Does higher quality primary care for people with dementia affect hospital admission?[1,2]

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Aims: Described as "one of the biggest challenges we face today", dementia is a high-level government priority for action. One in three people over 65 will develop dementia and the condition costs the UK around £23 billion annually. GPs are paid to identify and review patients with dementia as part of the Quality and Outcomes Framework (QOF). The reviews are a 'health check' with four components:

1. Physical and mental health review
2. Carer's needs for information
3. Impact of caring on carer
4. Communication and coordination arrangements with secondary care

Compared with their peers, people with dementia are at a higher risk of depression and are less likely to report physical conditions. Therefore, the dementia health check should increase planned care. It may reduce unplanned hospital admissions, but this has not previously been tested.

Methods: We run panel count data models to test the impact of primary care quality, measured by practice performance on the dementia QOF indicator, on hospital admissions. The unit of analysis is the GP practice. Our response variables are the number of people with dementia in a practice who were admitted to hospital at least once during the year, for i) emergency dementia care ii) emergency care for any ambulatory care sensitive (ACS) condition or iii) elective care for any non-dementia (physical) condition. As people with dementia often have complex health and social care needs, we adjust for an array of potential confounders. We also test a modified quality indicator to account for patients who are excluded ("exception-reported") from the QOF scheme.

Data: Our practice-level dataset covers around 8,000 practices from 2006/7 to 2010/11. Admissions data from the Hospital Episode Statistics are merged with QOF data. The GMS dataset is used to obtain practice characteristics, and the Attribution dataset is used to derive practice population characteristics. Small area characteristics including ethnicity, rurality, the prevalence of informal care, and deprivation, are estimated from ONS data, and we use Attendance Allowance data to model local need.

Results: In both the random and fixed effects models, better quality primary care is associated with a small but significant increase in the number of patients having at least one emergency admission for dementia, or for any ACS condition. Elective admissions for physical conditions were also significantly higher. However, the effects are insignificant when exception-reported patients are excluded from the quality measure in the fixed effects models.

Conclusions: These preliminary results suggest the QOF may have a small impact on hospital use by dementia patients. We plan further refinements to the model, including adjustments for distance and a more targeted set of conditions for the analysis of elective admissions.

Key words: Dementia, Primary Health Care, Patient Admission, Pay for Performance

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Introduction

Described as "one of the biggest challenges we face today" [1], dementia is a high-level government priority for action [2, 3]. One in three people over the age of 65 will develop dementia and the condition costs around £23 billion annually. At any one time, a quarter of acute hospital beds are in use by people with dementia [4]. The main causes of hospitalisation in individuals with dementia are falls (14%), broken/fractured hip (12%), urinary tract infection (9%), chest infection (7%) and stroke (7%). Hospital stays are longer for people with dementia than for other patients, and costs are higher [5].

In 2000, the Audit Commission published evidence showing that the quality of care for people with dementia was poor, and that there was little joint health and social care planning and working [6]. Only half of GPs believed it was important to look actively for signs of dementia and to make an early diagnosis. A range of policy measures were introduced in response to the Audit Commission report, and since 2006/7 GP practices have been paid to identify and review patients with dementia as part of the Quality and Outcomes Framework (QOF).

The QOF is a voluntary pay for performance incentive scheme for GP practices, who earn points (translated into additional income) for achieving clinical targets for chronic conditions (including dementia). Points are also given depending on how well the practice is organised, the extra services offered and how patients view their experience.

The QOF indicators for dementia are set out in Table 1. The annual reviews (DEM02) are a type of health check, and are designed to address the support needs of the carer and patient. There are four components to the care review:

1. Physical and mental health review for patient
2. Carer's needs for information
3. Impact of caring on carer
4. Communication and coordination arrangements with secondary care, if applicable

Compared with their peers, people with dementia are at a higher risk of depression, and are less likely to report physical conditions. Therefore, the QOF health check for people with

dementia should increase the level of care received in primary care settings, and increase outpatient and planned inpatient care. Insofar as it has a preventative effect, the health check may also reduce the rate of unplanned hospital admissions.

Aims

This paper examines whether the quality of care provided by the GP practice as measured by QOF achievement on dementia care indicators is associated with:

Q1: Higher levels of unplanned hospital admissions

Q2: Lower levels of planned hospital admissions

Methods

The analyses were based on data from routine administrative datasets, and the unit of analysis was the GP practice. We ran a series of count data models to test for an association between the quality of primary care and hospital admissions.

Quality of care

We measured the quality of care provided by the GP practice using QOF indicator scores,[4] with the GP practice as our unit of analysis. The indicators for dementia were introduced in 2006/7, and we compiled a set of panel data covering 4 years (2007/8 to 2010/11). Table 1 shows the QOF indicators we considered.

Table 1: QOF: overview of the dementia indicators

Indicator	Points	threshold
DEM1: The practice can produce a register of patients diagnosed with dementia	5	NA
DEM2: The percentage of patients diagnosed with dementia whose care has been reviewed	15	25–60%
Management 9 (M09): The practice has a protocol for the identification of carers and a mechanism for the referral of carers for social services assessment	3	NA

[4] QOF indicator scores for practices are available on the HSCIC website http://www.qof.ic.nhs.uk/ They are not available at patient-level, i.e. we do not know if an individual received care under the QOF.

We measured achievement based on the total number of people for whom the indicator was achieved, divided by the total number of eligible people. This means that individuals who were 'exception-reported' were added into the denominator for the achievement calculation, and so the measure is conservative in as much as the achievement rates for GP practices will be lower than if such patients were excluded from the calculation. Individuals may be exception reported by GPs from achievement on QOF indicators for various reasons including: the patient is deemed to be unsuitable for treatment, is newly registered with the practice or newly diagnosed, or that the patient makes an informed dissent. Research suggests that an average of 7.6% of eligible patients are exception reported from having their care reviewed (DEM 2) [7]. As a sensitivity analysis, we also tested a modified quality indicator that excluded exception-reported patients.

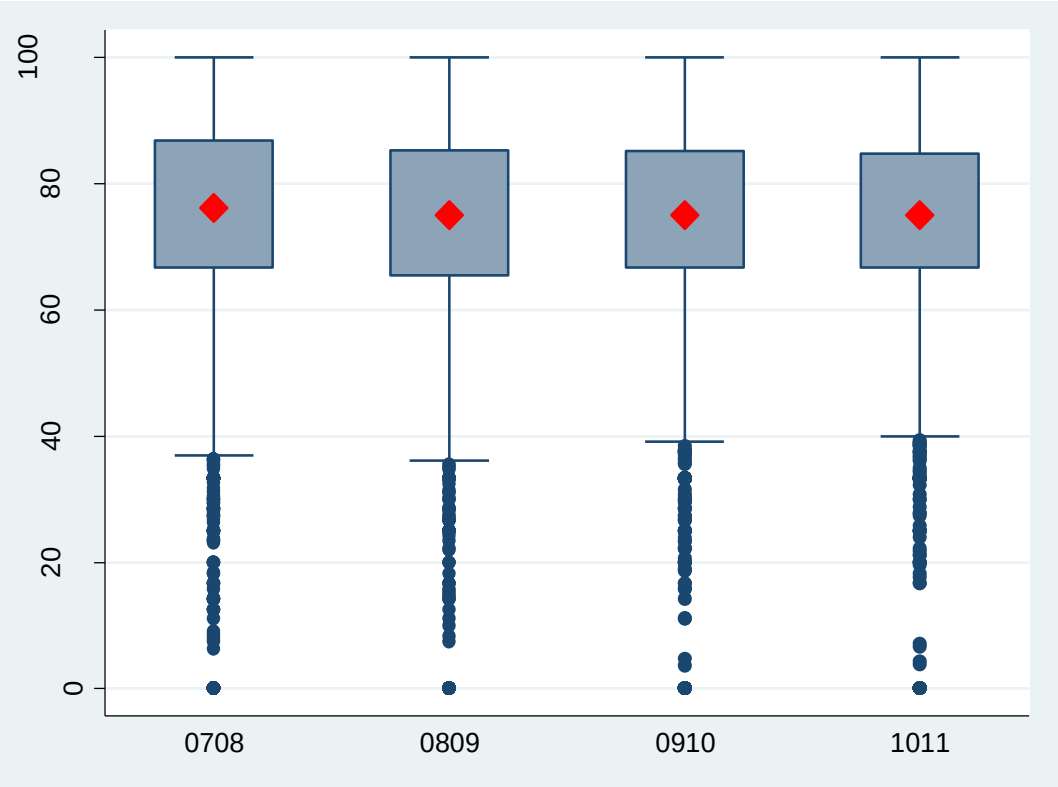
The average DEM2 (care review) and M09 (management) rates are relatively stable over our sample period at about 75 and 98 percentage points (Table 2).

Table 2: QOF mean achievement rates by year

Year	No. of practices	DEM2	DEM2 (net of exceptions)	M09
2007/08	7,903	75.43	82.35	97.27
2008/09	7,938	74.60	80.94	97.76
2009/10	7,965	75.34	81.30	98.22
2010/11	7,978	75.32	81.44	98.70
Al l years	31,784	75.17	81.55	97.99

Management 9 (M09) is a binary variable and achievement was consistently high over time. We therefore did not include this indicator in our analyses. However, achievement on DEM02 (annual care review) was sufficiently variable to allow differences in performance across practices to be tested (Figure 1).

Figure 1: DEM2 indicator: practice achievement rate with exceptions



Within-practice variation was evidenced by the fact that practice performance on this indicator varied over time: about 22% (28%) of practices realised reductions in DEM2 up to (over) 10 percentage points between their first and last year in the sample (i.e., performance worsened) and about 21% (24%) increased their DEM2 rates up to (over) 10 percentage points (i.e., performance improved). Only 5% of practices achieved the same score in their first and last year.

Hospital admissions (dependent variable)

To identify people admitted to hospital with dementia, we mapped the READ codes used by GP practices to identify patients for inclusion on the QOF dementia register, to the diagnostic codes used for hospital care (ICD10). The READ codes cover many types of dementia, such as vascular dementia, Alzheimer's disease with early or late onset, dementia in Huntington's disease, drug-induced dementia, Pick's disease and Lewy body dementia. We used the following approach. First, a colleague with access to a GP practice database (CPRD)

provided the initial mapping based on his own research.[5] Second, we requested a mapping algorithm from the Health and Social Care Information Centre (HSCIC). We then used these two data sources to draw up a list of ICD10 codes that mapped from the READ codes and that would identify all individuals with dementia who would have been eligible for the QOF register. Our project clinical adviser then helped us identify relevant ICD10 codes, and to reject those that were less relevant to our study.

Table 3: ICD codes used to identify dementia patients

ICD10	Definition
F00	Dementia in Alzheimer
F01	Vascular dementia
F02	Dementia in other diseases classified elsewhere
F03	Unspecified dementia
R54	Senility
G300	Alzheimer disease with early onset
G301	Alzheimer disease with late onset
G308	Other Alzheimer disease
G309	Alzheimer disease, unspecified
G310	Circumscribed brain atrophy
G311	Senile degeneration of brain
G318	Lewy body dementia
F051	Delirium superimposed on dementia
F107	Residual and late-onset psychotic disorder

We identified dementia patients as those having at least one of these codes for their primary or secondary diagnosis during the sample period 2006/07-2010/11. We then dropped all spells of care that occurred before a patient's first dementia diagnosis while retaining all subsequent episodes.

We originally planned to test four dependent variables: the number of people with dementia in a practice who were admitted to hospital at least once during the year, either for dementia (planned or unplanned) or for other conditions (planned/unplanned). For the analysis of admissions for dementia, the individual needed to have dementia coded as a primary diagnosis present on admission (i.e. in the first episode of the spell). This approach worked well for emergency admissions, but we found that the number of elective admissions with a primary diagnosis of dementia was relatively small and characterized by large between-provider variations, and by large variations *within* providers over time. About one third of planned dementia admissions were from a single provider, almost all of which were day cases

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and a high proportion (80%) had secondary diagnosis of 'unspecified fall' (ICD10: W199). However, the number of elective admissions for dementia reported by this provider fell sharply over time. After discussions with our project clinical adviser, we concluded that other providers would probably have classified similar cases as outpatients and that coding practice was therefore too inconsistent to allow meaningful analysis. Consequently, we did not run any further regressions for planned admissions where the primary diagnostic code was dementia.

For the analysis of emergency admissions, we restricted the reason for admission to one of three types of 'ambulatory care sensitive' (ACS) condition as specified by Bardsley and colleagues (2013) [8]. As identification of ACS admissions and classification into acute, chronic, and vaccine preventable is based mostly but not solely on primary conditions, there is a small overlap with each other and with dementia admissions. We restricted the count of emergency admissions because many are not amendable to primary care interventions, and the approach should help reduce the 'noise' and identify the 'signal'. However, for the analysis of elective admissions, we included any admission for a person known to have dementia, but where dementia was not the primary diagnosis. Our intention was to test whether the dementia 'health check' identified previously unmet need for any type of elective inpatient care, but the drawback of this approach is that it necessarily includes admissions that are unrelated to the health check. We plan to refine this analysis in future, for example we may limit the count of elective admissions to particular physical conditions that could reasonably be picked up in primary care.

Table 4 shows our six dependent (response) variables defined as the number of people admitted to hospital from a practice at least once in a given year for reasons indicated by the diagnostic and admission methods. For each admission type, we define the dependent variable as the number of practice patients aged 18 or over with at least one admission to hospital within a year. Table 4 shows that the average number of patients admitted at least once rises steadily over time.

Table 4: Response variables: by year and type of admission

Response variable			*Mean no. practice patients with dementia admitted from at least once within a year (percentage of practices with zero admissions)*				
Diagnosis	Admission method	Diagnostic field(s)*	2006/7**	2007/08	2008/09	2009/10	2010/11
Dementia	emergency	primary	4.29 (13.6%)	4.74 (10.5%)	5.29 (9.1%)	5.60 (8.5%)	5.98 (8.2%)
Acute ACSCs	emergency	mostly primary	2.47 (23.9%)	3.18 (16.6%)	3.92 (12.6%)	4.66 (10.6%)	5.32 (8.9%)
Chronic ACSCs	emergency	mostly primary	1.41 (37.2%)	1.92 (27.9%)	2.41 (21.5%)	2.79 (18.4%)	3.19 (16.1%)
Vaccine ACSCs	emergency	mostly any	0.85 (54.1%)	1.22 (43.6%)	1.74 (33.5%)	2.27 (25.9%)	2.77 (21.0%)
Any type of ACSC	emergency	primary	4.42 (12.8%)	5.86 (7.0%)	7.39 (4.7%)	8.80 (3.5%)	10.15 (3.1%)
Physical (non-dementia)	elective	primary	1.31 (40.7%)	2.86 (18.6%)	3.96 (12.8%)	4.84 (10.3%)	5.75 (7.3%)
Mean QOF dementia register				27.42	28.95	31.07	31.15

ACSC: ambulatory care sensitive condition; QOF: Quality and Outcomes Framework
* some ACSCs are identified by the primary diagnosis in the patient record, others by a code in any field
** baseline year, included in the random effects models.

Covariates

Hospital admissions are influenced by factors other than the quality of primary care, and people with dementia often have complex health and social care needs. To try to ensure that the effects of GP practice care were correctly identified, our analysis adjusted for an array of covariates, drawn from health and social care datasets (Table 5). We consulted with our project lay advisors, who have experience of caring for family members with dementia, in order to obtain their views on the factors which can precipitate hospital admission and conversely, the nature of support that can help to avoid admissions. In practice we were restricted by availability of data, and we return to this issue in the discussion section.

Table 5: Covariate Definitions and Sample Statistics

Variables	Definition	mean	std	min	max
QOF indicator					
DEM2	DEM2 QOF achievement rate **including** exceptions	75.17	15.62	0	100
DEM2	DEM2 QOF achievement rate **excluding** exceptions	81.57	14.28	0	100
GP practice characteristics					
size	no. of patients in practice list	6,756	4,055	1,002	40,766
pc_fem_gp	% of female GPs in practice	39.49	26.98	0	100
av_age_gp	average age of GPs in practice	47.97	7.63	28	76
pc_ukqual_gp	% of UK qualified GPs in practice	67.34	37.32	0	100
single_handed	single handed practice	14.88	35.59	0	100
pc_pms_gp	% of GPs under PMS in practice	41.32	48.72	0	100
av_age_gppop	average age of practice population	39.02	4.13	22.14	62
pc_male_gppop	% of male patients in practice	50.23	2.35	0	80.13
pc_urban_gppop	% of patients reside in urban in practice	82.16	30.61	0	100
pc_ethnic_gppop	% of non-white patients in practice	11.22	15.16	0.12	80.34
pc_depriv60_gppop	% of elderly practice population in income deprivation	23.63	11.45	2.92	66.79
pc_carers_gppop	% of carers in practice area	9.90	1.33	4.88	14.95
Access to care					
gp_48pct	% of patients reporting access to practice within 48 hours	83.46	10.92	22.01	100
Social care					
pc_aa_claimants	% of Attendance Allowance claimants	16.13	3.36	4.34	30.98
pc_hr_claimants	% of Attendance Allowance claimants paid higher rate	54.27	5.98	28.84	76.49
Baseline rates	2006 admission rates for 6 types of admissions		*See Table 4*		
Sample size			31,784		

QOF: Quality and Outcomes Framework; PMS: Personal Medical Services

We controlled for practice characteristics based on data from the General Medical Services (GMS) dataset, QOF dataset and Attribution Dataset (ADS). Variables included the average age of GPs, proportion of male GPs, whether the practice operates single-handed, and whether the practice was contracted under the Personal Medical Services (PMS) scheme. To control for local population characteristics, we used data from the ONS Neighbourhood Statistics (2001) which are available at Lower Super Output Area (LSOA) level. LSOAs are defined geographic units that cover an average population of 1,500, and there are 32,482 LSOAs in England. GP practices typically care for people who reside in multiple LSOAs and the ADS provides a breakdown of the practice population by LSOA. We derived a weighted

average of the local population characteristics of the practice and assigned this to the practice. From the ADS dataset we obtained the average age and male proportions of each practice's registered patients.[6] We also derived a measure of deprivation based on the proportion of the population aged 60 and over (arguably the most relevant age group for our study) living in income deprivation. Finally, we derived measures of ethnicity (% non-whites) and rurality (% living in urban areas). ADS data are collected at the beginning of each financial year, whereas QOF data are collected at the end of the financial year. We therefore adjusted the estimates based on ADS by taking moving averages across two years of data.

Finally, we derived three measures to reflect differences between practices in terms of supply of and access to care. These comprised the percentage of practice patients able to book an appointment within 48 hours (measured in the GP Patient Survey); a measure of informal care provision based on Census data (% of the catchment population providing informal care); and a measure of social support. The latter can be provided by the local authority, by private providers, and/or by informal carers. We considered social services activity from Community Care Statistics and indicators reported by the National Adult Social Care Intelligence Service (NASCIS). However, few measures were stable over time and all were available only at local authority level. Our chosen covariate for social support[7] was based on Department of Work and Pensions (DWP) data on Attendance Allowance (AA), which is a benefit for severely disabled people aged 65 or over who need help with personal care. It is not means tested, is available at lower and higher rates (depending on need), can be used to pay for care from any provider, and the measure is available at LSOA level for all our study years. We derived two measures at practice-level, using the same method we applied to the covariates based on ONS data.

After excluding patients younger than 18 and those that changed practices within a year, we merged the HES patient level data with the QOF practice level data and linked to the information obtained from the other datasets. Lastly, we dropped practices with a list size of fewer than 1,000 patients. Our final sample is an unbalanced panel with the majority of practices contributing all four years of data and total size of 31,784 practice-year observations (Table 6).

[6] We excluded these variables from the fixed effects models, because there was little variation within practices.
[7] Although this is really a 'need' variable, it arguably can also be interpreted as a measure of support if used as intended to purchase social care from public, private or voluntary sector providers.

Table 6: Number of years of data contributed by practices

Years of data	Number of practices	Number of observations
1	204	204
2	226	452
3	432	1,296
4	7,458	29,832
Sum	8653	31,784

Model specification

We ran panel count data models to test the impact of primary care quality on hospital admissions. Our response variable (adm_{it}) was defined as the number of people admitted to hospital at least once in year $t = 2007, \ldots, 2010$, from GP practice $i = 1, \ldots, N$. The number of practice patients with dementia who are at risk of admission is denoted as $risk_{it}$, based on the QOF register. We specified the Poisson regression model as follows:

$$adm_{it} \sim P[\alpha_i * risk_{it} * \exp(Q_{it}\gamma + X'_{it}\beta + D_t\lambda)] \qquad (1)$$

In this equation, Q_{it} is the variable for GP practice quality as measured by the QOF; X_{it} is a vector of covariates that capture differences in the practice patient population and the supply of and access to other care resources; and D_t is a vector of time dummy variables to control for trends in hospital admission. The GP practice-specific effects α_i are multiplicative and capture unobserved, time-invariant differences between practices in terms of their admission propensity.[8]

We estimated both fixed and random effects models. The Poisson fixed effects model [9, 10] excludes an intercept from X_{it} and treats the practice specific effects as parameters to be estimated and which are allowed to be correlated with some of the regressors. The random effects model [10] assumes a conjugate gamma density for the random effects which are assumed to be uncorrelated with the regressors. For the random effects models, we also included pre-sample baseline admission numbers per GP practice [11]. This is based on the admissions for 2006/7, the first year of operation for the dementia QOF indicator.

[8] The decision to admit – whether the admission is elective or emergency – is taken by the hospital, although elective admissions also reflect practice referral patterns. The variable captures any practice behaviour that influences admission rates, including but not limited to, specific decisions on hospital care.

The models share the strengths and caveats of their linear counterparts. Fixed effects account for a (limited) form of endogeneity but ignore between-practice variation, resulting in higher standard errors especially for variables with small within-practice variation. Random effects estimation makes use of both within and between-practice variation but coefficients may be inconsistent if exogeneity of the covariates is violated.

For the fixed effects model both conditional maximum likelihood (CML) which removes the practice specific effects from the likelihood by conditioning on the sufficient statistic and concentrated ML, provide the same consistent estimates[9]. Estimation of random effects is carried out by maximizing the likelihood that results after integrating out the conjugate random effects [12]. We calculated robust standard errors for the fixed effects model and bootstrapped standard errors for the random effects model.

The coefficient estimates can be interpreted as semi-elasticities. Alternatively, the exponentiated coefficients or incident rate ratios (IRRs) also facilitate a semi-elasticity interpretation and they are more suitable to explain the result of a discrete (one percentage point) change in QOF rate. To explore the effects of explanatory variables on admission *levels*, we calculate marginal effects by differentiating the conditional mean

$$E(adm_{it} \mid risk_{it}, Z_{it}, \theta, \alpha_i) \qquad (2)$$

where Z_{it} and θ are vectors of explanatory variables and parameters in the linear predictor. For the random effects model, practice specific effects integrate out and we simply differentiate $E(adm_{it} \mid risk_{it}, Z_{it}, \theta)$. For the fixed effects model, α_i are replaced by their sample estimates.[10] Average marginal effects are calculated averaging across practices and years. Since the models are non-linear, these partial marginal effects might differ from the effects of unit changes in the explanatory variables which we also calculated.

[9] The Poisson fixed effects model is one of the few non-linear models that is not affected by the incidental parameters problem and therefore CML is not necessary.

[10] Stata does not report the fixed effects and the command margins with the predict(nu0) option calculates marginal effects by setting α_i =0. Instead, we retrieve the estimated α_i which we use in the calculation of marginal effects.

Results

We estimated fixed and random effects Poisson models for the six admission types and for the two QOF indicators. Due to space limitations we present estimates of incidence rate ratios only for emergency dementia admissions in Table 7.

Table 7: IRR estimates for emergency dementia admissions – DEM2

	FE		RE	
	IRR	SE	IRR	SE
QOF rate	1.0009***	(0.0003)	1.0008***	(0.0003)
year2	1.0893***	(0.0106)	1.0743***	(0.0091)
year3	1.1191***	(0.0185)	1.0705***	(0.0111)
year4	1.1152***	(0.0207)	1.0647***	(0.0118)
% female GPs	1.0001	(0.0004)	0.9997	(0.0003)
mean age of GPs	1.0015	(0.0016)	1.0050***	(0.0010)
% UK qualified GPs	1.0001	(0.0004)	0.9997	(0.0002)
% GPs under PMS	1.0003	(0.0004)	0.9998	(0.0001)
single handed practice	1.0000	(0.0003)	1.0003	(0.0003)
mean age of practice pop †			1.0006	(0.0028)
% male patients †			1.0144***	(0.0039)
% patient reside in urban	1.0004	(0.0007)	1.0016***	(0.0002)
% non-white patients	1.0017	(0.0028)	1.0022***	(0.0007)
% carers	1.0170	(0.0212)	1.0138**	(0.0068)
% elderly in deprivation	1.0045	(0.0037)	1.0077***	(0.0013)
% AA claimants	0.9668***	(0.0093)	0.9912**	(0.0035)
% AA claimants paid higher rate	0.9902***	(0.0038)	0.9933***	(0.0011)
no patients in practice list	0.9900	(0.0083)	1.0000***	(0.0000)
% report access within 48h	0.9994	(0.0008)	0.9981***	(0.0006)
2006 dementia admission rate			1.0311***	(0.0020)

AA: attendance allowance; IRR: incidence rate ratio; QOF: Quality and Outcomes Framework; PMS: Personal Medical Services

† Two variables for the practice population were omitted from the fixed effects model because within-practice variation was too small.

DEM2 achievement rates, year dummies, and the social support variables (attendance allowance) are significant in both models. While several other variables are significant in the random effects model, limited within-practice variation weakens their significance in the fixed effects model. The IRR for the QOF rate is 1.0008 (1.0009) in the fixed (random) effects specification which translates to a 0.08% (0.09%) increase in emergency dementia admissions as a result of an increase in QOF achievement by one percentage point. IRR for the two social support variables is less than unity, indicating negative effects of supply of

social care support on admissions.

We also calculated marginal effects which describe the effects of variables on the *levels* of admissions. With very few exceptions, signs and significances are consistent between the estimated coefficients and marginal effects. We present marginal effects for our key variable QOF rates and for the two social support variables that are consistently estimated significant across all models and all admission types (Table 8).

Higher DEM2 scores are associated with larger numbers of emergency dementia and ACS admissions as well as larger numbers of physical elective admissions. When ACS admissions are analysed separately as acute, chronic, and vaccines conditions, QOF rates tend to turn insignificant. The magnitudes of the effects are very small but are robust between the two specifications. Dementia admissions are expected to increase by only 0.005 units as a result of a small change in the DEM2 indicator. Similarly, changes in ACS emergency admissions and physical elective admissions are marginal; estimated between 0.006 and 0.008 units and 0.006 and 0.007 respectively. We confirmed that these small effects are not due to non-linearities by calculating the effect of unit changes in QOF rates on the numbers of admissions (results not reported). For instance, as DEM2 rises by one percentage point the number of patients with at least one unplanned dementia admission increases by 0.003 (0.008) under the fixed (random) effects assumption. We also tested for QOF rates unadjusted for exception reporting (Table 9). For the random effects models, findings were similar. However, in the fixed effects specification, the QOF indicator was no longer significantly associated with admissions.

Table 8: AME: Average marginal effects (AME) of DEM2 achievement & social care variables

		FE		RE	
		AME	SE	AME	SE
Dementia	QOF rate	0.005**	(0.003)	0.005***	(0.002)
	% AA claimants	-0.186**	(0.076)	-0.055**	(0.022)
	% AA claimants paid higher rate	-0.054***	(0.019)	-0.042***	(0.007)
Acute	QOF rate	0.004**	(0.002)	0.002	(0.001)
	% AA claimants	-0.060	(0.045)	-0.041***	(0.016)
	% AA claimants paid higher rate	-0.017	(0.014)	0.0001	(0.007)
Chronic	QOF rate	0.003*	(0.002)	0.001	(0.001)
	% AA claimants	-0.022	(0.030)	-0.030***	(0.009)
	% AA claimants paid higher rate	-0.027**	(0.011)	0.003	(0.003)
Vaccine	QOF rate	0.002	(0.002)	0.001	(0.001)
	% AA claimants	-0.088*	(0.050)	-0.025***	(0.008)
	% AA claimants paid higher rate	-0.019*	(0.011)	-0.005*	(0.003)
ACS	QOF rate	0.008***	(0.003)	0.006***	(0.002)
	% AA claimants	-0.147**	(0.070)	-0.072***	(0.026)
	% AA claimants paid higher rate	-0.057***	(0.021)	-0.007	(0.008)
Physical electives	QOF rate	0.006**	(0.003)	0.007***	(0.002)
	% AA claimants	-0.058	(0.045)	-0.050***	(0.016)
	% AA claimants paid higher rate	-0.043***	(0.016)	-0.014**	(0.006)

Table 9: AMEs of DEM2 underlying achievement (net of exceptions) & social care variables

		FE		RE	
		AME	SE	AME	SE
Dementia	QOF rate	0.004	(0.002)	0.006***	(0.002)
	% AA claimants	-0.190**	(0.078)	-0.053***	(0.020)
	% AA claimants paid higher rate	-0.057***	(0.020)	-0.043***	(0.007)
Acute	QOF rate	0.001	(0.002)	0.002	(0.002)
	% AA claimants	-0.065	(0.046)	-0.043***	(0.015)
	% AA claimants paid higher rate	-0.019	(0.014)	0.0001	(0.005)
Chronic	QOF rate	0.001	(0.001)	0.002	(0.001)
	% AA claimants	-0.031	(0.032)	-0.030***	(0.009)
	% AA claimants paid higher rate	-0.027**	(0.011)	0.004	(0.003)
Vaccine	QOF rate	0.001	(0.001)	0.001	(0.001)
	% AA claimants	-0.090*	(0.051)	-0.027***	(0.007)
	% AA claimants paid higher rate	-0.016	(0.011)	-0.004	(0.003)
ACS	QOF rate	0.003	(0.002)	0.004*	(0.002)
	% AA claimants	-0.161**	(0.072)	-0.076***	(0.024)
	% AA claimants paid higher rate	-0.057***	(0.021)	-0.006	(0.008)
Physical electives	QOF rate	0.003	(0.002)	0.006***	(0.002)
	% AA claimants	-0.039	(0.043)	-0.049***	(0.018)
	% AA claimants paid higher rate	-0.037**	(0.015)	-0.014**	(0.006)

Table 7, Table 8 and Table 9 also show results for our area-level measure of social support, Attendance Allowance (AA). In almost all models, this variable is negatively associated with admissions. For example, a one percentage point increase in the number of people claiming Attendance Allowance within a local practice catchment area is associated with a decrease in emergency admissions for dementia of between approximately 1% and 3% (Table 7).

Discussion

A growing body of evidence is emerging on the type of interventions that are effective in reducing unplanned admissions, given that a proportion of such admissions are deemed to be avoidable if appropriate and timely care is delivered outside of the hospital. Purdy (2010)[13] summarises evidence showing lower rates of admission for asthma in practices whose prescribing patterns suggest better preventive care, and in practices providing diabetes clinics; but conversely, no such impact from the provision of asthma clinics and no definitive effect of high standards of diabetes care in primary care on admissions. Evidence on the link between higher quality primary care as measured by QOF indicators and reduced admissions is similarly mixed. Negative associations have been reported for diabetes [14, 15]; angina [16], stroke [17], although in some cases the effect is small; and no associations or small and mixed results have been reported for asthma, COPD and CHD [18, 19].

Evidence in relation to dementia is scarce. A large study of Medicare claims data reported that those with a dementia diagnosis, after controlling for other conditions, were more than three times as likely as others to have a hospital admission and more than twice as likely to have an ACS hospital admission, pointing to potential failures in the ambulatory care sector [20].

Preliminary findings from our analyses suggest that better quality care, as measured by achievement on the QOF dementia 'health check' is associated with a small but statistically significant increase in admissions. A one percentage point increase in QOF achievement is associated with a 0.1% increase in admissions, and this effect is consistent for various types of admission and for fixed and random effects specifications. The reason why better quality care increases emergency admissions is unclear, and these preliminary findings may change when we refine the model to control for other potential confounders (e.g. distance to hospital). For planned (elective) admissions, this finding is as expected: people with

dementia typically under-report their needs for care and an annual health check of the type incentivised through the QOF, should therefore help identify previously unmet need.

The QOF care review is targeted not only at the needs of the dementia patients but also at the needs and health of their carers. The vital role that carers have in the support of people with dementia is reflected in the fact that two-thirds of dementia patients live at home, most receiving care from their family members [21] and protecting carers' health and wellbeing are major factors in preventing crises and preventing or delaying admissions to hospital and nursing homes [22, 23]. However, we do not have data on whether individual patients had a carer, and we could adjust only for the provision of informal care at the small area level. Further, we do not know whether individual patients who were admitted to hospital had received care under the QOF, or what other types of care they may have received. A patient-level analysis that takes account of the clustering of patients within practices and of admissions within hospitals would be one way forward.

Future analysis can incorporate additional potential confounders. For instance, it may be the case that hospital admission rather than reflecting quality of primary care, reflects the availability of alternatives such as nursing homes, or intermediate care provision. Our lay advisers suggested numerous factors that might affect admissions and we can explore the potential to include these in our analysis. However, some are qualitative and are difficult to capture in a statistical model, and others may require data that are unavailable such as continuity of care with the GP, expertise of individual GPs, the role of practice staff, district nurses and pharmacists, and access to memory clinics.

The next steps are to refine the analysis. For the response variables, we can select particular physical conditions most likely to be influenced by primary care interventions, especially the annual health review. We also plan to include additional covariates to allow for distance to hospital, and for the proportion of practice patients who are cared for in a nursing home. We may also add further years of data, to extend the analysis to 2012/13.

Conclusion

It is estimated that by 2040 the number of people affected by dementia will double and the costs of care are predicted to treble [24]. In the absence of clinically effective pharmacological interventions for dementia, 'usual care' will continue to be defined by a

package of services designed to address the health and care needs of individuals with dementia and their carers. Further research on quality and effectiveness of those services is therefore essential.

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