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; Trompetas, 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 (Trompetas, 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.
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 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](image-url)
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.

**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.

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

| Risk factors | Adjusted odds ratio | Confidence intervals 95% |
|--------------|---------------------|--------------------------|
| Year of diagnosis |                     |                          |
| 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             |
| Age (years)  |                     |                          |
| 70           | 1                   |                          |
| 60           | 1.08                | 1.04 to 1.12             |
| 50           | 0.90                | 0.88 to 0.91             |
| 80           | 1.49                | 1.47 to 1.52             |
| 90           | 2.99                | 2.84 to 3.15             |
| Sex          |                     |                          |
| Male         | 1                   |                          |
| Female       | 1.12                | 1.08 to 1.16             |
| Ethnicity    |                     |                          |
| White        | 1                   |                          |
| Non-white    | 1.13                | 1.02 to 1.24             |
| Index of Multiple Deprivation |       |                          |
| 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).

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REFERENCES

Ansaloni L, Andersson RE, Bazzoli F, Catena F, Cennamo V, Di Saverio S, Fuccio L, Jeekel H, Leppäniemi A, Moore E, Pinna AD, Pisano M, Repici A, Sugarbaker PH, Tuech JJ (2010) Guidelines in the management of obstructing cancer of the left colon: consensus conference of the world society of emergency surgery (WSES) and peritonium and surgery (PnS) society. World J Emerg Surg 5: 29.

Armitage IN, van der Meulen JH (2010) Identifying co-morbidity in surgical patients using administrative data with the Royal College of Surgeons Charlson Score. Br J Surg 97(5): 772–781.

Berkowitz Z, Hawkins NA, Peipins LA, White MC, Nadel MR (2008) Beliefs, risk perceptions, and gaps in knowledge as barriers to colorectal cancer screening in older adults. J Am Geriatr Soc 56(2): 307–314.

Chaturvedi N, Ben-Shlomo Y (1995) From the surgery to the surgeon: does deprivation influence consultation and operation rates? Br J Gen Pract 45(392): 127–131.

Ellis-Brookes L, McPhail S, Ives A, Greenslade M, Shelton J, Hiom S, Richards M (2012) Routes to diagnosis for cancer – determining the patient journey using multiple routine data set. Br J Cancer 107: 1220–1226.

Farraye FA, Wong M, Hurwitz S, Puleo E, Emmons K, Wallace MB, Fletcher RH (2004) Barriers to endoscopic colorectal cancer screening: are women different from men? Am J Gastroenterol 99(2): 341–349.

Finan P, Smith J, Scott N, Walker K, van der Meulen J, Greenway K, Yelland A (2014) National bowel cancer audit report 2012. Available at www.ic.nhs.uk/bowelreports (accessed 7 May 2014).

Guessous I, Dash C, Lapin P, Doroshenk M, Smith RA, Klabunde CN (2010) Colorectal cancer screening barriers and facilitators in older persons. Prev Med 50(1-2): 3–10.

Gunnarsdottir H, Holm T, Ekholm A, Olsson I (2011) Emergency presentation of colon cancer is most frequent during summer. Colorectal Dis 13(6): 663–668.

Gupta SK, Lamont EB (2004) Patterns of presentation, diagnosis, and treatment in older patients with colon cancer and comorbid dementia. J Am Geriatr Soc 52(10): 1681–1687.

Health and Social Care Information Centre (2014) Hospital Episode StatisticsAvailable at http://www.hscic.gov.uk/hes (accessed 7 May 2014).

Khot UP, Lang AW, Murali K, Parker MC (2002) Systematic review of the efficacy and safety of colorectal stents. Br J Surg 89: 1096–1102.

Kim WH, Cho YJ, Park JY, Min PK, Kang JK, Park IS (2000) Factors affecting insertion time and patient discomfort during colonoscopy. Gastrointest Endosc 52(5): 600–605.

McArdle CS, Hole DJ (2004) Emergency presentation of colorectal cancer is associated with poor 5-year survival. Br J Surg 91: 605–609.

Mennees SB, Inadomi JM, Korsnes S, Elta GH (2005) Women patients’ preference for women physicians is a barrier to colon cancer screening. Gastrointest Endosc 62(2): 219–223.

Ng KC, Law WL, Lee YM, Choi HK, Seto CL, Ho JW (2006) Self-expanding metallic stent as a bridge to surgery versus emergency resection for obstructing left-sided colorectal cancer: a case-matched study. J Gastrointest Surg 10(6): 798–803.

NHS Connecting for Health (2009a) OPCS Classification of Interventions and Procedures Version 4.5. Vol. II - Tabular Index. The Stationery Office: London.

NHS Connecting for Health (2009b) OPCS Classification of Interventions and Procedures Version 4.5. Vol. I - Alphabetic Index. The Stationery Office: London.

Pollock AM, Vickers N (1998) Deprivation and emergency admissions for cancers of colorectum, lung, and breast in south east England: ecological study. BMJ 13: 245–252.

Rabenek L, Paszat LF, Li C (2006) Risk factors for obstruction, perforation, or emergency admission at presentation in patients with colorectal cancer: a population-based study. Am J Gastroenterol 101(5): 1098–1103.

Scott NA, Jeacock J, Kingston RD (1995) Risk factors in patients presenting as an emergency with colorectal cancer. Br J Surg 82: 321–323.

Tekkis PP, Kinsman R, Thompson MR, Stamatakis JD (2004) The Association of Coloproctology of Great Britain and Ireland study of large bowel obstruction caused by colorectal cancer. Ann Surg 204: 76–81.

The English Indices of Deprivation (2012) Department for Communities and Local Government. Available at http://data.gov.uk/dataset/index-of-multiple-deprivation (accessed 20 August 2012).

Trompteas V (2008) Emergency management of malignant acute left-sided colonic obstruction. Ann R Coll Surg Engl 90(3): 181–186.

World Health Organisation (2004) ICD10 International Statistical Classification of Disease and Related Health Problems. World Health Organisation: Geneva.

White I, Royston P, Wood A (2011) Multiple imputation by chained equations: issues and guidance for practice. Stat Med 30(4): 377–399.

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