, over time. These rates can provide some insight on the use of the exception reporting provision, for each indicator. For each indicator, the reasons for exception reporting patients did not differ substantially between met and unmet exemptions (figure A1). For example, for tight glycaemic control (HbA1c ≤7.0/7.5%), contraindications comprised 58% of met exemptions and 59% of unmet exemptions. For moderate glycaemic control (HbA1c ≤9.0/10.0%) the respective proportions were 51% and 53%.

References

1. Kontopantelis E, Buchan I, Reeves D, Checkland K, Doran T. Relationship between quality of care and choice of clinical computing system: retrospective analysis of family practice performance under the UK's quality and outcomes framework. *BMJ open* 2013;3.
2. Communities and Local Government. The English Indices of Deprivation 2010: Technical Report. Government DfCaL, 2011. http://www.communities.gov.uk/documents/statistics/pdf/1870718.pdf
3. McLean G, Guthrie B, Watt G, Gabbay M, O'Donnell CA. Practice postcode versus patient population: a comparison of data sources in England and Scotland. *International journal of health geographics* 2008;7:37.
4. Newman SC, Bland RC. Mortality in a Cohort of Patients with Schizophrenia - a Record Linkage Study. *Can J Psychiat* 1991;36:239-45.
5. Kontopantelis E, Springate D, Reeves D, Ashcroft DM, Valderas JM, Doran T. Withdrawing performance indicators: retrospective analysis of general practice performance under UK Quality and Outcomes Framework. *Bmj* 2014;348:g330.
6. Springate DA, Kontopantelis E, Ashcroft DM, Olier I, Parisi R, Chamapiwa E, et al. ClinicalCodes: an online clinical codes repository to improve the validity and reproducibility of research using electronic medical records. *PloS one* 2014;9:e99825.
7. R: A Language and Environment for Statistical Computing [program]. 3.1.1 version: R Foundation for Statistical Computing,, 2013.

8. Kontopantelis E, Parisi R, Reeves D, Springate DA. Longitudinal multiple imputation approaches for Body Mass Index: the mibmi command. *The Stata Journal* 2015.
9. Kontopantelis E, Reeves D, Valderas JM, Campbell S, Doran T. Recorded quality of primary care for patients with diabetes in England before and after the introduction of a financial incentive scheme: a longitudinal observational study. *BMJ quality & safety* 2013;22:53-64.
10. Stata Statistical software for Windows [program]. 13.1 version, 2013.

Table A1: Characteristics of excepted and non-excepted patients in 2010/11 (percentages within each characteristic, across exception reporting categories)

	No exception code[†]	Clinical contra-indication*[†]	Informed dissent*[†]	Reason unknown*[†]	Any (excluding logistical)*[‡]
Populations					
No of patients[§]	1266797	196762	145267	1578	315565
% of patients[§]	80.1	12.4	9.2	0.1	19.9
No of ONS linked patients[§]	767118	113256	84028	828	182208
% of ONS linked patients[§]	80.8	11.9	8.9	0.1	19.2
Patient characteristics					
%Male	78.5	13	10.2	0.1	21.5
%Female	81.3	12	8.4	0.1	18.7
Mean age (sd)	54.0(19.2)	64.5(18.8)	59.5(19.7)	60.3(21.9)	61.9(19.5)
Mean BMI (sd)	28.9(6.6)	28.8(6.5)	29.2(6.9)	29.2(6.6)	28.9(6.6)
Mean no of conditions (sd)[#]	1.6(0.9)	2.6(1.5)	2.1(1.3)	2.4(1.4)	2.3(1.4)
% dead in 2011/12	58.6	32.5	14.6	0.4	41.4
Smoking status (% of cases across exception categories)					
Never	82.2	10.4	8.7	0.1	17.8
Ex-smoker	78.1	14.6	9.3	0.1	21.9
Current smoker	81.3	10.4	10.0	0.1	18.7
Missing	89.8	4.6	5.8	0.1	10.2
Condition (% of cases across exception categories)					
Atrial fibrillation	58.6	34.0	12.1	0.2	41.4
Asthma	73.3	14.2	14.6	0.1	26.7
Hypertension	75.0	16.5	11.0	0.1	25.0
Cancer	79.6	14.0	8.4	0.1	20.4
Coronary heart disease	54.3	36.2	15.7	0.2	45.7
Heart failure	51.6	40.3	14.9	0.2	48.4
Chronic kidney disease	65.6	26.1	12.3	0.2	34.4
Chronic obstructive pulmonary disease	54.2	33.9	18.5	0.2	45.8
Dementia	61.7	31.2	11.5	0.3	38.3
Depression	84.0	11.1	6.2	0.1	16.0
Diabetes mellitus	61.4	24.5	18.9	0.2	38.6
Epilepsy	71.5	21.4	9.4	0.3	28.5
Learning disability	84.2	11.3	5.4	0.1	15.8
Severe mental illness	72.8	17.1	12.5	0.3	27.2
Stroke	59.4	28.9	17.1	0.2	40.6
Hypothyroidism	80.3	13.3	8.3	0.1	19.7
Patient IMD (% of cases across exception categories)[¶]					
1 (least deprived)	82.2	10.7	8.6	0.0	17.8
2	80.9	12.3	8.3	0.1	19.1
3	80.1	12.4	9.1	0.1	19.9

	No exception code†	Clinical contra-indication*†	Informed dissent*†	Reason unknown*†	Any (excluding logistical)*‡
4	80.4	12.0	9.3	0.1	19.6
5	79.9	12.7	9.1	0.1	20.1
Practice IMD (% of cases across exception categories)					
1 (least deprived)	81.7	11.4	8.4	0.2	18.3
2	80.4	12.3	8.9	0.1	19.6
3	79.6	13.1	8.9	0.1	20.4
4	79.9	12.1	9.7	0.1	20.1
5	78.6	13.3	10.0	0.1	21.4
Region (% of cases across exception categories)					
North East	81.0	11.1	9.8	0.1	19.0
North West	80.0	12.7	9.1	0.1	20.0
Yorkshire & Humber	81.3	12.1	8.1	0.0	18.7
East Midlands	79.5	12.7	9.2	0.7	20.5
West Midlands	81.6	12.0	7.8	0.0	18.4
East England	80.7	12.3	8.5	0.2	19.3
South West	77.5	15.2	9.4	0.2	22.5
South Central	82.0	10.8	8.6	0.1	18.0
London	82.2	10.5	8.7	0.1	17.8
South East	82.4	10.8	8.2	0.1	17.6
England	80.9	11.9	8.7	0.1	19.1
Northern Ireland	82.7	11.9	6.5	0.0	17.3
Scotland	75.7	15.0	11.5	0.1	24.3
Wales	76.9	13.7	11.7	0.1	23.1

* Patients associated with one or more codes from the respective category.

† Percentages within these categories are row percentages and add up to 100%.

‡ Within this category, reporting percentages of cases with any exception code (at least one) over all cases.

§ Patients with at least one of the 16 conditions included in the analyses: atrial fibrillation, asthma, hypertension, cancer, coronary heart disease, heart failure, chronic kidney disease, chronic obstructive pulmonary disease, dementia, depression, diabetes mellitus, epilepsy, learning disability, severe mental illness, stroke and hypothyroidism.

Over the 16 conditions of interest.

¶ Available for ONS linked patients only.

Table A2: Modelled condition prevalence rates for the population, 2006/7 to 2011/12

	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12
Populations - all practices						
No of practices	569	566	565	556	534	499
Total list size	5321351	5370801	5449547	5432224	5301520	5069748
% of patients with atrial fibrillation	1.3	1.4	1.4	1.4	1.4	1.5
No of patients with atrial fibrillation	71233	73368	75881	76661	76841	74027
% of patients with asthma	5.7	5.5	5.5	5.5	5.2	4.9
No of patients with asthma	301101	296572	301319	296629	275363	246156
% of patients with hypertension	11.3	11.4	11.5	11.5	11.4	11.2
No of patients with hypertension	602729	612786	626584	622213	606603	569697
% of patients with cancer	2.1	2.2	2.3	2.3	2.4	2.5
No of patients with cancer	114055	118399	124019	127610	128828	125072
% of patients with coronary heart disease	3.2	3.1	3	2.9	2.8	2.6
No of patients with coronary heart disease	169882	165220	161679	155019	146018	133264
% of patients with heart failure	0.8	0.7	0.7	0.6	0.6	0.6
No of patients with heart failure	39917	37655	36393	34833	33114	30903
% of patients with chronic kidney disease	2.3	2.8	3	3.1	3.1	3.1
No of patients with chronic kidney disease	122367	152527	165834	169533	166836	156903
% of patients with chronic obstructive pulmonary disease	1.1	1.2	1.2	1.2	1.2	1.2
No of patients with chronic obstructive pulmonary disease	59510	62079	64390	65114	65680	63333
% of patients with dementia	0.4	0.4	0.4	0.4	0.4	0.5
No of patients with dementia	20410	20864	21744	22711	23792	23144
% of patients with depression	12.2	12.3	12.4	12.5	12.5	12.5
No of patients with depression	647458	661287	674995	676790	664269	634759
% of patients with diabetes mellitus	3.2	3.4	3.5	3.6	3.7	3.8
No of patients with diabetes mellitus	172907	179937	189010	194202	195719	190502
% of patients with epilepsy	0.6	0.6	0.6	0.6	0.6	0.6
No of patients with epilepsy	33956	33720	33956	32752	31340	29433
% of patients with learning disability	0.2	0.2	0.2	0.2	0.2	0.3
No of patients with learning disability	9666	10322	12081	13088	13052	12870
% of patients with severe mental illness	0.7	0.8	0.8	0.8	0.8	0.8
No of patients with severe mental illness	39849	41117	41957	42629	42233	40946
% of patients with stroke	1.6	1.5	1.5	1.5	1.5	1.5
No of patients with stroke	82984	82927	83622	82797	81319	76590

	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12
Populations - all practices						
% of patients with hypothyroidism	2.7	2.8	2.8	2.9	2.9	2.9
No of patients with hypothyroidism	144127	148944	154520	155713	154856	147276

Table A3: Diabetes domain indicators in the Quality and Outcomes Framework and their changes over time

Indicator name	CPRD definition	Type	QOF year*	QOF name	QOF definition	Lt†	Ut†	P†
DM2	% patients with DM, whose notes record BMI in the previous 15 months	Monitoring	1-2	DM2	The percentage of patients with diabetes whose notes record BMI in the previous 15 months	25	90	3
			3-8			40	90	3
DM5	% patients with DM who have a record of HbA1c or equivalent in last 15m	Monitoring	1-2	DM5	The percentage of diabetic patients who have a record of HbA1c or equivalent in the previous 15 months	25	90	3
			3-7			40	90	3
DM6/20/23/26	% patients with DM in whom last HbA1c≤7.5 (or equivalent) in last 15m	Outcome	1-2	DM6	The percentage of patients with diabetes in whom the last HbA1C is 7.4 or less (or equivalent test / reference range depending on local laboratory) in last 15 months	25	50	16
			3-5	DM20	The percentage of patients with diabetes in whom the last HbA1C is 7.5 or less (or equivalent test / reference range depending on local laboratory) in the previous 15 months	40	50	17
			6-7	DM23	The percentage of patients with diabetes in whom the last HbA1c is 7 or less (or equivalent test/reference range depending on local laboratory) in the previous 15 months.	40	50	17
			8	DM26	The percentage of patients with diabetes in whom the last IFCC-HbA1c is 59 mmol/mol (equivalent to HbA1c of 7.5% in DCCT values) or less (or equivalent test/reference range depending on local laboratory) in the previous 15 months.	40	50	17
DM7/25/28	% patients with DM with last HbA1C level is 10 or less in last 15 months	Outcome	1-2	DM7	The percentage of patients with diabetes in whom the last HbA1C is 10 or less (or equivalent test / reference range depending on local laboratory) in last 15 months	25	85	11
			3-5			40	90	11
			6-7	DM25	The percentage of patients with diabetes in whom the last HbA1c is 9 or less (or equivalent test/reference range depending on local laboratory) in the previous 15 months.	40	90	10
			8	DM28	The percentage of patients with diabetes in whom the last IFCC-HbA1c is 75 mmol/mol (equivalent to HbA1c of 9% in DCCT values) or less (or equivalent test/reference range depending on local laboratory) in the previous 15 months.	40	90	10

Indicator name	CPRD definition	Type	QOF year*	QOF name	QOF definition	Lt†	Ut†	P†
DM8/21	% of patients with DM who have a record of retinal screening in the previous 15 months	Recording	1-2	DM8	The percentage of patients with diabetes who have a record of retinal screening in the previous 15 months	25	90	5
			3-8	DM21		40	90	5
DM9	% patients with DM with a record of presence or absence of peripheral pulses in the previous 15 months	Recording	1-7		The percentage of patients with diabetes with a record of presence or absence of peripheral pulses in the previous 15 months	40	90	3
DM10	% patients with DM with a record of neuropathy testing in the previous 15 months	Recording	1-2	DM10	The percentage of patients with diabetes with a record of neuropathy testing in the previous 15 months	25	90	3
			3-8			40	90	3
DM11	% patients with DM whose notes have a record of blood pressure in previous 15m	Monitoring	1-2	DM11	The percentage of patients with diabetes who have a record of the blood pressure in the past 15 months	25	90	3
			3-7			40	90	3
DM12/30	% patients with DM, with last blood pressure reading (15m) is 145/85 or less	Outcome	1-2	DM12	The percentage of patients with diabetes in whom the last blood pressure is 145/85 or less	25	55	17
			3-7			40	60	18
			8	DM30	The percentage of patients with diabetes in whom the last blood pressure is 150/90 or less	40	71	8
DM13	% patients with DM who have a record of micro-albuminuria testing in the previous 15 months (exception reporting for patients with proteinuria)	Recording	1-2	DM13	The percentage of patients with diabetes who have a record of micro-albuminuria testing in the previous 15 months (exception reporting for patients with proteinuria)	25	90	3
			3-8			40	90	3
DM14/22	% patients with DM, with record of serum creatinine testing in previous 15m	Monitoring	1-2	DM14	The percentage of patients with diabetes who have a record of serum creatinine testing in the previous 15 months	25	90	3
			3-8	DM22	The percentage of patients with diabetes who have a record of estimated glomerular filtration rate (eGFR) or serum creatinine testing in the previous 15 months	40	90	3

Indicator name	CPRD definition	Type	QOF year*	QOF name	QOF definition	Lt†	Ut†	P†
DM15	% patients with DM with proteinuria or micro-albuminuria who are treated with ACE inhibitors (or A2 antagonists)	Treatment	1-2		The percentage of patients with diabetes with proteinuria or micro-albuminuria who are treated with ACE inhibitors (or A2 antagonists)	25	70	3
			3-8			40	80	3
DM16	% patients with DM whose notes have a record of total cholesterol in previous 15m	Monitoring	1-2	DM16	The percentage of patients with diabetes who have a record of total cholesterol in the previous 15 months	25	90	3
			3-7			40	90	3
DM17	% patients with DM whose last measured total cholesterol (15m) ≤ 5mmol/l	Outcome	1-2	DM17	The percentage of patients with diabetes whose last measured total cholesterol within previous 15 months is 5 or less	25	60	6
			3-8			40	70	6
DM18	% patients with DM with a record of influenza vaccination in preceding 1Sep-31Mar	Treatment	1-2	DM18	The percentage of patients with diabetes who have had influenza immunisation in the preceding 1 September to 31 March	25	85	3
			3-8			40	85	3

* QOF year 1 corresponds to 2004/5, 2 to 2005/6 and so on, up to year 8 (2010/11).

† Lt: Lower threshold; Ut: Upper threshold; P: points indicator is worth (1 point≈£126). Also, $P = \min\{(Ut - Lt), \quad (RA - Lt)/(Ut - Lt))\}$, where RA is the practice reported achievement (excluding exception reported patients) under the Quality and Outcomes Framework.

Table A4: Counts (column percentages) for all exception codes identified, over time and overall.

CPRD code	Read code	Description	Persistent	Type*	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	Total
10674	9OX5.00	Influenza vaccination declined	No	Informed dissent	73165 (14.89)	79180 (15.51)	73053 (14.88)	68516 (13.84)	73704 (14.90)	65346 (14.26)	432964 (14.72)
10996	2126200	Asthma resolved	Yes	Contra-indication	23227 (4.73)	25184 (4.93)	27403 (5.58)	27939 (5.65)	28040 (5.67)	26414 (5.77)	158207 (5.38)
11695	9hA2.00	Excepted from asthma quality indicators: Informed dissent	No	Informed dissent	17106 (3.48)	18526 (3.63)	20774 (4.23)	21162 (4.28)	22507 (4.55)	22749 (4.97)	122824 (4.18)
19439	212S.00	Depression resolved	Yes	Contra-indication	7694 (1.57)	12427 (2.43)	14695 (2.99)	18329 (3.70)	22558 (4.56)	25769 (5.62)	101472 (3.45)
12267	68NE.00	No consent - influenza imm.	No	Informed dissent	16121 (3.28)	18248 (3.57)	14851 (3.02)	14971 (3.03)	15357 (3.10)	13846 (3.02)	93394 (3.18)
10566	8I62.00	Beta blocker not indicated	No	Contra-indication	16002 (3.26)	17035 (3.34)	14716 (3.00)	13716 (2.77)	10838 (2.19)	8778 (1.92)	81085 (2.76)
11667	TJC6.00	Adverse reaction to betablockers	Yes	Contra-indication	10788 (2.20)	11600 (2.27)	12493 (2.54)	14491 (2.93)	14301 (2.89)	12680 (2.77)	76353 (2.60)
10976	9h32.00	Excepted from hypertension qual indicators: Informed dissent	No	Informed dissent	8685 (1.77)	9845 (1.93)	11183 (2.28)	12666 (2.56)	13087 (2.65)	11631 (2.54)	67097 (2.28)
11056	8BL0.00	Patient on maximal tolerated antihypertensive therapy	No	Contra-indication	13852 (2.82)	13391 (2.62)	12793 (2.61)	10158 (2.05)	8406 (1.70)	7881 (1.72)	66481 (2.26)
11348	9h42.00	Excepted from diabetes quality indicators: Informed dissent	No	Informed dissent	8115 (1.65)	9209 (1.80)	10000 (2.04)	11556 (2.33)	12060 (2.44)	11261 (2.46)	62201 (2.12)
10567	8I26.00	Beta blocker contraindicated	No	Contra-indication	16714 (3.40)	12741 (2.50)	10472 (2.13)	9188 (1.86)	6167 (1.25)	4967 (1.08)	60249 (2.05)
11416	U60CA00	[X]Statin causing adverse effect in therapeutic use	Yes	Contra-indication	7423 (1.51)	8941 (1.75)	10150 (2.07)	10731 (2.17)	10976 (2.22)	10987 (2.40)	59208 (2.01)
11130	U60C400	[X]Angiotensin-convert-enz inhib caus advers eff therap use	Yes	Contra-indication	6495 (1.32)	8409 (1.65)	9515 (1.94)	9974 (2.02)	9895 (2.00)	9734 (2.12)	54022 (1.84)
10883	8I64.00	Angiotensin converting enzyme inhibitor not indicated	No	Contra-indication	10297 (2.10)	12488 (2.45)	9431 (1.92)	6233 (1.26)	5700 (1.15)	5198 (1.13)	49347 (1.68)
18721	8I6C.00	Angiotensin II receptor antagonist not indicated	No	Contra-indication	9425 (1.92)	12444 (2.44)	9177 (1.87)	6221 (1.26)	5948 (1.20)	5530 (1.21)	48745 (1.66)
28994	212R.00	Atrial fibrillation resolved	Yes	Contra-indication	4625 (0.94)	6336 (1.24)	7529 (1.53)	8352 (1.69)	8823 (1.78)	9191 (2.01)	44856 (1.53)
12213	8BL2.00	Patient on maximal tolerated therapy for diabetes	No	Contra-indication	4517 (0.92)	4840 (0.95)	4414 (0.90)	9379 (1.90)	11944 (2.41)	8835 (1.93)	43929 (1.49)

CPRD code	Read code	Description	Persistent	Type*	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	Total
3269	2126100	Hypertension resolved	Yes	Contra-indication	5333 (1.09)	6275 (1.23)	7035 (1.43)	7226 (1.46)	7384 (1.49)	7640 (1.67)	40893 (1.39)
10813	8I3C.00	Statin declined	No	Informed dissent	5833 (1.19)	6079 (1.19)	6141 (1.25)	6312 (1.28)	6972 (1.41)	6541 (1.43)	37878 (1.29)
11774	9h91.00	Except from mental health quality indicators: Patient unsuit	No	Contra-indication	15090 (3.07)	6140 (1.20)	5771 (1.18)	4141 (0.84)	3230 (0.65)	3265 (0.71)	37637 (1.28)
9998	TJ53.11	Adverse reaction to aspirin	Yes	Contra-indication	5760 (1.17)	5843 (1.14)	6233 (1.27)	6633 (1.34)	6467 (1.31)	6118 (1.34)	37054 (1.26)
11026	9h51.00	Excepted from COPD quality indicators: Patient unsuitable	No	Contra-indication	7467 (1.52)	6712 (1.31)	5922 (1.21)	6438 (1.30)	5744 (1.16)	4532 (0.99)	36815 (1.25)
10961	9h31.00	Excepted from hypertension qual indicators: Patient unsuit	No	Contra-indication	8667 (1.76)	6961 (1.36)	5775 (1.18)	5693 (1.15)	5352 (1.08)	4031 (0.88)	36479 (1.24)
11041	9h41.00	Excepted from diabetes qual indicators: Patient unsuitable	No	Contra-indication	7474 (1.52)	6328 (1.24)	5576 (1.14)	6106 (1.23)	6095 (1.23)	4829 (1.05)	36408 (1.24)
10910	9h02.00	Excepted from CHD quality indicators: Informed dissent	No	Informed dissent	5927 (1.21)	5801 (1.14)	6113 (1.24)	6006 (1.21)	5792 (1.17)	5169 (1.13)	34808 (1.18)
11387	9OJ2.00	Refuses asthma monitoring	No	Informed dissent	6469 (1.32)	6902 (1.35)	5557 (1.13)	5487 (1.11)	4923 (1.00)	3024 (0.66)	32362 (1.10)
43239	9hC1.00	Excepted from depression quality indicators: Informed dissen	No	Informed dissent	2269 (0.46)	3468 (0.68)	4552 (0.93)	6421 (1.30)	7234 (1.46)	7486 (1.63)	31430 (1.07)
12111	8BL1.00	Patient on maximal tolerated lipid lowering therapy	No	Contra-indication	5758 (1.17)	4971 (0.97)	4687 (0.95)	5434 (1.10)	4958 (1.00)	4489 (0.98)	30297 (1.03)
11038	9h01.00	Excepted from CHD quality indicators: Patient unsuitable	No	Contra-indication	7385 (1.50)	5853 (1.15)	4982 (1.01)	4624 (0.93)	4104 (0.83)	3180 (0.69)	30128 (1.02)
12561	8I6B.00	Clopidogrel not indicated	No	Contra-indication	6180 (1.26)	6018 (1.18)	4589 (0.93)	4300 (0.87)	4493 (0.91)	4463 (0.97)	30043 (1.02)
28970	9hC0.00	Excepted from depression quality indicators: Patient unsuita	No	Contra-indication	3845 (0.78)	4663 (0.91)	4346 (0.89)	5575 (1.13)	5480 (1.11)	5225 (1.14)	29134 (0.99)
11266	9h52.00	Excepted from COPD quality indicators: Informed dissent	No	Informed dissent	3428 (0.70)	4425 (0.87)	4768 (0.97)	5444 (1.10)	5680 (1.15)	5376 (1.17)	29121 (0.99)
11328	8I65.00	Warfarin not indicated	No	Contra-indication	5924 (1.21)	5793 (1.13)	4367 (0.89)	3960 (0.80)	4273 (0.86)	4057 (0.89)	28374 (0.96)
2526	TJ53.00	Adverse reaction to salicylates	Yes	Contra-indication	4477 (0.91)	4973 (0.97)	5043 (1.03)	4709 (0.95)	4353 (0.88)	3840 (0.84)	27395 (0.93)
12619	9hG1.00	Excepted from smoking quality indicators: Informed dissent	No	Informed dissent	2819 (0.57)	3657 (0.72)	4574 (0.93)	5512 (1.11)	5400 (1.09)	5164 (1.13)	27126 (0.92)
11039	9h21.00	Excepted from stroke quality indicators: Patient unsuitable	No	Contra-indication	6263 (1.27)	4951 (0.97)	4669 (0.95)	4117 (0.83)	3789 (0.77)	3116 (0.68)	26905 (0.91)

CPRD code	Read code	Description	Persistent	Type*	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	Total
12860	9hE0.00	Except chronic kidney disease qual indic: Patient unsuitable	No	Contra-indication	2705 (0.55)	3843 (0.75)	3439 (0.70)	5752 (1.16)	6196 (1.25)	4526 (0.99)	26461 (0.90)
6175	8I24.00	Aspirin prophyllaxis contra-indicated	No	Contra-indication	8230 (1.67)	5947 (1.16)	4156 (0.85)	3015 (0.61)	2566 (0.52)	1993 (0.43)	25907 (0.88)
11673	9hA1.00	Excepted from asthma quality indicators: Patient unsuitable	No	Contra-indication	5476 (1.11)	4355 (0.85)	3730 (0.76)	3819 (0.77)	3567 (0.72)	2863 (0.62)	23810 (0.81)
10512	8I66.00	Aspirin not indicated	No	Contra-indication	4322 (0.88)	4376 (0.86)	3729 (0.76)	3895 (0.79)	3566 (0.72)	3747 (0.82)	23635 (0.80)
11752	8BL3.00	Patient on maximal tolerated anticonvulsant therapy	No	Contra-indication	3877 (0.79)	3788 (0.74)	3867 (0.79)	3370 (0.68)	3266 (0.66)	3670 (0.80)	21838 (0.74)
12262	8I3X.00	Diabetic retinopathy screening refused	No	Informed dissent	3059 (0.62)	4835 (0.95)	5436 (1.11)	4914 (0.99)	2389 (0.48)	836 (0.18)	21469 (0.73)
13031	TJC2400	Adverse reaction to simvastatin	Yes	Contra-indication	1936 (0.39)	2827 (0.55)	3553 (0.72)	4022 (0.81)	4330 (0.88)	4493 (0.98)	21161 (0.72)
12732	8I6a.00	Dipyridamole not indicated	No	Contra-indication	1936 (0.39)	2768 (0.54)	2667 (0.54)	3411 (0.69)	3969 (0.80)	4179 (0.91)	18930 (0.64)
11231	8I73.00	Beta blocker not tolerated	No	Contra-indication	3600 (0.73)	3422 (0.67)	2977 (0.61)	2608 (0.53)	1918 (0.39)	1618 (0.35)	16143 (0.55)
19342	212K.00	Hypertension resolved	Yes	Contra-indication	1761 (0.36)	2013 (0.39)	2650 (0.54)	2842 (0.57)	3053 (0.62)	3211 (0.70)	15530 (0.53)
11601	U60CB00	[X]Angiotensin II receptor antagon adverse effect therap use	Yes	Contra-indication	1743 (0.35)	2419 (0.47)	2670 (0.54)	2857 (0.58)	2905 (0.59)	2796 (0.61)	15390 (0.52)
10681	8I63.00	Statin not indicated	No	Contra-indication	3758 (0.76)	3222 (0.63)	2562 (0.52)	2027 (0.41)	1904 (0.38)	1886 (0.41)	15359 (0.52)
11352	14LK.00	H/O: aspirin allergy	Yes	Contra-indication	2215 (0.45)	2465 (0.48)	2646 (0.54)	2702 (0.55)	2645 (0.53)	2427 (0.53)	15100 (0.51)
11529	8I76.00	Statin not tolerated	No	Contra-indication	2328 (0.47)	2246 (0.44)	2346 (0.48)	2634 (0.53)	2558 (0.52)	2298 (0.50)	14410 (0.49)
11750	9h92.00	Except from mental health quality indicators: Informed diss	No	Informed dissent	1652 (0.34)	1821 (0.36)	2051 (0.42)	2563 (0.52)	2687 (0.54)	3457 (0.75)	14231 (0.48)
11074	9h22.00	Excepted from stroke quality indicators: Informed dissent	No	Informed dissent	1935 (0.39)	2049 (0.40)	2253 (0.46)	2173 (0.44)	2254 (0.46)	2243 (0.49)	12907 (0.44)
30300	U60B700	[X]Beta-adrenorecep antag caus advers eff in ther use, NEC	Yes	Contra-indication	2026 (0.41)	2099 (0.41)	2119 (0.43)	2117 (0.43)	2033 (0.41)	1807 (0.39)	12201 (0.41)
11164	8I70.00	Aspirin not tolerated	No	Contra-indication	2466 (0.50)	2368 (0.46)	1898 (0.39)	1354 (0.27)	1385 (0.28)	1238 (0.27)	10709 (0.36)
20747	TJC7900	Adverse reaction to ramipril	Yes	Contra-indication	827 (0.17)	1267 (0.25)	1618 (0.33)	1904 (0.38)	2107 (0.43)	2217 (0.48)	9940 (0.34)

CPRD code	Read code	Description	Persistent	Type*	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	Total
12560	8I6N.00	Anticoagulation not indicated	No	Contra-indication	1467 (0.30)	1968 (0.39)	1498 (0.31)	1330 (0.27)	1888 (0.38)	1615 (0.35)	9766 (0.33)
18824	8I3W.00	Diabetic foot examination declined	No	Informed dissent	1038 (0.21)	1281 (0.25)	1485 (0.30)	1652 (0.33)	1652 (0.33)	2490 (0.54)	9598 (0.33)
8385	2126000	Epilepsy resolved	Yes	Contra-indication	1432 (0.29)	1465 (0.29)	1653 (0.34)	1670 (0.34)	1647 (0.33)	1647 (0.36)	9514 (0.32)
35383	9OLD.00	Diabetic patient unsuitable for digital retinal photography	No	Contra-indication	1337 (0.27)	1627 (0.32)	1506 (0.31)	1619 (0.33)	1690 (0.34)	1692 (0.37)	9471 (0.32)
13029	U604800	[X]Clopidogrel causing adverse effects in therapeutic use	Yes	Contra-indication	1201 (0.24)	1412 (0.28)	1640 (0.33)	1749 (0.35)	1709 (0.35)	1649 (0.36)	9360 (0.32)
10568	8I28.00	Angiotensin converting enzyme inhibitors contraindicated	No	Contra-indication	2516 (0.51)	2337 (0.46)	1494 (0.30)	1040 (0.21)	841 (0.17)	827 (0.18)	9055 (0.31)
11350	8I74.00	Angiotensin converting enzyme inhibitor not tolerated	No	Contra-indication	2114 (0.43)	2220 (0.43)	1578 (0.32)	1075 (0.22)	951 (0.19)	946 (0.21)	8884 (0.30)
13033	14LL.00	H/O: betablocker allergy	Yes	Contra-indication	1059 (0.22)	1228 (0.24)	1510 (0.31)	1664 (0.34)	1628 (0.33)	1571 (0.34)	8660 (0.29)
10684	8I2F.00	Influenza vaccination contraindicated	No	Contra-indication	872 (0.18)	756 (0.15)	1348 (0.27)	1667 (0.34)	1883 (0.38)	2024 (0.44)	8550 (0.29)
11672	9h61.00	Excepted from epilepsy quality indicators: Patient unsuitabl	No	Contra-indication	2169 (0.44)	1663 (0.33)	1421 (0.29)	1065 (0.22)	1017 (0.21)	1041 (0.23)	8376 (0.28)
19391	33BE.00	Exercise tolerance test contraindicated	Yes	Contra-indication	1061 (0.22)	1333 (0.26)	1531 (0.31)	1611 (0.33)	1549 (0.31)	1274 (0.28)	8359 (0.28)
11014	8I38.00	Aspirin prophylaxis refused	No	Informed dissent	1569 (0.32)	1499 (0.29)	1343 (0.27)	1334 (0.27)	1285 (0.26)	1128 (0.25)	8158 (0.28)
11726	8I3Y.00	Blood pressure procedure refused	No	Informed dissent	1384 (0.28)	1435 (0.28)	1097 (0.22)	1268 (0.26)	1277 (0.26)	1246 (0.27)	7707 (0.26)
18747	8I6F.00	Diabetic retinopathy screening not indicated	No	Contra-indication	1595 (0.32)	2022 (0.40)	1725 (0.35)	1308 (0.26)	610 (0.12)	224 (0.05)	7484 (0.25)
12247	8I6G.00	Diabetic foot examination not indicated	No	Contra-indication	1196 (0.24)	1444 (0.28)	1612 (0.33)	1319 (0.27)	862 (0.17)	854 (0.19)	7287 (0.25)
40100	9hE1.00	Exc chronic kidney disease quality indicators: Inform dissen	No	Informed dissent	303 (0.06)	694 (0.14)	854 (0.17)	1491 (0.30)	1896 (0.38)	1862 (0.41)	7100 (0.24)
11712	9h62.00	Excepted from epilepsy quality indicators: Informed dissent	No	Informed dissent	1075 (0.22)	1064 (0.21)	1204 (0.25)	1240 (0.25)	1261 (0.25)	1220 (0.27)	7064 (0.24)
10508	8I25.00	Warfarin contraindicated	No	Contra-indication	2126 (0.43)	1307 (0.26)	1004 (0.20)	832 (0.17)	922 (0.19)	749 (0.16)	6940 (0.24)
10767	8I36.00	Beta blocker therapy refused	No	Informed dissent	1465 (0.30)	1321 (0.26)	1160 (0.24)	1142 (0.23)	990 (0.20)	752 (0.16)	6830 (0.23)

CPRD code	Read code	Description	Persistent	Type*	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	Total
30674	8I2M.00	Spirometry reversibility testing contraindicated	No	Contra-indication	1351 (0.27)	1384 (0.27)	1272 (0.26)	1136 (0.23)	1007 (0.20)	647 (0.14)	6797 (0.23)
30644	9hG0.00	Excepted from smoking quality indicators: Patient unsuitable	No	Contra-indication	1673 (0.34)	1263 (0.25)	1107 (0.23)	1240 (0.25)	721 (0.15)	693 (0.15)	6697 (0.23)
13026	TJC6200	Adverse reaction to atenolol	Yes	Contra-indication	1239 (0.25)	1068 (0.21)	1063 (0.22)	1077 (0.22)	1072 (0.22)	1012 (0.22)	6531 (0.22)
11407	8I2K.00	Clopidogrel contraindicated	No	Contra-indication	1994 (0.41)	1403 (0.27)	981 (0.20)	763 (0.15)	741 (0.15)	610 (0.13)	6492 (0.22)
26349	8I3b.00	Spirometry test declined	No	Informed dissent	852 (0.17)	1118 (0.22)	965 (0.20)	1170 (0.24)	1221 (0.25)	1112 (0.24)	6438 (0.22)
12088	14LJ.00	H/O: influenza vaccine allergy	Yes	Contra-indication	941 (0.19)	1054 (0.21)	1096 (0.22)	1103 (0.22)	1077 (0.22)	1010 (0.22)	6281 (0.21)
13043	14LM.00	H/O: angiotensin converting enzyme inhibitor allergy	Yes	Contra-indication	813 (0.17)	974 (0.19)	1065 (0.22)	1113 (0.22)	1085 (0.22)	1175 (0.26)	6225 (0.21)
11465	8I6D.00	Influenza vaccination not indicated	No	Contra-indication	3092 (0.63)	882 (0.17)	603 (0.12)	488 (0.10)	381 (0.08)	416 (0.09)	5862 (0.20)
13030	TJ42100	Adverse reaction to warfarin sodium	Yes	Contra-indication	720 (0.15)	828 (0.16)	993 (0.20)	1073 (0.22)	1087 (0.22)	1010 (0.22)	5711 (0.19)
11510	8I2H.00	Angiotensin II receptor antagonists contraindicated	No	Contra-indication	1367 (0.28)	1495 (0.29)	1033 (0.21)	654 (0.13)	524 (0.11)	497 (0.11)	5570 (0.19)
12135	8I3D.00	Angiotensin converting enzyme inhibitor declined	No	Informed dissent	1169 (0.24)	1428 (0.28)	994 (0.20)	736 (0.15)	617 (0.12)	482 (0.11)	5426 (0.18)
12848	212J.00	Epilepsy resolved	Yes	Contra-indication	746 (0.15)	827 (0.16)	888 (0.18)	947 (0.19)	944 (0.19)	982 (0.21)	5334 (0.18)
28995	9hF0.00	Except from atr fib quality indicators: Patient unsuitable	No	Contra-indication	906 (0.18)	1071 (0.21)	908 (0.18)	874 (0.18)	871 (0.18)	704 (0.15)	5334 (0.18)
30573	U605100	[X]Salicylates causing adverse effects in therapeutic use	Yes	Contra-indication	722 (0.15)	810 (0.16)	894 (0.18)	937 (0.19)	929 (0.19)	896 (0.20)	5188 (0.18)
28622	2126300	Diabetes resolved	Yes	Contra-indication	573 (0.12)	716 (0.14)	854 (0.17)	914 (0.18)	955 (0.19)	1072 (0.23)	5084 (0.17)
12813	8I3E.00	Warfarin declined	No	Informed dissent	728 (0.15)	795 (0.16)	717 (0.15)	698 (0.14)	878 (0.18)	1034 (0.23)	4850 (0.16)
13025	U60K400	[X]Influenza vaccine causing adverse effects therapeutic use	Yes	Contra-indication	656 (0.13)	763 (0.15)	805 (0.16)	808 (0.16)	788 (0.16)	787 (0.17)	4607 (0.16)
12827	8I6L.00	Spirometry not indicated	No	Contra-indication	678 (0.14)	831 (0.16)	755 (0.15)	690 (0.14)	767 (0.16)	783 (0.17)	4504 (0.15)
12571	8I75.00	Angiotensin II receptor antagonist not tolerated	No	Contra-indication	789 (0.16)	1041 (0.20)	943 (0.19)	583 (0.12)	504 (0.10)	464 (0.10)	4324 (0.15)

CPRD code	Read code	Description	Persistent	Type*	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	Total
22335	8I3P.00	Angiotensin II receptor antagonist declined	No	Informed dissent	847 (0.17)	1204 (0.24)	807 (0.16)	528 (0.11)	489 (0.10)	367 (0.08)	4242 (0.14)
25917	9h72.00	Excepted from thyroid quality indicators: Informed dissent	No	Informed dissent	686 (0.14)	724 (0.14)	773 (0.16)	707 (0.14)	630 (0.13)	694 (0.15)	4214 (0.14)
10808	8I27.00	Statins contraindicated	No	Contra-indication	1170 (0.24)	824 (0.16)	679 (0.14)	545 (0.11)	522 (0.11)	417 (0.09)	4157 (0.14)
26495	U60C414	[X]Adverse reaction to lisinopril	Yes	Contra-indication	399 (0.08)	507 (0.10)	581 (0.12)	660 (0.13)	696 (0.14)	748 (0.16)	3591 (0.12)
12815	8I3R.00	Clopidogrel declined	No	Informed dissent	640 (0.13)	670 (0.13)	557 (0.11)	519 (0.10)	577 (0.12)	590 (0.13)	3553 (0.12)
19218	8I3S.00	Exercise tolerance test refused	Yes	Informed dissent	584 (0.12)	607 (0.12)	617 (0.13)	618 (0.12)	545 (0.11)	471 (0.10)	3442 (0.12)
18692	9hA..00	Exception reporting: asthma quality indicators	No	Unknown	542 (0.11)	1069 (0.21)	759 (0.15)	544 (0.11)	325 (0.07)	87 (0.02)	3326 (0.11)
18766	212H.00	Diabetes resolved	Yes	Contra-indication	331 (0.07)	409 (0.08)	481 (0.10)	532 (0.11)	583 (0.12)	635 (0.14)	2971 (0.10)
21928	TJC4400	Adverse reaction to dipyridamole	Yes	Contra-indication	200 (0.04)	290 (0.06)	489 (0.10)	643 (0.13)	667 (0.13)	676 (0.15)	2965 (0.10)
30749	9hH0.00	Excepted heart failure quality indicators: Patient unsuitabl	No	Contra-indication	159 (0.03)	558 (0.11)	627 (0.13)	638 (0.13)	473 (0.10)	414 (0.09)	2869 (0.10)
31224	8I2b.00	Dipyridamole contraindicated	No	Contra-indication	486 (0.10)	518 (0.10)	441 (0.09)	478 (0.10)	491 (0.10)	389 (0.08)	2803 (0.10)
11685	9h71.00	Excepted from thyroid quality indicators: Patient unsuitable	No	Contra-indication	755 (0.15)	520 (0.10)	400 (0.08)	298 (0.06)	341 (0.07)	350 (0.08)	2664 (0.09)
89207	8I6d.00	Spirometry reversibility testing not indicated	No	Contra-indication	3 (0.00)	87 (0.02)	428 (0.09)	751 (0.15)	836 (0.17)	493 (0.11)	2598 (0.09)
34108	9h3..00	Exception reporting: hypertension quality indicators	No	Unknown	595 (0.12)	498 (0.10)	458 (0.09)	438 (0.09)	315 (0.06)	179 (0.04)	2483 (0.08)
30641	9hD0.00	Excepted from dementia quality indicators: Patient unsuitabl	No	Contra-indication	320 (0.07)	440 (0.09)	378 (0.08)	371 (0.07)	358 (0.07)	511 (0.11)	2378 (0.08)
11790	8I72.00	Clopidogrel not tolerated	No	Contra-indication	476 (0.10)	505 (0.10)	408 (0.08)	282 (0.06)	380 (0.08)	298 (0.07)	2349 (0.08)
28574	9h4..00	Exception reporting: diabetes quality indicators	No	Unknown	501 (0.10)	469 (0.09)	439 (0.09)	404 (0.08)	282 (0.06)	156 (0.03)	2251 (0.08)
13034	TJC2500	Adverse reaction to pravastatin	Yes	Contra-indication	197 (0.04)	282 (0.06)	363 (0.07)	414 (0.08)	458 (0.09)	527 (0.12)	2241 (0.08)
21039	TJC7800	Adverse reaction to enalapril	Yes	Contra-indication	227 (0.05)	323 (0.06)	392 (0.08)	419 (0.08)	421 (0.09)	405 (0.09)	2187 (0.07)

CPRD code	Read code	Description	Persistent	Type*	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	Total
12816	8I3n.00	Dipyridamole declined	No	Informed dissent	222 (0.05)	305 (0.06)	299 (0.06)	411 (0.08)	441 (0.09)	460 (0.10)	2138 (0.07)
34360	9h9..00	Exception reporting: mental health quality indicators	No	Unknown	1162 (0.24)	498 (0.10)	118 (0.02)	120 (0.02)	85 (0.02)	104 (0.02)	2087 (0.07)
34768	TJ42.00	Adverse reaction to anticoagulants	Yes	Contra-indication	176 (0.04)	260 (0.05)	337 (0.07)	392 (0.08)	382 (0.08)	381 (0.08)	1928 (0.07)
13046	8I2R.00	Anticoagulation contraindicated	No	Contra-indication	403 (0.08)	411 (0.08)	320 (0.07)	257 (0.05)	270 (0.05)	238 (0.05)	1899 (0.06)
7309	ZV14800	[V]Personal history of aspirin allergy	Yes	Contra-indication	286 (0.06)	307 (0.06)	328 (0.07)	324 (0.07)	311 (0.06)	302 (0.07)	1858 (0.06)
12814	8I3d.00	Anticoagulation declined	No	Informed dissent	262 (0.05)	342 (0.07)	265 (0.05)	246 (0.05)	311 (0.06)	286 (0.06)	1712 (0.06)
25369	ZV14D00	[V]PH angiotensin-converting-enzyme inhibitor allergy	Yes	Contra-indication	261 (0.05)	267 (0.05)	278 (0.06)	264 (0.05)	245 (0.05)	234 (0.05)	1549 (0.05)
11613	9h11.00	Excepted from LVD quality indicators: Patient unsuitable	No	Contra-indication	1036 (0.21)	322 (0.06)	74 (0.02)	50 (0.01)	43 (0.01)	24 (0.01)	1549 (0.05)
11789	8I71.00	Warfarin not tolerated	No	Contra-indication	269 (0.05)	275 (0.05)	251 (0.05)	182 (0.04)	237 (0.05)	167 (0.04)	1381 (0.05)
39114	9hF1.00	Excepted from atrial fibrillation qual indic: Inform dissent	No	Informed dissent	140 (0.03)	203 (0.04)	226 (0.05)	264 (0.05)	223 (0.05)	230 (0.05)	1286 (0.04)
13367	U605112	[X] Adverse reaction to aspirin	Yes	Contra-indication	183 (0.04)	199 (0.04)	212 (0.04)	227 (0.05)	225 (0.05)	216 (0.05)	1262 (0.04)
18717	9h5..00	Exception reporting: COPD quality indicators	No	Unknown	320 (0.07)	318 (0.06)	222 (0.05)	162 (0.03)	96 (0.02)	138 (0.03)	1256 (0.04)
10963	9h0..00	Exception reporting: CHD quality indicators	No	Unknown	278 (0.06)	282 (0.06)	234 (0.05)	163 (0.03)	122 (0.02)	88 (0.02)	1167 (0.04)
13040	14LN.00	H/O: angiotensin II receptor antagonist allergy	Yes	Contra-indication	155 (0.03)	196 (0.04)	206 (0.04)	201 (0.04)	201 (0.04)	189 (0.04)	1148 (0.04)
11703	9h81.00	Excepted from cancer quality indicators: Patient unsuitable	No	Contra-indication	395 (0.08)	212 (0.04)	188 (0.04)	132 (0.03)	115 (0.02)	83 (0.02)	1125 (0.04)
32463	14LP.00	H/O: warfarin allergy	Yes	Contra-indication	132 (0.03)	154 (0.03)	188 (0.04)	206 (0.04)	207 (0.04)	198 (0.04)	1085 (0.04)
48970	9hC..00	Exception reporting: depression quality indicators	No	Unknown	79 (0.02)	257 (0.05)	295 (0.06)	178 (0.04)	109 (0.02)	120 (0.03)	1038 (0.04)
43491	8I7J.00	Dipyridamole not tolerated	No	Contra-indication	93 (0.02)	191 (0.04)	171 (0.03)	167 (0.03)	201 (0.04)	142 (0.03)	965 (0.03)
20916	U60B711	[X] Adverse reaction to betablockers	Yes	Contra-indication	122 (0.02)	131 (0.03)	143 (0.03)	159 (0.03)	154 (0.03)	140 (0.03)	849 (0.03)

CPRD code	Read code	Description	Persistent	Type*	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	Total
30745	8I7A.00	Anticoagulation not tolerated	No	Contra-indication	149 (0.03)	199 (0.04)	170 (0.03)	93 (0.02)	127 (0.03)	93 (0.02)	831 (0.03)
10962	9h2..00	Exception reporting: stroke quality indicators	No	Unknown	188 (0.04)	144 (0.03)	159 (0.03)	130 (0.03)	109 (0.02)	79 (0.02)	809 (0.03)
46626	9hE..00	Exception reporting: chronic kidney disease quality indicato	No	Unknown	70 (0.01)	250 (0.05)	218 (0.04)	84 (0.02)	87 (0.02)	56 (0.01)	765 (0.03)
40805	9hD1.00	Excepted from dementia quality indicators: Informed dissent	No	Informed dissent	68 (0.01)	85 (0.02)	124 (0.03)	110 (0.02)	164 (0.03)	143 (0.03)	694 (0.02)
42993	TJC6z00	Adverse reaction to betablockers NOS	Yes	Contra-indication	105 (0.02)	107 (0.02)	111 (0.02)	121 (0.02)	121 (0.02)	117 (0.03)	682 (0.02)
42312	14LX.00	H/O: dipyridamole allergy	Yes	Contra-indication	37 (0.01)	62 (0.01)	99 (0.02)	125 (0.03)	124 (0.03)	129 (0.03)	576 (0.02)
14000	56F1.00	Echocardiogram declined	Yes	Informed dissent	84 (0.02)	85 (0.02)	90 (0.02)	95 (0.02)	100 (0.02)	106 (0.02)	560 (0.02)
47141	U60C413	[X] Adverse reaction to ramipril	Yes	Contra-indication	65 (0.01)	72 (0.01)	85 (0.02)	101 (0.02)	112 (0.02)	116 (0.03)	551 (0.02)
30752	U604200	[X]Anticoagulant causing adverse effects in therapeutic use	Yes	Contra-indication	74 (0.02)	88 (0.02)	103 (0.02)	103 (0.02)	90 (0.02)	89 (0.02)	547 (0.02)
48351	U60B715	[X] Adverse reaction to atenolol	Yes	Contra-indication	76 (0.02)	84 (0.02)	86 (0.02)	95 (0.02)	95 (0.02)	96 (0.02)	532 (0.02)
64062	9hH1.00	Excepted heart failure quality indicators: Informed dissent	No	Informed dissent	18 (0.00)	98 (0.02)	84 (0.02)	117 (0.02)	104 (0.02)	83 (0.02)	504 (0.02)
30772	ZV14F00	[V]Personal history of influenza vaccine allergy	Yes	Contra-indication	64 (0.01)	74 (0.01)	83 (0.02)	89 (0.02)	89 (0.02)	83 (0.02)	482 (0.02)
48350	TJC7700	Adverse reaction to captopril	Yes	Contra-indication	47 (0.01)	61 (0.01)	88 (0.02)	93 (0.02)	90 (0.02)	83 (0.02)	462 (0.02)
30522	9h82.00	Excepted from cancer quality indicators: Informed dissent	No	Informed dissent	73 (0.01)	62 (0.01)	87 (0.02)	84 (0.02)	84 (0.02)	51 (0.01)	441 (0.01)
45535	9h6..00	Exception reporting: epilepsy quality indicators	No	Unknown	58 (0.01)	73 (0.01)	85 (0.02)	83 (0.02)	79 (0.02)	47 (0.01)	425 (0.01)
58678	9hG..00	Exception reporting: smoking quality indicators	No	Unknown	43 (0.01)	56 (0.01)	52 (0.01)	98 (0.02)	26 (0.01)	33 (0.01)	308 (0.01)
42580	U605111	[X] Adverse reaction to salicylates	Yes	Contra-indication	41 (0.01)	51 (0.01)	51 (0.01)	53 (0.01)	50 (0.01)	50 (0.01)	296 (0.01)
30638	8I3w.00	Cholesterol test declined	No	Informed dissent	33 (0.01)	38 (0.01)	38 (0.01)	62 (0.01)	51 (0.01)	59 (0.01)	281 (0.01)
46541	U60B71C	[X] Adverse reaction to betablockers NOS	Yes	Contra-indication	40 (0.01)	41 (0.01)	44 (0.01)	48 (0.01)	52 (0.01)	48 (0.01)	273 (0.01)

CPRD code	Read code	Description	Persistent	Type*	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	Total
28649	9h12.00	Excepted from LVD quality indicators: Informed dissent	No	Informed dissent	147 (0.03)	37 (0.01)	25 (0.01)	10 (0.00)	5 (0.00)	20 (0.00)	244 (0.01)
30714	56F0.00	CT scan brain declined	Yes	Informed dissent	42 (0.01)	37 (0.01)	35 (0.01)	38 (0.01)	42 (0.01)	34 (0.01)	228 (0.01)
46076	TJC6400	Adverse reaction to metoprolol	Yes	Contra-indication	32 (0.01)	35 (0.01)	37 (0.01)	39 (0.01)	41 (0.01)	39 (0.01)	223 (0.01)
34469	ZV14E00	[V]PH of angiotensin II receptor antagonist allergy	Yes	Contra-indication	35 (0.01)	38 (0.01)	36 (0.01)	33 (0.01)	33 (0.01)	37 (0.01)	212 (0.01)
28681	9h7..00	Exception reporting: thyroid quality indicators	No	Unknown	16 (0.00)	24 (0.00)	50 (0.01)	30 (0.01)	45 (0.01)	40 (0.01)	205 (0.01)
39564	TJC6700	Adverse reaction to sotalol	Yes	Contra-indication	30 (0.01)	28 (0.01)	32 (0.01)	33 (0.01)	39 (0.01)	40 (0.01)	202 (0.01)
45023	U60C412	[X] Adverse reaction to enalapril	Yes	Contra-indication	21 (0.00)	23 (0.00)	25 (0.01)	29 (0.01)	31 (0.01)	27 (0.01)	156 (0.01)
34213	9h1..00	Exception reporting: LVD quality indicators	No	Unknown	55 (0.01)	69 (0.01)	13 (0.00)	12 (0.00)	4 (0.00)	1 (0.00)	154 (0.01)
90935	9hH..00	Exception reporting: heart failure quality indicators	No	Unknown	6 (0.00)	49 (0.01)	25 (0.01)	33 (0.01)	12 (0.00)	6 (0.00)	131 (0.00)
63350	9hF..00	Exception reporting: atrial fibrillation quality indicators	No	Unknown	38 (0.01)	40 (0.01)	19 (0.00)	12 (0.00)	12 (0.00)	2 (0.00)	123 (0.00)
68285	U60C314	[X] Adverse reaction to isosorbide mononitrate	Yes	Contra-indication	14 (0.00)	13 (0.00)	15 (0.00)	18 (0.00)	20 (0.00)	17 (0.00)	97 (0.00)
41412	U60B712	[X] Adverse reaction to propranolol	Yes	Contra-indication	10 (0.00)	11 (0.00)	16 (0.00)	17 (0.00)	21 (0.00)	21 (0.00)	96 (0.00)
47554	ZV14C00	[V]Personal history of betablocker allergy	Yes	Contra-indication	13 (0.00)	17 (0.00)	20 (0.00)	15 (0.00)	14 (0.00)	15 (0.00)	94 (0.00)
30713	5695.00	Magnetic resonance imaging scan declined	Yes	Informed dissent	14 (0.00)	13 (0.00)	11 (0.00)	14 (0.00)	17 (0.00)	14 (0.00)	83 (0.00)
55949	U60C316	[X] Adverse reaction to dipyridamole	Yes	Contra-indication	5 (0.00)	7 (0.00)	9 (0.00)	17 (0.00)	20 (0.00)	19 (0.00)	77 (0.00)
44341	9hD..00	Exception reporting: dementia quality indicators	No	Unknown	8 (0.00)	12 (0.00)	3 (0.00)	6 (0.00)	28 (0.01)	6 (0.00)	63 (0.00)
36674	TJ42000	Adverse reaction to heparin	Yes	Contra-indication	7 (0.00)	8 (0.00)	10 (0.00)	12 (0.00)	15 (0.00)	10 (0.00)	62 (0.00)
70388	TJ42300	Adverse reaction to phenindione	Yes	Contra-indication	6 (0.00)	9 (0.00)	9 (0.00)	10 (0.00)	10 (0.00)	11 (0.00)	55 (0.00)
52662	TJC6800	Adverse reaction to timolol	Yes	Contra-indication	7 (0.00)	6 (0.00)	7 (0.00)	7 (0.00)	9 (0.00)	11 (0.00)	47 (0.00)

CPRD code	Read code	Description	Persistent	Type*	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	Total
35480	TJ42z00	Adverse reaction to anticoagulants NOS	Yes	Contra-indication	4 (0.00)	5 (0.00)	6 (0.00)	6 (0.00)	12 (0.00)	10 (0.00)	43 (0.00)
39450	U604213	[X] Adverse reaction to warfarin sodium	Yes	Contra-indication	7 (0.00)	6 (0.00)	8 (0.00)	7 (0.00)	6 (0.00)	4 (0.00)	38 (0.00)
47857	U604211	[X] Adverse reaction to anticoagulants	Yes	Contra-indication	5 (0.00)	5 (0.00)	7 (0.00)	6 (0.00)	4 (0.00)	3 (0.00)	30 (0.00)
60147	ZV14B00	[V]Personal history of clopidogrel allergy	Yes	Contra-indication	2 (0.00)	4 (0.00)	6 (0.00)	6 (0.00)	5 (0.00)	5 (0.00)	28 (0.00)
12334	9h8..00	Exception reporting: cancer quality indicators	No	Unknown	8 (0.00)	6 (0.00)	5 (0.00)	4 (0.00)	1 (0.00)	2 (0.00)	26 (0.00)
43499	TJC6100	Adverse reaction to acebutolol	Yes	Contra-indication	4 (0.00)	5 (0.00)	5 (0.00)	4 (0.00)	3 (0.00)	3 (0.00)	24 (0.00)
73878	U60B717	[X] Adverse reaction to metoprolol	Yes	Contra-indication	2 (0.00)	4 (0.00)	4 (0.00)	5 (0.00)	4 (0.00)	4 (0.00)	23 (0.00)
14001	5534.00	Angiocardiography declined	Yes	Informed dissent	2 (0.00)	4 (0.00)	4 (0.00)	4 (0.00)	3 (0.00)	2 (0.00)	19 (0.00)
68465	U60C411	[X] Adverse reaction to captopril	Yes	Contra-indication	5 (0.00)	4 (0.00)	2 (0.00)	3 (0.00)	1 (0.00)	1 (0.00)	16 (0.00)
49679	U60B71A	[X] Adverse reaction to sotalol	Yes	Contra-indication	2 (0.00)	2 (0.00)	3 (0.00)	3 (0.00)	3 (0.00)	3 (0.00)	16 (0.00)
96808	U604216	[X] Adverse reaction to anticoagulants NOS	Yes	Contra-indication	2 (0.00)	2 (0.00)	2 (0.00)	2 (0.00)	2 (0.00)	2 (0.00)	12 (0.00)
61025	ZV14A00	[V]Personal history of warfarin allergy	Yes	Contra-indication	3 (0.00)	3 (0.00)	2 (0.00)	1 (0.00)	1 (0.00)	2 (0.00)	12 (0.00)
92414	TJ42200	Adverse reaction to nicoumalone	Yes	Contra-indication	1 (0.00)	2 (0.00)	2 (0.00)	2 (0.00)	2 (0.00)	2 (0.00)	11 (0.00)
73787	U60C312	[X] Adverse reaction to glyceryl trinitrate	Yes	Contra-indication	2 (0.00)	2 (0.00)	2 (0.00)	1 (0.00)	2 (0.00)	2 (0.00)	11 (0.00)
61975	TJC6500	Adverse reaction to nadolol	Yes	Contra-indication	2 (0.00)	2 (0.00)	2 (0.00)	2 (0.00)	2 (0.00)	1 (0.00)	11 (0.00)
96532	U60C311	[X] Adverse reaction to coronary vasodilator	Yes	Contra-indication	1 (0.00)	1 (0.00)	1 (0.00)	1 (0.00)	2 (0.00)	3 (0.00)	9 (0.00)
49682	U604212	[X] Adverse reaction to heparin	Yes	Contra-indication	1 (0.00)	1 (0.00)	1 (0.00)	1 (0.00)	1 (0.00)	1 (0.00)	6 (0.00)
57521	TJC6300	Adverse reaction to labetalol	Yes	Contra-indication	0 (0.00)	1 (0.00)	1 (0.00)	1 (0.00)	1 (0.00)	1 (0.00)	5 (0.00)
94109	TJC6600	Adverse reaction to oxprenolol	Yes	Contra-indication	1 (0.00)	1 (0.00)	0 (0.00)	1 (0.00)	1 (0.00)	1 (0.00)	5 (0.00)

CPRD code	Read code	Description	Persistent	Type*	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	Total
65814	U60B716	[X] Adverse reaction to labetolol	Yes	Contra-indication	2 (0.00)	1 (0.00)	1 (0.00)	0 (0.00)	0 (0.00)	1 (0.00)	5 (0.00)
96151	U60C313	[X] Adverse reaction to isosorbide dinitrate	Yes	Contra-indication	0 (0.00)	0 (0.00)	1 (0.00)	1 (0.00)	1 (0.00)	2 (0.00)	5 (0.00)
70518	U60C318	[X] Adverse reaction to coronary vasodilators NOS	Yes	Contra-indication	0 (0.00)	0 (0.00)	1 (0.00)	1 (0.00)	1 (0.00)	1 (0.00)	4 (0.00)
96531	U60B714	[X] Adverse reaction to acebutolol	Yes	Contra-indication	1 (0.00)	1 (0.00)	1 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	3 (0.00)

* Types include: informed dissent (refusal), contraindication (unsuitability) and unknown reason (generic code).

Table A5: Predictors of exception reporting (at least one exception code within each year and patient); logistic regression analyses on ONS linked data from 357 practices.

	Odds Ratios (99% Confidence interval)		
	All reasons*†	Clinical contraindication‡	Informed dissent
QOF year			
2006/7	Reference	Reference	Reference
2007/8	1.01(0.9999,1.03)	0.92(0.90,0.94)	1.13(1.11,1.15)
2008/9	0.96(0.95,0.98)	0.90(0.88,0.91)	1.06(1.04,1.08)
2009/10	1.06(1.04,1.07)	0.996(0.98,1.02)	1.16(1.14,1.18)
2010/11	1.24(1.22,1.26)	1.12(1.09,1.14)	1.40(1.37,1.42)
2011/12	1.20(1.18,1.22)	1.12(1.10,1.14)	1.29(1.27,1.32)
List size (1000s)	1.01(1.01,1.01)	0.99(0.99,0.997)	1.02(1.02,1.02)
English region			
North East	Reference	Reference	Reference
North West	1.09(1.02,1.16)	1.66(1.52,1.81)	0.75(0.70,0.80)
Yorkshire & The Humber	0.69(0.64,0.75)	1.01(0.91,1.11)	0.58(0.54,0.63)
East Midlands	1.15(1.06,1.25)	1.60(1.43,1.78)	0.93(0.86,1.01)
West Midlands	0.67(0.63,0.72)	1.02(0.94,1.12)	0.49(0.46,0.53)
East of England	1.09(1.02,1.17)	1.89(1.72,2.07)	0.65(0.61,0.70)
South West	1.11(1.04,1.19)	1.84(1.68,2.01)	0.70(0.65,0.75)
South Central	0.87(0.81,0.93)	1.23(1.13,1.35)	0.67(0.62,0.72)
London	0.70(0.66,0.75)	0.94(0.86,1.03)	0.61(0.57,0.65)
South East Coast	0.70(0.66,0.75)	0.93(0.85,1.02)	0.63(0.58,0.67)
Practice deprivation quintile			
1(least deprived)	Reference	Reference	Reference
2	1.29(1.25,1.33)	1.60(1.53,1.67)	1.01(0.97,1.04)
3	1.51(1.46,1.57)	1.77(1.70,1.85)	1.15(1.11,1.20)
4	1.27(1.23,1.31)	1.49(1.43,1.57)	1.02(0.98,1.06)
5	1.34(1.29,1.39)	1.41(1.35,1.48)	1.19(1.14,1.24)
Gender			
Female	Reference	Reference	Reference
Male	1.59(1.56,1.62)	1.40(1.37,1.44)	1.53(1.49,1.56)
Age	1.02(1.02,1.02)	1.04(1.04,1.04)	1.01(1.005,1.01)
Patient deprivation quintile			
1(least deprived)	Reference	Reference	Reference
2	1.07(1.04,1.10)	1.14(1.10,1.18)	1.00(0.97,1.03)
3	1.12(1.08,1.15)	1.14(1.10,1.19)	1.09(1.06,1.13)
4	1.18(1.15,1.22)	1.22(1.17,1.27)	1.15(1.11,1.19)
5	1.22(1.17,1.26)	1.44(1.38,1.51)	1.07(1.03,1.11)
Number of conditions¶			
One	Reference	Reference	Reference
Two	3.82(3.75,3.88)	4.28(4.18,4.38)	2.68(2.63,2.74)
Three	10.43(10.18,10.69)	16.32(15.82,16.83)	4.02(3.91,4.13)
Four or more	30.34(29.43,31.28)	68.69(66.12,71.37)	5.17(5.00,5.35)

* Clinical contraindication, informed dissent or reason unknown. Logistical exceptions were not included in analyses.

† No. of observations=5787456, No of subjects=1414897, Log likelihood=-1906771, Wald Chi^2=177557.

‡ No. of observations=5787456, No of subjects=1414897, Log likelihood=-1233953, Wald Chi^2=155098.

§ No. of observations=5787456, No of subjects=1414897, Log likelihood=-1278646, Wald Chi^2=44177.

¶ From the 16 conditions included in the analyses: atrial fibrillation, asthma, hypertension, cancer, coronary heart disease, heart failure, chronic kidney disease, chronic obstructive pulmonary disease, dementia, depression, diabetes mellitus, epilepsy, learning disability, severe mental illness, stroke and hypothyroidism.

Table A6: Exception reporting (all reasons*) as a predictor of survival in the subsequent year; proportional-hazards survival analyses on ONS linked data from 357 practices.

	Hazard Ratios (99% Confidence Interval)	
	CPRD deaths†	ONS deaths‡
Exception reported§		
All reasons	1.38(1.35,1.41)	1.38(1.35,1.41)
Age¶	1.07(1.05,1.09)	1.07(1.05,1.09)
Gender		
Female	Reference	Reference
Male	1.29(1.26,1.31)	1.28(1.25,1.30)
Smoking status		
Never smoked	Reference	Reference
Ex-smoker	0.96(0.94,0.98)	0.97(0.95,0.996)
Current smoker	1.58(1.53,1.64)	1.60(1.55,1.66)
Missing¶	6.19(0.95,40.30)	8.45(1.19,59.85)
Patient deprivation quintile		
1 (least deprived)	Reference	Reference
2	1.07(1.04,1.10)	1.06(1.03,1.09)
3	1.15(1.11,1.18)	1.12(1.09,1.16)
4	1.22(1.18,1.26)	1.20(1.16,1.24)
5	1.36(1.31,1.41)	1.32(1.27,1.37)
Practice list size (1000s)	1.001(0.9995,1.003)	1.000(0.999,1.002)
Practice deprivation quintile		
1 (least deprived)	Reference	Reference
2	1.01(0.97,1.04)	0.99(0.96,1.03)
3	0.97(0.93,1.001)	0.98(0.95,1.01)
4	0.96(0.93,0.997)	0.99(0.95,1.02)
5	1.03(0.99,1.07)	1.03(0.99,1.07)
Conditions		
Atrial fibrillation	1.33(1.30,1.37)	1.33(1.29,1.36)
Asthma	0.92(0.89,0.95)	0.92(0.89,0.95)
Hypertension	0.90(0.88,0.92)	0.90(0.88,0.92)
Cancer¶	2.75(1.93,3.93)	1.60(1.11,2.31)
Coronary heart disease	0.98(0.96,1.01)	0.98(0.96,1.005)
Heart failure	1.71(1.66,1.77)	1.69(1.63,1.74)
Chronic kidney disease¶	1.50(1.07,2.12)	1.62(1.14,2.29)
Chronic obstructive pulmonary disease	1.76(1.70,1.81)	1.73(1.68,1.79)
Dementia¶	3.52(2.12,5.86)	3.14(1.89,5.22)
Depression	1.05(1.03,1.08)	1.06(1.04,1.08)
Diabetes mellitus¶	1.52(1.03,2.22)	1.39(0.94,2.05)
Epilepsy	1.67(1.56,1.78)	1.69(1.58,1.80)
Learning disability¶	12.02(0.53,274.09)	9.44(0.35,258.31)
Severe mental illness	1.46(1.38,1.54)	1.43(1.35,1.51)
Stroke	1.33(1.29,1.36)	1.32(1.29,1.36)
Hypothyroidism	0.99(0.96,1.02)	0.99(0.96,1.02)

	Hazard Ratios (99% Confidence Interval)	
	CPRD deaths†	ONS deaths‡
Time-varying (x log(_t))		
Age	1.01(0.998,1.01)	1.01(0.999,1.01)
Smoking status: missing	0.40(0.16,0.99)	0.34(0.13,0.89)
Cancer	0.93(0.79,1.10)	1.20(1.01,1.43)
Chronic kidney disease	0.90(0.77,1.06)	0.87(0.74,1.03)
Dementia	0.82(0.65,1.04)	0.89(0.70,1.13)
Diabetes mellitus	0.90(0.76,1.08)	0.94(0.78,1.13)
Learning disability	0.46(0.10,2.14)	0.52(0.10,2.64)

* Clinical contraindication, informed dissent or reason unknown. Logistical exceptions were not included in analyses.

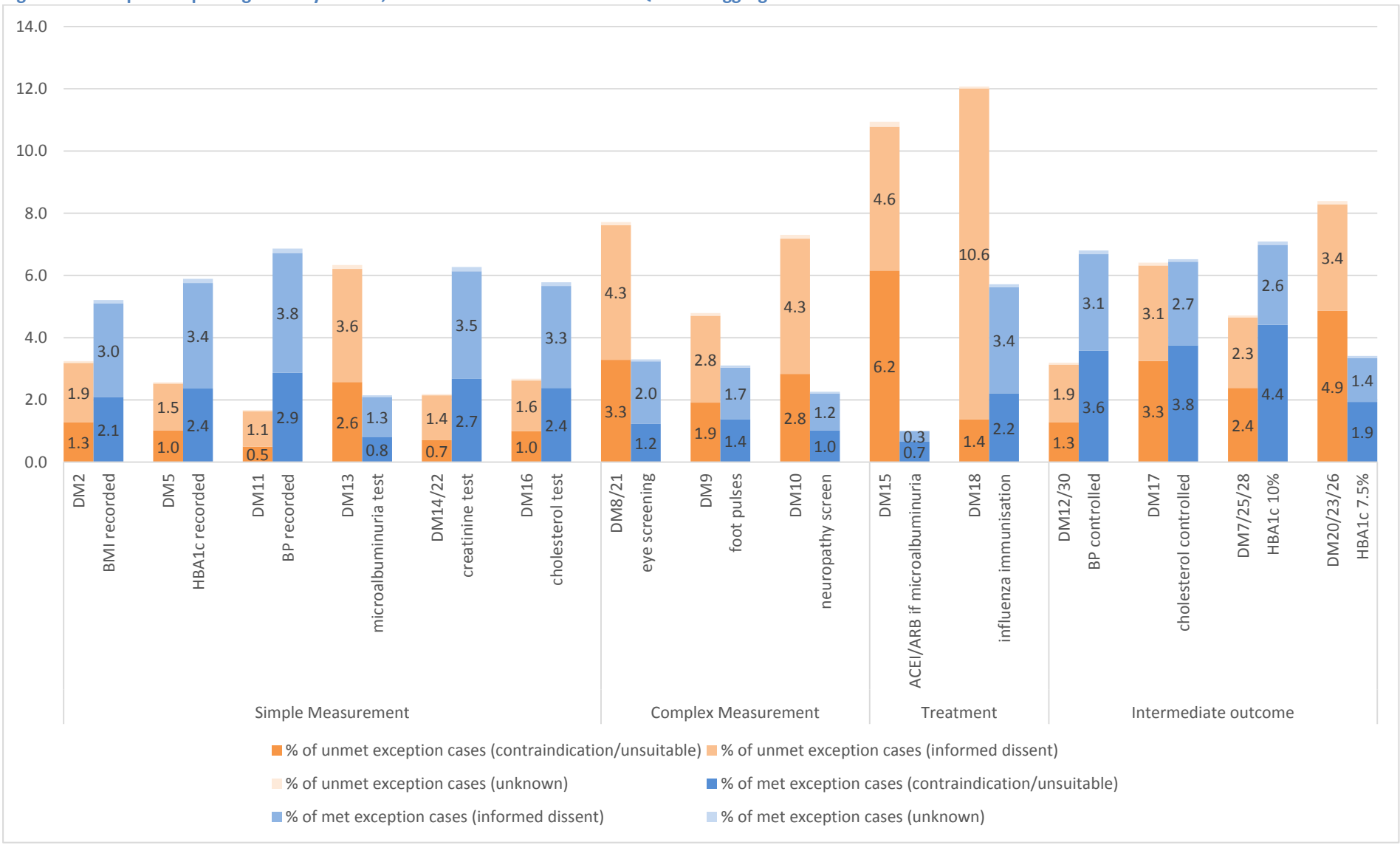
† No. of observations / time at risk=4416374, No of subjects=1194389, No. of failures=68567, Log pseudolikelihood=-869257, Wald Chi^2=119932.

‡ No. of observations / time at risk=4416374, No of subjects=1194389, No. of failures=68756, Log pseudolikelihood=-869508, Wald Chi^2=121371.

§ At least one code.

¶ Interpretation of the hazard ratios for these covariates is not straightforward because of the inclusion of the time-varying components.

Figure A1: Exception reporting rates by reason, in the diabetes domain of the QOF and aggregated over time*†‡



* Details on the indicators are provided in appendix table A3

† DM9 changes significantly in 2011/12 so calculations for that indicator are limited to 2006/7-2010/11

‡ The reason for the first exception associated with a patient is reported