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The Impact of Primary Care Quality on Inpatient Length of Stay for People with Dementia: An Analysis by Discharge Destination

Panagiotis Kasteridis, Maria Goddard, Rowena Jacobs, Rita Santos, Anne Mason

CHE Research Paper 113

The impact of primary care quality on inpatient length of stay for people with dementia: an analysis by discharge destination

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The research is one of three analyses undertaken as part of a larger project:
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Acronyms

A	Numerator for QOF review (number of patients reviewed, i.e. 'achieved')
BMI	Body Mass Index
CH	Care Home
D	Denominator for QOF review (number of patients deemed eligible for review)
E	Number of patients exception-reported for QOF review
FMM	Finite Mixture Models
GLM	Generalized Linear Models
GP	General Practitioner
HES	Hospital Episode Statistics
HSCIC	Health and Social Care Information Centre
ICD10	International Classification of Diseases, version 10
IRR	Incidence rate ratio
LA	Local Authority
LoS	Length of (hospital) stay
LSOA	Lower Layer Super Output Area
NICE	National Institute for Health and Care Excellence
ONS	Office for National Statistics
PCT	Primary Care Trust
QOF	Quality and Outcomes Framework
SA	Sensitivity analysis (model)
SD	Standard Deviation

Contents

Abstract

Introduction

Dementia is a chronic and progressive condition, characterized by memory loss, mood swings, and difficulties in communication, mobility, reasoning and self-care. Around 800,000 individuals in the UK have dementia and the disease imposes a huge financial burden on the formal care systems, as well as having an enormous emotional impact on carers and their families.

Older people with dementia currently occupy up to 25% of NHS hospital beds and stay longer than those without dementia. Hospital admission can have a significant negative impact on the person with dementia, adversely affecting their general physical health as well as their dementia symptoms.

Since 2006, GPs have been paid to identify and review patients with dementia as part of the Quality and Outcomes Framework (QOF). The dementia QOF review should focus on the patient's and carer's support needs, address the patient's physical and mental health, and assess communication and coordination arrangements across care boundaries. Where appropriate, this includes ensuring that suitable discharge arrangements are in place for patients admitted to hospital, for example by linking the patient to the local community mental health team. The QOF review may help facilitate timely discharge, but this has not previously been tested.

Methods

We ran multilevel Poisson regression models to test the impact of practice performance (in terms of the dementia QOF indicator) on the time to discharge following an acute hospital admission. Our response variable was length of stay (LoS) following emergency hospital admission for people with a primary diagnosis of dementia. We analysed the whole dataset (pooled analysis of all admitted individuals) and also investigated three mutually exclusive subgroups that were defined by their discharge 'destination': those who died in hospital (DisDeath); those discharged to a care home (DisCH); and those discharged elsewhere (DisOther). As people with dementia often have complex health and social care needs, we adjusted for an array of potential confounders. In the pooled analysis, we also controlled for the reason for discharge.

The dataset included 36,744 individuals admitted over the period 2006/7 to 2010/11. We merged admissions data from Hospital Episode Statistics with practice-level data on the QOF dementia review. We also used data from NHS England on delayed transfers of care (DTOC) to test for the impacts of delays due to the NHS or where social services were responsible. To identify relevant local area effects, we merged in variables derived from ONS neighbourhood statistics and deprivation measures from the Department for Work and Pensions.

In the base case analysis, admissions were clustered within GP practices. We reported findings as incidence rate ratios, and estimated marginal effects (e.g. absolute change in number of days). We used sensitivity analyses to test the robustness of findings.

Results

Length of stay (LoS) varied considerably within and between the subgroups analysed. Overall, mean length of stay was 18.1 days (standard deviation, SD: 22.3). For those who died in hospital (DisDeath), mean LoS was 23.1 days (SD: 22.5, N=5,051); admissions resulting in a discharge to a care home (DisCH) had a mean stay of 33.0 days (SD: 29.9, N=6,208); and for those discharged to somewhere other than a care home (DisOther), mean LoS was 13.5 days (SD: 17.8, N=25,485). In the

pooled analysis, median length of stay was 11 days, and the corresponding subgroup figures were 17 days (DisDeath), 27 days (DisCH) and 7 days (DisOther) respectively.

When assessed as a practice-level indicator of quality, the QOF dementia review was not significantly associated with length of stay either in the pooled analysis or in the analysis of those who died in hospital. In patients discharged to a care home, an improved QOF review performance of 1 percentage point was associated with an increase in LoS of around 0.02 days. In those who were discharged to somewhere other than a care home, the same QOF improvement was associated with significantly lower LoS (by 0.01 days).

In all three subgroup analyses, older inpatients had significantly shorter length of stay. Longer stays were predicted by a diagnosis of vascular dementia, urinary incontinence, cerebrovascular disease, hip fracture, fall, or senility. Higher levels of other comorbidity (i.e. additional to conditions modelled individually in the analyses) were also predictive of longer stays. Admission on a Sunday was associated with a shorter stay.

People admitted from neighbourhoods with high uptake of Pension Savings Credits had significantly shorter hospital stays, but the impact of Pension Guarantee Credit on hospital stay was mixed. Areas with a higher supply of care home beds per head of population were characterised by shorter stays for two subgroups, but there was no significant effect in the pooled analysis. In areas where a high proportion of people provided over 50 hours a week of informal care, length of stay was significantly longer - reinforcing the need for GPs to pay particular attention to the support needs of 'intensive' carers.

In all analyses, higher rates of delayed transfers of care for which social services were responsible were associated with significantly longer stays. Where delayed transfers due wholly or in part to the NHS, the effect was smaller and its statistical significance was inconsistent.

Conclusions

For those who are discharged home or to the community setting, the QOF review may have a small negative influence on length of stay. Such modest effects suggest that the QOF review does not have a major influence on LoS for dementia hospital admissions. However, this does not mean the review is unimportant for patient care: the increasing prevalence of dementia and the constraints on capacity in the acute hospital sector may mean even modest impacts are important financially. We also found that the number of clinical conditions was consistently associated with longer LoS. GPs are uniquely placed to manage multimorbidity in dementia patients and this may help prevent some hospitalisations. There may also be scope within the QOF review to encourage greater preventative uptake of outpatient and community services to enable people with dementia to live independently for longer.

Introduction

Dementia is a chronic and progressive condition, characterized by memory loss, mood swings, and difficulties in communication, mobility, reasoning and self-care.[1-3] In the UK, approximately 800,000 people have dementia and this is predicted to rise to two million by 2050, doubling the current annual total costs of care to almost £60 billion.[4] These financial costs reflect the human toll taken by the disease: dementia has a devastating impact on the lives of people living with dementia, their families and carers.[5]

At any one time, people with dementia occupy a quarter of acute hospital beds.[6] Compared to similar patients without dementia, their hospital stays tend to be longer and costlier, and their health outcomes are poorer.[7] When someone with dementia enters emergency hospital care they are at increased risk of delirium, dehydration, falls, healthcare associated infections and death.[7] Hospital stays for these individuals are often prolonged, adversely impacting acute service capacity.[8] There have been calls to reduce inappropriate acute usage for people with dementia, and to increase the provision of alternative community-based services.[9] As shown in Figure 1, mean length of hospital stay for people with dementia has fallen over time.

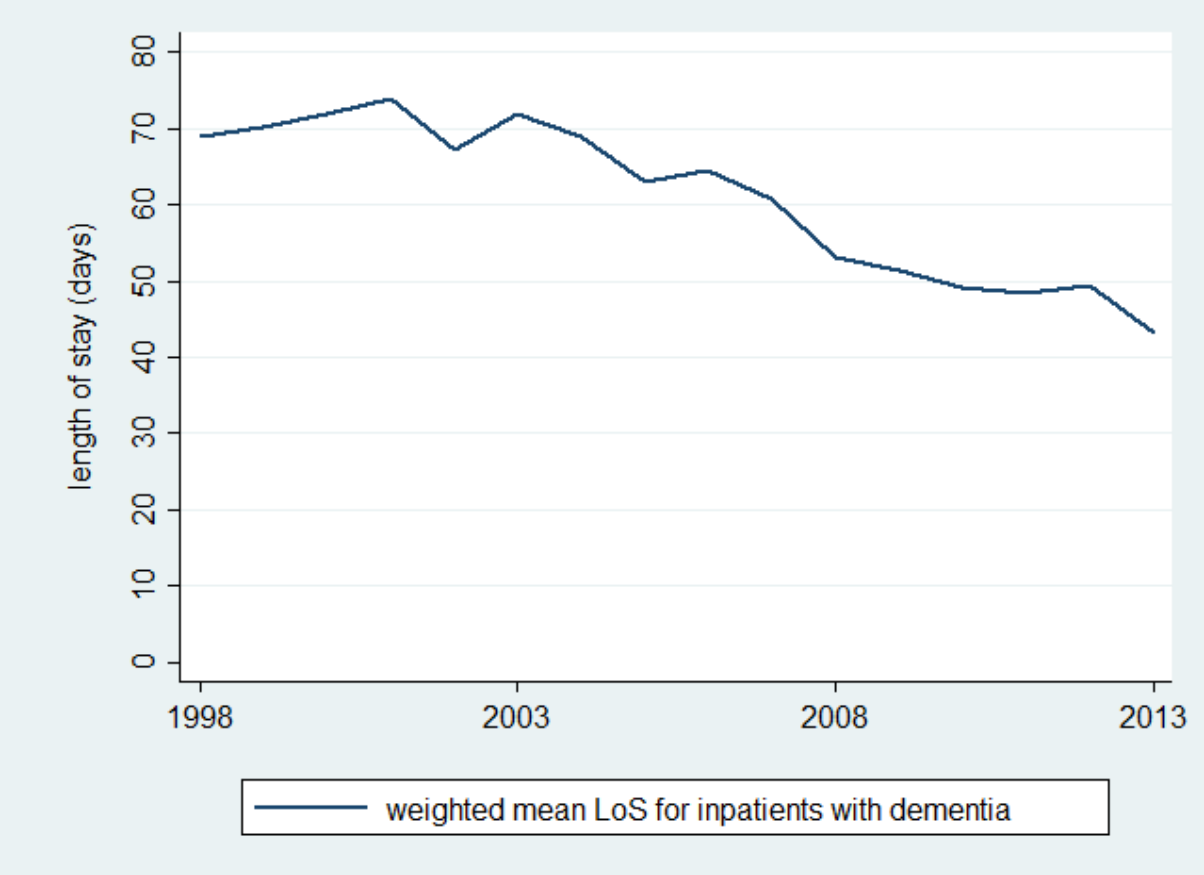

Figure 1: Trends in LoS for people with dementia: England 1998/99 to 2013/14

Source: HES aggregated admitted patient care data http://www.hscic.gov.uk/
Note: length of stay (LoS) is based on all inpatients with dementia, so includes individuals with stays longer than 270 days, and patients treated in acute and/or mental health hospitals. This is why mean LoS is higher in this figure than the mean in our study sample, which is based on acute hospital inpatients with stays of up to 270 days.

To maintain their health and wellbeing, people with dementia typically need access to support from a range of health and social care professionals.[10] Good care "helps people to maintain their health and wellbeing and avoid unnecessary admissions to hospital or prolonged lengths of stay in acute care." [10] Despite some improvements, however, care for dementia remains poor and fragmented.[3 7 11 12] Poor co-ordination, especially between health and social care, can lead to cost shifting and 'problem dumping' – a major cause of poor care and inefficiency.[13]

Since 2006, general practitioners (GPs) have been paid to identify and review their patients with dementia as part of the Quality and Outcomes Framework (QOF). The overall aim is to ensure that "potentially complex needs are addressed".[14] The review is intended to focus on the patient's and carer's support needs, to address the patient's physical and mental health, and to assess communication and coordination arrangements across care boundaries including coordination across the primary / secondary care divide. Patients who are regularly reviewed in this way may be better supported than those who do not receive a review, which may in turn facilitate timely discharge from hospital should they be admitted. For example, if patients and carers are already linked into the local community mental health team or are in receipt of appropriate voluntary and social care services, this may minimise delays in discharge arising from the need to organise the support required for care at home. Similarly, if as a result of the review, the GP ensures that communication and liaison between primary, secondary and community services is good, this will enable a timelier discharge than for patients whose needs are not known to local service providers. GPs who know and review the patients with dementia may also be able to liaise more effectively with hospital discharge teams and the patient's carer.

Methods

The aim of the study was to determine whether achievement on the QOF dementia review by GP practices was associated with their patients having shorter length of stay in acute hospitals. The analysis focused on admissions with a primary diagnosis of dementia.

Quality of care

The primary explanatory variable of interest was the quality of care provided by the practice, which was proxied by the QOF indicator score for the annual dementia review. The QOF dementia review is a face-to-face interview designed to support the care needs of the patient and their carer. The four elements included in the review are: 1) physical and mental health of the patient; 2) carer's need for information; 3) effect of caring on carer (e.g. the need for respite); and 4) communication and coordination measures with secondary care. As the disease progresses, and more agencies become involved, the review should also assess communication between health and social care and non-statutory sectors where relevant, "to ensure that complex needs are addressed. Communication and referral issues highlighted in the review need to be followed up as part of the review process." [14] NHS England (previously, Primary Care Trusts) has authority to audit a random sample of patient case notes to verify that all four key issues have been addressed.[14 15] The intervention, therefore, embodies a tailored, comprehensive provision of care. In our previous work, we showed that the QOF dementia review is associated with a small reduction in unplanned hospital admissions.[16] In this study, we tested for an impact on hospital length of stay.

The indicators for dementia were introduced in April 2006, and we compiled a set of panel data covering the financial years 2006/7 to 2010/11. QOF indicator scores are freely available at practice-level (http://qof.hscic.gov.uk/), but are not published at patient-level.

GPs may 'exception report' individuals who are considered unsuitable for treatment, or who are newly registered with the practice or newly diagnosed, or who make an informed dissent. Let D be the number of patients eligible for the review net of exceptions, E the number of people excluded as exceptions, and A the number of people for whom the indicator is achieved. Then, the percentage of patients receiving the intervention (achievement rate) is given by:

$$QOF = \frac{A}{D+E} \times 100 \quad (1)$$

As a sensitivity analysis, we also tested 'underlying achievement' which differs from equation (1) in that it excludes exception-reported patients from the denominator (see Table 1, [SA-4]).

Table 1: Base case and sensitivity analyses for LoS analyses

MODEL		PCT fixed effects	Hospital fixed effects	Multiple spells per patient	QOF review: A/(D+E)	QOF review: A/D
M1	Poisson	×	×	×	✓	×
SA-1	Poisson	✓	×	×	✓	×
SA-2	Poisson	×	✓	×	✓	×
SA-3	Poisson	×	×	✓	✓	×
SA-4	Poisson	×	×	×	×	✓
SA-5	Cox PH	×	×	×	✓	×

Legend: PCT: primary care trust; QOF: quality and outcomes framework; A: numerator for QOF (number of patients reviewed, or 'achieved'); D: denominator for QOF (number of patients deemed eligible for review); E: number of patients exception-reported for QOF review; PH: proportional hazards.
M1 is the base case analysis, SA-1 to SA-5 are the sensitivity analyses. For the base case, we investigated three mutually exclusive subgroups of admissions, defined by the reason for discharge: those who died in hospital (DisDeath); those discharged to a care home (DisCH); and those discharged elsewhere (DisOther). Four sensitivity analyses (SA-1 to SA-4) were tested on DisCH only. The Cox proportional hazards model was tested on all three subsamples and on the pooled sample.

Literature review of factors driving LoS

To isolate the impact of the QOF dementia review, the models need to take account of other factors that affect LoS for people with dementia. We searched the literature to identify the key determinants of LoS from which we could construct a set of explanatory variables. We searched several bibliographic databases (e.g. Medline, EMBASE, PsycINFO, DARE, CENTRAL) to identify relevant literature published between 2000 and 2014. Our search strategy applied methodological filters in order to obtain randomised controlled trials, systematic reviews, meta-analyses and cohort studies (Appendix A). The search was limited to English language. After de-duplication we retrieved 157 records. Titles were screened and we identified 9 studies with LoS as the primary or secondary outcome for patients with dementia. We classified the confounding influences using the behavioural model [17] of health services use:

a) users' predisposing characteristics, e.g. age, gender;
b) enabling variables, e.g. income, access to services; and
c) need variables, e.g. illness, symptoms, pain.

Patients' predisposing characteristics

In a number of studies older age was associated with a longer LoS.[18-21] The impact of gender was inconsistent, but white ethnicity was associated with a longer LoS in one study.[19] Two studies found that married care recipients experienced a longer LoS [18 19] while those living in more remote areas with less accessibility and longer physical distances from services also experienced a longer LoS.[19]

Enabling factors

A lower pension received by a patient was found to be a significant predictor of long hospitalisation.[22] Doctors with fewer years of experience in treating dementia were also associated with longer hospitalisations.[22] Private hospitals were found to have a shorter LoS than public hospitals and community and psychiatric hospitals were found to have a longer LoS than general hospitals.[23] A specialist social worker, holding a budget for domiciliary care packages, did not achieve a statistically significant reduction in length of stay on an acute psychogeriatric ward.[24]

Need factors

In the behavioural model of health services use, need variables are separated into primary and secondary stressors. Primary stressors include objective patient and carer need, such as type, severity and duration of the person's illness, including dementia, cognitive and functional impairment and the behavioural and psychological symptoms of dementia. Weekly caregiving hours and objective measures of carer health are examples of primary stressors. Secondary stressors relate to subjective measures such as carer burden and carer quality of life.

Primary stressor

A longer LoS was associated with measures of cognitive impairment or a diagnosis of dementia or a history of dementia [18 25] or a particular type of dementia (e.g. Alzheimer's disease) in several studies [19 21] and was also associated with the severity of dementia. [21] The effect of patient functioning or activities of daily living were inconsistent in their association with LoS.[20 21] Medical co-morbidities, usually measured through the Charlson co-morbidity index,[19 21 25] but also measured as independent factors (e.g. delirium,[26] sleep disturbance,[22] walking difficulties,[26] Body Mass Index[21] (BMI)), were all found to be associated with a longer LoS. Patients discharged home stayed for a shorter period in hospital[20] while patients admitted on a weekend[25] and with a history of more prior hospitalisations[23] stayed longer.

Secondary stressors

Patients' whose carer experienced a better quality of life had a shorter LoS, [26] whilst those whose carer reported a higher care burden[26] stayed in hospital for longer.

Data

The dataset included 36,744 adults (aged 18+) admitted over the period 2006/7 to 2010/11. We merged admissions data from Hospital Episode Statistics (HES) and neighbourhood statistics with practice-level data on the QOF dementia review.

The dependent variable, LoS, was modelled from HES data from the Health and Social Care Information Centre. In HES, information on an individual's inpatient care is stored as one record per finished consultant episode (FCE) – the time a patient spends in hospital under the care of a single consultant. A spell is defined as the period from admission to discharge within one hospital (Trust) and the spell may or may not include multiple episodes. A patient can experience several spells of care (admissions) within the same year either because she is transferred from one hospital to another or because she is admitted or readmitted later in the year.

We adjusted for an array of confounding factors, including patient case-mix (clinical diagnoses) and socio-demographic characteristics. Findings from the literature review informed our choice of covariates (Appendix A) although a lack of data meant we could control for deprivation, living status and informal care only at small area level.

To model deprivation, we assigned values based on the patient's residential neighbourhood. Neighbourhoods are defined by Census statistics and we used lower layer super output areas (LSOAs) which typically cover 1,500 individuals. Rather than a generic measure of deprivation, we used Pension Credit data from the Department for Work and Pensions. Pension credit is a benefit for older people on low incomes and has two parts: guarantee credit, which tops up income; and savings credit, which is available only to people who have saved something towards their retirement. Individuals may receive guarantee credit only, savings credit only, or both credits. The poorest individuals are likely to receive guarantee credit only. Data on whether individuals admitted to hospital have an informal (unpaid) carer is also unavailable, so we used a proxy based on Census

data from the Office of National Statistics (ONS). We used three measures: the percentage of the LSOA population providing some, substantial, or intensive levels of informal care. The Census questions on which measures were based were: 1 to 19 hours/week; 20 to 49 hours/week; and 50 hours per week or more. We also included a variable capturing the proportion of people aged 65 and over living alone.

People with dementia often have complex health and social care needs, and the level of provision of support services outside of the hospital sector can also influence length of stay.

Inpatients may experience a 'delayed transfer of care' (DTOC) from acute or non-acute care if they are ready to be discharged from hospital but are still occupying a bed. NHS England provided delayed transfers data at local authority level. The DTOC datasets record the number of adult (18+) patients whose transfer of care is delayed (counted as a 'snapshot' once a month), with results reported for both acute and non-acute settings. The reason for any delay and the organisation responsible for the delay are also recorded. For each year (2006 to 2010), we calculated the mean number of acute patients daily experiencing a DTOC, distinguishing cases where the delay was attributable to (a) the NHS (b) social services (c) both the NHS and social services. For the denominator, we used HES data to calculate the mean daily number of hospital discharges for each local authority, limiting the sample to adults (aged 18+) who were discharged from hospital alive. We then calculated a percentage rate for each measure.

The model also included: a measure of rurality from the ONS; dummy variables to capture the effects of day of admission (reference category: Sunday); and the number of care home beds within 10 kilometres of the individual's LSOA to proxy supply-side constraints.

There were some factors known to be important drivers of LoS that we could not control for at either individual or neighbourhood level. Appendix A provides a summary of the evidence and indicates which of the potential predictors were captured in the models.

Modelling

The dependent variable was length of stay (LoS) for an emergency admission in an acute hospital Trust where the primary diagnosis was dementia.

Econometric modelling of LoS data is often complicated by the count nature of the variable, skewedness characterized by a long tail towards high values, presence of outliers, censoring and unobserved heterogeneity. Several approaches have been used in the literature to accommodate these issues including linear regression on log-transformed LoS,[27-29] survival analysis,[30 31] Generalized Linear Models (GLM) with a log link and Gaussian, Poisson, negative binomial or gamma distributions to characterize the relationship between the variance and conditional mean,[32] and finite mixture models (FMM).[33] A comprehensive review of conventional estimators for LoS and more innovative approaches including extended generalised linear models and multilevel models is provided by Moran and Solomon.[34]

In our sample, the average LoS for dementia was 18 days but there was wide variation with some people staying in hospital for as long as 9 months resulting in a much lower median value of 11 days. Although LoS was highly skewed, the presence of outliers is limited by our study design which excludes spells with LoS above 270 days. Another feature of our data is that patients are nested in GP practices and there is significant variation in mean LoS across practices.

Figure 2 shows the number of practices with average LoS in specific 5-day LoS categories: 1,431 practices have average LoS between 10 and 15 days and although the number of practices decreases

as we move up the LoS categories there are 199 practices with average hospital stays totalling over one month (35-40 days). This variation in LoS across practices calls for a multilevel modelling approach. Figure 3 shows geographical variation in mean LoS across practices.

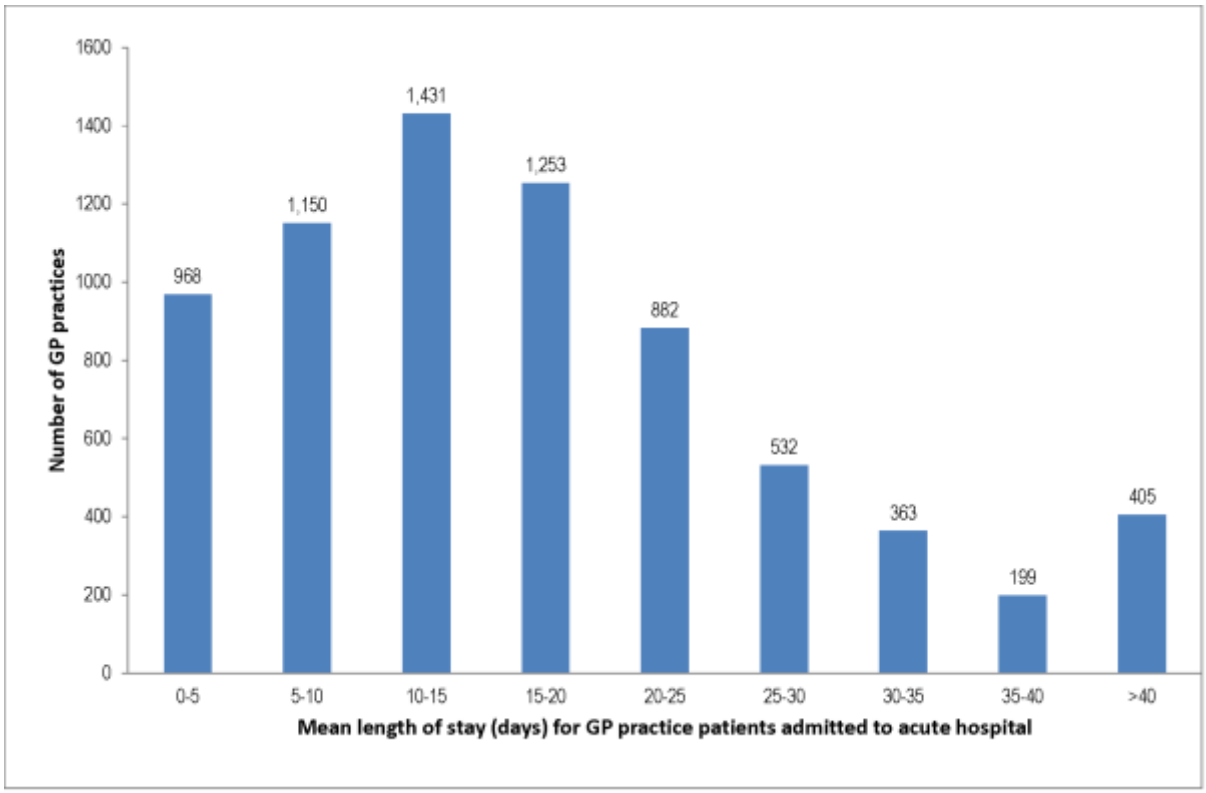

Figure 2: Variation of LoS across practices: bar chart

In our preliminary single-level analysis, the Poisson model performed better [i] than a log-transformation model, so we decided to proceed with a multilevel Poisson model (xtpoisson command in Stata). [ii] We also tested a Cox proportional hazards model, and provide details in Appendix B.

First, we analysed a joint (pooled) sample that includes all patients regardless of their discharge destination. The calculated effects on LoS of being discharged to care home or of in-hospital death are large, suggesting further analysis by destination-segmented subsamples is appropriate. We investigated three mutually exclusive subgroups of admissions, defined by the reason for discharge: those who died in hospital (DisDeath); those discharged to a care home (DisCH); and those discharged elsewhere, i.e. to community or home settings (DisOther). Figure 4 shows how length of stay varies by discharge subgroup and Figure 5 shows the corresponding survivor functions. These functions capture the probability of a stay lasting longer than a specific time. The survivor functions differ remarkably across the three groups, with patients discharged to a care home at higher risk of staying longer in hospital. The probability of a spell lasting 10 days or more was about 0.43 for discharges elsewhere, 0.69 for discharges as death and 0.78 for discharges to care home.

[i] Performance in terms of root mean square error and mean absolute prediction error

[ii] In single-level settings, a negative binomial model is often preferred as it relaxes the restrictive equidispersion assumption of the Poisson (conditional variance is equal to the conditional mean). However, multilevel models by introducing a level 2 random effect, moderate, to some degree, the problem of overdispersion.

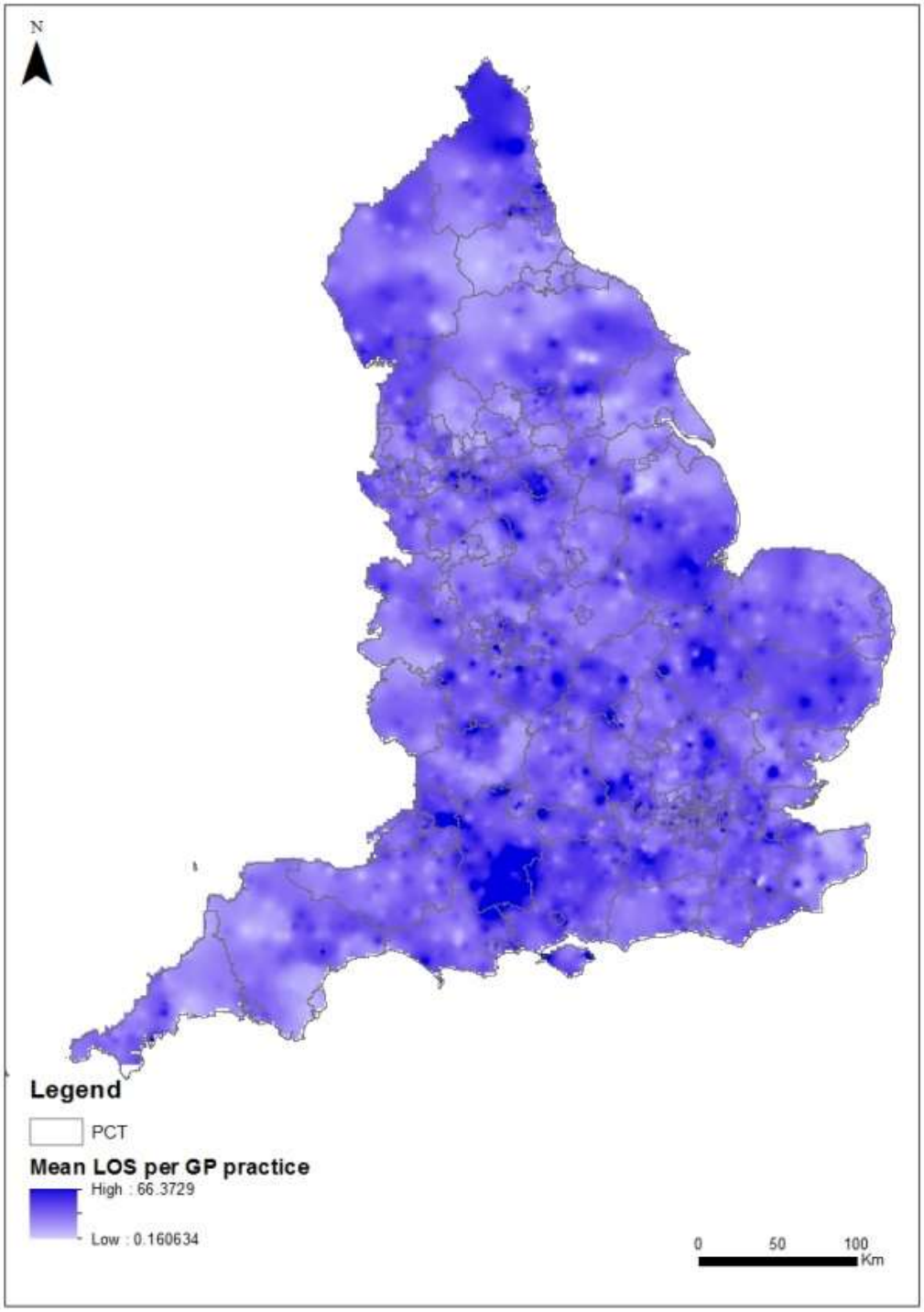

Figure 3: Mean length of stay (LoS) across practices: geographical variation

Note: Variation across GP practices is averaged at Primary Care Trust (PCT) level

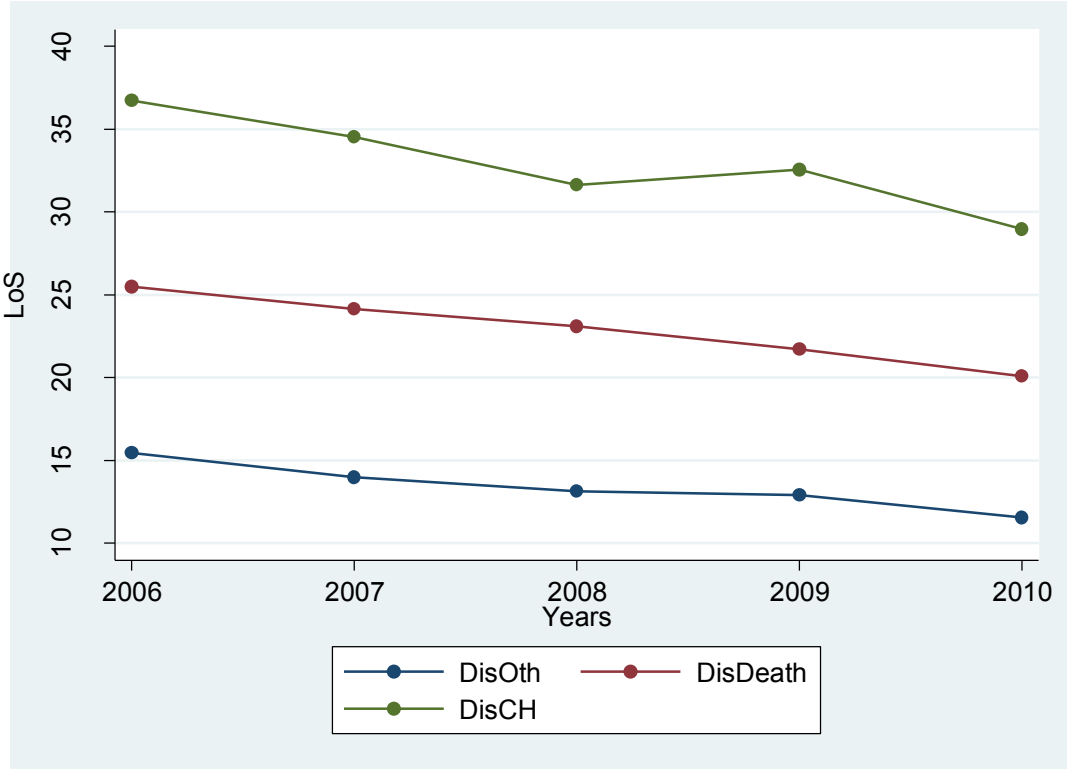

Figure 4: Trends in mean LoS by discharge destination subgroup, 2006 to 2010

DisDeath: died in hospital; DisCH: discharged to Care Home; DisOther: discharged elsewhere.

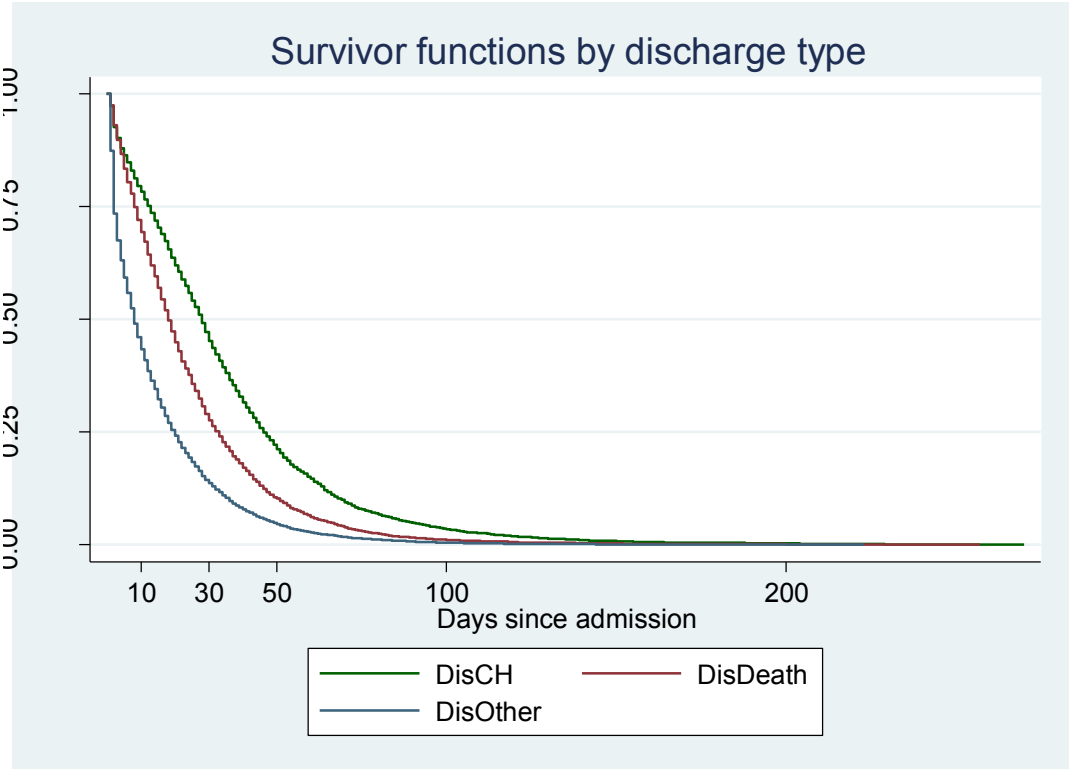

Figure 5: LoS for dementia: survival functions by type of hospital discharge

Note: survivor functions capture the probability of discharge from hospital. Data are from admissions during the period 2006 to 2010. DisDeath: died in hospital; DisCH: discharged to Care Home; DisOther: discharged elsewhere

For the multilevel Poisson analysis of patients who were discharged to a care home (DisCH), we ran five models: a base case analysis [M1] and four sensitivity analyses [SA] (Table 1). Three of the four sensitivity analyses investigated the complex clustering nature of the data. Policies by Primary Care Trusts [iii] (PCTs) – for example, on the supply of intermediate care for rehabilitation or reablement – may have an impact on hospital length of stay [SA-1]. However, the inclusion of PCT effects in the model along with LSOA level variables raises some concerns. The higher level PCT dummy variables may mask or even wash out the effects that are assessed at local level. It is critical to retain the LSOA level informal care and deprivation variables as they could inform policy deliberations. Therefore our base case model excluded PCT fixed effects.

Another level of influence is the hospital: patients are clustered within GP practices but are also cross-classified within hospitals (i.e. patients from the same GP practice can be treated in different hospitals; patients in the same hospital come from different GP practices). In the absence of information on hospitals' multidisciplinary discharge teams, we used hospital fixed effects [SA-2] to capture these influences. However, these variables also risk masking local level effects.

In addition, some patients had multiple admissions to hospital during the study period 2006/7 to 2010/11. In effect, spells are therefore clustered within patients. Our base model specification considers only the first spell of each patient excluding about 7% of total spells. The third sensitivity analysis [SA-3] included all spells in the analyses (ignoring any intra-class correlation at the patient level).

In our final sensitivity analysis [SA-4], we used the reported value for QOF achievement (i.e. the one on which reimbursement is based, known as 'underlying achievement'). This differs from the base-case QOF measure in that it excludes exception-reported patients from the denominator.

Effects were measured as incidence rate ratios (IRRs), which can be interpreted as having a value greater than one if the effect on LoS is positive (i.e. longer stays). We also estimated marginal effects, so that results could be interpreted as natural units (e.g. absolute change in number of days). Statistical significance was assessed at 10%, 5% and 1% levels.

In addition to the five Poisson models, we ran a Cox proportional hazards model [SA-5, Table 1] and provide details of our methods in Appendix B.

All analyses were undertaken in Stata 13.1.

[iii] PCTs were local health authorities, each covering a population of around 350,000. They were replaced by Clinical Commissioning Groups in April 2013.

Results

For the pooled sample of all admissions where dementia was the primary diagnosis, average length of stay was around 18 days. However, this varied by discharge destination (Table 2). Most patients were white (86%), the mean age was 83 years, and 38% were male. Only 24% had a diagnosis of Alzheimer's disease and vascular dementia was diagnosed in 27%.

Results from the base case model regressions are shown as IRRs (Table 3) and marginal effects (Table 4).

When assessed as a practice-level indicator of quality, the QOF dementia review was not significantly associated with length of stay in the pooled analysis or in the analysis of those who died in hospital. However, those who were discharged to somewhere other than a care home had significantly shorter LoS if they were cared for by practices that reviewed a higher percentage of their patients with dementia. This effect was small: a one percentage point increase in QOF score was associated with a reduction in stay of 0.01 days. Length of stay for patients who were subsequently discharged to a care home was longer (by 0.02 of a day) in practices with higher achievement on the QOF, although this effect was not significant at the 1% level.

In all three subgroup analyses, older inpatients had significantly shorter stays: one additional year of age was associated with a decrease in LoS of between 0.03 days (DisOther) and 0.24 (DisCH).

Longer stays were predicted by a diagnosis of vascular dementia, urinary incontinence, cerebrovascular disease, hip fracture, fall, or senility. Of these conditions, the largest effects were for hip fracture which prolonged LoS by almost 20 days people who were discharged to a care home (DisCH). Urinary incontinence, sometimes considered to be a marker for frailty,[35] was associated with an additional inpatient stay of between 1.3 days (for those discharged alive) and 4.3 days (for those who died in hospital).

Higher levels of other comorbidity (i.e. additional to conditions modelled individually in the analyses) were also predictive of longer stays – for each additional comorbidity, the effects ranged from 1.60 days (DisOther) to 2.11 days (DisCH).

Admission on a day of the week other than a Sunday was associated with longer stays with mid-week admissions for people discharged to care homes extended by around 4 to 5 days (18% to 20% longer than stays initiated on Sunday). This may be partly because patients are less likely to be discharged from hospital at the weekend.

People admitted from deprived neighbourhoods (measured by high uptake of the savings component of Pension Credit) had significantly shorter stays, but the effect was small – a one percentage point increase in uptake was associated with a reduced LoS of around one-third of a day for both those who died in hospital and those who were discharged to a care home. When deprivation was assessed by the Guarantee Credit component, findings were mixed.

Table 2: Descriptive statistics for the base case analyses

	Statistics	Died in hospital (DisDeath)		Discharged to care home (DisCH)		Discharged alive, not to care home (DisOther)		Pooled	
Length of spell (days)	(mean, sd)	23.1	22.5	33.0	29.9	13.5	17.8	18.1	22.3
Length of spell (days)	(median, IQR)	17	7-32	27	12-45	7	1-19	11.0	2-26
QOF dementia indicator (% reviewed)	(mean, sd)	73.9	13.4	73.8	12.8	73.6	13.3	73.7	13.2
Age (years)	(mean, sd)	84.7	7.2	83.6	7.2	82.1	8.5	82.7	8.2
Male	(n, %)	1,984	39.3	2,159	34.8	9,843	38.6	13,986	38.1
White	(n, %)	4,384	86.8	5,400	87.0	21,898	85.9	31,682	86.2
Alzheimer's disease	(n, %)	1,310	25.9	1,542	24.8	5,830	22.9	8,682	23.6
Vascular dementia	(n, %)	1,349	26.7	1,844	29.7	6,663	26.1	9,856	26.8
Urinary incontinence	(n, %)	401	7.9	545	8.8	1,383	5.4	2,329	6.3
Faecal incontinence	(n, %)	256	5.1	304	4.9	683	2.7	1,243	3.4
Fall	(n, %)	423	8.4	740	11.9	2,132	8.4	3,295	9.0
Hip fracture	(n, %)	62	1.2	47	0.8	97	0.4	206	0.6
Cancer	(n, %)	213	4.2	193	3.1	582	2.3	988	2.7
Myocardial infarction	(n, %)	106	2.1	91	1.5	338	1.3	535	1.5
Peripheral vascular disease	(n, %)	141	2.8	118	1.9	489	1.9	748	2.0
Cerebrovascular disease	(n, %)	740	14.7	960	15.5	3,260	12.8	4,960	13.5
Delirium	(n, %)	155	3.1	355	5.7	1,348	5.3	1,858	5.1
Senility	(n, %)	490	9.7	725	11.7	2,054	8.1	3,269	8.9
No. other diagnoses	(mean, sd)	6.0	3.2	5.6	2.9	4.7	2.7	5.0	2.8
Carers 1-19 hours/week	(n, %)	348	6.9	432	7.0	1,759	6.9	2,539	6.9
Carers 20-49 hours/week	(n, %)	55	1.1	68	1.1	283	1.1	406	1.1
Carers 50+ hours/week	(n, %)	107	2.1	132	2.1	546	2.1	784	2.1
% pop 60+ living alone	(n, %)	360	7.1	454	7.3	1,831	7.2	2,644	7.2
% guarantee credit	(n, %)	478	9.5	594	9.6	2,548	10.0	3,620	9.9
% saving credit	(n, %)	276	5.5	341	5.5	1,363	5.3	1,979	5.4

	Statistics	Died in hospital (DisDeath)		Discharged to care home (DisCH)		Discharged alive, not to care home (DisOther)		Pooled	
% guarantee & saving credit	(n, %)	591	11.7	735	11.8	2,939	11.5	4,264	11.6
CH Beds/100 pop 60+	(mean, sd)	4.8	1.2	4.9	1.5	4.8	1.3	4.8	1.3
Urban residential area	(n, %)	4,181	82.8	5,229	84.2	21,258	83.4	30,668	83.5
Year of admission: 2006 (ref)	(n, %)	1,035	20.5	1,183	19.1	4,641	18.2	6,859	18.7
Year of admission: 2007	(n, %)	996	19.7	1,145	18.4	4,661	18.3	6,802	18.5
Year of admission: 2008	(n, %)	1,018	20.2	1,252	20.2	4,959	19.5	7,229	19.7
Year of admission: 2009	(n, %)	1,050	20.8	1,358	21.9	5,430	21.3	7,838	21.3
Year of admission: 2010	(n, %)	952	18.9	1,270	20.5	5,794	22.7	8,016	21.8
Day of admission: Sunday (ref)	(n, %)	570	11.3	727	11.7	3,097	12.2	4,394	12.0
Day of admission: Monday	(n, %)	805	15.9	920	14.8	3,890	15.3	5,615	15.3
Day of admission: Tuesday	(n, %)	724	14.3	935	15.1	3,873	15.2	5,532	15.1
Day of admission: Wednesday	(n, %)	739	14.6	882	14.2	3,714	14.6	5,335	14.5
Day of admission: Thursday	(n, %)	733	14.5	953	15.4	3,795	14.9	5,481	14.9
Day of admission: Friday	(n, %)	829	16.4	1,003	16.2	3,888	15.3	5,720	15.6
Day of admission: Saturday	(n, %)	651	12.9	788	12.7	3,228	12.7	4,667	12.7
% LA daily discharges delayed (NHS)	(mean, sd)	5.0	2.6	4.7	2.7	4.8	2.7	4.8	2.7
% LA daily discharges delayed (Social services)	(mean, sd)	1.5	1.7	1.5	1.7	1.4	1.7	1.4	1.7
% LA daily discharges delayed (Both)	(mean, sd)	0.5	0.8	0.5	0.8	0.5	0.8	0.5	0.8
Died in hospital	(n, %)	5051	100	0	0	0	0	5,051	13.7
Discharged to care home	(n, %)	0	0	6,208	100	0	0	6,208	16.9
	N	5051		6,208		25,485		36,744	

Legend: CH: care home; IQR: interquartile range; LA: local authority; QOF: quality and outcomes framework; sd: standard deviation. For the base case, we investigated three mutually exclusive subgroups of admissions, defined by the reason for discharge: those who died in hospital (DisDeath); those discharged to a care home (DisCH); and those discharged elsewhere (DisOther).

Table 3: Poisson analysis of length of stay: incidence rate ratios (IRRs) for all models

	Died in hospital (DisDeath)		Discharged to care home (DisCH)		Discharged alive, not to care home (DisOther)		Pooled	
	IRR	P- value	IRR	P- value	IRR	P-value	IRR	P- value
QOF dementia review	1.000	0.951	1.001**	0.033	0.999***	0.000	1.000	0.717
Age	0.993***	0.000	0.991***	0.000	0.997***	0.000	0.995***	0.000
Male	0.953***	0.000	1.123***	0.000	0.990**	0.020	1.021***	0.000
White	1.047***	0.002	0.992	0.430	1.041***	0.000	1.029***	0.000
Alzheimer's disease	0.950***	0.000	1.008	0.345	0.976***	0.000	0.983***	0.000
Vascular dementia	1.026**	0.030	1.085***	0.000	1.136***	0.000	1.106***	0.000
Urinary incontinence	1.244***	0.000	1.054***	0.000	1.132***	0.000	1.144***	0.000
Faecal incontinence	0.943**	0.048	0.999	0.956	1.086***	0.000	1.020**	0.024
Fall	1.275***	0.000	1.103***	0.000	1.180***	0.000	1.165***	0.000
Hip fracture	1.317***	0.000	1.791***	0.000	1.706***	0.000	1.619***	0.000
Cancer	1.084***	0.000	1.000	0.986	1.177***	0.000	1.108***	0.000
Myocardial infarction	0.949*	0.097	0.937**	0.027	1.017	0.301	1.001	0.897
Peripheral vascular disease	0.881***	0.000	1.042*	0.094	0.945***	0.000	0.926***	0.000
Cerebrovascular disease	1.249***	0.000	1.074***	0.000	1.203***	0.000	1.163***	0.000
Delirium	1.104***	0.000	0.951***	0.001	1.125***	0.000	1.047***	0.000
Senility	1.059***	0.001	1.123***	0.000	1.176***	0.000	1.150***	0.000
No. other diagnoses	1.095***	0.000	1.084***	0.000	1.157***	0.000	1.119***	0.000
Carers 1-19 hours/week	0.996	0.375	0.999	0.765	1.000	0.968	0.994***	0.000
Carers 20-49 hours/week	0.992	0.618	1.107***	0.000	1.021***	0.001	1.045***	0.000
Carers 50+ hours/week	1.019**	0.044	1.057***	0.000	1.039***	0.000	1.036***	0.000
% pop 60+ living alone	0.988***	0.000	1.002	0.104	1.001	0.172	1.000	0.675
% guarantee credit	0.990***	0.000	0.998**	0.022	1.000	0.286	0.998***	0.000
% saving credit	0.985***	0.000	0.986***	0.000	0.995***	0.000	0.991***	0.000
% guarantee & saving credit	1.013***	0.000	0.999	0.612	0.998***	0.003	0.999*	0.054

	Died in hospital (DisDeath)		Discharged to care home (DisCH)		Discharged alive, not to care home (DisOther)		Pooled	
	IRR	P- value	IRR	P- value	IRR	P-value	IRR	P- value
CH Beds/100 pop 60+	0.971***	0.000	0.981***	0.000	1.005*	0.070	0.998	0.285
Urban residential area	1.003	0.891	0.965**	0.010	1.000	0.992	0.982***	0.003
Year of admission: 2006 (ref)								
Year of admission: 2007	0.931***	0.000	0.955***	0.000	0.930***	0.000	0.941***	0.000
Year of admission: 2008	0.863***	0.000	0.874***	0.000	0.819***	0.000	0.846***	0.000
Year of admission: 2009	0.738***	0.000	0.843***	0.000	0.754***	0.000	0.780***	0.000
Year of admission: 2010	0.618***	0.000	0.721***	0.000	0.575***	0.000	0.629***	0.000
Day of admission: Sunday (ref)								
Day of admission: Monday	1.115***	0.000	1.131***	0.000	1.064***	0.000	1.085***	0.000
Day of admission: Tuesday	1.092***	0.000	1.071***	0.000	1.070***	0.000	1.074***	0.000
Day of admission: Wednesday	1.197***	0.000	1.183***	0.000	1.118***	0.000	1.138***	0.000
Day of admission: Thursday	1.012	0.524	1.206***	0.000	1.111***	0.000	1.108***	0.000
Day of admission: Friday	1.101***	0.000	1.122***	0.000	1.094***	0.000	1.101***	0.000
Day of admission: Saturday	1.054***	0.008	1.066***	0.000	1.073***	0.000	1.060***	0.000
% LA daily discharges delayed (NHS)	1.022***	0.000	0.997	0.204	1.008***	0.000	1.004***	0.000
% LA daily discharges delayed (Social services)	1.054***	0.000	1.030***	0.000	1.028***	0.000	1.025***	0.000
% LA daily discharges delayed (Both)	0.968***	0.002	1.001	0.877	0.989**	0.032	0.994*	0.059
Died in hospital							1.438***	0.000
Discharged to care home							2.144***	0.000
	5,051		6,208		25,485		36,744	

Legend: CH: care home; LA: local authority; QOF: Quality and Outcomes Framework; IRR: incidence rate ratio

* p< 0.1, ** p < 0.05, *** p < 0.01

Table 4: Marginal effects: base case analyses for the three discharge types

Variable	Died in hospital (DisDeath)		Discharged to care home (DisCH)		Discharged alive, not to care home (DisOther)	
	change in no. of days	% change in no. of days	change in no. of days	% change in no. of days	change in no. of days	% change in no. of days
Changes from 0 to 1						
Male	-0.86***	-4.72***	2.95***	12.31***	-0.10**	-0.98**
White	0.80***	4.68***	-0.21	-0.82	0.40***	4.11***
Alzheimer's disease	-0.91***	-5.03***	0.20	0.79	-0.25***	-2.42***
Vascular dementia	0.46**	2.58**	2.08***	8.52***	1.33***	13.60***
Urinary incontinence	4.26***	24.41***	1.35***	5.44***	1.33***	13.21***
Faecal incontinence	-1.02**	-5.71**	-0.03	-0.10	0.87***	8.59***
Fall	4.77***	27.50***	2.55***	10.31***	1.79***	17.96***
Hip fracture	5.61***	31.66***	19.62***	79.11***	7.13***	70.65***
Cancer	1.49***	8.41***	0.01	0.03	1.78***	17.68***
Myocardial infarction	-0.90*	-5.07*	-1.58**	-6.31**	0.17	1.67
Peripheral vascular disease	-2.13***	-11.89***	1.05	4.21	-0.56***	-5.48***
Cerebrovascular disease	4.27***	24.91***	1.84***	7.44***	1.99***	20.29***
Delirium	1.85***	10.44***	-1.23***	-4.89***	1.26***	12.52***
Senility	1.05***	5.92***	3.02***	12.28***	1.75***	17.60***
Urban residential area	0.05	0.27	-0.91**	-3.53***	0.00	-0.01
Day of admission: Monday	2.02***	11.54***	3.21***	13.08***	0.64***	6.36***
Day of admission: Tuesday	1.62***	9.22***	1.75***	7.07***	0.71***	7.03***
Day of admission: Wednesday	3.41***	19.65***	4.48***	18.32***	1.18***	11.79***
Day of admission: Thursday	0.22	1.24	5.00***	20.58***	1.11***	11.10***
Day of admission: Friday	1.77***	10.07***	3.00***	12.21***	0.94***	9.41***
Day of admission: Saturday	0.95**	5.38**	1.63***	6.56***	0.74***	7.35***
Year=2007/08	-1.26***	-6.95***	-1.15***	-4.54***	-0.72***	-7.03***
Year=2008/09	-2.51***	-13.67***	-3.25***	-12.64***	-1.91***	-18.12***
Year=2009/10	-4.98***	-26.18***	-4.08***	-15.67***	-2.67***	-24.63***

Variable	Died in hospital (DisDeath)		Discharged to care home (DisCH)		Discharged alive, not to care home (DisOther)	
	change in no. of days	% change in no. of days	change in no. of days	% change in no. of days	change in no. of days	% change in no. of days
Year=2010/11	-7.48***	-38.17***	-7.46***	-27.87***	-4.94***	-42.51***
Unit change from x to x+1[&]						
Age	-0.12***	-0.66***	-0.24***	-0.94***	-0.03***	-0.29***
QOF achievement rate	0.00	0.00	0.02**	0.08**	-0.01***	-0.09***
% carers 1 to 19 h/w	-0.07	-0.39	-0.02	-0.09	0.00	0.01
% carers 20 to 49 h/w	-0.14	-0.80	2.67***	10.66***	0.22***	2.14***
% carers >=50 h/w	0.33**	1.85**	1.42***	5.67***	0.39***	3.89***
% pop 60+ living alone	-0.21***	-1.18***	0.05	0.20	0.01	0.10
% guarantee credit	-0.19***	-1.05***	-0.05**	-0.20**	0.00	0.05
% saving credit	-0.27***	-1.49***	-0.36***	-1.44***	-0.05***	-0.47***
% guarantee & saving credit	0.23***	1.28***	-0.01	-0.06	-0.02***	-0.20***
CH Beds/100 pop 60+	-0.52***	-2.93***	-0.46***	-1.85***	0.05*	0.51*
Total diagnoses	1.70***	9.53***	2.11***	8.44***	1.60***	15.73***
% LA daily discharges delayed (NHS)	0.39***	2.20***	-0.07	-0.27	0.08***	0.76***
% LA daily discharges delayed (Social)	0.95***	5.36***	0.75***	2.99***	0.28***	2.78***
% LA daily discharges delayed (Both)	-0.58**	-3.23**	0.03	0.13	-0.11**	-1.05**

Legend: CH: care home; LA: local authority; QOF: Quality and Outcomes Framework; h/w: hours per week

[&] For percentages a unit change is equivalent to one percentage point change

*p<0.1, **p<0.05, ***p<0.01

Amongst patients who were discharged to a care home, those who were from areas with a higher concentration of care home beds had shorter stays. For every additional bed per 100 population, stays were reduced by around half a day (Table 4). The effects of informal care depended on the intensity of caring. When the proportion of people in the local area providing over 50 hours a week of informal care increased by 1%, length of stay was prolonged by between one-third of a day (DisDeath and DisOther) and 1.4 days (DisCH). The effects of less intensive informal care (20 to 49 hours per week) varied by discharge group, and there was no significant relationship between the prevalence of low intensity informal care (less than 19 hours per week) and length of stay.

In all analyses, stays were significantly longer in localities with higher rates of delayed transfers of care for which social services were responsible. On average, a 1% increase in the DTOC rate was linked to an extension in hospital stay of 3% for two subgroups (DisOther, DisCH) and of 5.4% for those who died in hospital (DisDeath). Where delayed transfers were due wholly or in part to the NHS, the effect was smaller and there was no statistically significant effect for patients who were discharged to a care home (DisCH).

There was a clear downward trend in LoS over time: relative to the baseline year (2006/07), LoS fell each year irrespective of the patient's discharge destination. For patients who died in hospital and for those who were discharged to a care home, LoS was typically around a week shorter in 2010/11 than in 2006/07. For those discharged elsewhere, stays were around 5 days shorter on average in 2010/11 relative to 2006/07.

In the sensitivity analyses of LoS for patients who were discharged to a care home, findings were generally robust (Table 5). The QOF dementia review was associated with a small increase in LoS in four models though the effect was only significant at the 5% level. The effect was not significant when exception-reported patients were removed from the measure of QOF performance (SA-4; Table 5). A higher supply of care home beds per head of population was consistently associated with shorter LoS, and a higher rate of delayed discharges due to social services was consistently associated with longer stays. Results from the sensitivity analysis using a Cox proportional hazards model [SA-5] generally supported these findings and details are provided in Appendix B (Table 6).

Table 5: Poisson analysis of LoS for patients discharged to care home: IRRs for all models

	M1 (N=6,208)	**SA-1** (N=6,208)	**SA-2** (N=6,208)	**SA-3** (N= N=6,664)	**SA-4** (N=6,208)
QOF dementia review	1.001**	1.001**	1.001**	1.001**	1.000
Age	0.991***	0.991***	0.991***	0.991***	0.991***
Male	1.123***	1.123***	1.129***	1.102***	1.123***
White	0.992	0.992	1.006	1.002	0.992
Alzheimer's disease	1.008	1.008	1.012	0.991	1.008
Vascular dementia	1.085***	1.085***	1.091***	1.083***	1.085***
Urinary incontinence	1.054***	1.059***	1.061***	1.006	1.055***
Faecal incontinence	0.999	0.996	1.036*	1.071***	0.997
Fall	1.103***	1.104***	1.096***	1.098***	1.103***
Hip fracture	1.791***	1.787***	1.857***	1.739***	1.792***
Cancer	1.000	1.000	1.011	0.973	1.001
Myocardial infarction	0.937**	0.940**	0.958	0.964	0.937**
Peripheral vascular disease	1.042*	1.038	1.057**	1.033	1.042*
Cerebrovascular disease	1.074***	1.075***	1.089***	1.057***	1.074***
Delirium	0.951***	0.952***	0.955***	0.923***	0.951***
Senility	1.123***	1.122***	1.122***	1.143***	1.121***
No. other diagnoses	1.084***	1.085***	1.088***	1.086***	1.084***
Carers 1-19 hours/week	0.999	1.002	0.999	1.010***	0.999
Carers 20-49 hours/week	1.107***	1.115***	1.092***	1.088***	1.107***
Carers 50+ hours/week	1.057***	1.058***	1.060***	1.043***	1.057***
% pop 60+ living alone	1.002	1.001	1.001	1.000	1.002*
Receiving guarantee credit	0.998**	0.998	0.997***	0.999	0.998**
Receiving saving credit	0.986***	0.986***	0.990***	0.992***	0.986***
Receiving guarantee & saving credit	0.999	1.000	1.000	1.001	0.999
CH Beds/100 pop 60+	0.981***	0.985***	0.986***	0.977***	0.981***
Urban residential area	0.965**	0.973*	0.978	0.956***	0.965**
Year of admission: 2006 (reference)					
Year of admission: 2007	0.955***	0.955***	0.962***	0.968***	0.954***
Year of admission: 2008	0.874***	0.873***	0.877***	0.872***	0.872***
Year of admission: 2009	0.843***	0.841***	0.850***	0.841***	0.841***
Year of admission: 2010	0.721***	0.718***	0.723***	0.712***	0.720***
Day of admission: Sunday (reference)					
Day of admission: Monday	1.131***	1.131***	1.137***	1.127***	1.132***

	M1 (N=6,208)	**SA-1** (N=6,208)	**SA-2** (N=6,208)	**SA-3** (N= N=6,664)	**SA-4** (N=6,208)
Day of admission: Tuesday	1.071***	1.071***	1.070***	1.083***	1.072***
Day of admission: Wednesday	1.183***	1.182***	1.185***	1.194***	1.182***
Day of admission: Thursday	1.206***	1.205***	1.206***	1.226***	1.206***
Day of admission: Friday	1.122***	1.122***	1.114***	1.117***	1.122***
Day of admission: Saturday	1.066***	1.065***	1.055***	1.054***	1.066***
% LA daily discharges delayed (NHS)	0.997	0.994***	0.993***	0.999	0.997
% LA daily discharges delayed (Social)	1.030***	1.028***	1.026***	1.029***	1.030***
% LA daily discharges delayed (Both)	1.001	0.994	1.001	1.014*	1.001

Legend: M1: Model 1 (base case); SA-1: sensitivity analysis 1 (PCT fixed effects included); SA-2: sensitivity analysis 2 (Hospital fixed effects included); SA-3: sensitivity analysis 3 (multiple spells per patient included); SA-4: sensitivity analysis 4 (quality measured by underlying achievement); CH: care home; IRR: incidence rate ratio; LA: local authority; QOF: Quality and Outcomes Framework

* p< 0.1, ** p < 0.05, *** p < 0.01

Discussion

The study examined the impact of a measure of GP practice care quality, the QOF dementia review, on length of hospital stay where dementia was the primary reason for the emergency admission. The analysis was confined to acute hospitals and focused on the first five years in which the QOF review was operational. Using a multilevel model that took account of the clustering of patients within GP practices, we distinguished three types of admission, defined by their discharge destination. The effect of the QOF review differed across the groups: for those who died in hospital (DisDeath), there was no significant association. For the group discharged to a care home (DisCH), an improved QOF review performance of 1 percentage point was associated with an increase in LoS of around 0.02 days. For the remaining patients (DisOther), an identical improvement in QOF score was associated with a small reduction in LoS of 0.01 days.

There are a number of possible explanations for the results, some of which may be linked to limitations of the data. QOF performance data are not published at individual patient level and so the link between primary care received by an individual patient and their carer, and the length of their subsequent admission to hospital had to be proxied by a practice-level indicator – effectively, this assigns to each individual in the dataset a probability of having had a review. As with most studies of the impact of QOF, the measure does not tell us specifically what care patients and their carers actually received during the review, nor how well GPs executed their co-ordination and communication responsibilities. In theory, GPs would liaise with the hospital discharge team to support timely discharges. The QOF review is also an opportunity for GPs to discuss with carers how they are coping in the caring role and to discuss their needs for support. If carers are well supported, this could also facilitate a timely discharge.[26 36]

In addition to investigating the relationship between LoS and QOF performance, our analysis adds to the general literature on the determinants of LoS for people with dementia, an important issue given the increasing prevalence of the illness and the constraints on hospital resources. The 5-7 day reduction in average LoS observed between 2006/07 and 2010/11, across all three types of discharges, is notable and is consistent with longer term trends (Figure 1). For those discharged home or to a care home, this may reflect changes in patterns of care and general improvements in the availability of services in the community for people with dementia. For instance, the 2006 NICE guideline on dementia, stressed the importance of co-ordination and planning, as well as specialist dementia liaison discharge services.[37] However, further research, especially looking at re-admission rates, would be required to draw conclusions about the impact of the reduction in LoS. For those who died in hospital, it is possible that better support in the community means that they are admitted closer to death, but we cannot confirm this from our study.

Our analysis investigated the impact of some factors that have not been considered previously in the investigation of LoS for dementia patients, including the impact of delayed transfers of care. In all the analyses, mean length of stay was consistently longer for individuals whose local authority of residence had higher rates of delayed transfers of care – but only for delays that were attributable solely to social services. A one percentage point increase in the delayed transfer rate[iv] was associated with a prolonged stay of between one-quarter of a day and one day. However, this is an average, i.e. the effect spread over all patients regardless of whether or not they personally experienced a delay. Nonetheless, it implies that a shortage of social care in the community (e.g. intermediate care facilities) does give rise to 'bed blocking': health and social care are substitutes in this context. The finding is consistent with the effect of care home bed supply, where a higher level of per-capita supply was associated with shorter hospital stays for those discharged to care homes.

[iv] A one percentage point increase raises the average daily rate from 1.5% to 2.5%, which is equivalent to almost doubling of the number of daily delayed transfers of care due to social services (from 5.2 to 9.2 per local authority per day).

Surprisingly, delayed transfers attributable to the NHS were not consistently associated with longer stays. This may be a feature of the delayed transfer measure we used in the analysis: hospital level data were not available for our study period, and so the NHS variable measures the effect of multiple hospitals used by all patients from a single local authority. This potentially dilutes the effect of a 'poorly performing' hospital.

The modest effects we found in terms of the impact of the QOF review may imply that although important for the care of patients with dementia, it is not a major influence on LoS for hospital admissions for dementia. However, the increasing prevalence of dementia and the constraints on capacity in the acute hospital sector may mean even modest impacts can be important financially. Some clinical conditions were consistently associated with longer LoS, such as urinary incontinence, vascular dementia, fall, hip fracture and cerebrovascular disease. These conditions were also influential in our related analysis of risk factors for care home placement (unpublished). GPs are uniquely placed to manage these conditions (or the related risk factors), and thus may be able to prevent some hospitalisations by paying particular attention to multi-morbidity in patients with dementia. If the QOF process provides GPs with a regular opportunity to review their dementia patients, there may be added benefits via prevention and detection of such conditions. There may also be scope within the QOF review to encourage greater preventative use of outpatient and community services to enable people with dementia to live independently for longer.

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Appendix A: Overview of evidence on predictors of length of stay

Variable	Association with hospital LoS	Covariate name in models
Patient's predisposing characteristics		
Age	Positive [18-21] Insignificant [22 23 25 26]	Age
Gender (male)	Positive [19] Negative [20 21 23] Insignificant [22 25 26]	Male
Ethnic minority	Positive [19]	White
Years of education	Insignificant [22]	Not assessed
Living at home / Admitted from home	Insignificant [22] Insignificant [26]	Not assessed
Marital status	Positive [18 19] Insignificant [25 26]	Not assessed
Geographic isolation	Positive [19]	Urban residential area % pop 60+ living alone
Area of socio-economic disadvantage	Insignificant [19]	Not assessed
Enabling factors		
Amount of pension (smaller pension)	Positive [22]	% guarantee credit % saving credit % guarantee & saving credit (LSOA)
Dedicated social worker with dedicated budget for domiciliary care packages	Insignificant [24]	Proxied through % LA daily discharges delayed (Social services) (Local Authority)
Size of municipality of residence	Positive [18]	Urban residential area % pop 60+ living alone
Doctor's years of experience treating dementia (fewer years)	Positive [22]	Not assessed
Institution type (Psychiatric or Community hospital)	Positive [23]	Not applicable
Institution ownership type (Private)	Negative [23]	Not applicable
Need factors: primary stressors		
Cognitive impairment / Diagnosis of dementia	Positive [18 25] Insignificant [20 22 23]	Alzheimer's disease Vascular dementia Senility

Variable	Association with hospital LoS	Covariate name in models
Dementia type (Alzheimer's)	Positive [19 21] Insignificant [22]	Alzheimer's disease Vascular dementia
Severity of dementia	Positive [21] Insignificant [20 22]	Not assessed
Patient functioning / Activities of daily living	Positive [20] Negative [21] Insignificant [22]	Not assessed
Delirium	Positive [26]	Delirium
Neuropsychiatric symptoms	Insignificant [22]	Not assessed
Medical co-morbidities (Charlson index)	Positive [19 21 25] Insignificant [26]	fall; hip fracture; cancer; myocardial infarction; peripheral vascular disease; cerebrovascular disease Number of other diagnoses (excluding fall etc)
Complications	Negative [20]	No. other diagnoses
Mood disorders	Insignificant [26]	Not assessed
Delusion	Insignificant [22]	Not assessed
Hallucination	Insignificant [22]	Not assessed
Agitation / aggression	Insignificant [22]	Not assessed
Depression	Insignificant [22]	Not assessed
Anxiety	Insignificant [22]	Not assessed
Euphoria	Insignificant [22]	Not assessed
Apathy	Insignificant [22]	Not assessed
Disinhibition	Insignificant [22]	Not assessed
Irritability	Insignificant [22]	Not assessed
Aberrant motor activity	Insignificant [22]	Not assessed
Sleep disturbance	Positive [22]	Not assessed
Eating problems / Malnutrition risk	Insignificant [22 26] Positive [21]	Not assessed
Body Mass Index (BMI)	Positive [21]	Not assessed
Walking difficulties	Positive [26]	Not assessed
Gait and balance disorders	Insignificant [26]	Not assessed
Bedridden	Insignificant [26]	Not assessed
Pressure sores risk	Insignificant [26]	Not assessed
Incontinence	Insignificant [26]	Urinary incontinence

Variable	Association with hospital LoS	Covariate name in models
		Faecal incontinence
Referral to aged care assessment	Positive [25]	Not assessed
Change in discharge destination	Insignificant [25]	Died in hospital Discharged to care home
Discharged home	Negative [20]	Discharged not to a care home
Admitted on a weekend	Positive [25]	Day of admission
Number of hospitalisations	Positive [23]	Not assessed
Informal carer	Insignificant [26]	Carers 1-19 hours/week Carers 20-49 hours/week Carers 50+ hours/week
Carer age	Insignificant [22]	Not assessed
Carer female	Insignificant [22]	Not assessed
Carer years of education	Insignificant [22]	Not assessed
Carer is spouse	Insignificant [22]	Not assessed
Need factors: secondary stressors		
Carer quality of life	Negative [26]	Not assessed
Carer burden	Insignificant [22] Positive [26]	Not assessed

Appendix B: Cox Proportional Hazards Models

Length of stay (LoS) is usually measured as the number of whole days (or, more accurately, nights) in hospital, and this can be viewed as a 'count' which is why Poisson models are commonly used to analyse LoS. However, LoS is a period of time and so duration models may also provide an appropriate alternative. The 'hazard' that defines the termination of the period is the risk of being discharged from hospital. To check whether our findings were robust to the choice of model we also estimated Cox proportional hazards models (stcox command in Stata).

The hazard ratio is calculated for each patient beginning at time zero which is the admission date. If a person dies, their hazard is unobserved – it is censored, because we do not know how long they would have stayed in hospital had they not died. But before they die, their hazard of 'surviving' (staying in hospital) contributes to the denominator. Therefore, hazard ratios do not make an efficient use of all available information when data are censored, as those who die contribute only partially to the hazard function.

The interpretation of the hazard ratio is in terms of relative risk: a change in risk as a result of being (say) female, not male. When plotted, the y axis is rate of discharge, and the two hazard functions are parallel. This is why the hazards are 'proportional'. Poisson models provide effects in terms of days – and therefore predict LoS; hazard models do not.

For the three subsamples (DisDeath, DisCH, and DisOther) we are interested in time to hospital 'separation', defined as death, discharged to care home, and discharged to other destination respectively. As these are three separate samples, the event (time to hospital separation) is observed for all patients and therefore censoring is not an issue. However, for the pooled sample, we define time to event as the time from admission to medically planned discharge which is censored if a patient dies prior to discharge. In this context, hazard ratios are interpreted as the rate at which a patient completes the stay (i.e. is discharged) at time t given that she is in hospital until t. Therefore, values below one signify longer stays (i.e. the risk of discharge is lower) and hazard ratios above one signify shorter stays. Their interpretation is therefore the opposite of that for incidence rate ratios, where values above one indicate longer stays.

Results of the Cox proportional hazards model for the three subsamples and the pooled sample are presented in Table 6.

In general, findings from the Cox models supported those from the Poisson analyses in the direction and significance of the effects. However, there were some inconsistencies in findings from the Cox proportional hazards model when compared with the base case analysis of the pooled sample (Table 3). In particular, older age was associated with a longer LoS (hazard ratio: 0.997) and white ethnicity was not a significant predictor of LoS. Peripheral vascular disease was predictive of shorter stays in the pooled base case analysis (Table 3), but the effect was not statistically significant in the hazards model (Table 6). Local authority rates of delayed discharge were consistently associated with longer stays in the hazards model, irrespective of whether the delay was attributable to the NHS or social services – this finding supports the pooled base case findings for two of the three measures of delayed transfers. The results of the hazard models for the subsamples also exhibited only small differences to those of the Poisson models.

Table 6: Cox proportional hazards model of length of stay: hazard ratios

	Died in hospital (DisDeath)		Discharged to care home (DisCH)		Discharged alive, not to care home (DisOther)		Pooled	
	HR	P- value	HR	P- value	HR	P-value	HR	P- value
QOF dementia review	1.000	0.825	1.000	0.990	1.001	0.239	1.000	0.565
Age	1.008***	<0.001	1.011***	<0.001	1.003***	<0.001	0.997***	<0.001
Male	0.998	0.950	0.906***	<0.001	1.005	0.73	0.969***	0.009
White	0.931*	0.094	1.010	0.797	0.987	0.491	0.986	0.383
Alzheimer's disease	1.023	0.508	0.941*	0.054	1.002	0.897	0.964***	0.008
Vascular dementia	0.949	0.128	0.913***	0.002	0.880***	<0.001	0.906***	<0.001
Urinary incontinence	0.835**	0.014	0.965	0.547	0.899***	0.002	0.907***	0.001
Faecal incontinence	1.140	0.144	1.012	0.882	1.02	0.682	0.946	0.175
Fall	0.768***	<0.001	0.883***	0.004	0.857***	<0.001	0.903***	<0.001
Hip fracture	0.644***	0.001	0.508***	<0.001	0.533***	<0.001	0.486***	<0.001
Cancer	0.844**	0.017	0.982	0.808	0.879***	0.002	0.798***	<0.001
Myocardial infarction	0.913	0.356	1.129	0.255	0.979	0.694	0.922*	0.095
Peripheral vascular disease	1.122	0.184	1.006	0.947	0.993	0.886	0.987	0.757
Cerebrovascular disease	0.846***	<0.001	0.935*	0.061	0.842***	<0.001	0.857***	<0.001
Delirium	0.920	0.316	1.070	0.224	0.855***	<0.001	0.988	0.618
Senility	0.943	0.251	0.904**	0.019	0.846***	<0.001	0.854***	<0.001
No. other diagnoses	0.918***	<0.001	0.904***	<0.001	0.878***	<0.001	0.868***	<0.001
Carers 1-19 hours/week	1.021*	0.059	1.021**	0.041	1	0.984	1.006	0.188
Carers 20-49 hours/week	0.964	0.384	0.998	0.954	0.987	0.480	0.982	0.287
Carers 50+ hours/week	1.012	0.604	0.932***	0.001	0.969***	0.002	0.983*	0.055
% pop 60+ living alone	0.999	0.902	0.986***	0.001	0.994***	0.003	0.997	0.105
% guarantee credit	1.004*	0.087	1.005**	0.033	1.003***	0.008	1.005***	<0.001
% saving credit	1.020***	0.007	1.008	0.219	1.003	0.341	1.002	0.536
% guarantee & saving credit	1.001	0.762	1.011***	0.003	1.001	0.523	1.000	0.83

	Died in hospital (DisDeath)		Discharged to care home (DisCH)		Discharged alive, not to care home (DisOther)		Pooled	
	HR	P- value	HR	P- value	HR	P-value	HR	P- value
CH Beds/100 pop 60+	1.039***	0.001	1.041***	<0.001	1.018***	<0.001	1.026***	<0.001
Urban residential area	0.963	0.346	0.981	0.609	1.046**	0.012	1.030*	0.063
Year of admission: 2006 (ref)								
Year of admission: 2007	1.053	0.258	1.020	0.645	1.099***	<0.001	1.083***	<0.001
Year of admission: 2008	1.167***	0.001	1.197***	<0.001	1.197***	<0.001	1.219***	<0.001
Year of admission: 2009	1.335***	<0.001	1.215***	<0.001	1.297***	<0.001	1.338***	<0.001
Year of admission: 2010	1.561***	<0.001	1.451***	<0.001	1.559***	<0.001	1.662***	<0.001
Day of admission: Sunday (ref)								
Day of admission: Monday	0.905*	0.070	0.934	0.169	0.937***	0.007	0.917***	<0.001
Day of admission: Tuesday	0.905*	0.077	0.923	0.106	0.946**	0.021	0.942***	0.006
Day of admission: Wednesday	0.906*	0.078	0.819***	<0.001	0.900***	<0.001	0.887***	<0.001
Day of admission: Thursday	0.940	0.272	0.860***	0.002	0.917***	<0.001	0.911***	<0.001
Day of admission: Friday	0.879**	0.019	0.889**	0.016	0.918***	<0.001	0.889***	<0.001
Day of admission: Saturday	0.935	0.248	0.951	0.328	0.957*	0.078	0.942***	0.008
% LA daily discharges delayed (NHS)	0.988*	0.054	0.995	0.328	0.992***	0.002	0.989***	<0.001
% LA daily discharges delayed (Social services)	0.964***	<0.001	0.954***	<0.001	0.987***	0.001	0.973***	<0.001
% LA daily discharges delayed (Both)	1.014	0.426	0.972	0.102	0.984*	0.052	0.983**	0.021
Discharged to care home							0.638***	<0.001
	5,051		6,208		25,485		36,744	

Legend: CH: care home; LA: local authority; QOF: Quality and Outcomes Framework; HR: hazard ratio

* p< 0.1, ** p < 0.05, *** p < 0.01