Association between surgeon special interest and mortality after emergency laparotomy

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Presented to the Association of Surgeons of Great Britain and Ireland International Congress, Liverpool, UK, May 2018

Background: Approximately 30 000 emergency laparotomies are performed each year in England and Wales. Patients with pathology of the gastrointestinal tract requiring emergency laparotomy are managed by general surgeons with an elective special interest focused on either the upper or lower gastrointestinal tract. This study investigated the impact of special interest on mortality after emergency laparotomy.

Methods: Adult patients having emergency laparotomy with either colorectal or gastroduodenal pathology were identified from the National Emergency Laparotomy Audit database and grouped according to operative procedure. Outcomes included all cause 30-day mortality, length of hospital stay and return to theatre. Logistic and Poisson regression were used to analyse the association between consultant special interest and the three outcomes.

Results: A total of 33 819 patients (28 546 colorectal, 5273 upper gastrointestinal (UGI)) were included. Patients who had colorectal procedures performed by a consultant without a special interest in colorectal surgery had an increased adjusted 30-day mortality risk (odds ratio (OR) 1.23, 95 per cent c.i. 1.13 to 1.33). Return to theatre also increased in this group (OR 1.13 02, 1.05 to 1.20). UGI procedures performed by non-UGI special interest surgeons

carried an increased adjusted risk of 30-day mortality (OR 1.24, 1.02 to 1.53). The risk of return to theatre was not increased (OR 0.89, 0.70 to 1.12).

Conclusion: Emergency laparotomy performed by a surgeon whose special interest is not in the area of the pathology carries an increased risk of death at 30 days. This finding potentially has significant implications for emergency service configuration, training and workforce provision, and should stimulate discussion among all stakeholders.

+A: Introduction

Emergency laparotomy is a major surgical procedure used to treat a wide range of intra-abdominal pathologies. A mortality rate of 10–11 per cent at 30 days[1–3], and morbidity, often leading to prolonged inpatient recovery and long-term rehabilitation, are common after emergency laparotomy[4]. Around 35 000 of these procedures are performed annually in England and Wales[1–3]. Patients having emergency laparotomy are heterogeneous in relation to presentation, co-morbid status and pathological findings[1–3,5], and a range of operations are undertaken. General surgical training has always produced a surgeon who is able to manage an unselected general surgical take and who has the technical skills to deal themselves with the vast majority of conditions encountered at emergency laparotomy.

Competency in emergency general surgery (EGS) procedures is required for all UK surgical trainees before obtaining Certification of Completion of Training in General Surgery[6], regardless of special interest development. However, many continue to develop a special interest once in a consultant post, leading to an elective practice focused, sometimes exclusively, in one area and an emergency practice at odds with this. In many hospitals EGS may be provided by consultants with oesophagogastric, hepatobiliary, colorectal, endocrine, breast and vascular elective special interests[7]. Increasingly in the UK there is a reduction in the contribution of breast and vascular surgeons to the EGS service with the evolution of

service provision and specialization[8,9]. Smaller hospitals may still rely heavily on surgeons with non-gastrointestinal special interests for EGS provision[7].

In 2011, the Association of Surgeons of Great Britain and Ireland[10] acknowledged that the standards of care for patients undergoing emergency laparotomy were often suboptimal. Following this, and in conjunction with the Health Care Quality Improvement Partnership and the Royal College of Anaesthetists, the National Emergency Laparotomy Audit (NELA)[1] was established.

NELA collects patient-level data for prospectively identified individuals undergoing emergency laparotomy in hospitals within England and Wales. The data collected have been selected specifically to include risk factors and organizational factors that are particularly relevant to the emergency laparotomy population[1–3]. To date, there has been no formal evaluation of the impact of special interest on outcomes after emergency laparotomy. Both the NELA Collaboration and the subspecialty surgical associations (Association of Coloproctologists of Great Britain and Ireland (ACPGBI) and Association of Upper Gastrointestinal Surgeons of Great Britain and Ireland (AUGIS)) have identified this as an area requiring investigation[7]. The aim of the present analysis was to determine the impact of special interest of operating surgeon on outcomes and mortality after emergency laparotomy in the UK.

+A: Methods

Patient-level data for years 1–3 (December 2013 to November 2016) of the audit were extracted from the NELA data set. Data are submitted by National Health Service (NHS) hospitals in England and Wales; this process is described in detail in the NELA annual reports[1–3]. NELA is approved under section 251 of the NHS Act 2006 by the Confidential

Advisory Group. This analysis was performed as part of the NELA Collaboration's remit to understand and improve the care of patients having emergency laparotomy[11].

All-cause 30-day mortality was derived by linkage of the data set with the Office for National Statistics death register. For the purpose of this study, the cohort was analysed according to operative procedure. Patients included were aged 18 years or over and had an emergency laparotomy as either a colorectal procedure or an upper gastrointestinal (UGI) procedure as their first, main operation after admission. Patients were excluded if they had incomplete data on variables and outcomes required for analysis (1653 patients (4.6 per cent); 641 colorectal, 1012 UGI procedures)

Patients were classed as having had a colorectal specialty procedure if they had emergency laparotomy leading to right hemicolectomy, left hemicolectomy (including anterior resection and sigmoid colectomy), subtotal or panproctocolectomy, Hartmann's procedure, stoma formation or stoma revision. They were classed as having had a UGI specialty procedure if they underwent emergency laparotomy leading to peptic ulcer suture or repair of perforation, under-running of bleeding peptic ulcer, gastrectomy (partial or total) or other gastric surgery. Patients with small bowel pathology were not included as this was not deemed to be either a colorectal or UGI specific procedure.

Data on age, sex, preoperative ASA fitness grade, preoperative predictive mortality (derived from P-POSSUM score)[12] and morbidity (P-POSSUM)[13], grade of senior operating surgeon, special interest of the consultant surgeon responsible for the patient's care, and whether the patient was admitted directly to a critical care unit after surgery, were extracted.

Previously reported data from the same cohort of patients undergoing emergency laparotomy demonstrated no increase in mortality associated with case volume, hospital size

or hospital configuration[14]. Therefore, these structural factors were not included in the risk adjustment model here.

NELA[15] defines a consultant surgeon as 'a surgeon whose name appears on the specialist register and is appointed as a substantive, fixed term or honorary consultant within the NHS'. The present authors have defined the special interest of a consultant as an area within the scope of general surgery in which a consultant focuses their elective practice, for example breast or colorectal surgery[16].

When data on a patient are entered in the NELA database, the consultant responsible for their care and operation is entered by the hospital alongside their General Medical Council (GMC) registration number, which is linked to their special interest. The GMC number and personal details were fully anonymized before analysis. This anonymization means that it is not possible to tell how long a surgeon has been a consultant, so experience in that role could not be included as a variable. Colorectal consultants were those with a colorectal special interest. Oesophagogastric and hepatobiliary special interest surgeons were classified together as UGI surgeons, as the latter is the special interest defined by the general surgery curriculum[17]. All other special interests (breast, vascular, endocrine, transplantation) were classified as non-special interest for the purpose of this analysis. The present study outcomes were all-cause 30-day mortality, return to theatre in the same hospital admission, and length of stay (LOS) in the acute hospital setting. LOS was defined as time from admission to date of discharge or death. The main exposure variable of interest was consultant surgeon special interest.

+B: Statistical analysis

Descriptive data are presented as mean(s.d.), median (i.q.r.) or number with percentage, as appropriate. To test the association between surgeon special interest and outcomes, logistic

regression was performed initially, with results calculated as unadjusted odds ratios (ORs) and ORs adjusted for the following *a priori* selected co-variables: patient age, sex, ASA grade, P-POSSUM-predicted mortality and morbidity, and grade of surgeon. Direct admission to a critical care unit was added into logistic regression models as a *post hoc* co-variable. Only patient age and P-POSSUM scores were modelled as continuous variables. Owing to collinearity, only one of the P-POSSUM variables was used in each model, as appropriate. Mediation analysis was not undertaken as there was no evidence that any of these variables fitted the criteria as mediators. Separate analyses are presented for colorectal *versus* non-colorectal surgeon and UGI *versus* non-UGI surgeons for their respective procedures. Results are presented with 95 per cent confidence intervals. The significance of each co-variable was evaluated using the likelihood ratio χ^2 test when each co-variable was added to the model. However, inclusion in the model was not based on this test, as the clinical relevance of variables in the model was deemed more important than statistical significance. For LOS, Poisson regression was performed with the *a priori* co-variables listed above. Results for this analysis are presented as incident rate ratios (IRRs) with 95 per cent confidence intervals. A Poisson regression model was also used with a robust variance estimator to report mortality and return to theatre outcomes as adjusted risk ratios to aid clinical interpretation.

Additional sensitivity analyses were undertaken as follows: excluding non-gastrointestinal surgeons from the analysis; limiting the analysis to patients in National Confidential Enquiry into Perioperative Deaths (NCEPOD) category 1; adjusting for hospital in a multilevel logistic regression model with random intercept; limiting analyses to consultant surgeons only; and after removal of the 'other gastric surgery' subgroup from the UGI cohort. Subgroup analyses included procedures in patients aged 65 years or above. All analyses were done in Stata® version 15 (StataCorp, College Station, Texas, USA).

+A: Results

The study cohort of patients who underwent emergency laparotomy included 28 546 patients who had a colorectal procedure and 5273 who had a UGI procedure in 195 hospitals in England and Wales. Baseline characteristics for each group are shown in *Table 1*.

+B: Operative procedures

The distribution of operations is summarized in *Tables 2* and *3*. Consultant special interest is shown in *Figs 1* and *2*. Right hemicolectomy was the most common colorectal procedure followed by Hartmann's procedure. The most common UGI procedure was suture or repair of perforated peptic ulcer followed by 'other gastric surgery'; further details of the actual procedure were not available for the latter group. Consultant surgeons were recorded as the senior surgeon in the majority of procedures. Consultants were present in theatre in 90.8 per cent of all colorectal procedures and in 79.6 per cent of all UGI procedures (*Table 1*).

+B: Outcomes

The all-cause 30-day mortality rate was 11.1 per cent for patients having a colorectal procedure and 12.2 per cent for those who had an UGI procedure. Analysis with special interest of consultant as main variable was performed for each procedure group.

For colorectal procedures, there was an increased risk of death when operated on by a non-colorectal special interest surgeon (unadjusted OR 1.50, 95 per cent c.i. 1.40 to 1.62). This increased risk remained following adjustment for potential confounders (adjusted OR 1.23, 1.13 to 1.33; adjusted risk ratio 1.17, 1.10 to 1.24) (*Table 4*). The risk of return to theatre was also found to be increased in those having emergency laparotomy for colorectal conditions performed by non-colorectal special interest surgeons (unadjusted OR 1.20, 1.10 to 1.29), and again remained significant after adjustment for confounders (adjusted OR 1.13,

1.05 to 1.20; adjusted RR 1.12, 1.04 to 1.20). There was a small increase in LOS if operations were conducted by non-colorectal special interest surgeons (IRR 1.02, 1.02 to 1.03).

For UGI procedures, a possible increased risk of 30-day mortality was noted if the operation was done by a non-UGI special interest surgeon, although the confidence interval included a mortality reduction (unadjusted OR 1.16, 0.97 to 1.39) (*Table 5*). This risk of 30-day mortality increased slightly when adjustment for confounders was performed (adjusted OR 1.24, 1.02 to 1.53; adjusted risk ratio 1.17, 1.01 to 1.35). Special interest of the consultant operating did not appear to have an impact on return to theatre, although estimates were more uncertain than those for the colorectal analysis (adjusted OR 0.89, 0.70 to 1.12; adjusted RR 0.90, 0.73 to 1.11). However, LOS was shorter when patients were operated on by a non-UGI surgeon in adjusted analysis (IRR 0.91, 0.90 to 0.92).

+B: Sensitivity and subgroup analyses

When non-gastrointestinal special interest surgeons (vascular, endocrine, breast, emergency, general and unknown) were removed from the analyses, an increased risk of death remained in the colorectal procedure group (30-day mortality: adjusted OR 1.28, 95 per cent c.i. 1.14 to 1.43). For UGI procedures, the increase in risk of death was no longer significant, although estimates were wider, reducing confidence in this outcome (adjusted OR 1.19, 0.91 to 1.49). No increased risk of return to theatre was found after removal of non-gastrointestinal specialists from the analyses for either colorectal (adjusted OR 1.02, 0.91 to 1.15) or UGI (adjusted OR 0.96, 0.75 to 1.24) procedures, although confidence intervals were again wide.

The impact of special interest on the most urgent procedures, booked as NCEPOD category 1, was investigated. All surgical special interests were included in the analyses. NCEPOD 1 priority was given to 5782 colorectal and 216 UGI procedures. The adjusted risk of 30-day mortality was increased in the colorectal NCEPOD 1 group (adjusted OR 1.33,

1.04 to 1.69). No significant increased risk of death was demonstrated in the NCEPOD 1 UGI group (adjusted OR 1.67, 0.39 to 7.02), although confidence intervals were wide, probably owing to the small number of patients in this analysis.

To allow for different baseline mortality rates at participating hospitals, multilevel logistic regression models with mortality and return to theatre as outcomes were performed with each hospital included as a random intercept. Increased risk of death and return to theatre remained in the colorectal procedure group (*Table 6*), whereas risk of death and return to theatre were not affected in the UGI cohort (*Table 7*). Limiting the analyses to consultant surgeons only and procedures on patients aged 65 years or above did not affect the results. In addition, removal of the 'other gastric surgery' subgroup from the UGI cohort did not alter the statistical significance of the results for this group.

+A: Discussion

This study has shown that patients undergoing emergency laparotomy for colorectal and UGI procedures have an increased risk of death when the operation is performed under the care of someone who does not have an elective special interest in the relevant area of the pathology. Although some work on this topic has been undertaken in the paediatric surgical population[18], the literature on adults undergoing emergency laparotomy is sparse. Biondo and colleagues[19] investigated the impact of surgical specialization on patients having emergency colorectal surgery, and concluded that specialization in colorectal surgery improved morbidity, mortality and complication rates. Boyce and co-workers[20] reported decreased mortality and complication rates in patients who had emergency operations for diverticulitis performed by surgeons with a colorectal special interest; however, there was no evidence of risk adjustment in their analysis.

Mortality rates for colorectal and UGI procedures in the present study were 11.1 and 12.2 per cent respectively, and compare favourably with published values. Before the implementation of NELA, other UK sources[5,21] reported mortality rates of up to 15 per cent among those who had emergency laparotomy. A similar mortality rate was noted in a large population-based study[22] of emergency gastrointestinal surgery in Denmark. A Swiss study[23] reported a mortality rate of 14 per cent among patients undergoing emergency colonic resections, whereas a recent European study[24] described 90-day mortality rates of up 19 per cent after surgery for patients with perforated peptic ulcers. The present results demonstrate an improvement in outcomes compared with those reported previously. This may be partly attributable to the implementation of NELA, which over the past 3 years has reported reductions in mortality rates for all patients undergoing emergency laparotomy. This has been achieved through promotion of early identification of high-risk patients, adequate resuscitation, early radiology input, consultant-delivered intraoperative care, and postoperative stay in high-dependency or intensive care units (level 2/3 care) for all high-risk patients[1–3].

In the present study, mortality rates were higher in the groups whose operations were not performed by a consultant with a special interest in the field. The data available provided no firm reason for this difference. Contributing factors may be non-technical, such as delay in decision-making in less familiar areas and reluctance to enter the abdomen when the pathology is outside the elective area of expertise, or technical, such as unfamiliarity with techniques for operating on organs not encountered in elective practice. However, an increased risk of death and complications remained after removal of non-gastrointestinal special interest surgeons from analysis. A previous systematic review[25] identified that subspecialization of surgeon was associated with better outcomes. Although the review

included patients from all general surgical special interests in both the emergency and elective settings, the difference in outcomes was statistically significant[25].

Within elective general surgery there has been a rapid shift towards special interest practice in the past 20 years. This move is 'supported' by those in training[26], and the majority of UK consultants in general surgery who affiliate themselves with subspecialty associations (such as ACPGBI, AUGIS)[8], while still contributing to EGS as a significant part of their scope of practice[7]. EGS represents around half of the overall surgical workload[6]. Approximately 80 per cent of all general surgical deaths follow emergency admission[27,28]. Variation in outcome between units and individual surgeons has been highlighted, and the benefits of surgeons treating emergency conditions in their elective area of interest proposed[26,29,30]. However, it was acknowledged that implementation of special interest-specific on-call would have implications for elective service provision[31]. Currently, approximately 20 per cent of EGS units are running a specialty interest on-call, but this is rarely a 24/7 service[31]. It is not yet known whether these units report outcomes different from those employing the traditional unselected model.

The pressure of acute care has prompted increased ring-fencing of time-in-job plans for EGS[32], with some consultant posts being advertised with EGS as the sole, or major, focus of the scope of practice[33]. It is too early to know whether specialization in EGS leads to improvement in outcomes.

This paper reports the impact of special interest of consultant surgeon on outcomes after emergency laparotomy in the UK. Special interest seems to have a significant impact on the risk of both return to theatre and 30-day mortality. The underlying reasons for this cannot be deduced from this data set, and are most likely multifactorial. However, despite controlling for all confounders possible from the data set available, the effect seems to be

real, although residual confounding cannot be excluded fully. These findings have potential implications for configuration of emergency services and the workforce available to receive surgical emergencies. They may also have implications for training in general surgery and scope of practice thereafter. Although development of a special interest may have had an impact on elective outcomes, it may be desirable to support exposure to a greater range of elective procedures, so that surgeons participating in the unselected emergency take are exposed to colonic resection electively. It is also difficult to suggest a solution that will be feasible across the UK. Larger hospitals may have the capacity to have both UGI and colorectal special interest surgeons available to perform emergency laparotomy in their area, but this may be much less practical in smaller hospitals, where there may not be enough surgeons to deliver this model. In addition, special interest emergency provision may have a considerable impact on elective services whatever the size of a hospital, doubling the workforce commitment to emergency care. There are no immediate answers to these questions, but hopefully this paper will stimulate discussion among the profession, professional associations, training bodies and other stakeholders, not least patients, whose outcomes may be affected by the special interest of the surgeon who performs their laparotomy.

This study has several strengths as a nationwide, multicentre, prospective audit linked to an externally validated national mortality data registry. The audit collects a wide range of variables and information, allowing risk adjustment to be undertaken. Thirty-day mortality was an outcome here. Short-term mortality is currently the most widely reported outcome after emergency laparotomy and is the most commonly reported in many other areas of healthcare research. However, the effects of postoperative morbidity extend long beyond the operative period, and long-term outcomes are poorly defined. It may be that current outcome

data underestimate the burden of emergency laparotomy not only to patients but also to other healthcare and social systems[34–36].

There are some limitations to this study. Case ascertainment was estimated at 65–70 per cent in first 2 years of the audit[1,2], which may have led to underestimation or overestimation of adverse outcomes. As the authors do not have access to patients who were not included in the audit, they cannot comment further. However, case ascertainment rates have increased through each cycle of the NELA audit. Urgency code of surgery was not included as a potential confounder as, when the raw data were interrogated, there was a clear discrepancy between NCEPOD booking codes and the timings of surgical intervention entered into the data set. Data were not collected on the presence of sepsis within the years 1–3 cohort, so it was not possible to add this into the risk adjustment model. Direct questions on sepsis have now been added to the data entry form, and can be included in future analyses. Furthermore, the risk scoring tools used were calculated before surgery when the patient was first reviewed by either the surgical or anaesthetic team. These scores may have deteriorated if the emergency laparotomy was delayed for any reason. Alternatively, if the patient improved after resuscitation there may have been some overestimation of risk, which could have diluted the effect of other factors in the risk adjustment model. Although grade of senior surgeon operating was included in the risk adjustment model, the authors cannot be certain that this meant the consultant was the lead operator because the definition in the NELA data set is that the surgeon is present in theatre. However, if a consultant were present, one would hope that supervision would include stepping in and taking over from a junior colleague in the event of difficulty or the procedure taking too long to the detriment of the patient. In addition, as NELA records data only for patients who actually had emergency laparotomy, the proportion turned down for surgery because of fitness or patient choice is unknown. This is an observational study and as such associations but not causality can be highlighted.

Indeed, the underlying reasons for the present findings are not clear and may still represent residual confounding.

Emergency laparotomy performed by a surgeon whose special interest is not in the area of the pathology carries an increased risk of return to theatre after surgery and of death within 30 days. This potentially has significant implications for emergency service configuration, training and workforce, and should stimulate discussion among all stakeholders, including patients.

+A: Acknowledgements

The NELA Project Team at time of submission: D. Murray, S. Hare, S. Lockwood, C. M. Oliver, L. J. Spurling, T. Poulton, C. Johnston, D. Cromwell, A. Kuryba, P. Martin, J. Lourtie, J. Goodwin, R. Mooesinghe, N. Eugene, S. Catrin-Cook and I. Anderson.

P.J.J.H. is supported by a 2-year research training fellowship awarded jointly by the Royal College of Surgeons of England and the Dunhill Medical Trust. NELA is approved under section 251 of the NHS Act 2006 by the Confidential Advisory Group. This analysis was performed as part of the NELA Collaboration's remit to understand and improve the care of patients having emergency laparotomy. The lead author affirms that this manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Disclosure: The authors declare no conflict of interest.

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Fig. 1 Distribution of colorectal procedures according to special interest of consultant surgeon

Footnote to Fig. 1 HPB, hepatopancreatobiliary; EGS, emergency general surgery; OG, obstetrics and gynaecology.

Fig. 2 Distribution of upper gastrointestinal procedures according to special interest of consultant surgeon

HPB, hepatopancreatobiliary; EGS, emergency general surgery; OG, oesphago-gastric.

Table 1 Characteristics of patients undergoing colorectal and upper gastrointestinal surgery according to special interest of consultant				
	Colorectal procedures		**UGI procedures**	
	Colorectal consultant (*n* = 16 889)	**Non-colorectal consultant (*n* = 11 657)**	**UGI consultant (*n* = 1771)**	**Non-UGI consultant (*n* = 3502)**
Age (years)*	63.7(17.3)	65.6(16.1)	60.2(18.1)	58.4(18.2)
Men	8262 (48.9)	5684 (48.8)	981 (55.4)	2101 (60.0)
ASA fitness grade				
I	1468 (8.7)	1059 (9.1)	280 (15.8)	715 (20.4)
II	6441 (38.1)	3931 (33.7)	514 (29.0)	988 (28.2)
III	6152 (36.4)	4074 (34.9)	491 (27.7)	933 (26.6)
IV	2600 (15.4)	2337 (20.0)	427 (24.1)	734 (21.0)
IV	228 (1.3)	256 (2.2)	59 (3.3)	132 (3.8)
P-POSSUM scores*				
Predicted mortality	17.07(21.72)	20.91(24.39)	22.47(26.64)	23.35(27.62)
Predicted morbidity	71.10(22.46)	74.54(22.09)	73.71(23.45)	74.74(22.73)
Consultant present in theatre	15 440 (91.4)	10 474 (89.9)	1442 (81.4)	2758 (78.8)

Values in parentheses are percentages unless indicated otherwise; *values are mean(s.d.).
UGI, upper gastrointestinal.

Table 2 Colorectal procedures		
	Colorectal consultant (*n* = 16 889)	**Non-colorectal consultant (*n* = 11 657)**
Left hemicolectomy (including sigmoid colectomy and anterior resection)	1349 (8.0)	809 (6.9)
Right hemicolectomy (including ileocaecal resection)	5032 (29.8)	3737 (32.1)
Subtotal or Panproctocolectomy	2413 (14.3)	1328 (11.4)
Hartmann's procedure	4739 (28.1)	3868 (33.2)
Other colorectal resection	739 (4.4)	483 (4.1)
Stoma formation	2315 (13.7)	1294 (11.1)
Stoma revision	302 (1.8)	138 (1.2)

Values in parentheses are percentages.

Table 3 Upper gastrointestinal procedures		
	UGI consultant (*n* = 1771)	**Non-UGI consultant (*n* = 3502)**
Peptic ulcer: suture or repair of perforation	1001 (56.5)	2732 (78.0)
Peptic ulcer: oversew of bleed	175 (9.9)	381 (10.9)
Partial or total gastrectomy	78 (4.4)	57 (1.6)
Other gastric surgery	517 (29.2)	332 (9.5)

Values in parentheses are percentages unless indicated otherwise; *values are mean(s.d.).
UGI, upper gastrointestinal.

Table 4 Logistic and Poisson regression analysis of non-colorectal *versus* colorectal special interest

	Non-colorectal consultant	Colorectal consultant	Unadjusted OR/IRR	Adjusted OR/IRR
30-day mortality (%)	14.2	9.5	1.50 (1.40, 1.62)	1.23 (1.13, 1.33)
Return to theatre (%)	9.8	8.8	1.20 (1.10, 1.29)	1.13 (1.05, 1.20)
Median LOS (days)	16	16	0.99 (0.98, 0.99)	1.02 (1.02, 1.03)

Values in parentheses are 95 per cent confidence intervals. Logistic regression was used for analysis of mortality and return to theatre, and Poisson regression for length of hospital stay (LOS), with results expressed as odds ratios (ORs) and incident rate ratios (IRRs) respectively.

Table 5 Logistic and Poisson regression analysis of non-upper gastrointestinal *versus* upper gastrointestinal special interest				
	Non-UGI consultant	**UGI consultant**	**Unadjusted OR/IRR**	**Adjusted OR/IRR**
30-day mortality (%)	12.72	11.14	1.16 (0.97, 1.39)	1.24 (1.02, 1.53)
Return to theatre (%)	7.0	6.7	0.87 (0.70, 1.10)	0.89 (0.70, 1.12)
Median LOS (days)	10	12	0.89 (0.88, 0.90)	0.91 (0.90, 0.92)

Values in parentheses are 95 per cent confidence intervals. UGI, upper gastrointestinal. Logistic regression was used for analysis of mortality and return to theatre, and Poisson regression for length of hospital stay (LOS), with results expressed as odds ratios (ORs) and incident rate ratios (IRRs) respectively.

Table 6 Multilevel logistic regression analysis of non-colorectal *versus* colorectal special interest with hospital included as random intercept	
	Adjusted odds ratio
30-day mortality	1.24 (1.14, 1.35)
Return to theatre	1.13 (1.04, 1.23)

Values in parentheses are 95 per cent confidence intervals.

Table 7 Multilevel logistic regression analysis of non-upper gastrointestinal *versus* upper gastrointestinal special interest with hospital included as random intercept	
	Adjusted odds ratio
30-day mortality	1.21 (0.98, 1.51)
Return to theatre	0.88 (0.69, 1.12)

Values in parentheses are 95 per cent confidence intervals.

Figure 1

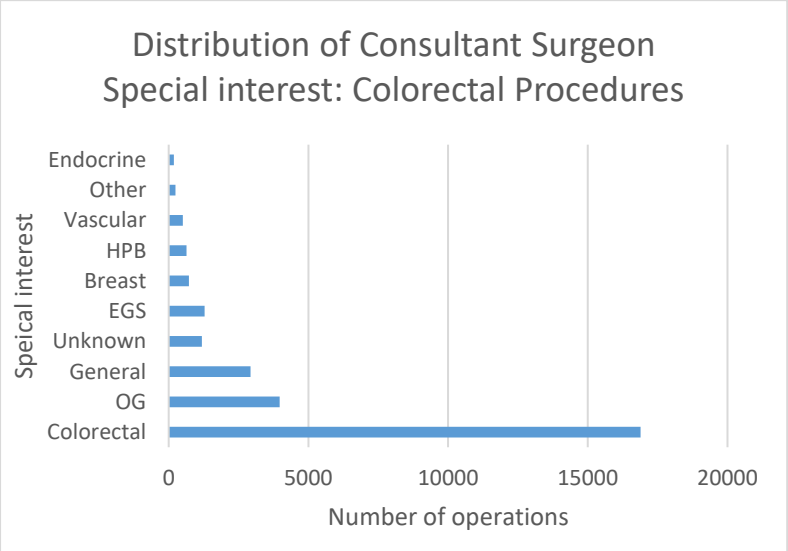
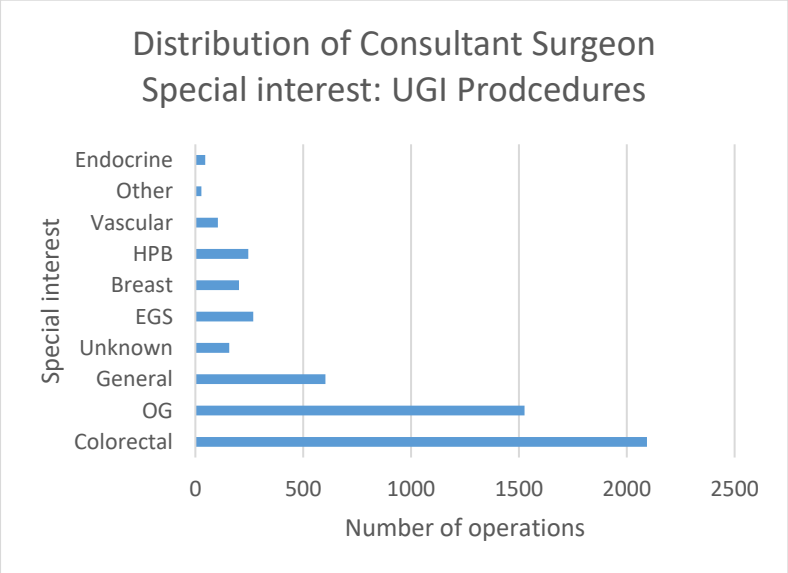


Figure 2



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BLURB Mortality after emergency laparotomy is increased at 30 days if the operation is not performed by a consultant with a special interest in the area of pathology (colorectal or gastroduodenal).