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# Identifying patients at risk of emergency admission for colorectal cancer

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**Background:** Patients whose colorectal cancer is treated after an emergency admission tend to have late-stage cancer and a poor prognosis. We identified risk factors for an emergency admission by linking data from the National Bowel Cancer Audit (NBCA) and the English Hospital Episode Statistics (HES), an administrative database of all admissions to English National Health Service hospitals, which includes data on mode of admission.

**Methods:** We identified all adults included in the NBCA with a primary diagnosis of bowel cancer, excluding cancer of the appendix, between August 2007 and July 2011 whose record could be linked to HES. Multivariable logistic regression was used to estimate adjusted odds ratios (OR) for an emergency admission for colorectal cancer. All risk factors were adjusted for cancer site and calendar year.

**Results:** 97 909 adults were identified with a primary diagnosis of bowel cancer and 82 777 patients could be linked to HES. Patients who were older, female, of a non-white ethnic background, and more socioeconomically deprived, and those with dementia or cardiac, neurologic and liver disease had an increased risk of presenting as an emergency admission. The strongest risk factors were age (90 compared with 70 years: OR 2.99, 95% CI 2.84 to 3.15), dementia (OR 2.46, 2.18 to 2.79), and liver disease (OR 1.87, 1.69 to 2.08).

**Conclusions:** Our study identifies risk factors that may impair health-seeking behaviour and access to healthcare. An earlier recognition of symptoms in patients with these risk factors may contribute to better outcomes.

Surgery in patients with colorectal cancer who are admitted as an emergency is associated with a perioperative mortality of 20% and morbidity of 50% (Tekkis *et al*, 2004; Trompelas, 2008; Khot *et al*, 2002; Ng *et al*, 2006). These patients tend to have late-stage cancer and are often physically frail (Scott *et al*, 1995). Various procedures, including preoperative colonic stenting, have been tried in order to improve outcomes but with varying degrees of success (Trompelas, 2008; Ansaloni *et al*, 2010).

An alternative way of improving overall outcomes in this patient group is to identify and treat the cancer before it causes symptoms so severe that an emergency admission to hospital is necessary. There have been a number of studies that tried to identify risk

factors for an emergency presentation but many of these studies were relatively small or did not adjust for potential confounders (Scott *et al*, 1995; McArdle and Hole 2004; Gunnarsson *et al*, 2011).

We used clinical data from the National Bowel Cancer Audit (NBCA), a national project assessing the quality of care in all patients who undergo treatment for colorectal cancer in National Health Service (NHS) hospitals in England and Wales (Finan *et al*, 2014) linked to administrative data from the Hospital Episode Statistics (HES). The NBCA receives clinical data from 161 NHS hospitals in England and Wales for all patients with bowel cancer admitted to NHS hospitals for the first time. HES is an administrative database of all admissions to English NHS hospitals.

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It contains data collected to allow hospitals to be paid for the care they provide (Health and Social Care information Centre, 2014).

The aim of this study is to identify demographic and clinical risk factors for an emergency admission in patients with colorectal cancer. Identifying these risk factors should help clinicians, especially those working in primary care, to recognise patients at higher risk of presenting with an advanced stage of disease.

## MATERIALS AND METHODS

**Participants.** All 97 909 adults with a primary diagnosis of colorectal cancer between 1 August 2007 and 31 July 2011, excluding those with cancer of the appendix, who were admitted to an NHS hospital and included in the NBCA, were candidates for inclusion. The patients were admitted to one of the 150 NHS hospital Trusts in England (Finan *et al*, 2014). We included all 82 777 patients (84.5%) who could be linked to a HES record with data on mode of admission. In HES, diagnostic information is coded according to the International Classification of Diseases, Version 10 (ICD-10, World Health Organisation, 2004) and procedure information according to the Office of Population Censuses and Surveys classification, 4th revision (OPCS-4, NHS Connecting for Health, 2009a, b).

**Definitions of data items.** The mode of the first hospital admission with a diagnosis of colorectal cancer was obtained from HES data (method of admission coded as 21, 22, 23, 24, and 28). The socioeconomic status was derived from the Index of Multiple Deprivation (IMD, The English Indices of Deprivation, 2012). The IMD ranks 32 482 areas, each of which covers an average population of around 1500 people or 400 households. We grouped the patients into five socioeconomic categories based on fifths of the national ranking of these areas. We used the RCS Charlson Score to identify co-morbid conditions in the HES record of the first admission with a diagnosis of colorectal cancer or in the records in the preceding year (Armitage and van der Meulen, 2010). Age at diagnosis, date of diagnosis, and cancer site were obtained from NBCA data; sex and IMD from NBCA data but updated from HES data, if they were missing; and ethnicity from HES.

**Statistical analysis.** Multivariable logistic regression was used to estimate odds ratios (OR) adjusted for the potential correlation between the risk factors: age (modelled as a linear plus quadratic term), sex, white and non-white ethnicity, IMD in quintiles, and co-morbidities according to the Charlson Score. Ethnicity was missing for 7281 patients and socioeconomic status for 40 patients. Values for these risk factors were imputed with multiple imputation using chained equations creating 10 datasets and using Rubin's rules to combine the estimated odds ratios across the datasets (White *et al*, 2011).

## RESULTS

**Calendar year.** Overall 17 889 out of 82 777 patients (21.6%) with a primary diagnosis of colorectal cancer presented as emergency admissions (Table 1). This proportion has remained relatively stable since 2007, but with some evidence of a small decrease in 2010–2011.

**Demographic risk factors.** The proportion of patients with an emergency presentation is higher in older patients, in women, in non-white patients, and in patients from a more deprived socioeconomic background (Table 1).

**Clinical risk factors.** Around one third of patients with two or more co-morbidities presented as an emergency compared with

one fifth of those with no co-morbidity (Table 1). An emergency presentation was especially frequent in patients with dementia or cerebrovascular disease. Emergency presentation was also more frequent in patients with hemi- and paraplegia as well as in patients with congestive cardiac failure, liver disease, peripheral vascular, and chronic pulmonary disease.

**Multivariable analysis.** The same risk factors were identified when multivariable logistic regression was used to adjust for the correlation between the risk factors (Table 2). With adjustment, the

Table 1. Risk factors for emergency presentation in patients with colorectal cancer

	Distribution of risk factor Number (%)	Diagnosis at emergency admission	
		Number	Percentage
	82 777	17 889	21.6
<b>Year of diagnosis</b>			
2007–2008	17 259 (20.8)	3786	21.9
2008–2009	20 048 (24.2)	4360	21.7
2009–2010	23 785 (28.7)	5214	21.9
2010–2011	21 685 (26.2)	4529	20.9
<b>Age group (years)</b>			
≤64	23 727 (28.7)	4184	17.6
65–74	25 673 (31.0)	4349	16.9
75–84	24 912 (30.1)	5994	24.1
≥85	8465 (10.2)	3362	39.7
<b>Patient demographics</b>			
Sex			
Male	47 263 (57.1)	9317	19.7
Female	35 514 (42.9)	8572	24.1
Ethnicity			
White	72 920 (88.1)	15 934	21.9
Non-white	2576 (3.1)	647	25.1
Missing	7281 (8.8)	1308	18.0
Index of Multiple Deprivation population quintile			
1: Most deprived	14 025 (16.9)	3637	25.9
2	15 225 (18.4)	3575	23.5
3	17 651 (21.3)	3766	21.3
4	18 337 (22.2)	3635	19.8
5: Least deprived	17 499 (21.1)	3265	18.7
Missing	40 (0.05)	11	27.5
No. of co-morbidities			
0	53 493 (64.6)	10 308	19.3
1	21 420 (25.9)	5145	24.0
≥2	7860 (9.5)	2436	31.0
<b>Co-morbidities</b>			
Myocardial infarction	1551 (1.9)	395	25.5
Congestive cardiac failure	3051 (3.7)	1093	35.8
Peripheral vascular disease	2808 (3.4)	758	27.0
Cerebrovascular disease	1704 (2.1)	650	38.1
Dementia	1152 (1.4)	549	47.7
Chronic pulmonary disease	11 171 (13.5)	2760	24.7
Rheumatologic disease	1364 (1.6)	321	23.5
Diabetes mellitus	10 793 (13.0)	2411	22.3
Liver disease	1824 (2.2)	616	33.8
Hemi/paraplegia	437 (0.5)	164	37.5
Chronic renal disease	3608 (4.4)	1143	31.7

**Table 2.** Risk factors for emergency presentation in patients with colorectal cancer

Risk factors	Adjusted odds ratio	Confidence intervals 95%
<b>Year of diagnosis</b>		
2011	1	
2010	1.05	1.00 to 1.10
2009	1.06	1.01 to 1.12
2008	1.09	1.03 to 1.15
<b>Age (years)</b>		
50	1.08	1.04 to 1.12
60	0.90	0.88 to 0.91
70	1	
80	1.49	1.47 to 1.52
90	2.99	2.84 to 3.15
<b>Sex</b>		
Male	1	
Female	1.12	1.08 to 1.16
<b>Ethnicity</b>		
White	1	
Non-white	1.13	1.02 to 1.24
<b>Index of Multiple Deprivation</b>		
1: Most deprived	1	
2	0.86	0.82 to 0.91
3	0.76	0.72 to 0.81
4	0.70	0.66 to 0.74
5: Least deprived	0.65	0.61 to 0.69
Myocardial Infarction	1.00	0.88 to 1.13
Congestive cardiac failure	1.49	1.37 to 1.61
Peripheral vascular disease	1.16	1.06 to 1.27
Cerebrovascular disease	1.67	1.49 to 1.87
Dementia	2.46	2.18 to 2.79
Chronic pulmonary disease	1.12	1.07 to 1.18
Rheumatological disease	0.94	0.83 to 1.07
Diabetes mellitus	0.97	0.92 to 1.02
Liver disease	1.87	1.69 to 2.08
Hemi/paraplegia	1.41	1.13 to 1.76
Chronic renal disease	1.23	1.14 to 1.33

decrease in risk of an emergency presentation over the study period became more prominent. The strongest risk factors were old age (OR 2.99 comparing patients aged 90 with those age 70) and dementia (OR 2.46).

## DISCUSSION

This study, which is the largest to date presenting results adjusted for potential correlations between the included risk factors, demonstrates that age, sex, ethnicity and socioeconomic background, and the presence of co-morbidity had an impact on the risk of an emergency admission for colorectal cancer.

Mode of admission was available for only 84.5% of the patients because of incomplete linkage to HES. However, the linkage rate did not depend on risk factors for an emergency admission, which reduces the potential for bias. For example, mode of admission was available for 85.9% of patients younger than 65 and 84.4% of those between 75 and 84.

The decrease in the proportion of patients presenting as an emergency from 2007 to 2011 may be the earliest sign of the impact of screening for colorectal cancer. The NHS bowel screening programme started in 2006 and only in a few screening centres. The programme coverage gradually expanded over the years resulting in participation of all 58 UK screening centres since 2012.

Our finding that older patients are more likely to present with an emergency presentation is consistent with the observation that in 30% of English patients (over 70 at diagnosis) their diagnosis of cancer was made after an emergency admission to hospital (Elliss-Brookes *et al*, 2012). This may be explained because elderly patients are more likely to live alone and they may have a poorer awareness of the early symptoms of cancer (Berkowitz *et al*, 2008; Guessous *et al*, 2010).

Women were found to have a higher risk of emergency presentation than men, which is consistent with a Canadian population-based study (Rabeneck *et al*, 2006). It has been reported that women express more fear and embarrassment about the prospect of undergoing a colonoscopy and experience more discomfort during it (Kim *et al*, 2000; Farraye *et al*, 2004; Menees *et al*, 2005).

The increase in risk of emergency admission in patients from a more deprived background has been seen in other studies of colorectal and other cancers (Pollock and Vickers, 1998; Rabeneck *et al*, 2006). Further research is needed to gain a better understanding of the extent to which these differences are due to cancer awareness, health-seeking behaviour or to more limited access to health. However, it is important to note that an area-based study of the provision of services for six common surgical conditions found that patients from the most deprived areas were the most likely to consult a primary care clinician but less likely to receive surgical treatment (Chaturvedi and Ben-Shlomo, 1995).

Cancer awareness and health-seeking behaviour are also obvious explanations for the relatively high risk of emergency presentation in patients with dementia. This is consistent with an autopsy study that demonstrated that patients with dementia were twice as likely to have undiagnosed colorectal cancer (Gupta and Lamont, 2004). A greater awareness among clinicians in primary care that patients with dementia not always accurately report key symptoms may result in an earlier diagnosis in this patient group.

It is difficult to explain why patients with other co-morbidities, such as liver disease, are more often diagnosed after an emergency admission to hospital. One could speculate that a focus on other more problematic co-morbid conditions may lead patients to neglect the sometimes subtle early signs of colorectal cancer.

Presenting with later stage disease and being physiologically more fragile than their elective counterparts, patients with an emergency presentation of colorectal cancer have a significantly poorer prognosis. Our study identifies age, sex, ethnicity, and socioeconomic background, and the presence of co-morbidity as risk factors that may cause impaired access to healthcare and health-seeking behaviour. An earlier recognition of symptoms in patients with these risk factors, especially in very old patients and those with dementia, may contribute to better outcomes.

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