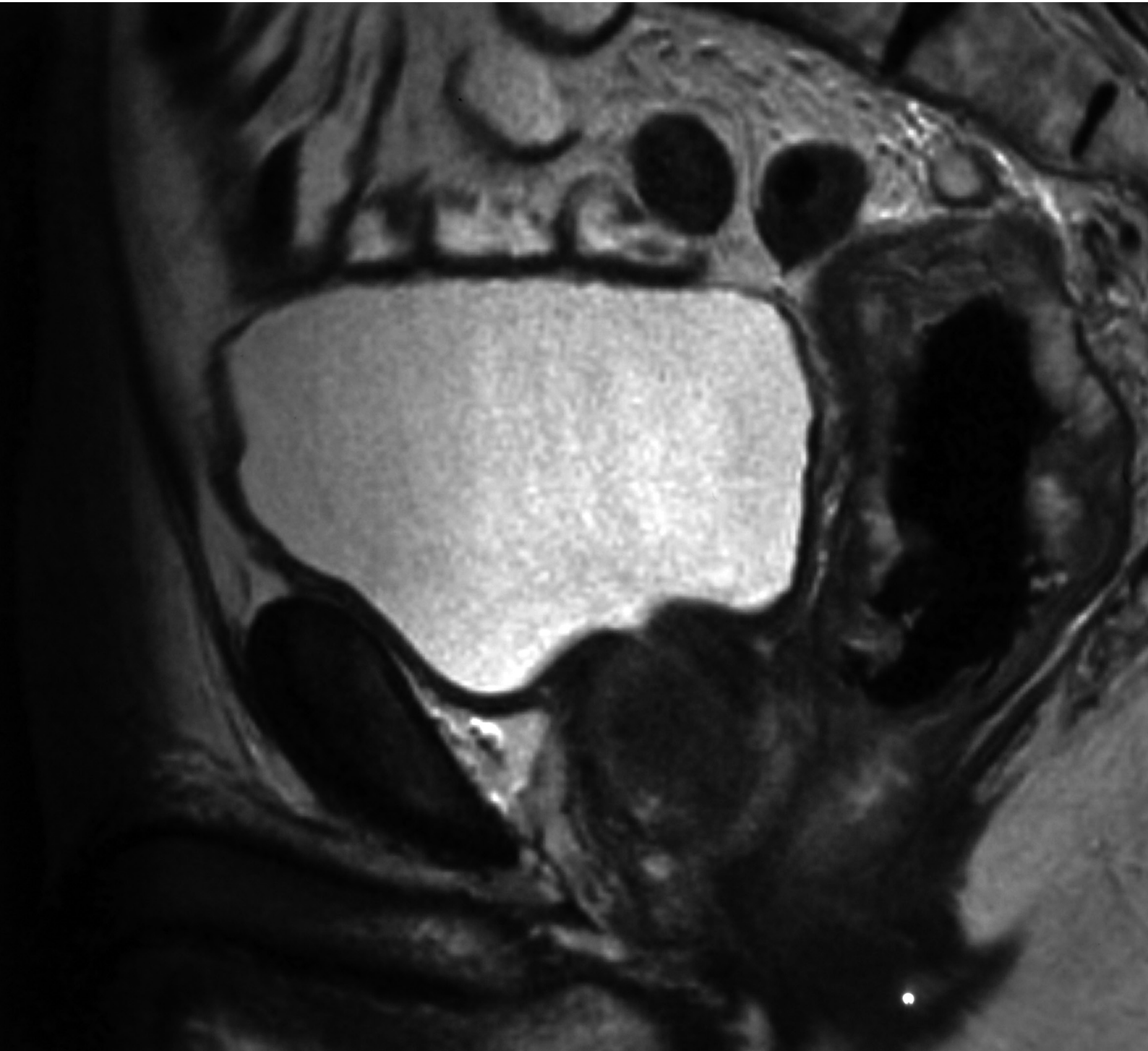


National Bowel Cancer Audit Supplementary Report 2011



This Supplementary Report contains data from the 2009/2010 reporting period which covers patients in England with a diagnosis date from 1 August 2009 to 31 July 2010, and in addition, rectal cancer patients having major surgery between 1 August 2008 and 31 July 2010.

Most of the analyses described in this supplementary report include patients for whom Hospital Episode Statistics data could be linked to Audit data.

This report was prepared by:

Association of Coloproctology of Great Britain and Ireland

Paul Finan

Clinical Effectiveness unit of the Royal College of Surgeons of England – London School of Hygiene and Tropical Medicine

Kate Walker

Jan van der Meulen

The Health and Social Care Information Centre

Kimberley Greenaway

Arthur Yelland

This supplementary report is available to download at www.ic.nhs.uk/bowel

Prepared in partnership with:



The Association of Coloproctology of Great Britain and Ireland (ACPGBI) is The professional body that represents UK colorectal surgeons. ACPGBI provided a clinical interpretation of the data analysed in the 2011 Supplementary Report.



The Royal College of Surgeons of England (RCS) is an independent professional body committed to enabling surgeons to achieve and maintain the highest standards of surgical practice and patient care. The RCS carried out the analysis of the data for the 2011 Supplementary Report.



The Health and Social Care Information Centre (HSCIC) is England's central, authoritative, source of essential data and statistical information for frontline decision makers in health and social care. The HSCIC managed the publication of The 2011 Supplementary Report.



The Healthcare Quality Improvement Partnership (HQIP) promotes quality in healthcare. HQIP holds commissioning and funding responsibility for the National Bowel Cancer Audit and other national clinical audits as part of the National Clinical Audit & Patient Outcomes Programme (NCAPOP).

National Bowel Cancer Audit Supplementary Report 2011

Contents

	Acknowledgements	6
	Executive Summary	7
1	Introduction	8
2	Methods	9
2.1	Inclusion of Patients	9
2.2	Definition of data items	9
2.3	Definition of postoperative complications	9
2.4	Definition of 12-month stoma in rectal cancer patients	9
2.5	Definition of emergency admission and surgical urgency	9
2.6	Statistical analysis	10
2.7	Funnel plots	10
2.8	Adjusted outcomes	10
3	Postoperative Complications	11
3.1	Emergency readmission within 90 days	11
3.2	Return to theatre within 28 days	15
4	12-Month Stoma Rates in Rectal Cancer Patients	21
4.1	Data quality	21
4.2	Results	23
5	Emergency Admissions and Surgical Urgency	27
5.1	Emergency admissions	27
5.1.1	Data Quality	27
5.1.2	Results	27
5.2	Surgical urgency for patients with an emergency admission	31

Acknowledgements

The National Bowel Cancer Audit (NBCA), commissioned by the Healthcare Quality Improvement Partnership (HQIP), has been developed by the Association of Coloproctology of Great Britain and Ireland (ACPGBI) and is managed by the Clinical Audit Support Unit within the Health and Social Care Information Centre (HSCIC).

The analyses for this report were carried out by the Clinical Effectiveness Unit (CEU) of the Royal College of Surgeons of England (Kate Walker and Jan van der Meulen) with support from the Health and Social Care Information Centre (Arthur Yelland).

The writing of the report was undertaken by Kate Walker, Paul Finan, and Jan van der Meulen.

The Project Team and Board would like to thank the clinical and non-clinical staff at all NHS Trusts who collected and submitted data to the Audit for their hard work, support and leadership.

We would like to acknowledge the contribution of the Open Exeter Helpdesk.

Executive Summary

In this report, the results of a number of additional analyses are described including patients that were diagnosed with bowel cancer between 1 August 2009 and 31 July 2010, and for estimates of 12-month stoma rates, rectal cancer patients having major surgery between 1 August 2008 and 31 July 2010.

All analyses use data from the National Bowel Cancer Audit (NBCA) linked to records of the Hospital Episode Statistics database (HES), the administrative database of all admissions of patients to English NHS trusts.

The aim of these analyses was to demonstrate the value of linked data. Areas that are covered in this report include postoperative complications and readmissions, 12-month stoma rates, and the treatment and outcomes of patients with bowel cancer after an emergency admission to hospital.

The analyses presented in this supplementary report demonstrate that linkage to HES adds value to the Audit.

Emergency readmissions

The overall rate of emergency readmission within 90 days from major surgery was 19.7 per cent. These readmissions rates were more common in young patients, patients who had a longer stay in hospital, and in patients with more advanced cancer.

There was little variation in emergency readmissions rates between cancer networks. Variation between NHS trusts was somewhat higher. The emergency readmission rate of one trust indicates that it is a *potential* outlier.

Return to theatre

The overall return to theatre rate within 28 days of major surgery was 8.9 per cent. Return to theatre was more common in men, younger patients, patients with rectal cancer, patients with a relatively long hospital stay, patients with comorbidity, and patients having emergency surgery.

There was little variation in return to theatre rate between cancer networks. The variation between NHS trusts was larger and two trusts were identified as *potential* outliers.

12-month stoma rates

We found that most patients who were reported in the Audit to have had a stoma after major surgery for rectal cancer were also reported to have had a stoma in HES data. The reverse was not true, in part due to the large amount of missing data in the Audit.

Based on linked data, we found that 83 per cent of patients undergoing major surgery for rectal cancer had a stoma and that 57 per cent of patients still had a stoma 12 months after surgery. Of the 4,965 patients who underwent an anterior resection, 24 per cent had no stoma at all, 38 per cent had a stoma that was reversed within 12 months, and 38 per cent still had a stoma at 12 months.

We identified two cancer networks and four trusts as *potential* outliers in terms of their 12-month stoma rate in all patients undergoing major surgery for rectal cancer.

Emergency admissions and surgical urgency

The agreement between the Audit and HES on patients being admitted as an emergency was very good, but the Audit had a higher level of missing data.

Overall, 25 per cent of patients were diagnosed after an emergency admission. This percentage was much higher in patients with Dukes' stage D and ASA grades 4 or 5. The rate was higher in patients with colon cancer than in patients with rectal cancer.

There was little evidence of variation between cancer networks beyond what would be expected from random variation alone.

29 per cent of patients admitted as an emergency had non-emergency surgery at a later date. Colon cancer patients admitted as an emergency were less likely to have delayed non-emergency surgery (25 per cent) than patients with rectal cancer (65 per cent). Similarly, patients with less advanced cancer and those with more comorbidity were more likely to have delayed non-emergency surgical treatment.

Patients admitted as an emergency having delayed non-emergency surgery tended to have a shorter stay in hospital, a lower return to theatre rate and a lower postoperative mortality, but the statistical evidence supporting these observations is weak given the number of patients who could be included in the analysis, and the reasons for delay in surgery are not established.

1. Introduction

In the Annual Report 2011, the Audit has used, for the first time, Hospital Episode Statistics (HES) linked to Audit data. Use of Audit data linked to HES has the advantage that the analysis can benefit from the detailed clinical information of the Audit data and the completeness of inclusion and follow-up provided by HES data. An important advantage of using HES data is that it contains information not very well recorded in the Audit. HES data only covers patients residing in England. Therefore, the results in this supplementary report cover only patients admitted to English NHS trusts.

In this Supplementary Report, the results are presented of a number of analyses that have the potential to benefit from linkage of HES and Audit data. The main aim of these analyses is to demonstrate the value of linked data. Areas that are covered in this report include postoperative complications and readmissions, 12-month stoma rates in rectal cancer patients, and the treatment and outcomes of patients diagnosed with bowel cancer after an emergency admission into hospital.

For all these analyses based on linked data, the analyses were carried out as much as possible using data from the Audit about the characteristics of the patients, their cancer and their treatment. Data on the occurrence of complications, readmissions as well as reversals of a stoma were derived from HES. Also, HES was the source of data on whether the first admission of a patient was an emergency.

The results presented in this Supplementary Report demonstrate the added value of linking data from the Audit to HES records and are to be used in subsequent audit reports commencing with the 2012 Annual Report.

2. Methods

2.1 Inclusion of Patients

The National Bowel Cancer Audit, described previously in the Audit Report 2011, aims to include all patients with a diagnosis of bowel cancer admitted for the first time to a NHS Trust in England and Wales. This year, for the purposes of the Supplementary Report, patients in England in the Audit were linked to the HES database by the Trusted Data Linkage Service from the HSCIC using the patients' NHS number.

The Audit included 26,251 patients in England diagnosed with bowel cancer between 1 August 2009 and 31 July 2010. 30,878 patients could be identified in HES during the same period admitted for the first time with a diagnosis of bowel cancer in the same period. Of the 26,251 patients included in the Audit 22,169 of these patients (84.5 per cent) could be linked to a HES record. In many of the analyses in this report, data items from the Audit and the HES database were required and the analyses were then restricted to the patients linked between HES and the Audit.

2.2 Definition of Data Items

The following variables were defined from the Audit, where available, otherwise from HES: cancer site, sex, age, procedure, admission date, date of surgery and length of stay. The number of comorbid conditions according to the Charlson index (0, 1, ≥ 2)¹, mode of admission and all of the following outcomes were defined from HES: emergency readmission within 90 days of surgery, return to theatre within 28 days of surgery, and emergency admission. Dukes' stage, surgical urgency, ASA grade and date of death were defined from the Audit.

2.3 Definition of Postoperative Complications

Emergency readmission within 90 days of surgery and return to theatre within 28 days of surgery were derived from HES data in patients undergoing major surgery.

Emergency readmissions analysis was restricted to patients discharged from hospital within 28 days of surgery, and emergency readmission was defined as an emergency admission to any hospital for any cause within 90 days of surgery, according to HES.

Return to theatre was defined as the occurrence of a set of procedure codes in HES data for return to theatre other than the code for the original procedure, between 1 and 28 days of surgery, in any of the procedure fields in HES, regardless of the date of discharge from hospital. The codes used to define return to theatre were those used by Burns et al. as a starting point², with additional codes identified using a strategy to identify frequent procedure codes amongst patients with poor outcomes (death within 90 days of surgery, emergency readmission within 90 days of surgery, or a hospital stay longer than 14 days) as well as a search strategy for keywords amongst all procedure codes. All additional procedure codes were clinically verified.

Procedure codes for return to theatre occurring up until midnight on the day of surgery could not be distinguished from the original procedure, hence the requirement of at least one day between the original surgery and the procedure code identifying return to theatre. A subset of codes, which were either described as a re-operation or which could only occur during a return-to-theatre as a result of a complication and not during the primary procedure, were included as a return to theatre, even if they occurred on the day of surgery.

2.4 Definition of 12-Month Stoma Rate in Rectal Cancer Patients

Rectal cancer patients undergoing an abdomino perineal excision of the rectum (APER) or Hartmann's procedure were assumed to have had a colostomy at the time of their primary procedure. In patients having an APER this colostomy was assumed to be permanent. Patients were assumed to have had an ileostomy or colostomy if this information was recorded in the Audit, whether permanent or temporary. This information was missing in some patients, and was updated from procedure codes for colostomy or ileostomy in HES from the time of the primary procedure onwards. As the information on patient follow-up was poorly recorded in the Audit, information on reversal of stomas was taken from procedure codes in HES only.

A procedure code for reversal of ileostomy or reversal of colostomy within 12 months of surgery was assumed to mean that the patient had their stoma reversed, regardless of whether the stoma was coded as an ileostomy or colostomy. This approach to dealing with coding inconsistencies was taken on the grounds that if a procedure code for stoma reversal was recorded in HES it was most conceivable that a stoma reversal took place, and that the details of the procedure were incorrectly coded.

2.5 Definition of Emergency Admission and Surgical Urgency

Mode of admission was derived from HES, and the urgency of the surgical procedure from the Audit.

2.6 Statistical Analysis

Most results reported in this audit report are descriptive. The results of categorical data items are reported as percentages. The denominator of these proportions is, in most cases, the number of patients for whom the value of the data item was non-missing.

Results are typically grouped by cancer network and NHS trust. Only if hospitals within a trust were part of different cancer networks, were their results reported at hospital level.

2.7 Funnel Plots

Funnel plots were used to compare the following between networks or between trusts/hospitals: emergency readmission within 90 days of surgery, return to theatre within 28 days of surgery, 12-month stoma rate, and emergency admission to hospital. The rate for each network or for each trust or hospital was plotted against the volume of patients from which the rate was estimated. The “target” is specified as the overall rate across all networks or trusts/hospitals. The funnel limits depend on the target rate and the number of patients from which the rates are estimated; estimates have greater uncertainty when estimated from fewer patients.

Results fall outside the inner limits if they are statistically significantly different from the target at a 0.05 level, and outside the outer limits if they are statistically significantly different from the target at a 0.002 level. The inner funnel limit is the threshold for an “alert” and the outer funnel level is the threshold for an “alarm”. This implies that 95 per cent of the trusts or hospitals are expected to be within the inner funnel limits and 99.8 per cent within the outer funnel limits, if they are all performing according to the target. In this report, those networks, trusts or hospitals with results outside the outer funnel limit are considered as *potential* outliers.

2.8 Adjusted Outcomes

Multivariable logistic regression was carried out to estimate case-mix-adjusted outcomes. Depending on which were the most appropriate variables to adjust for in the analysis, the logistic regression model included a subset of the following case-mix variables: the patients’ sex, age, ASA grade, Dukes’ stage, surgical procedure, urgency of operation, site of cancer and Charlson index. Patients with missing outcome variables were excluded, and multiple imputation, with ten imputation sets, was used to fill in any missing information on the case-mix variables.

The adjusted outcomes were estimated using indirect standardisation. The observed number of events for a trust, hospital or network was divided by the number expected on the basis of the logistic regression model. The adjusted rate was then estimated by multiplying this ratio by the average rate in all patients included in the analysis.

All Statistical analyses were performed using Stata version 11.

3. Postoperative Complications

The postoperative complications analysis included the 20,438 patients undergoing major surgery according to the Audit where available, otherwise HES, whether linked to the Audit or not. In analyses using items available only in the Audit, the analysis was limited to the 16,447 patients linked to the Audit, and this is explicitly stated.

3.1. Emergency Readmission Within 90 Days

The analysis of emergency readmissions was restricted to the 18,873 patients discharged from their admission for major surgery within 28 days. The results were not sensitive to this choice of length of stay: overall 19.7 per cent of patients who were discharged within 28 days of surgery had an emergency readmission within 90 days, compared to 18.7 per cent of patients who were discharged within 14 days of surgery, and 19.8 per cent of patients who were discharged within 56 days of surgery. Exclusion of patients who were still in hospital at 28 days did not result in a large amount of data loss, causing the loss of only 7 per cent of patients.

The choice of 90-day emergency readmission captures the majority of patients who went on to have an emergency readmission whilst capturing substantially more emergency readmissions than if patients were only followed up for 14 or 28 days: 27.1 per cent of patients had an emergency readmission within 180 days, whilst only 5 per cent and 9.9 per cent of patients had an emergency readmission within 14 days and 28 days, respectively.

The overall rate of emergency readmission within 90 days of major surgery, for patients discharged within 28 days, was 19.7 per cent. [Table 3.1](#) shows that emergency readmission is more common in younger patients, patients who had a longer stay in hospital for their original admission, patients with more advanced cancer, and in patients who died within 90 days of surgery.

The variables in [Table 3.2](#) were used for case-mix adjustment. With simultaneous adjustment for all variables in this table, the strongest predictors of emergency readmission were age and Dukes' stage, with ASA grade and procedure being less strongly associated. The model has only moderate discriminatory power (c-statistic=0.58 (95 per cent CI: 0.57, 0.59)) and there was no evidence of any lack of fit by deciles of risk.

[Figure 3.1](#) shows that there was no more variation in emergency readmission by cancer network than would be expected by chance. Adjustment changed the estimates very little, and there were no networks outside the alert or alarm thresholds.

[Figure 3.2](#) shows more variation in emergency readmission between trusts/hospitals than between cancer networks. One trust/hospital was above the outer limit and a further six were above the inner limit after case-mix adjustment.

Table 3.1
Emergency readmission within 90 days of surgery, for the 18,873 patients having major surgery who were discharged within 28 days of surgery, by patient characteristics

			Emergency admission within 90 days	
		Total number	Number	%
	Overall	18,873	3,717	19.7
Linked to the audit?	No	3,660	681	18.6
	Yes	15,213	3,036	20.0
Cancer site	Colon	12,501	2,232	17.9
	Rectosigmoid	1,126	208	18.5
	Rectal	5,246	1,277	24.3
Sex	Male	10,505	2,161	20.6
	Female	8,367	1,556	18.6
	Missing	1	0	
Age-group	≤64 yrs	5,797	1,266	21.8
	65-74 yrs	6,308	1,280	20.3
	75-84 yrs	5,375	933	17.4
	85+ yrs	1,390	238	17.1
	Missing	3	0	
Length of stay	≤ 1 week	9,447	1,678	17.8
	1 to 2 weeks	6,423	1,289	20.1
	2 to 3 weeks	2,053	513	25.0
	3 to 4 weeks	950	237	24.9
Charlson index (number comorbidities)	0	12,217	2,343	19.2
	1	4,944	997	20.2
	2+	1,712	377	22.0
Died within 90 days of surgery?	No	13,249	2,630	19.9
	Yes	653	137	21.0
	Missing	4,971	950	19.1
For patients linked to the audit only: N=15,213				
Dukes' stage	A	2,272	389	17.1
	B	4,893	881	18.0
	C	4,175	951	22.8
	D	1,677	385	23.0
	Missing	2,196	430	19.6
Surgical urgency	Elective	8,343	1,664	19.9
	Scheduled	2,143	413	19.3
	Urgent	1,572	320	20.4
	Emergency	1,149	214	18.6
	Missing	2,006	425	21.2
ASA grade	1	1,748	349	20.0
	2	6,104	1,176	19.3
	3	2,863	623	21.8
	4 or 5	315	56	17.8
	Missing	4,183	832	19.9

Table 3.2

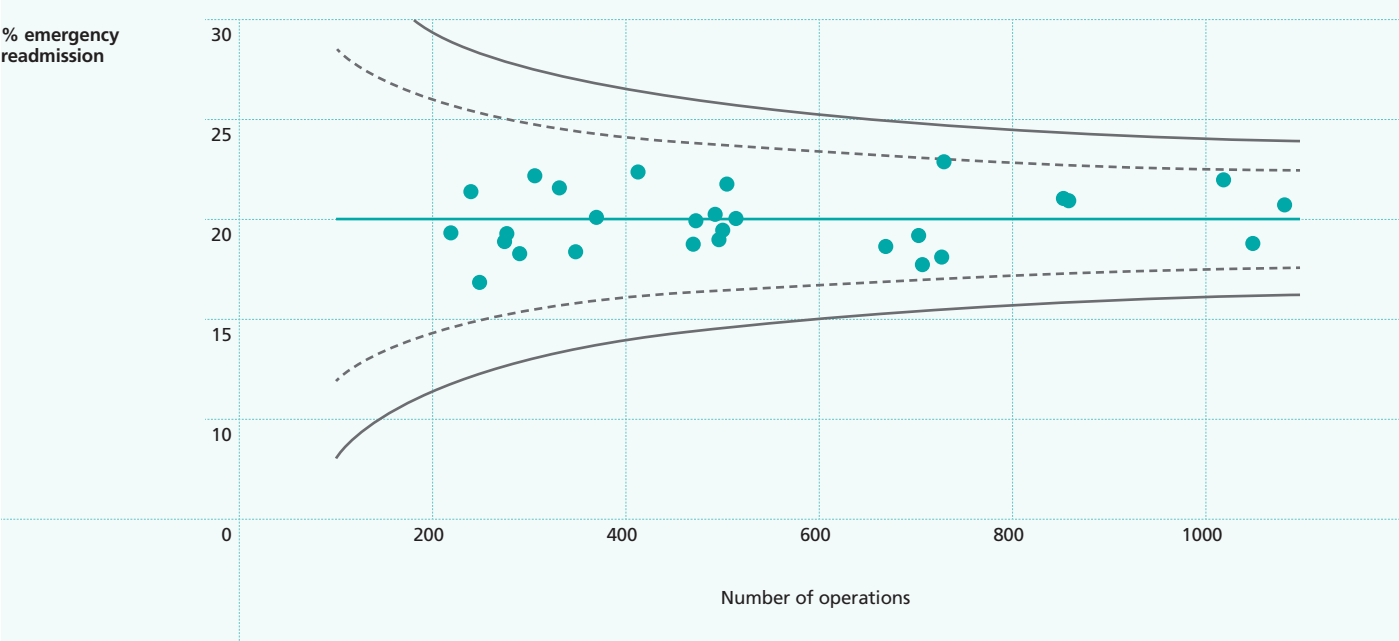
Adjusted risk factors for emergency readmission within 90 days of surgery, for the 15,213 patients linked to the Audit who were discharged within 28 days

		OR	95% CI
Sex	Male	1	
	Female	0.94	0.87 to 1.02
Age-group	≤64 yrs	1	
	65-74 yrs	0.92	0.83 to 1.02
	75-84 yrs	0.75	0.67 to 0.84
	85+ yrs	0.77	0.64 to 0.92
Dukes' stage	A	1	
	B	1.16	1.02 to 1.32
	C	1.50	1.31 to 1.71
	D	1.53	1.30 to 1.81
Urgency of surgery	Elective	1	
	Scheduled	0.94	0.83 to 1.07
	Urgent	1.02	0.88 to 1.18
	Emergency	0.91	0.77 to 1.08
ASA grade	1	1	
	2	1.05	0.90 to 1.23
	3	1.27	1.07 to 1.50
	4 or 5	1.09	0.79 to 1.51
Procedure	Right hemicolectomy	1	
	Transverse colectomy	0.83	0.47 to 1.49
	Left hemicolectomy	0.92	0.76 to 1.12
	Sigmoid colectomy	0.76	0.63 to 0.92
	Total/subtotal colectomy	1.20	0.92 to 1.57
	Anterior resection	1.26	1.14 to 1.39
	APER	1.40	1.19 to 1.64
	Hartmann procedure	1.00	0.83 to 1.20

Figure 3.1
Observed and adjusted 90-day emergency readmission rate by network, for 15,213 patients linked to the Audit who were discharged within 28 days of surgery

● Emergency readmission rate — Audit average - - - - - 95% limits — 99.8% limits

Observed 90-day emergency readmission by network



Adjusted 90-day emergency readmission by network

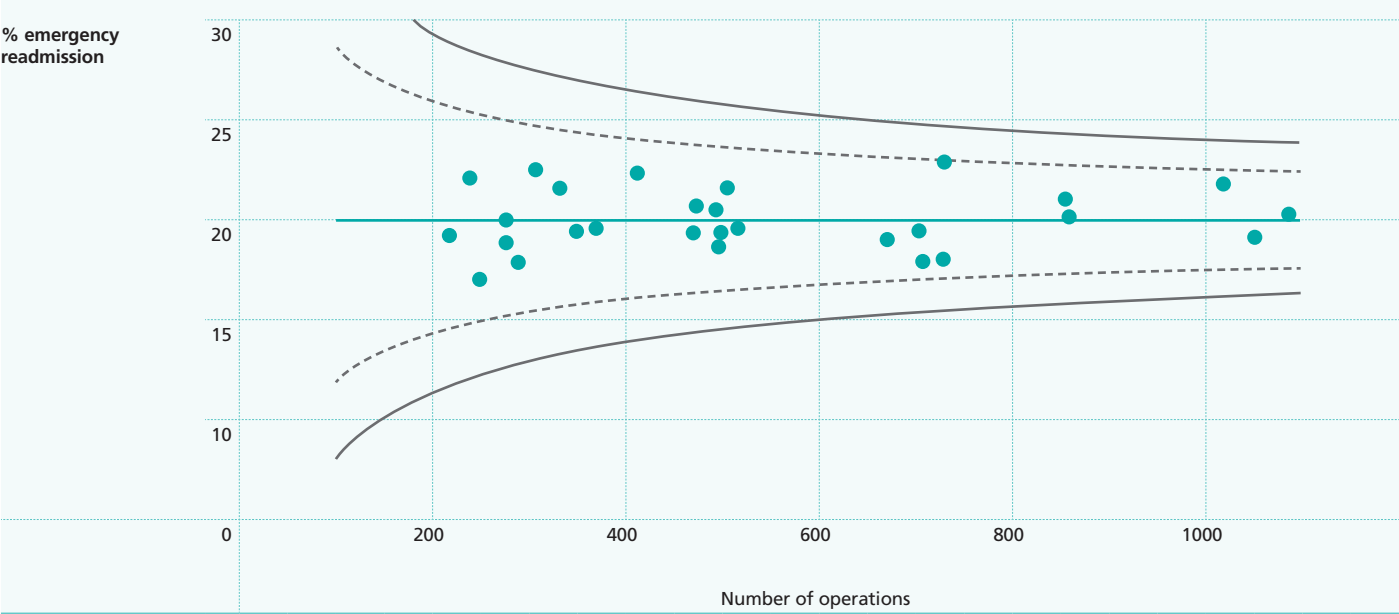
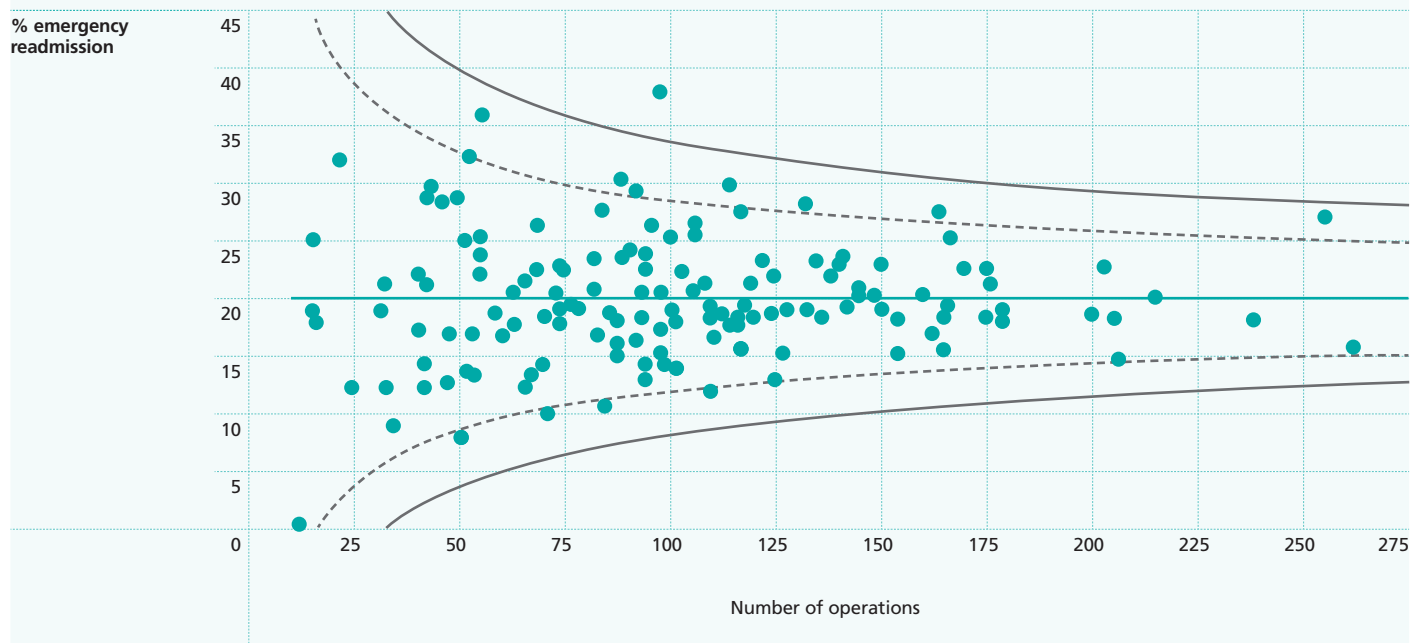


Figure 3.2

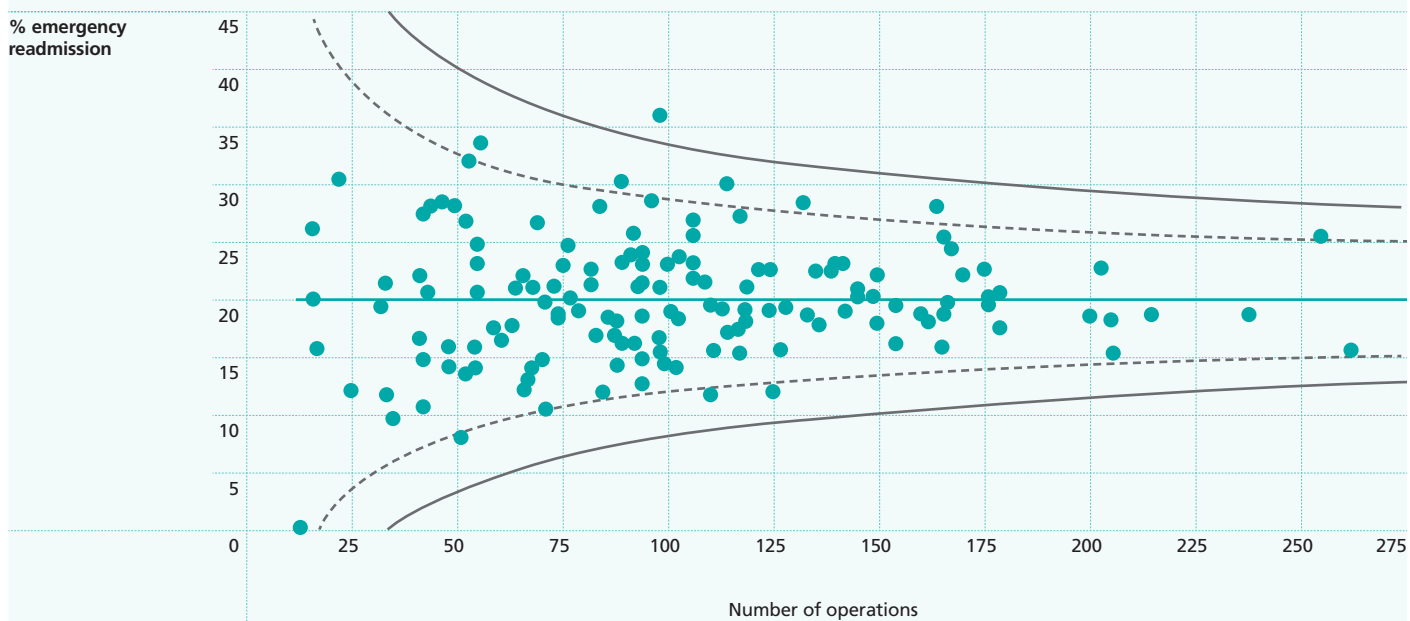
Observed and adjusted 90-day emergency readmission rate by trust/hospital, for 15,213 patients linked to the Audit who were discharged within 28 days of surgery

● Emergency readmission rate — Audit average - - - - - 95% limits — 99.8% limits

Observed 90-day emergency readmission by trust / site with more than 10 operations



Adjusted 90-day emergency readmission by trust / site with more than 10 operations



3.2 Return to Theatre Within 28 Days

Overall 1,811 out of 20,438 patients (8.9 per cent) were identified as having returned to theatre within 28 days.

Table 3.3 shows that return to theatre was more common in males, younger patients, rectal cancer patients, those who had a longer admission for their original procedure, those who had more comorbidity according to the Charlson index, and finally those who were operated on as an emergency, or who had a higher ASA grade. The rate of return to theatre was also higher in patients not linked to the Audit.

The multivariable model estimates in Table 3.4 were used for case-mix adjustment in order to compare cancer networks and trusts/hospitals. The model has moderate discriminatory power (c-statistic=0.64 (95 per cent CI: 0.62, 0.65)) and there was no evidence of any lack of fit by deciles of risk.

The variables predictive of return to theatre were sex, age, surgical urgency, ASA grade, and to a lesser extent, surgical procedure. In contrast to emergency readmission, it could be argued that the majority of these variables reflect characteristics of the patient, rather than the tumour, whereas for emergency readmission the strongest predictor was Dukes' stage, reflecting a characteristic of the tumour.

Figure 3.3 shows the variation in return to theatre between cancer networks. No networks were above the outer limit on adjusted rates of return to theatre. Four networks were above the inner limit on adjusted rates of return to theatre.

Figure 3.4 shows the variation in return to theatre between trusts. Two trusts/hospitals were above the outer limit with case-mix adjustment, and a further 7 trusts/hospitals were above the inner limit and below the outer limit on adjusted rates of return to theatre.

Table 3.3

Return to theatre within 28 days of major surgery, for 20,438 patients, by patient characteristics

		Total number	Return to theatre within 28 days	
			Number	%
	Overall	20,438	1,811	8.9
Linked to the audit?	No	3,991	394	9.9
	Yes	16,447	1,417	8.6
Cancer site	Colon	13,498	1,002	7.4
	Rectosigmoid	1,228	115	9.4
	Rectal	5,712	694	12.1
Sex	Male	11,435	1,205	10.5
	Female	9,002	606	6.7
	Missing	1	0	
Age-group	≤64 yrs	6,109	573	9.4
	65-74 yrs	6,738	636	9.4
	75-84 yrs	5,949	491	8.3
	85+ yrs	1,635	110	6.7
	Missing	7	1	
Length of stay	≤ 1 week	9,447	285	3.0
	1 to 2 weeks	6,423	348	5.4
	2 to 3 weeks	2,053	326	15.9
	> 3 weeks	2,460	849	34.5
	Missing	55	3	
Charlson index (number comorbidities)	0	13,037	1,127	8.6
	1	5,436	461	8.5
	2+	1,965	223	11.3
Died within 90 days of surgery?	No	13,249	2,630	19.9
	Yes	653	137	21.0
	Missing	4,971	950	19.1
For patients linked to the audit only: N=16,447				
Dukes' stage	A	2,396	200	8.3
	B	5,274	441	8.4
	C	4,538	382	8.4
	D	1,845	167	9.1
	Missing	2,394	227	9.5
Surgical urgency	Elective	8,861	664	7.5
	Scheduled	2,287	186	8.1
	Urgent	1,757	193	11.0
	Emergency	1,384	173	12.5
	Missing	2,158	201	9.3
ASA grade	1	1,821	131	7.2
	2	6,425	507	7.9
	3	3,232	298	9.2
	4 or 5	410	72	17.6
	Missing	4,559	409	9.0
Died within 90 days of surgery?	No	14,245	1,115	7.8
	Yes	792	168	21.2
	Missing	1,410	134	9.5

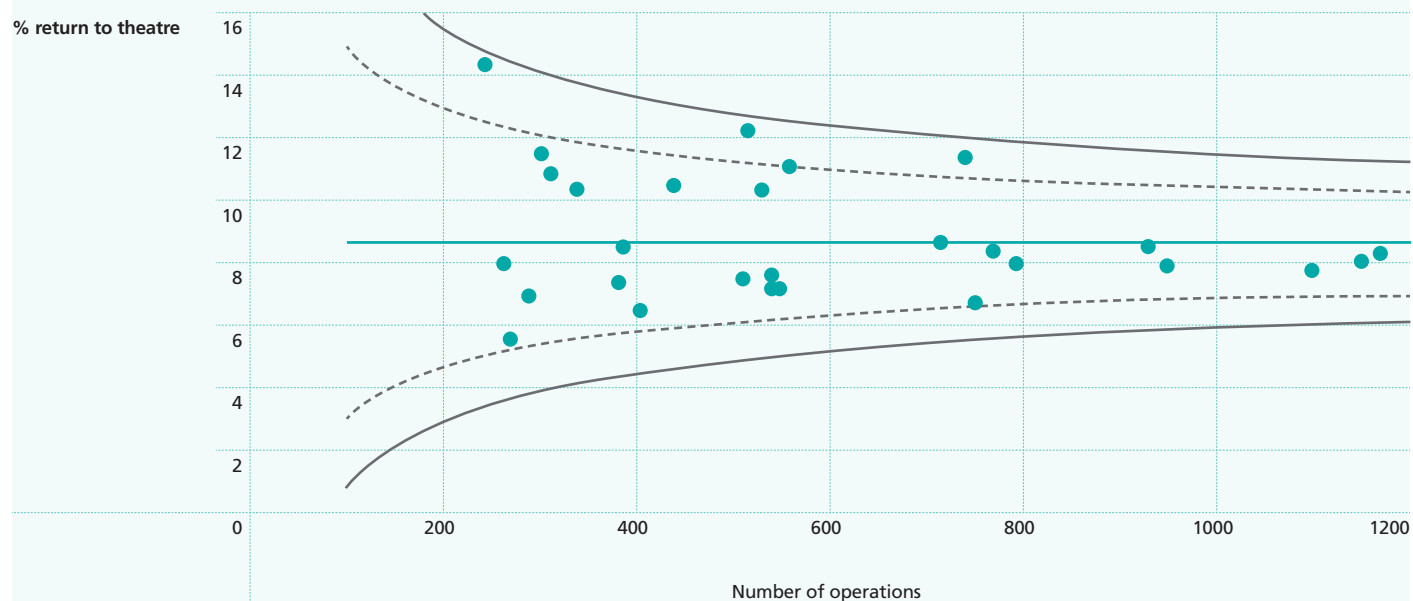
Table 3.4 Risk of return to theatre within 28 days of major surgery, for the 16,447 patients linked to the Audit			
		OR	95% CI
Sex	Male	1	
	Female	0.65	0.58 to 0.74
Age-group	≤64 yrs	1	
	65-74 yrs	0.96	0.83 to 1.10
	75-84 yrs	0.86	0.74 to 1.01
	85+ yrs	0.75	0.58 to 0.96
Dukes' stage	A	1	
	B	1.09	0.90 to 1.31
	C	1.02	0.85 to 1.23
	D	1.02	0.81 to 1.28
Urgency of surgery	Elective	1	
	Scheduled	1.09	0.91 to 1.30
	Urgent	1.60	1.35 to 1.89
	Emergency	1.77	1.46 to 2.15
ASA grade	1	1	
	2	1.16	0.95 to 1.43
	3	1.37	1.11 to 1.70
	4 or 5	2.48	1.76 to 3.50
Procedure	Right hemicolectomy	1	
	Transverse colectomy	0.98	0.42 to 2.26
	Left hemicolectomy	1.36	1.05 to 1.77
	Sigmoid colectomy	1.32	1.03 to 1.69
	Total/subtotal colectomy	2.33	1.72 to 3.16
	Anterior resection	1.72	1.49 to 1.99
	APER	2.56	2.08 to 3.14
	Hartmann procedure	1.81	1.45 to 2.26

Figure 3.3

Funnel plot of observed and adjusted rate of return to theatre by network, for the 16,447 patients having major surgery linked to the Audit

● Return to theatre rate — Audit average - - - - 95% limits — 99.8% limits

Observed 28-day return to theatre by network



Adjusted 28-day return to theatre by network

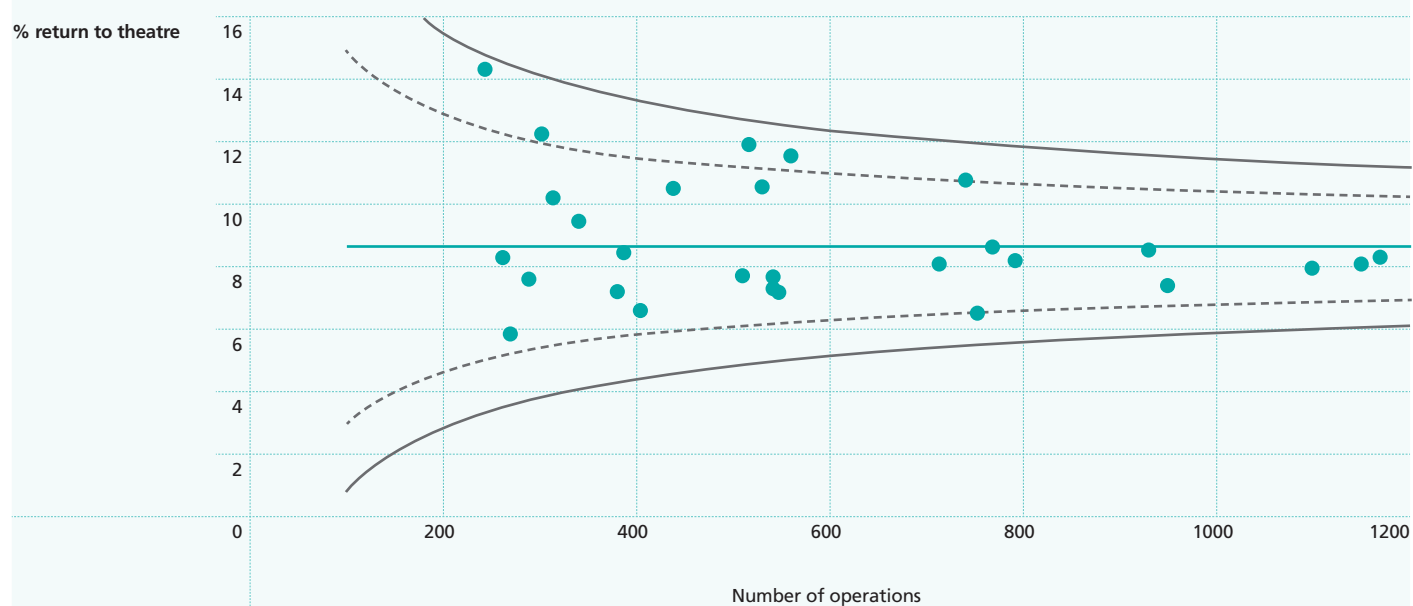
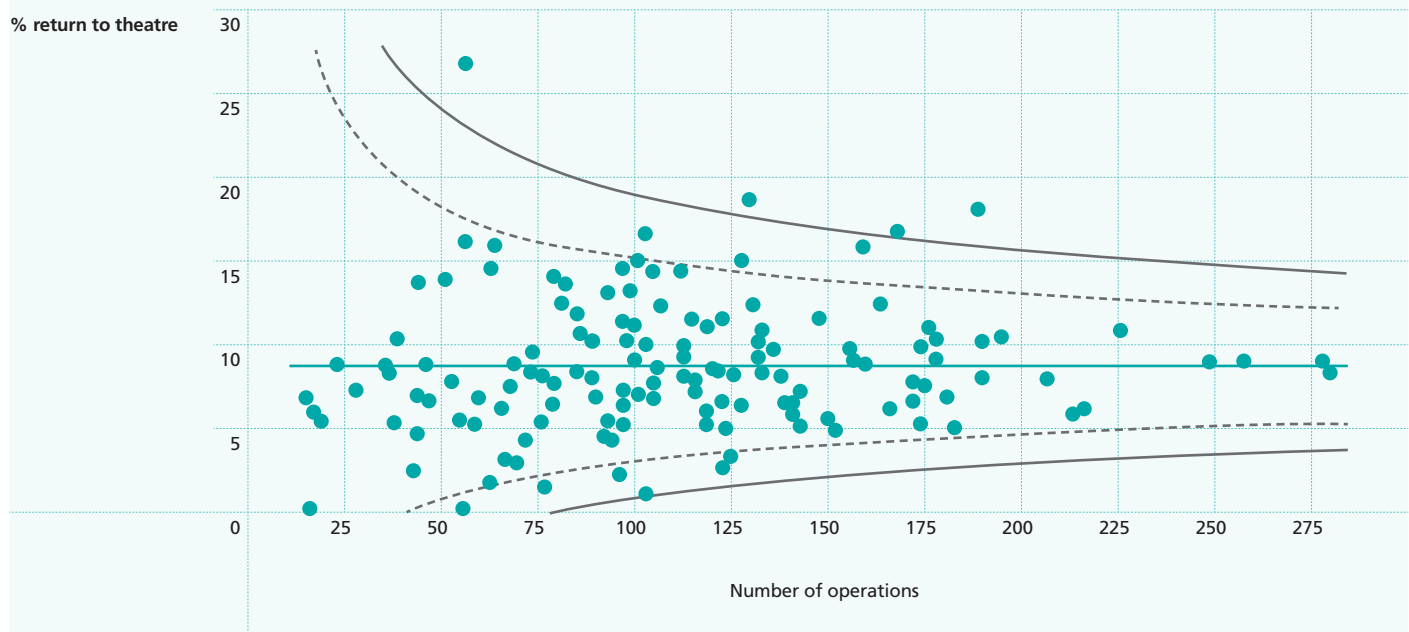


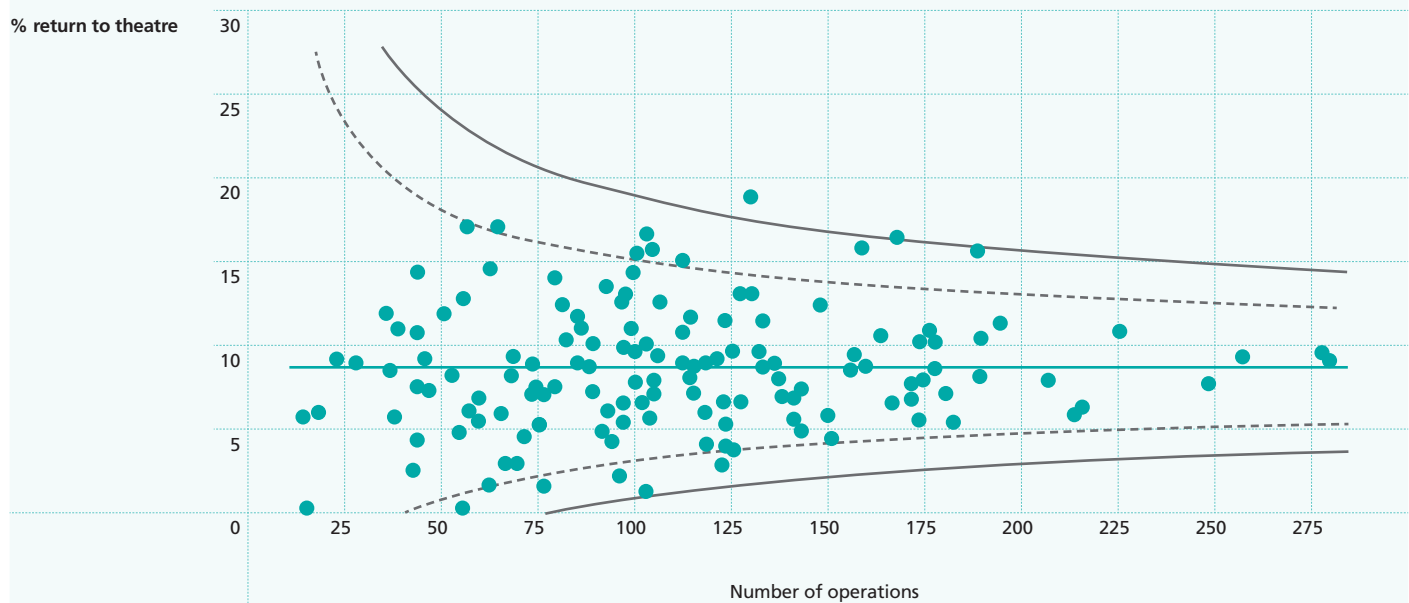
Figure 3.4
 Funnel plot of observed and adjusted rate of return to theatre by trust, for the 16,447 patients having major surgery linked to the Audit

● Return to theatre rate — Audit average - - - - - 95% limits — 99.8% limits

Observed 28-day return to theatre by trust / site with more than ten operations



Adjusted 28-day return to theatre by trust / site with more than ten operations



4. 12-Month Stoma Rates in Rectal Cancer Patients

All 7,326 rectal cancer patients having major surgery between 1 August 2008 and 31 July 2010, who were linked to HES were included. Inclusion for these analyses is based on date of surgery rather than date of diagnosis, because at least 12 months follow-up is required in HES. Patients operated on up until the end of July 2010 were included to ensure there was 12 months of follow up in HES on all patients, and 2 years of data are included so that the sample size is sufficient to compare 12-month stoma rates at the trust level.

The information on stomas in rectal cancer patients in the Audit was incomplete, with one-quarter of patients having an APER or Hartmann's procedure recorded as having no stoma. For this reason procedure codes in HES were used to enhance the information available in the Audit. Information on stoma location came from the Audit, where available, otherwise from HES procedure codes. Information on reversal of stomas was taken from HES procedure codes, regardless of the information on temporary versus permanent stomas in the Audit. Information on stoma type was updated from the primary procedure, assuming that all patients undergoing an APER had a permanent colostomy, and all patients undergoing a Hartmann's procedure were given a colostomy, which may or may not have been reversed.

[Section 4.1](#) explores the quality of stoma data in the Audit and HES by reporting: agreement between the Audit and HES on stoma type; consistency between the type of stoma recorded and surgical procedure; and consistency between type of stoma closed and the type of stoma given to the patient.

[Section 4.2](#) summarises the stoma rates, stoma locations, stoma type at 12 months, and 12-month stoma rate, by primary procedure. These results were updated from the primary procedure, assuming that all patients undergoing an APER had a permanent colostomy, and all patients undergoing a Hartmann's procedure were given a colostomy, which may or may not have been reversed.

4.1 Data Quality

[Table 4.1](#) shows that patients reported to have had an ileostomy or colostomy in the Audit were likely to be reported to have had the same type of stoma in HES. Patients with no stoma according to the Audit, however, may well have had a stoma recorded in HES. Amongst patients reported to have had an ileostomy or colostomy in HES, only a low proportion had the same stoma type recorded in the Audit. This lower agreement in the Audit was likely to be, at least in part, due to the missing information in the Audit.

[Table 4.2](#) highlights the poor quality of patient follow-up data in the Audit. Although most patients with a permanent stoma according to the Audit had a stoma at 12 months according to HES, the same cannot be said for patients recorded as having had a temporary stoma in the Audit. The agreement in the Audit with the type of stoma recorded in HES was relatively low, which again, is likely to be affected by missing information in the Audit.

[Table 4.3](#) summarises the type of stoma recorded by primary procedure. All APERs lead to a permanent stoma. [Table 4.3](#) shows that 97 per cent of patients recorded as having an APER are reported to have a stoma at 12 months. All patients who have a Hartmann's procedure are given a colostomy, which may be reversed, and the information from the Audit and HES combined, shows no patients having undergone a Hartmann's procedure without a stoma.

[Table 4.4](#) examines the quality of data on closure of ileostomy and closure of colostomy in HES. Approximately half of patients with an ileostomy had it reversed within 12 months, according to HES. Closure of ileostomy was only reported in a small proportion of patients with no stoma or with a colostomy. Likewise, closure of colostomy was only reported in a small proportion of patients with no stoma or with an ileostomy, although it was also true that only a small proportion of colostomies were coded as having been reversed. It was not possible to record the decision as to why a temporary stoma was reversed but it is likely to be a combination of both patient and tumour characteristics e.g. co-morbidity, patient choice, on-going non-surgical management etc.

Table 4.1 Agreement on location of stoma between the Audit and HES							
		Audit					% agree with HES
		None	Ileostomy	Colostomy	Missing	Total	
HES	None	1,107	246	255	284	1,892	58.5
	Ileostomy	668	1,862	92	277	2,899	64.2
	Colostomy	677	173	1,372	313	2,535	54.1
	Total	2,452	2,281	1,719	874	7,326	
% agree with Audit		45.1	81.6	79.8			

Table 4.2 Agreement on stoma type between the Audit and HES							
		Audit					% agree with HES
		None	Temporary	Permanent	Missing	Total	
HES	None	1,107	242	259	284	1,892	58.5
	Reversed by 12 months	392	1,180	70	172	1,814	65.0
	Stoma at 12 months	953	918	1,331	418	3,620	36.8
	Total	2,452	2,340	1,660	874	7,326	
% agree with Audit		45.1	50.4	80.2			

Table 4.3 Stoma type by surgical procedure, according to the Audit and HES combined (stoma procedure from the Audit where available, reversal of stoma information from HES only)								
	Anterior resection		APER		Hartmann's		Other	
	Number	%	Number	%	Number	%	Number	%
None	1,318	26.5	15	0.9	0	0.0	58	36.7
Reversed by 12 months	1,761	35.5	34	2.0	12	2.5	7	4.4
Stoma at 12 months	1,886	38.0	1,678	97.2	464	97.5	93	58.9
Total	4,965	100.0	1,727	100.0	476	100.0	158	100.0

Table 4.4 Type of closure (from HES) by stoma location (from the Audit where available, otherwise HES)						
	None		Ileostomy		Colostomy	
	Number	%	Number	%	Number	%
Rectal cancer patients undergoing major surgery	1,391		3,226		2,709	
Ileostomy closed	50	3.6	1,725	53.5	78	2.9
Colostomy closed	8	0.6	38	1.2	87	3.2

4.2 Results

Over all procedures, 6,067 out of 7,326 rectal cancer patients who underwent major surgery (83 per cent) had a stoma, whether temporary or permanent. Overall, 31 per cent of these stomas were reversed. 4,180 out of 7,326 rectal cancer patients having undergone major surgery (57 per cent) still had a stoma 12 months after surgery. Table 4.5 summarises the locations and types of stoma, as well as the 12-month stoma rate, by type of surgical procedure. Amongst patients undergoing an anterior resection, approximately a quarter had no stoma at all, a little under 40 per cent had a stoma that was reversed within 12 months, and a little under 40 per cent still had a stoma at 12 months. More prolonged follow-up may of course reduce this figure further.

Table 4.6 shows the estimated adjusted effects of age, age-squared, sex, ASA grade, TNM stage, mode of admission, and Charlson comorbidity index on risk of stoma at 12 months. Figure 4.1 compares the 12-month stoma rates by cancer network, both observed rates and rates adjusted for the variables in table 4.6. Two networks were above the outer control limit for adjusted 12-month stoma rate, and no networks were above the inner limit and below the outer limit. Figure 4.2 compares the 12-month stoma rates by trust / hospital, both observed rates and adjusted rates. Four trusts / hospitals were above the outer limit and a further eight trusts / hospitals were above the inner limit on adjusted 12-month stoma rate. Differences in 12-month stoma rates between networks and trusts may reflect differences in the time to reversal of stoma and not just differences in permanent stoma rates. Depending on the underlying clinical question, a longer follow-up time may be justified when comparing networks and trusts.

Table 4.5

Summary of stoma types and locations by procedure of the 7,326 rectal cancer patients linked between the Audit and HES, having major surgery between 1 August 2008 and 31 July 2010. Stoma information is updated from procedure: all APERs are assumed to have a stoma at 12 months, and all Hartmann's are assumed to have a stoma, which may be reversed

		AR		APER		Hartmann's		Other	
		Number	%	Number	%	Number	%	Number	%
Total rectal cancer patients undergoing major resection		4,965		1,727		476		158	
Any stoma	No	1,203	24.2	0	0.0	0	0.0	56	35.4
	Yes	3,762	75.8	1,727	100.0	476	100.0	102	64.6
Stoma location	None	1,203	24.2	0	0.0	0	0.0	56	35.4
	Ileostomy	3,029	61.0	90	5.2	28	5.9	79	50.0
	Colostomy	733	14.8	1,637	94.8	448	94.1	23	14.6
Stoma type at 12 months, ignoring deaths	None	1,203	24.2	0	0.0	0	0.0	56	35.4
	Reversed ileostomy	1,725	34.7	0	0.0	7	1.5	8	5.1
	Ileostomy not reversed	1,304	26.3	90	5.2	21	4.4	71	44.9
	Reversed colostomy	139	2.8	0	0.0	7	1.5	1	0.6
	Colostomy not reversed	594	12.0	1,637	94.8	441	92.6	22	13.9
Stoma at 12 months	No	3,067	61.8	0	0.0	14	2.9	65	41.1
	Yes	1,898	38.2	1,727	100.0	462	97.1	93	58.9

* Regardless of whether patient is dead or alive at 12 months

Table 4.6

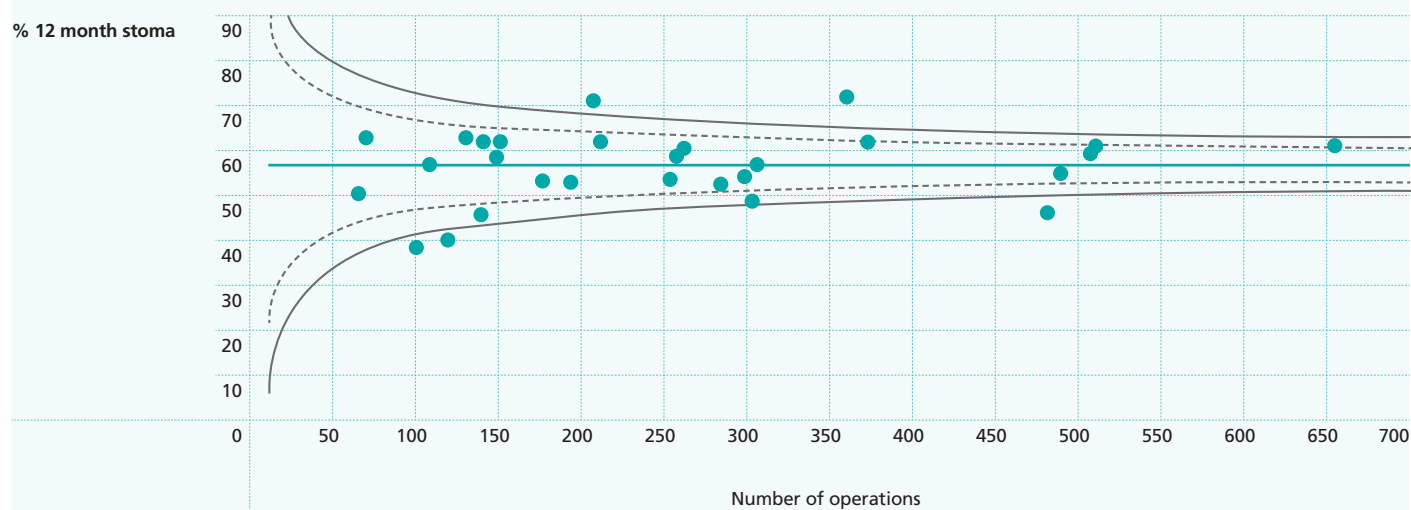
Logistic regression model of 12-month stoma rate after major resection for rectal cancer

		Odds ratio*	95% CI
Year of surgery	2009-2010	1	
	2008-2009	0.93	0.85 to 1.02
Sex	Male	1	
	Female	0.80	0.72 to 0.88
Age	50 yrs	0.90	0.82 to 1.00
	60 yrs	0.92	0.88 to 0.96
	70 yrs	1	
	80 yrs	1.16	1.08 to 1.25
	90 yrs	1.44	1.18 to 1.74
ASA	1	1	
	2	1.24	1.08 to 1.43
	3	1.65	1.39 to 1.97
	4 or 5	2.92	1.80 to 4.73
TNM T stage	T1	1	
	T2	1.23	1.02 to 1.49
	T3	1.34	1.12 to 1.61
	T4	1.44	1.12 to 1.85
TNM N stage	N0	1	
	N1	1.25	1.11 to 1.41
	N2	1.16	0.98 to 1.35
Distant metastases	No	1	
	Yes	1.56	1.29 to 1.89
Mode of admission	Elective	1	
	Emergency	1.94	1.51 to 2.50
Charlson index (number comorbidities)	0	1	
	1	1.07	0.95 to 1.20
	2+	1.33	1.07 to 1.64

Figure 4.1
Observed and adjusted stoma rate 12 months after surgery by network, for 7,326 rectal cancer patients linked between the Audit and HES, having major surgery between 1 August 2008 and 31 July 2010

● 12 month stoma rate — Audit average - - - - - 95% limits — 99.8% limits

Observed 12 month stoma rate by network



Adjusted 12 month stoma rate by network

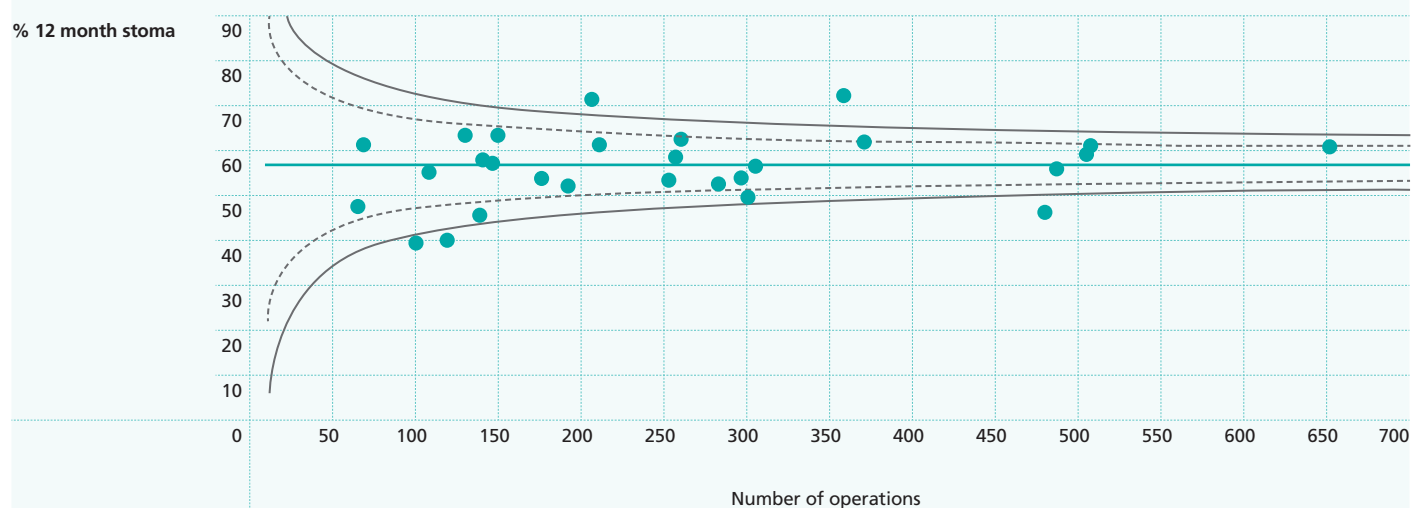
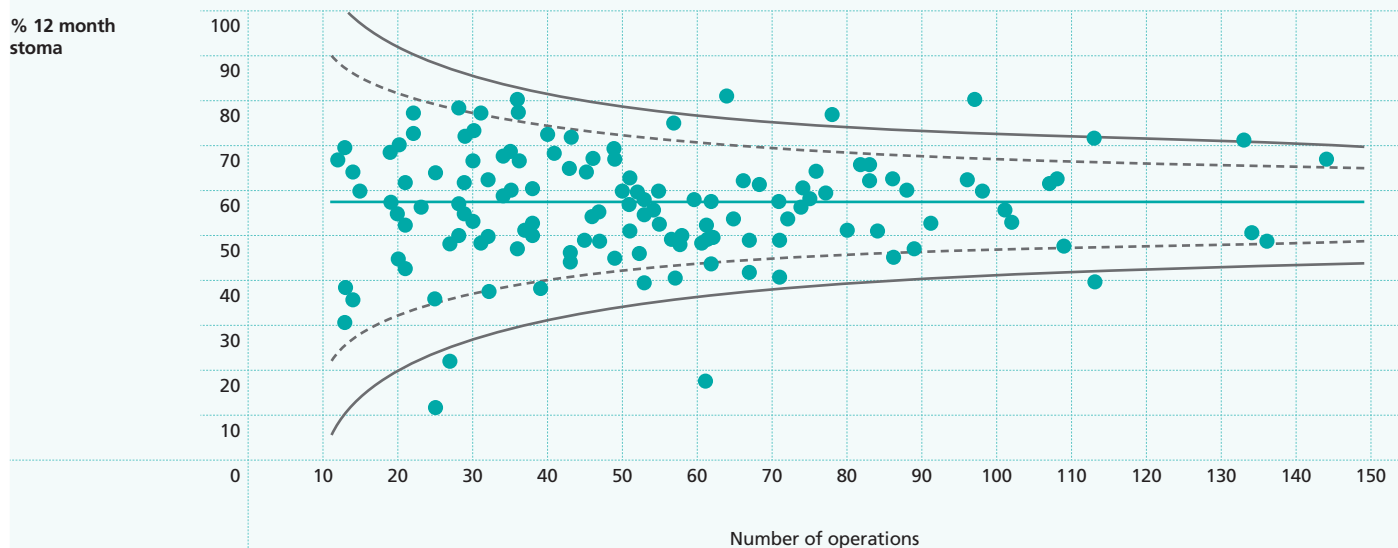


Figure 4.2

Observed and adjusted stoma rate 12 months after surgery by English trust / hospital for 7,326 rectal cancer patients linked between the Audit and HES, having major surgery between 1 August 2008 and 31 July 2010

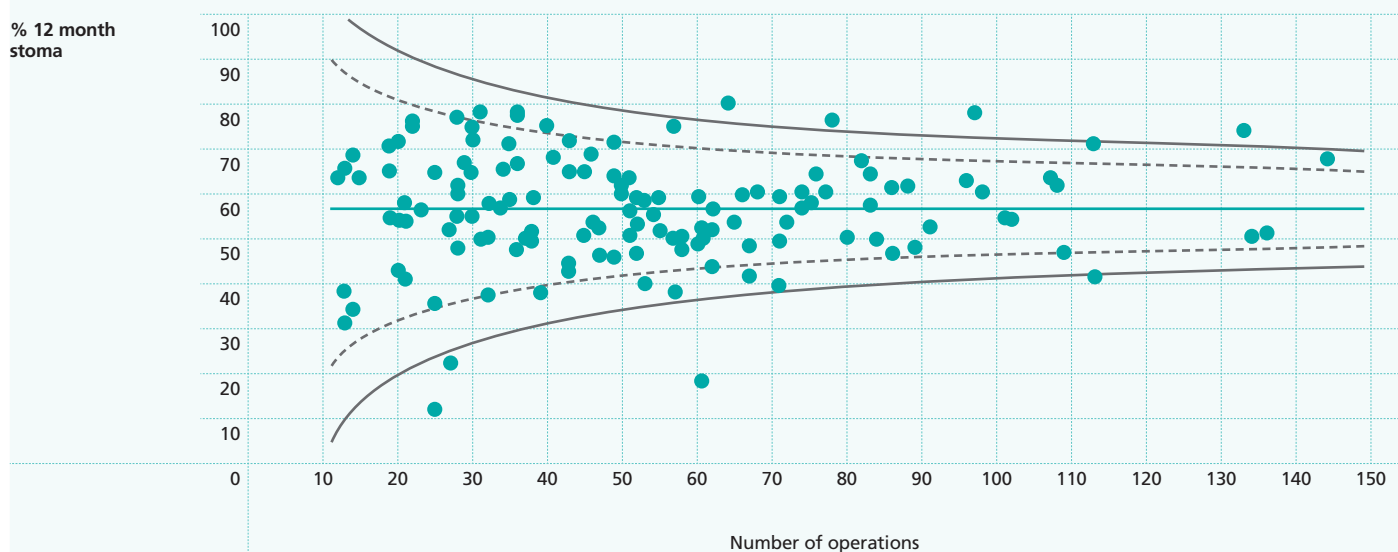
● 12 month stoma rate — Audit average - - - - - 95% limits — 99.8% limits

Observed 12 month stoma rate by trust / site with more than ten operations



● 12 month stoma rate — Audit average - - - - - 95% limits — 99.8% limits

Adjusted 12 month stoma rate by trust / site with more than ten operations



5. Emergency Admissions and Surgical Urgency

This section is in two parts. The first is an analysis of the rate of patients diagnosed with bowel cancer during an emergency admission. After risk adjustment, rates of emergency admissions were compared between cancer networks. The second part is restricted to patients who were admitted as an emergency. The proportion of these patients who had non-emergency surgery at a later date was estimated, and the characteristics and outcomes of patients having delayed non-emergency surgery was explored.

5.1 Emergency Admissions

The analyses in this section on emergency admissions included all 30,812, patients ascertained in HES with known admission type (60 patients had unknown admission type). The definition of emergency admission was the first admission to hospital with a diagnosis of bowel cancer was an emergency admission, according to HES. ASA grade and Dukes' stage were available only in the Audit in patients undergoing surgery, so analyses including these items were restricted to the 16,850 patients linked between HES and the Audit with known admission type undergoing major surgery according to the Audit.

5.1.1 Data quality

Table 5.1 shows that there was very good agreement between the Audit and HES on patients admitted as non-emergencies, but that the agreement on patients admitted as an emergency was not as good. Part of this was likely to be because of missing data in the Audit. There was a higher proportion of missing admission types in the Audit (11 per cent missing in those linked between HES and the Audit) compared to HES (0.3 per cent missing). In order to provide a fair comparison of emergency admission rates between networks, admission type was taken from HES.

Table 5.1
Agreement between the Audit and HES on emergency admission, for the 22,169 patients linked to the Audit.

		Audit				% agree with HES
		Non-emergency	Emergency	Missing	Total	
HES	Non-emergency	14,496	827	1,857	17,180	84.4
	Emergency	1,985	2,393	577	4,955	48.3
	Missing	19	5	10	34	
	Total	16,500	3,225	2,444	22,169	
% agree with audit		87.9	74.2			

5.1.2 Results

Overall, 25 per cent of patients were diagnosed after an emergency admission. This rate was higher in patients not linked to the Audit (Table 5.2). The set of patients admitted as an emergency will include a group whose cancer has not been detected until the point at which symptoms become very severe and possibly life-threatening. This was reflected in patients' Dukes' stage and ASA grade, with only 4 per cent of patients with Dukes' stage A admitted as an emergency compared to 35 per cent of patients with Dukes' stage D, and only 11 per cent of patients with ASA grade 1 admitted as an emergency compared to over 50 per cent of patients with ASA grade 4 or 5. The rate was also much higher in colon cancer patients than patients with rectal cancer, and was higher in female patients and patients with a greater number of comorbidities.

Fewer patients admitted as an emergency received a surgical intervention, and only half of emergency admissions had major surgery (Table 5.3). In most of those who were admitted as an emergency and who then had major surgery, the procedure was performed on an urgent or emergency basis. As with patients operated on in an emergency, postoperative mortality was higher in patients admitted as an emergency. The rate of return to theatre, however, was no higher in patients admitted as an emergency.

Case-mix adjustment was carried out using the model described in Table 5.4. Dukes' stage was not adjusted for as advanced cancer can be part of the reason for having an emergency admission, and adjustment for Dukes' stage would therefore result in over-adjustment. We did not adjust for ASA grade so that the comparison could include all patients, irrespective of whether or not they were linked to the Audit. The model has moderate discriminatory power (c-statistic=0.68 (95 per cent CI: 0.67,0.69)) and there is no evidence of a lack of fit by deciles of risk.

Rates of emergency admission were compared between cancer networks in [Figure 5.1](#). Any evidence of variation, after adjustment for case-mix, may highlight a difference in referring practice in the PCTs within each network. There is, however, little evidence of this, with no networks falling above the outer limit and only one falling above the inner limit.

Funnels by trust were not included as the mode of admission reflects the referral practices of surrounding PCTs and not the hospital trusts itself.

Table 5.2
Emergency admissions of the 30,812 patients with known admission type, by patient characteristics

		Total number	First admission was emergency	
			Number	%
Total patients		30,812	7,691	25.0
Linked to the audit?	No	8,653	2,731	31.6
	Yes	22,159	4,960	22.4
Cancer site	Colon	19,440	5,976	30.7
	Rectosigmoid	1,994	466	23.4
	Rectal	9,378	1,249	13.3
Sex	Male	17,241	3,874	22.5
	Female	13,569	3,817	28.1
	Missing	2		
Age-group	≤64 yrs	8,768	1,718	19.6
	65-74 yrs	9,303	1,736	18.7
	75-84 yrs	9,096	2,535	27.9
	85+ yrs	3,579	1,693	47.3
	Missing	66	9	13.6
Charlson index (number comorbidities)	0	19,576	4,216	21.5
	1	8,047	2,311	28.7
	2+	3,189	1,164	36.5
IMD quintile	1: Most deprived	4,943	1,467	29.7
	2	5,548	1,484	26.7
	3	6,540	1,681	25.7
	4	6,769	1,536	22.7
	5: Least deprived	6,546	1,408	21.5
	Missing	466	115	24.7
For the 16,850 patients linked to NBOCAP undergoing major surgery				
Dukes' stage	A	2,437	94	3.9
	B	5,404	932	17.2
	C	4,633	984	21.2
	D	1,922	671	34.9
	Missing	2,454	498	20.3
ASA grade	1	1,870	227	12.1
	2	6,579	844	12.8
	3	3,332	828	24.8
	4 or 5	431	231	53.6
	Missing	4,638	1,049	22.6

Table 5.3

Outcomes of the 30,812 patients with known admission type, by emergency admission

		First admission was emergency?			
		No		Yes	
		N	%	N	%
Overall		23,121		7,691	
Surgical intervention?	No	5,608	24.3	3,152	41.0
	Yes	17,513	75.7	4,539	59.0
Major surgery?	No	6,273	27.1	3,700	48.1
	Yes	16,848	72.9	3,991	51.9
Length of stay*	≤ 1 week	9,257	52.0	1,257	29.0
	1 to 2 weeks	5,378	30.2	1,408	32.4
	2 to 3 weeks	1,519	8.5	661	15.2
	3 to 4 weeks	1,655	9.3	1,015	23.4
	Missing (%)	102 (0.6)		55 (1.4)	
For the 16,850 patients linked to NBOCAP					
Surgical urgency	Elective	8,459	70.9	616	22.6
	Scheduled	2,131	17.9	215	7.9
	Urgent	1,076	9.0	736	27.0
	Emergency	268	2.2	1,163	42.6
	Missing (%)	1737 (12.7)		449 (14.1)	
Died within 90 days of major surgery?	No	12,072	96.5	2,526	86.5
	Yes	440	3.5	393	13.5
	Missing (%)	1159 (8.5)		260 (8.2)	
Return to theatre within 28 days of major surgery?	No	21,703	93.9	7,299	94.9
	Yes	1,418	6.1	392	5.1

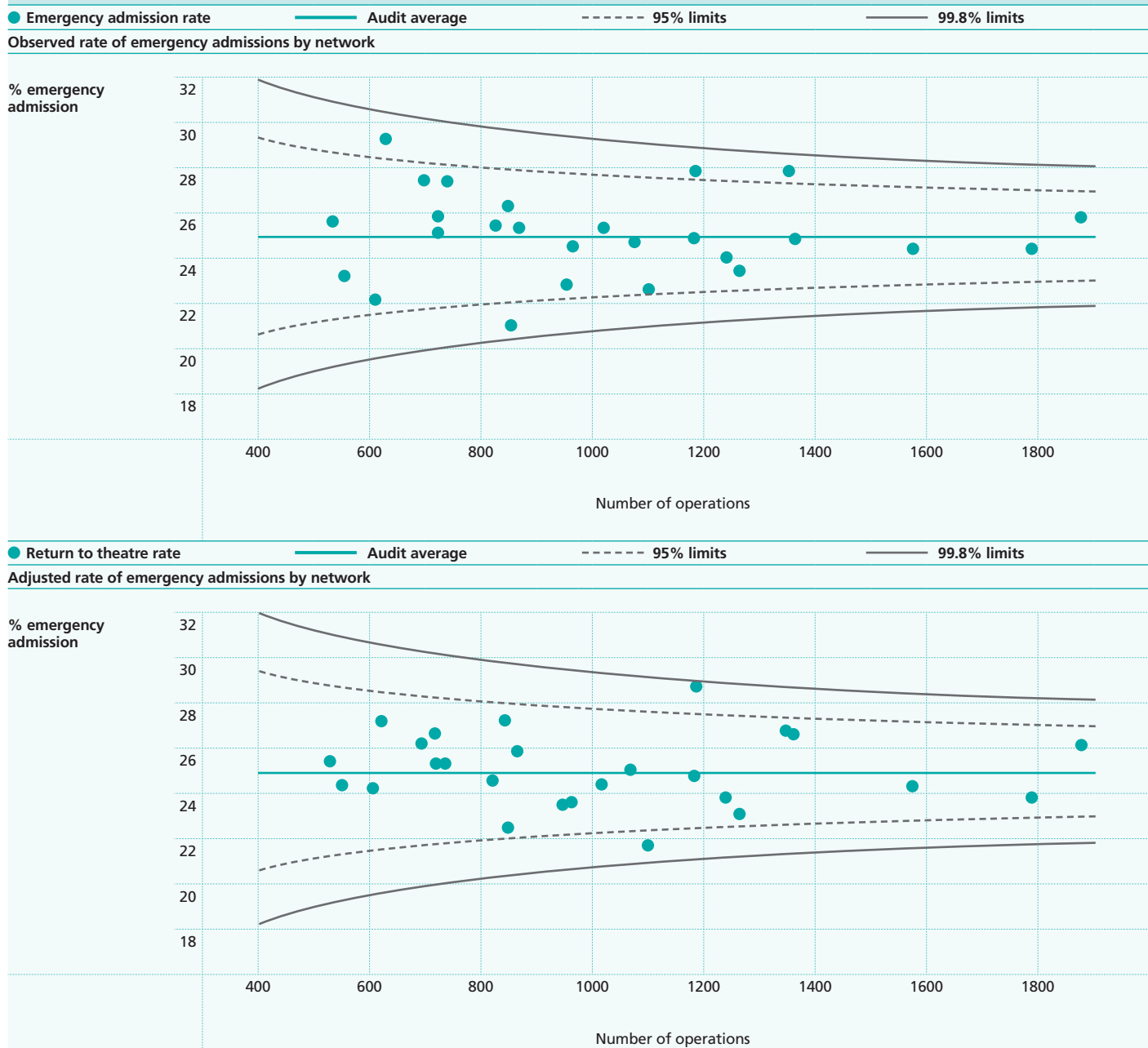
* Time from surgery to discharge, only for patients having major surgery

Table 5.4

Adjusted risk of emergency admission of the 30,812 patients with known admission type

		OR	95% CI
Cancer site	Colon	1	
	Colorectal	0.73	0.65 to 0.81
	Rectal	0.36	0.34 to 0.39
Sex	Male	1	
	Female	1.17	1.11 to 1.23
Age-group	≤64 yrs	1	
	65-74 yrs	0.86	0.79 to 0.93
	75-84 yrs	1.34	1.24 to 1.44
	85+ yrs	3.10	2.84 to 3.39
Charlson index (number comorbidities)	0	1	
	1	1.32	1.24 to 1.40
	2+	1.72	1.58 to 1.87
IMD quintile	1: Most deprived	1	
	2	0.85	0.78 to 0.93
	3	0.80	0.73 to 0.87
	4	0.69	0.63 to 0.75
	5: Least deprived	0.63	0.58 to 0.69

Figure 5.1
Observed and adjusted emergency admission rate by network, for the 30,812 patients with known admission type



5.2 Surgical Urgency for Patients with an Emergency Admission

There was a particular interest in patients with an emergency admission who had elective/scheduled surgery at least one day after an emergency admission. Urgency of admission was taken from HES and surgical urgency was recorded in the Audit. Table 5.5 shows that 29 per cent of patients admitted as an emergency had elective/scheduled surgery at a later date. The vast majority of patients recorded as having an emergency admission and elective/scheduled surgery had at least one day between admission and surgery.

The following analyses of delayed non-emergency surgery were restricted to the 2,612 patients who were admitted as an emergency, amongst those patients having major surgery, linked to the Audit, with urgency of surgery, date of admission and date of surgery recorded, and date of surgery after admission date.

Rectal cancer patients, as well as being less likely to be admitted as an emergency, were also much more likely to have delayed non-emergency surgery (Table 5.6). Similarly, patients with less advanced cancer were less likely to be admitted as an emergency, and for those who were admitted as an emergency were much more likely to have delayed non-emergency surgery. Patients admitted as an emergency with more than one comorbidity were more likely to have delayed non-emergency surgery.

5.2.1 Outcomes of patients admitted as an emergency according to whether or not they had delayed elective/scheduled surgery

Patients with an emergency admission who had delayed non-emergency surgery tended to have a shorter stay in hospital, had a lower postoperative mortality and a lower rate of return to theatre, at least in univariate associations (Table 5.7). However, these patients tended to be lower risk in terms of the site of their cancer, the stage of their tumour, and their ASA grade, albeit higher risk in terms of their comorbidity.

Table 5.5
Urgency of admission compared to urgency of surgery for the 14,272 patients having major surgery, linked to the Audit, with urgency of admission, urgency of surgery, date of admission and date of surgery recorded, by urgency of admission and urgency of surgery

Admission	Surgical urgency	N	%
Elective	Elective/ scheduled	10,347	88.8
	Urgent/ emergency	1,309	11.2
	Total	11,656	100
Emergency	Urgent/ emergency	1,821	69.6
	Elective/ scheduled same day	38	1.5
	Elective/ scheduled 1+ day later	753	28.8
	Unknown*	4	0.2
	Total	2,616	100

* Admission date after date of surgery in HES

Table 5.6

Elective/scheduled surgery at a later date of the 2,612 emergency admissions having major surgery, linked to the Audit, with urgency of surgery, date of admission and date of surgery recorded, and date of surgery after admission date, by patient characteristics

		Elective/scheduled surgery at a later date		
		Total number	Number	%
Total patients		2,612	753	28.8
Cancer site	Colon	2,250	563	25.0
	Rectosigmoid	125	35	28.0
	Rectal	237	155	65.4
Sex	Male	1,327	399	30.1
	Female	1,285	354	27.5
Age-group	≤64 yrs	706	198	28.0
	65-74 yrs	680	194	28.5
	75-84 yrs	826	251	30.4
	85+ yrs	400	110	27.5
Charlson index (number comorbidities)	0	1,546	420	27.2
	1	743	212	28.5
	2+	323	121	37.5
IMD quintile	1: most deprived	458	143	31.2
	2	520	152	29.2
	3	567	162	28.6
	4	551	152	27.6
	5: least deprived	506	142	28.1
	Missing	10	2	20.0
Dukes' stage	A	85	54	63.5
	B	825	257	31.2
	C	896	248	27.7
	D	586	141	24.1
	Missing	220	53	24.1
ASA grade	1	209	69	33.0
	2	774	256	33.1
	3	755	234	31.0
	4 or 5	213	33	15.5
	Missing	661	161	24.4

Table 5.7

Outcomes of the 2,612 emergency admissions having major surgery, linked to the Audit, with urgency of surgery, date of admission and date of surgery recorded, and date of surgery after admission date, by whether or not their surgery was carried out as elective/scheduled at a later date

		Elective/scheduled surgery at a later date?			
		No		Yes	
		N	%	N	%
Overall		1,859		753	
Length of stay*	≤ 1 week	463	25.0	276	36.7
	1 to 2 weeks	610	32.9	232	30.9
	2 to 3 weeks	302	16.3	88	11.7
	3 to 4 weeks	477	25.8	156	20.7
	Missing (%)	7 (0.4)		1 (0.1)	
Died within 90 days of major surgery?	No	1,582	85.7	669	89.8
	Yes	263	14.3	76	10.2
	Missing (%)	14 (0.8)		8 (1.1)	
Return to theatre within 28 days of major surgery?	No	1,665	89.6	688	91.4
	Yes	194	10.4	65	8.6

References

1. Identifying comorbidity in surgical patients using administrative data with the Royal College of Surgeons Charlson Score. Armitage J et al. Br J Surg. 2010; 97: 772 – 781.
2. Variation in reoperation after colorectal surgery in England as an indicator of surgical performance: retrospective analysis of Hospital Episode Statistics. Burns E et al. BMJ. 2011; 343: d4836.

Health and Social Care Information Centre (HSCIC) is working to make information more relevant and accessible to the public, regulators, health and social care professionals and policy makers, leading to improvements in knowledge and efficiency.

The HSCIC is a special NHS health authority that collects, analyses and distributes data to reduce the burden on frontline staff, releasing more time for direct care.

This work remains the sole and exclusive property of The HSCIC and may only be reproduced where there is explicit reference to the ownership of The HSCIC. This work may be re-used by NHS and government organisations without permission. Commercial re-use of this work must be granted by The HSCIC.

Copyright © 2012. Health and Social Care Information Centre, The National Bowel Cancer Audit. All rights reserved.

Need to know more?

T. 0845 300 6016
E. enquiries@ic.nhs.uk
www.ic.nhs.uk

Health and Social Care
Information Centre
1 Trevelyan Square
Boar Lane
Leeds
LS1 6AE