British Journal of Cancer (2012) 107, 1213–1219

www.bjcancer.com

Association between patient and general practice characteristics and unplanned first-time admissions for cancer: observational study

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BACKGROUND: To identify patient and general practice (GP) characteristics associated with emergency (unplanned) first admissions for cancer in secondary care.

METHODS: Patients who had a first-time admission with a primary diagnosis of cancer during 2007/08 to 2009/10 were identified from administrative hospital data. We modelled the associations between the odds of these admissions being unplanned and various patient and GP practice characteristics using national data sets, including the Quality and Outcomes Framework (QOF).

RESULTS: There were 639 064 patients with a first-time admission for cancer, with 139 351 unplanned, from 7957 GP practices. The unplanned proportion ranged from 13.9% (patients aged 15–44 years) to 44.9% (patients aged 85 years and older, $P<0.0001$), with large variation by ethnicity (highest in Asians), deprivation, rurality and cancer type. In unadjusted analyses, all included patient and practice-level variables were statistically significant predictors of the admissions being unplanned. After adjustment, patient area-level deprivation was a key factor (most deprived compared with least deprived quintile OR 1.36, 95% CI 1.32–1.40). Higher total QOF performance protected against unplanned admission (OR 0.94 per 100 points; 95% CI 0.91–0.97); having no GPs with a UK primary medical qualification (OR 1.08, 95% CI 1.04–1.11) and being less able to offer appointments within 48 h were associated with higher odds.

CONCLUSION: We have identified some patient and practice characteristics associated with a first-time admission for cancer being unplanned. The former could be used to help identify patients at high risk, while the latter raise questions about the role of practice organisation and staff training.

British Journal of Cancer (2012) **107,** 1213–1219. doi:10.1038/bjc.2012.320 www.bjcancer.com
Published online 24 July 2012

Keywords: hospital admissions; primary care; socio-economic deprivation; access

Cancer survival in the United Kingdom is poorer than in many other European countries (Berrino *et al*, 2001; Coleman *et al*, 2008) and is not adequately explained by artefact such as death registrations (Woods *et al*, 2011). Strategies to improve cancer care and patient survival focus on early diagnosis (Department of Health, 1995; 2000; 2007; 2011). Raine *et al* (2010) showed how hospital data could be used to look at late, unplanned presentation for three common cancers. Shawihdi *et al* (2011) found that unplanned presentation was associated with poorer outcomes for oesophagogastric cancers and suggested that it could be a quality indicator for local services.

Cancer indicators based on admission rates will be strongly affected by variation in prevalence, but a proportional approach that takes first admissions for cancer as a marker of incidence minimises this problem. Alongside tailored general practice cancer profiles devised in association with the Association of Public Health Observatories, National Cancer Intelligence Network (NCIN) showed that, nationally, 25% of cancers are diagnosed via the emergency route (National Cancer Intelligence Network, 2010). As late diagnosis is a key factor in poorer cancer survival in the United Kingdom, it is important to understand how patient and general practice (GP) characteristics might influence late presentation. We investigated the associations between first-time unplanned (emergency) admissions for cancer, patient factors and practice characteristics using established national databases.

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Received 19 March 2012; revised 25 June 2012; accepted 26 June 2012; published online 24 July 2012

MATERIALS AND METHODS

Data sources

The index admission for cancer for each patient was derived from 3 years of Hospital Episodes Statistics (HES) data (financial years 2007/8 to 2009/10). This administrative database covers all admissions and outpatient appointments in NHS (public) hospitals in England. Eligible admissions were selected from records where the primary diagnosis was cancer (World Health Organization, 1992). We tracked back 3 years (3×365 days) from the admission date of the patient's first admission within the 3-year study period (in-patients, day cases or regular day/night attenders) and excluded any patients who had a prior admission with a primary diagnosis of cancer (ICD10 codes C00–C96, excluding C44 and C97). Although we had access to data for outpatient attendances, these data contained very little diagnostic information, and the use of oncology specialty codes would have identified patients diagnosed with a minority of cancers and only those patients

who were principally managed medically. We therefore did not use outpatient data.

All patients who had a prior admission with a primary diagnosis of cancer within the 3 years preceding their index admission were excluded from our analyses; tracking back just 1 year was insufficient. Cancers were grouped by ICD10 codes according to NCIN's set of 22 broad groupings (National Cancer Intelligence Network, 2010). Hospital Episodes Statistics classifies admissions as 'elective' (from waiting list, booked or planned), 'emergency' (via the Accident and Emergency Department, emergency GP referral and so on), maternity, elective transfer and other. The outcome measure used throughout this study had a value of 1 if the admission was unplanned ('emergency' in HES) and 0 otherwise.

Population factors

We assigned an Index of Multiple Deprivation 2007 deprivation score for each patient via the patient's postcode; these were averaged and assigned to GP practices via the practice postcode (Department for Communities and Local Government, 2008). Rural/urban classification of patients' places of residence was made using the National Statistics Postcode Directory from November 2010, available from the Office for National Statistics (2010). The rurality of patients' homes was mapped to Lower Super Output Areas based on postcodes. The GeoConvert online tool at MIMAS was used for classifying the rural/urban status of GP practices (University of Manchester, 2011).

Practice characteristics and Quality and Outcomes Framework scores

For 2010, we obtained numbers of GPs (excluding GP Retainers and GP Registrars) as full-time equivalents in total and broken down by age group, sex and country of primary medical qualification from the NHS Information Centre for Health and Social Care (2011). Practices with unknown list size or <500 registered patients were excluded. Our practice sample size was therefore 7957 (out of 8305 practices in England with Quality and Outcomes Framework (QOF) data).

Quality and Outcomes Framework is a national pay for performance scheme for GPs introduced in 2004 (Ashworth and Millett, 2008). Each GP practice receives payments depending on its performance in >100 indicators in four domains: clinical, organisational, patient experience and additional services. Of 1000 points available in total, the clinical domain accounts for between 650 and 697. The QOF total practice score summarises overall performance, with higher scores indicating better performance. The two QOF cancer indicators of interest measured whether practices keep a register of patients diagnosed with any cancer, except non-melanotic skin cancers, from 1 April 2003 ('Cancer01') and the percentage of patients with cancer diagnosed within the last 18 months and who had a review within 6 months of confirmed diagnosis ('Cancer03') (NHS Information Centre for Health and Social Care, 2011). Quality and Outcomes Framework scores were averaged over the study years. Performance for the two patient experience indicators on access were averaged over the two available years: providing appointments within 48 h (PE07) and providing advance booking more than 2 days ahead (PE08).

Analysis strategy

We explored bivariate (crude) associations between each of the six patient factors and the outcome measure using χ^2-tests. The selected patient factors were age group (seven categories), sex, ethnicity (White, Black, Mixed, Asian and other), broad cancer type (22 groups), deprivation and rurality. We will refer to these crude proportions as 'unplanned proportions'. Associations between the outcome and each practice characteristic were assessed using Pearson's/Spearman's correlation coefficient or *t*-tests/analysis of variance, as appropriate.

To investigate the independent effects of the patient and practice variables, we fitted a logistic regression model containing all available variables; to adjust for the clustering of patients within practices, we also fitted Generalised Estimating Equations. Deprivation was considered first as a linear term, and second as five categories representing equal population. All analyses used SAS Version 9.2 (SAS Institute, Cary, NC, USA).

RESULTS

Figure 1 shows the selection process for the study. During the 3 study years, there were 4 272 780 admissions to hospital with a primary diagnosis of cancer. Of these, 21.9% were unplanned ($n=665\,637$ patients had a valid first-time admission). After excluding patients from practices with <500 patients or missing practice identification codes, 21.8% of patients had unplanned admissions ($n=139\,351$ of 639 064 patients with a first-time admission for cancer). Most practices (98.5%, $n=7957$) had 10 or more included patients, while 62.9% of practices had 50 or more included patients. Unplanned admissions had a median stay of 10 days, with two-thirds having a diagnostic (mostly scans or endoscopies) or other procedure (e.g., drainage of ascites) recorded.

The unplanned proportion was higher among the youngest, oldest and those living in deprived or non-rural areas (Table 1). There was wide variation across the 22 types of cancer, with a small decrease over the study period.

By cancer type, the lowest unplanned proportions were for patients diagnosed with melanoma (2.2%) and breast cancer

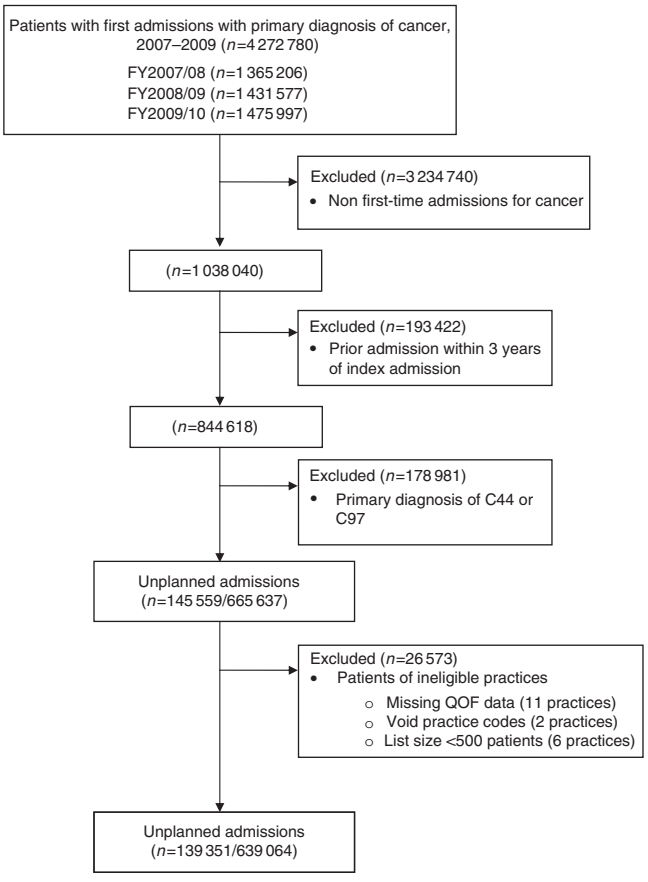

Figure 1 Patient sample selection process.

Table 1 Crude proportions of first-time unplanned admissions for cancer

Patient characteristic	Number of patients with first-time cancer admission	Number with first-time unplanned admission for cancer	Percentage of admissions that were unplanned (%)	*P*-value
Age group (years)				<0.0001
0–4	2044	783	38.3	
5–14	2503	814	32.5	
15–44	50 666	7041	13.9	
45–64	211 785	32 054	15.1	
65–74	175 011	34 225	19.6	
75–84	147 269	42 067	28.6	
85 and over	49 786	22 367	44.9	
Sex				<0.0001
Male	312 951	71 349	22.8	
Female	326 113	68 002	20.9	
Ethnic group				<0.0001
White	531 657	117 837	22.2	
Mixed	2063	401	19.4	
Asian	11 389	2486	21.8	
Black	9385	2092	22.3	
Other	5978	1455	24.3	
Not known	78 592	15 080	19.2	
Cancer type				<0.0001
Pancreas	13 225	7436	56.2	
Brain and central nervous system	13 170	6484	49.2	
Acute leukaemia	8336	4087	49.0	
Lung	62 442	24 803	39.7	
Other	96 961	37 398	38.6	
Ovary	12 079	3493	28.9	
Multiple myeloma	9654	2674	27.7	
Stomach	13 970	3684	26.4	
Chronic leukaemia	7192	1716	23.9	
Kidney	13 653	3157	23.1	
Non-Hodgkin's lymphoma	23 541	5318	22.6	
Colorectal	80 508	17 285	21.5	
Oesophagus	18 946	3407	18.0	
Larynx	4764	661	13.9	
Cervix	5964	779	13.1	
Prostate	55 275	6487	11.7	
Testis	4732	445	9.4	
Bladder	48 333	3696	7.6	
Oral	9863	721	7.3	
Uterus	16 017	1036	6.5	
Breast	101 506	4170	4.1	
Melanoma	18 933	414	2.2	
Deprivation quintile, derived from patient's postcode				<0.0001
1 (least deprived)	131 224	25 373	19.3	
2	136 924	27 519	20.1	
3	133 580	28 537	21.4	
4	122 964	28 304	23.0	
5 (most deprived)	113 717	29 436	25.9	
6 (unknown)	655	182	27.8	
Rurality of residence				<0.0001
Urban >10 K	496 040	111 039	22.4	
Town and fringe	72 445	14 897	20.6	
Village, hamlet and isolated dwellings	70 170	13 297	18.9	
Not resident in England	409	118	28.9	
Year of diagnosis				<0.0001
2007	206 656	46 421	22.5	
2008	214 097	46 713	21.8	
2009	218 311	46 217	21.2	

Table 2 Summary of practice characteristics (7957 practices with complete data)

Characteristic	Measure	Results
Practice list size	Median (IQR)	5974 (3511–9230)
GPs (full-time equivalents) per practice	Mean (s.d.)	4 (3)
Single-handed practices	*N* (%)	1100 (13.8)
FTE GPs per 10 000 patients	Median (IQR)	5.7 (4.5–6.5)
GPs aged 50 years and older	*Percentage*	*47*
None	*N* (%)	991 (12.5%)
Some	*N* (%)	5484 (68.9%)
All	*N* (%)	1482 (18.6%)
GPs qualified in the United Kingdom	*Percentage*	*68*
None	*N* (%)	1399 (17.6%)
Some	*N* (%)	3225 (40.5%)
All	*N* (%)	3333 (41.9%)
Female GPs	*Percentage*	*40*
None	*N* (%)	1667 (21.0%)
Some	*N* (%)	5937 (74.6%)
All	*N* (%)	353 (4.4%)
Deprivation quintile, derived from mean score for the practice		
1–4	*N* (%)	6366 (80.0%)
5 (most deprived)	*N* (%)	1591 (20.0%)
Rurality of practice[a]		
Urban >10 K	*N* (%)	6717 (84.4%)
Town and fringe	*N* (%)	909 (11.4%)
Village, hamlet and isolated dwellings	*N* (%)	321 (4.0%)
QOF performance		
QOF total practice performance score (maximum of 1000 points)	Median (IQR)	967.3 (947.7–981.5)
CANCER 01 indicator (recording of new diagnoses of cancer)		
Always recorded	*N* (%)	7943 (99.8%)
Sometimes/never recorded	*N* (%)	14 (0.2%)
CANCER 03 indicator (review of patients diagnosed with cancer in previous 18 months)		
Patients always reviewed	*N* (%)	5347 (67.2%)
Patients sometimes/never reviewed	*N* (%)	2610 (32.8%)
Patient experience (PE07): providing appointments within 48 h (figures are % of total points available)	Median (IQR)	85.6 (77.2–91.8)
Patient experience (PE08): providing advance booking (figures are % of total points available)	Median (IQR)	78.5 (65.1–88.7)

Abbreviations: FTE = full-time equivalent; GR = general practice; IQR = interquartile range; QOF = Quality and Outcomes Framework. [a]Missing data for 10 practices.

(4.1%), and highest for brain and central nervous system cancers (49.2%) and pancreatic cancer (56.2%). There was a small fall in the outcome rate during the 3 years of interest.

Approximately one in seven practices included in the study was single-handed, defined as one full- or part-time GP at the practice (Table 2). Nearly half of all GPs were aged 50 years and older (47%), with 19% of practices consisting of GPs all aged 50 years and older. Over two-thirds of GPs gained their primary medical qualification in the United Kingdom (68%) and one in six practices did not have any UK-qualified GPs (17.6%). Less than 5% of practices had only female GPs and 21.0% of practices did not have any female GPs.

According to QOF data, almost all practices always recorded new diagnoses of cancer. In contrast, only two-thirds of practices always reviewed patients who had been diagnosed with cancer in the past 18 months.

In the unadjusted analysis, all examined patient and most practice-level variables were statistically significant predictors of

the first-time admission for cancer being unplanned. In the adjusted analysis, there were statistically significant relationships between the outcome measure and all patient and many practice-level characteristics (Table 3).

After adjustment, practice rurality, having only one GP, having all GPs aged 50 or older or having all female GPs were no longer significant. Patient area deprivation remained more important than practice deprivation (most deprived compared with least deprived quintile: OR 1.36; 95% CI 1.32–1.40). Patients of practices with more GPs per 10 000 population were slightly less likely to use the unplanned route (OR 0.97; 95% CI 0.95–0.99). The unplanned route remained more common for patients of practices where no GP gained their primary medical qualification in the United Kingdom (OR 1.08; 95% CI 1.04–1.11).

For the QOF measures, the adjusted odds was inversely associated with higher average QOF total performance (OR 0.94 per extra 100 points; 95% CI 0.91–0.97). In contrast, there was no statistically significant relation with either QOF cancer indicator. Higher performance for 48 h appointments was associated with lower odds, but the relation with advance booking was no longer statistically significant after adjustment.

We found various two-way interactions to be statistically significant at the 5% level. These suggest, for instance, that the adjusted odds is higher with large lists in towns, but lower with large lists in villages. For clarity, however, we have not shown these.

DISCUSSION

Summary of results

We assessed the associations between the odds of a patient's first-time admission for cancer being unplanned rather than planned and various patient and practice characteristics. We found large variation in this measure by age, sex and ethnicity. The highest outcome rates were among Asian patients, those aged 85 years and over and for females. There was also wide variation for different types of cancer, which was affected by deprivation and rurality of patients' places of residence. After adjusting for patient factors and deprivation, higher unplanned proportions were significantly associated with smaller list size and the country of qualification of the GP. In contrast, there were only weak associations with the QOF indicators considered. The strongest associations found were the protective effects of higher QOF total performance scores and the proportion of patients obtaining appointments within 48 h (indicator PE07).

If this outcome is a useable indicator of practice quality (which we discuss below), then one would hope to see correlations with other performance measures such as QOF indicators. We did observe relations with total QOF score and patient experience measures but not with cancer-specific indicators after adjustment. The relation was significant with GPs per 10 000 patients, with a 1% drop in odds per GP per 10 000 patients, as inconsistently found with other indicators (Saxena *et al*, 2007). There are also significant relations between quality of care (e.g., QOF or prescribing) and the age, sex and country of origin or qualification of GPs (Baker, 1996; Tsimtsiou *et al*, 2009; Ashworth *et al*, 2011), although these findings were also inconsistent and sociodemographic factors usually appear to be more important (Baker, 1996; Tsimtsiou *et al*, 2009). We found an inverse relation between patients obtaining appointments within 2 working days and the odds of unplanned admissions, suggesting that timely primary-care access is important.

We observed 16% higher unadjusted odds of the admission being unplanned in single-handed practices, which became 1% and not significant after adjusting for area-level factors and deprivation. Definitions of the term 'single-handed' differ (Smith, 2004), although we found similar results by applying full-time equivalents or headcounts. Other studies have documented difficulties faced by practices with only one GP (Ashworth *et al*, 2011), although these practices can still achieve good patient ratings, for example, in terms of patient access and consultation time (Campbell *et al*, 2001; van den Hombergh *et al*, 2005; Vamos *et al*, 2011).

The analysis presented here is far from exhaustive, but suggests what is possible with current data. We now discuss the strengths and limitations of this study before considering policy implications and further research.

Strengths of this study

We have used two established national data sets, HES and QOF, and a range of geographical and practice information with good completeness.

Limitations

These may be divided into definition, data and analysis issues.

Definition issues The outcome measure relies on being able to identify a patient's first admission for cancer. Tracking back 3 years incurred less misclassification than the 1 year look-back adopted by Raine *et al* (2010), although any method depends on the availability of unique patient identifiers (no method is perfect). We used only the primary diagnosis rather than the first four diagnoses, opting for greater specificity. Owing to missing diagnostic information, we were unable to use outpatient records, and thus were unable to determine precisely where the patient is along the pathway. Cancer registration data contain an 'anniversary' (diagnosis) date which could be compared with the date of admission, but these dates need to be linked to HES and we did not have access. Even with successful linkage of dates, because many practices have fairly few cancer patients, this prevents assessment of practice performance on the measure.

Data issues We excluded practices with <500 registered patients, missing QOF data or practice identification codes, but these exclusions should not affect our findings. As this study was exploratory, we have not performed sensitivity analyses or imputation. We considered only several practice variables as national practice-level information is limited.

We also considered a small number of patient factors, and more might be made of HES data (see future work). We did not have information on patient behaviour including patient preferences (Raine *et al*, 2010), diet, smoking, exercise, exposure to other carcinogens and tumour stage, i.e., factors partly or largely beyond the GPs' control that may lead to poorer outcomes. Socio-demographic information was at area-level only.

Analysis issues We found a number of statistically significant interactions, but for clarity have not shown these. We fitted deprivation first as a linear term and second in fifths. Although plots of residuals suggested that adjustment for deprivation was incomplete even after trying polynomials, we reported the effects just by deprivation fifth for simplicity, noting that the choice made little difference to the other coefficients. Also for clarity, we categorised several continuous variables, including rurality and the proportions of GPs aged 50 or over or who were female.

Policy and research implications

The Kings Fund recommended that an integral part of quality improvement will be to gather data to evaluate care in broader terms and to compare inter-practice and temporal performance (King's Fund, 2010). The Royal College of GPs has produced a cancer diagnosis audit tool for practices and cancer networks to help with this (Royal College of General Practitioners, 2011); referral rates are known to vary across England (National Audit Office, 2010).

Table 3 Associations between admissions, patient and practice characteristics

Variable	Unadjusted analysis		Adjusted analysis	
	Odds ratio (95% CI)	***P*-value**	**Odds ratio (95% CI)**	***P*-value**
Patient variables				
Age group (years)		<0.0001		<0.0001
0–4	0.76 (0.70–0.83)	<0.0001	0.20 (0.18–0.22)	<0.0001
5–14	0.59 (0.54–0.64)	<0.0001	0.17 (0.15–0.19)	<0.0001
15–44	0.20 (0.19–0.20)	<0.0001	0.15 (0.14–0.15)	<0.0001
45–64	0.22 (0.21–0.22)	<0.0001	0.20 (0.19–0.20)	<0.0001
65–74	0.30 (0.29–0.30)	<0.0001	0.26 (0.25–0.26)	<0.0001
75–84	0.49 (0.48–0.50)	<0.0001	0.43 (0.42–0.44)	<0.0001
85 and over	1	—	1	—
Sex				
Male	1	—	1	—
Female	0.89 (0.88–0.90)	<0.0001	1.07 (1.05–1.08)	<0.0001
Ethnicity		<0.0001		<0.0001
White	1	—	1	—
Mixed	0.83 (0.81–0.85)	<0.0001	0.87 (0.85–0.89)	<0.0001
Asian	1.13 (1.06–1.20)	<0.0001	1.16 (1.08–1.24)	<0.0001
Black	1.01 (0.96–1.06)	0.828	1.12 (1.05–1.18)	0.241
Other	0.98 (0.94–1.03)	0.404	1.03 (0.98–1.08)	0.212
Not known	0.85 (0.76–0.94)	0.003	0.93 (0.83–1.04)	<0.0001
Cancer type		<0.0001		<0.0001
Acute leukaemia	1.53 (1.46–1.60)	<0.0001	1.78 (1.69–1.87)	<0.0001
Bladder	0.13 (0.13–0.14)	<0.0001	0.10 (0.10–0.10)	<0.0001
Brain and CNS	1.55 (1.49–1.60)	<0.0001	1.99 (1.92–2.07)	<0.0001
Breast	0.07 (0.07–0.07)	<0.0001	0.07 (0.07–0.08)	<0.0001
Cervix	0.24 (0.22–0.26)	<0.0001	0.30 (0.28–0.32)	<0.0001
Chronic leukaemia	0.50 (0.47–0.53)	<0.0001	0.48 (0.45–0.51)	<0.0001
Colorectal	0.44 (0.43–0.45)	<0.0001	0.37 (0.36–0.38)	<0.0001
Kidney	0.48 (0.46–0.50)	<0.0001	0.50 (0.48–0.52)	<0.0001
Larynx	0.26 (0.24–0.28)	<0.0001	0.26 (0.23–0.28)	<0.0001
Lung	1.05 (1.03–1.07)	<0.0001	0.95 (0.93–0.98)	<0.0001
Melanoma	0.04 (0.03–0.04)	<0.0001	0.04 (0.03–0.04)	<0.0001
Multiple myeloma	0.61 (0.58–0.64)	<0.0001	0.55 (0.52–0.58)	<0.0001
Non-Hodgkin's lymphoma	0.47 (0.45–0.48)	<0.0001	0.47 (0.45–0.49)	<0.0001
Oesophagus	0.35 (0.34–0.36)	<0.0001	0.30 (0.28–0.31)	<0.0001
Oral	0.13 (0.12–0.14)	<0.0001	0.13 (0.12–0.14)	<0.0001
Ovary	0.65 (0.62–0.68)	<0.0001	0.68 (0.65–0.71)	<0.0001
Pancreas	2.05 (1.97–2.12)	<0.0001	1.91 (1.84–1.99)	<0.0001
Prostate	0.21 (0.21–0.22)	<0.0001	0.20 (0.19–0.20)	<0.0001
Stomach	0.57 (0.55–0.59)	<0.0001	0.45 (0.43–0.47)	<0.0001
Testis	0.17 (0.15–0.18)	<0.0001	0.30 (0.27–0.33)	<0.0001
Uterus	0.11 (0.10–0.12)	<0.0001	0.11 (0.10–0.11)	<0.0001
Other	1	—	1	—
Deprivation quintile		<0.0001		<0.0001
1 (least deprived)	1	—	1	—
2	1.05 (1.03–1.07)	<0.0001	1.04 (1.02–1.07)	<0.0001
3	1.13 (1.11–1.16)	<0.0001	1.12 (1.09–1.15)	<0.0001
4	1.25 (1.22–1.27)	<0.0001	1.20 (1.17–1.23)	<0.0001
5 (most deprived)	1.46 (1.43–1.49)	<0.0001	1.36 (1.32–1.40)	<0.0001
6 (unknown)	1.61 (1.35–1.91)	<0.0001	1.46 (1.12–1.89)	<0.0001
Rurality of residence		<0.0001		<0.0001
Urban >10 K	1.12 (1.09–1.14)	<0.0001	1.04 (1.01–1.06)	0.002
Town and fringe	1	—	1	
Village, hamlet and isolated dwellings	0.90 (0.88–0.93)	<0.0001	0.96 (0.93–0.99)	0.003
Not resident in England	1.57 (1.26–1.96)	<0.0001	1.03 (0.72–1.48)	0.876
Year of diagnosis		<0.0001		<0.0001
2007	1	—	1	—
2008	0.96 (0.95–0.98)	<0.0001	0.96 (0.94–0.97)	<0.0001
2009	0.93 (0.91–0.94)	<0.0001	0.91 (0.90–0.93)	<0.0001
Practice variables				
List size per 10 000 patients	0.94 (0.92–0.95)	<0.0001	0.97 (0.95–0.99)	0.014
FTE per 10 000 patients	0.98 (0.97–0.99)	<0.0001	0.99 (0.98–1.00)	0.001
Single-handed practices				
Single GP	1.16 (1.12–1.19)	<0.0001	1.01 (0.96–1.06)	0.628
More than one GP	1	—	1	—
GPs aged 50 years and over		<0.0001		0.486
None	1	—	1	—
Some	0.97 (0.95–0.99)	0.015	1.00 (0.97–1.02)	0.797
All	1.10 (1.06–1.14)	<0.0001	1.02 (0.98–1.06)	0.343
GPs qualified in the United Kingdom		<0.0001		<0.0001
None	1.23 (1.19–1.26)	<0.0001	1.08 (1.04–1.11)	<0.0001
Some	1.06 (1.04–1.08)	<0.0001	1.04 (1.02–1.06)	0.001
All	1	—	1	—
Female GPs		<0.0001		0.310
None	1	—	1	—
Some	0.88 (0.86–0.90)	<0.0001	0.98 (0.95–1.01)	0.205
All	0.98 (0.93–1.04)	0.553	1.02 (0.96–1.08)	0.594
Practice deprivation average score[a]	1.01 (1.01–1.01)	<0.0001	1.00 (1.00–1.00)	0.002
Practice deprivation quintile[a]				
<5	1	—	1	—
5 (most deprived)	1.23 (1.21–1.26)	<0.0001	1.01 (0.98–1.03)	0.576
Practice deprivation quintile[a]		<0.0001		<0.0001
1 (least deprived)	1	—	1	—
2	1.03 (1.01–1.05)	0.011	0.95 (0.93–0.98)	<0.0001
3	1.08 (1.06–1.11)	<0.0001	0.92 (0.90–0.95)	<0.0001
4	1.16 (1.14–1.19)	<0.0001	0.91 (0.88–0.93)	<0.0001
5 (most deprived)	1.31 (1.27–1.34)	<0.0001	0.93 (0.90–0.96)	<0.0001
Rurality of practice[b]		<0.0001		0.330
Urban >10 K	0.95 (0.90–0.99)	0.010	1.02 (0.99–1.06)	0.192
Town and fringe	1	—	1	—
Village, hamlet and isolated dwellings	1.13 (1.11–1.16)	<0.0001	0.99 (0.95–1.04)	0.809
QOF total practice performance score (per 100 points)	0.85 (0.83–0.88)	<0.0001	0.94 (0.91–0.97)	<0.0001
QOF CANCER01				
Diagnosis always recorded	1	—	1	—
Diagnosis sometimes or never recorded	0.90 (0.61–1.32)	0.576	0.75 (0.55–1.01)	0.052
QOF CANCER03				
Patient always reviewed	1	—	1	—
Patient sometimes or never reviewed	1.02 (1.00–1.03)	0.060	1.01 (0.99–1.02)	0.567
QOF PE07: providing 48 h appointments	0.72 (0.68–0.77)	<0.0001	0.85 (0.79–0.92)	<0.0001
QOF PE08: providing advance booking	0.83 (0.79–0.87)	<0.0001	0.98 (0.92–1.04)	0.520

Abbreviations: CI = confidence interval; CNS = central nervous system; FTE = full-time equivalent; GP = general practice; QOF = Quality and Outcomes Framework. [a]Only one of these deprivation variables was included at a time. [b]Missing data for 1013 patients at 10 practices.

The measure used in our study has been proposed as an indicator of practice quality. The key assumption is that unplanned admission is a poor outcome (which has support from other studies) and follows on from presentation to A&E with more advanced symptoms. Some types of cancer rarely present with symptoms when a GP consultation might make a difference to early diagnosis. Some unplanned admissions will also be unavoidable. Although numbers of patients with cancer can be small at practice level (nearly half of practices had <10 patients in 3 years), the indicator may function better for GP consortia or other larger practices. Access to and use of diagnostic facilities is not uniform across the United Kingdom, and some referrals for private treatment or investigation are not captured in HES (Baughan *et al*, 2009).

There are striking differences in admissions by age, cancer type and deprivation. The findings could therefore help to identify patient groups who are susceptible to late diagnosis, including the very young or very old, patients diagnosed with brain or pancreatic tumours and patients living in deprived areas.

CONCLUSION

We have identified some patient and practice characteristics that are associated with a first-time admission for cancer being unplanned rather than planned. The former could be used to help identify patients at high risk of the outcome, while the latter raise questions about the role of organisation of practices and staff training. Specialists also have a role in preventing unplanned admissions. For example, rapid access to diagnostic services and cancer specialists could lead to earlier diagnosis. Methods for general practitioners to obtain advice and support from specialist services for their patients when they experience complications would also help reduce unplanned admissions. In-depth study of practices with very low or high first-time emergency admission rates for cancer may provide lessons that are more widely applicable to improve cancer detection, referral delay and survival.

ACKNOWLEDGEMENTS

The Department of Primary Care & Public Health at Imperial College London is grateful for support from the NIHR Collaboration for Leadership in Applied Health Research & Care scheme, and the NIHR Biomedical Research Centre scheme.

Conflict of interest

The Dr Foster Unit at Imperial is principally funded through a research grant by Dr Foster Intelligence, an independent healthcare information company and joint venture with the Information Centre of the NHS. The Dr Foster Unit at Imperial is affiliated with the Imperial Centre for Patient Safety and Service Quality at Imperial College Healthcare NHS Trust, which is funded by the National Institute of Health Research.

Author contributions

AB, AM, MS and PA conceived the study. AB, CT and MP performed the analysis. AB and CT drafted the manuscript and all authors critically reviewed it.

Role of the funding source

The funders had no role in the design, analysis, write-up or decision to submit for publication.

Ethics

We hold Section 251 (formerly Section 60) National Information Governance Board for Health and Social Care permission to hold these data for research purposes. We hold South East Local Research Ethics Committee approval to analyse the data.

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