



## Patient outcome of emergency laparotomy improved with increasing “number of surgeons on-call” in a university hospital: Audit loop



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### ABSTRACT

**Aim:** Emergency laparotomy is a commonly performed high-mortality surgical procedure. The National Emergency Laparotomy Network (NELA) published an average mortality rate of 11.1% and a median length of stay equivalent to 16.3 days in patients undergoing emergency laparotomy. This study presents a completed audit loop after implementing the change of increasing the number of on-call surgeons in the general surgery rota of a university hospital. The aim of this study was to evaluate the outcomes of emergency laparotomy in a single UK tertiary centre after addition of one more consultant in the daily on-call rota.

**Methods:** This is a retrospective study involving patients who underwent emergency laparotomy between March to May 2013 (first audit) and June to August 2015 (second audit). The study parameters stayed the same. The adult patients undergoing emergency laparotomy under the general surgical take were included. Appendicectomy, cholecystectomy and simple inguinal hernia repair patients were excluded. Data was collected on patient demographics, ASA, morbidity, 30-day mortality and length of hospital stay. Statistical analysis including logistic regression was performed using SPSS.

**Results:** During the second 3-month period, 123 patients underwent laparotomy compared to 84 in the first audit. Median age was 65(23–93) years. 56.01% cases were ASA III or above in the re-audit compared to 41.9% in the initial audit. 38% patients had bowel anastomosis compared to 35.7% in the re-audit with 4.2% leak rate in the re-audit compared to 16.6% in the first audit. 30-day mortality was 10.50% in the re-audit compared to 21% and median length of hospital stay 11 days in the re-audit compared to 16 days. The lower ASA grade was significantly associated with increased likelihood of being alive, as was being female, younger age and not requiring ITU admission post-operatively. However, having a second on-call consultant was 2.231 times more likely to increase the chances of patients not dying ( $p = 0.031$ ).

**Conclusion:** Our audit-loop suggests that adding a second consultant to the daily on-call rota significantly reduces postoperative mortality and morbidity. Age, ASA and ITU admission are other independent factors affecting patient outcomes. We suggest this change be applied to other high volume centres across the country to improve the outcomes after emergency laparotomy.

### 1. Introduction

Emergency Laparotomy is a commonly performed general surgical procedure [1]. 30–50,000 emergency laparotomies are performed annually in the UK [2] with an estimated incidence of 1:1100 of the population [3]. Furthermore, emergency laparotomies in the UK were associated with an increased risk of morbidity and mortality [1,4–6].

The initial Emergency Laparotomy Network (ELN) prospective study of 1853 patients found a 30-day mortality rate of 14.9% following which the National Emergency Laparotomy Audit (NELA) was established, a national quality improvement programme for patient outcomes [7,8]. A retrospective study of 37,553 patients who had undergone emergency laparotomy from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database (2005–2009) reported

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a 30-day mortality rate of 14% [9].

The establishment of NELA emphasized the orientation towards improving outcomes particularly in high risk surgical patients [2,8]. Various factors can affect patient outcome following emergency laparotomy including patient age, co-morbidities, underlying pathology, the operation performed, urgency of surgery, assessment and management in the pre- and perioperative period, the seniority of decision makers as well as need for post-operative critical care [2,3,7,8,10]. The study from the American College of Surgeons database identified increased age, higher ASA grade, dependent functional status, abnormal white blood cell count, and septic shock as significantly associated with increased mortality [9]. Therefore, identifying risk factors and stratifying risk is vital to improving outcomes from emergency laparotomies [5,11,12]. Recent studies have shown that decreasing medical staffing level directly relate to poor outcome of emergency surgical patients [13]. The Reports of the National Confidential Enquiry into Perioperative Deaths (NCEPOD) reports have suggested that senior medical staff should be involved in the perioperative care of emergency surgical patient [14–16]. No previous studies have looked at the relationship between the number of on-call consultants and patient outcomes after emergency laparotomy.

The aim of this study was to evaluate the morbidity and mortality outcomes of emergency laparotomy after addition of one more consultant in the daily on-call rota at a busy UK tertiary care centre. We performed an initial cohort study to identify length of stay, morbidity and 30-day mortality in patients who underwent an emergency laparotomy under general surgery and compared our outcomes to the national database (NELA). We subsequently re-audited, hypothesising that patients would benefit from an additional consultant surgeon on call.

## 2. Methods

The initial audit was a retrospective study of prospectively maintained data incorporating patients who underwent unscheduled, urgent or emergency laparotomy, between March 2013 to May 2013, in a single unit high-volume UK teaching hospital. The second audit to complete the audit cycle was completed between June 2015 and August 2015. The study parameters remained the same. This audit loop was completed after implementing the primary recommendation from the first audit of increasing the number of on-call consultant surgeons in the general surgical on-call rota from one to two.

Inclusion criteria were any adult (aged 18 or more) undergoing an emergency laparotomy under the general surgical domain. Exclusion criteria were any patient under the age of 18, patients undergoing laparotomies for non-general surgical causes (for example ruptured aneurysm, ruptured ectopic pregnancy), patients undergoing appendectomy, cholecystectomy as well as simple ventral or inguinal hernia repair or gynaecological laparotomy.

Data was collected on patient demographics, procedure performed, American Society of Anaesthesiologists (ASA) grade, morbidity, unadjusted 30-day mortality and length of hospital stay. Furthermore, the timing of the intervention, presence of consultant general surgeon and anaesthetist as well the sub-specialty of the on-call consultant general surgeon was identified. Finally, the specific co-morbidities documented included ileus, anastomotic leak, need for re-operation, chest infection, wound infection and cardiac events.

Logistic regression analysis identifying factors predictive of increased risk of 30-day mortality was performed using SPSS version 24.0. A p-value of < 0.05 was considered statistically significant.

As this was an audit study against published standards, no formal ethical approval was required for use of anonymized patient data.

**Table 1**  
Patient demographics.

<b>Total</b>	<b>84</b>
Age	Median 68(18–90)
Male	54(64%)
Female	30(36%)
ASA	Median 2(1–5)
ASA III or more	35(41.9%)

## 3. Results

### 3.1. First audit

The first audit collected data from 221 patients but only 84 were included after applying our exclusion criteria. The median age of this group was 68 (range 18–90), 54 (64%) were male and 30 (36%) were female (Table 1). The median ASA grade was 2, although patients of grades from 1-5 were incorporated with 35 (41.9% being ASA grade three or more). Furthermore 36 (42.8%) of these laparotomies were performed out of hours with 23 (27.4%) requiring ITU admission post-operatively and 30 (35.7%) involved the formation of an anastomosis. For these procedures, 64 (76.2%) had presence of consultant anaesthetist in theatre whereas 69 (82.1%) had presence of consultant surgeon (Table 2). Of those laparotomies where a consultant surgeon was present 52 (61.9%) were lower GI consultants, the remainder being Upper GI. Median length of stay in these patients was 16 days (range 6–159 days). 17 of these 84 patients died within 30 days giving a 30-day mortality rate of 20.2%.

In addition, morbidity data amongst these patients was collected including anastomotic leak rate, post-operative ileus, intra-abdominal collections, post-operative infection and cardiac events (summarized in Table 3). The anastomotic leak rate was 16.7% and rate of chest infection was 20%, by far the commonest complications.

### 3.2. Second audit

During the second 3-month period, 123 patients included out of 474 patients undergoing laparotomy compared to 84 in the first audit. 67 (54.4%) patients were males and 56 (45.6%) were females (Table 4). Median age was 65 (23–93) years. 56.0% cases were ASA three or above. 23.4% required ITU admission (Table 5). 38% patients had bowel anastomosis. Furthermore, consultants were present in 112 of the 123 procedures reflecting an increase to 91%. Of these 93 involved the presence of a lower GI consultant (75.6%) with the remainder being upper GI (Tables 6 and 7).

In this second audit, the 30-day mortality was 10.50% compared to 20.2% previously and median length of hospital stay 11 days (range 1–102 days). In addition, the complication rate altered, with anastomotic leaks reduced to 4.2% but chest infections increased to 25.2%, intra-abdominal collections increased to 19.5% and there was an increased rate of post-operative ileus of 28.4% (Tables 8 and 9). There was 100% compliance with the new rota arrangement. The new rota was accepted by all the gastrointestinal surgeons and all shifts in the study period were manned by an extra consultant during the re-audit period.

**Table 2**  
First Audit on emergency Laparotomy. Proportion of procedures performed out of hours, requiring ITU admission and involving the formation of an anastomosis.

<b>Total</b>	<b>84</b>
Out of hours	36(42.86%)
After midnight	13(15.48%)
ITU admission	23(27.38%)
Anastomosis	30(35.7%)

**Table 3**  
Complications following emergency laparotomy during First Audit.

Total	84
Leak	Median 5(16.66%)
Reoperation	6(7.14%)
Ileus	3(3.57%)
Collection	8(9.52%)
Chest	17(20.02%)
Wound	8(9.52%)
Heart	6(7.14%)

**Table 4**  
Second Audit, patient demographics.

Total	N = 84	N = 123	P
Age	Median 68(18–90)	Median 65(23–93)	
Male	54(64%)	67(54.4%)	0.154
Female	30(36%)	56(45.6%)	0.154
ASA	Median 2(1–5)	Median 3(1–5)	
ASA III or more	35(41.9%)	69(56.09%)	0.039

**Table 5**  
Second Audit on emergency Laparotomy. Proportion of procedures performed out of hours, requiring ITU admission and involving the formation of an anastomosis.

Total	84	123	P
Out of hours	36(42.86%)	57(46.3%)	0.620
After midnight	13(15.48%)	21(16.9%)	0.759
ITU admission	23(27.38%)	29(23.4%)	0.539
Anastomosis	30(35.7%)	47(38%)	0.714

**Table 6**  
Sub speciality of the surgeon.

	n (%)	n (%)	P
Upper GI	32(38.09%)	23(18.69%)	0.002
Lower GI	52(61.90%)	93(75.61%)	0.037

**Table 7**  
Presence of consultant anaesthetist and surgeon.

	n (%)	n (%)	P
Anaesthetist	64(76.19%)	121(98.37%)	0.000
Surgeon	69(82.14%)	112(91%)	0.069

**Table 8**  
Complications comparison.

Total	N = 84	N = 123	P
Anastomotic Leak	5(16.66%)	2 (4.20%)	0.047
Reoperation	6(7.14%)	11 (8.94%)	0.631
Ileus	3(3.57%)	35 (28.4%)	0.000
Collection	8(9.52%)	24 (19.51%)	0.037
Chest	17(20.02%)	31 (25.2%)	0.398
Wound	8(9.52%)	30 (23.6%)	0.003
Heart	6(7.14%)	11 (8.94%)	0.637

**Table 9**  
Length of stay and mortality comparison.

Total	N = 84	N = 123	P
Length of stay	Median 16(6–159)	Median 11(1–102)	
Death	17(20.2%)	13 (10.56%)	0.062

**Table 10**  
Logistic regression analyses of patients undergoing emergency laparotomy to determine factors predicting unadjusted 30-day mortality.

Variable	Odds Ratio of being alive	95% CI	P-Value
Second consultant	2.231	1.06–5.01	0.031*
ASA III-IV	0.259	0.089–0.754	0.013*
Female	3.062	1.049–8.935	0.041*
Operative duration	1.000	0.993–1.008	0.906
Age Increase	0.956	0.924–0.990	0.012*
ITU Admission	0.265	0.107–0.655	0.004*

\*p-Value is significant.

Logistic regression analysis was performed to analyse factors, which predicted increased risk of 30-day mortality amongst our cohort of patients (Table 10). Several factors were modelled including presence of a second on-call consultant, ASA grade, gender, operative duration, age and requirement for ITU admission. A lower ASA grade (I-II) was significantly associated with reduced 30-day mortality, as was being female, younger age and not requiring ITU admission post-op (Table 4). Significantly having a second on-call consultant was associated with a 2.2 (95% Confidence Interval: 1.06–5.01) times reduced 30-day mortality rate ( $p = 0.031$ ). Operative duration was not associated with any change in risk.

#### 4. Discussion

While looking at the patient outcome after emergency laparotomy in general surgery, our audit-loop found that adding a second consultant to the daily on-call rota significantly reduces postoperative 30-day mortality whilst altering morbidity in a high-volume acute general surgical take. Age, ASA and ITU admission post-operatively are other independent factors affecting patient outcome. Although there was an increased morbidity due to certain complications, including chest infection, this could be related to an increased proportion of relatively unwell patients surviving. Having two consultants simultaneously on-call, one lower GI and the other Upper GI can also provide subspecialty input to cover the range of pathologies encountered, which may improve outcome. There is evidence for example that mortality and complications arising from emergency colonic resection are lower when performed by colorectal sub-specialists [17].

The NELA audit examines both processes of care and patient outcomes [8]. Modifiable factors affecting outcomes following laparotomy have been audited including prompt clinical assessment, access to diagnostic imaging, and senior clinician review within 14 h as well as documented formal risk assessment. Furthermore patients with high risk should have appropriate input from a consultant surgeon and anaesthetist as well as appropriate post-operative critical care management [8,14–16]. Based on these standards the first NELA audit reported an average 30-day mortality rate of 11.7% and a median length of stay of 18.1 days in, which improved in the second year to 11.1% and 16.3 days respectively [8]. Moreover by highlighting areas for improvement, there have been improvements in most of the key standards assessed by NELA with many hospitals meeting standards for 60–70% of patients [8]. Whilst some studies have examined the impact of having a specialist emergency gastrointestinal surgeon on-call [18], no studies to date have examined the effect of the number of on-call consultants on the overall morbidity and mortality from emergency laparotomy. As our results have shown, having an additional on-call consultant can more readily provide the senior experience and decision-making capability to ensure that patients are promptly directed down the relevant management pathways, which may improve outcomes.

The significant morbidity and mortality associated with laparotomies is also dependent on the specific procedure as well as underlying pathology for example, n cases of perforation, haemorrhage, ischaemic bowel and anastomotic leaks [2]. Barrow and colleagues have shown

that 30-day mortality from the majority of pathologies and procedures including small bowel resection, Hartman's, subtotal colectomy perforated duodenal ulcer repair exceeds the 10% threshold the Royal College of Surgeons of England deem the threshold for high risk procedures [2,7]. In light of this, having senior consultant input as well as post-operative critical care input becomes vital. However only 27.4% of our patients in the first audit and 23.4% of patients in the second audit received post-operative ITU care although whether this was based on clinical risk assessment of POSSUM scoring criteria was not clear from our work. This raises the possibility that more consistent physiological risk scoring as well as having a low threshold for critical care input may further improve mortality outcomes.

Advancing age is an independent factor associated with poor patient outcome after major surgery particularly in emergency settings [19–21]. The findings in our audit that age of more than 80 significantly reduces patients' chances of survival after emergency laparotomy ( $p = 0.012$ ) is consistent with the published literature.

Our Study has shown that increasing the number of consultants on-call from one to two can help reduce 30-day mortality in patients undergoing emergency laparotomy in a high volume acute general surgical take. We suggest this change be applied to other high volume general surgical centres across the country to improve the outcomes after emergency laparotomy.

The limitations of our study are that it is a retrospective analysis of data collected at a single busy UK tertiary centre with a particular demographic and resources including staffing that enabled us to enact the particular change and re-audit its implementation. This will not be applicable or even practical in smaller centres or less resourceful settings. Having an additional consultant on-call means additional resources are required including more frequent on-calls for consultants. This will require a critical mass of consultants employed at any given centre to allow for sufficient breaks between on-calls and may not work in smaller centres. We have 2 models for the GI consultants at our centre, one for upper GI and another for lower GI, with varying total length of on-calls. This has to be negotiated with individual specialities but the end result is the same of having an additional consultant from complimentary specialities on-call at any given time.

The implications are that in the presence of an additional consultant there is greater senior support available to junior surgical doctors which facilitates more efficient clinical decision making for patients who require theatre as well as support within the theatre environment. In the absence of an emergency surgery speciality within the UK, having both Upper GI and Lower GI consultants on-call simultaneously also ensures that patients with upper or lower GI pathology have access to the relevant speciality input promptly which may also explain the improved outcomes. Thus, having prompt senior and specialist input is a driving factor in improving outcomes for patients if on-call rotas can be designed to accommodate this.

### Ethical approval

It's a quality improvement project/audit so ethical approval not required.

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### Author contribution

A Hussain: Conception, design, data collection, writing.  
 F Mahmood: data collection, analysis, writing.  
 C Teng: Data collection.  
 S Jafferbhoy: design, data collection.  
 David Luke: Conception, design.  
 A Tsiamis: Conception, design, supervisory role, revision.

### Conflict of interest

The authors declare they have no conflict of interest.

### Guarantor

A Hussain.

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