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Reliability in the process of care during emergency general surgical admission: a prospective cohort study

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Abstract

Introduction

Emergency general surgery (EGS) is responsible for 80-90% of surgical in-hospital deaths and the early management of these unwell patients is critical to improving outcomes. Unfortunately care for EGS patients is often fragmented and important care processes are frequently omitted.

Methods

This study aimed to define a group of important processes during EGS admission and assess their reliability. Literature review and semi-structured interviews were used to define a draft list of processes, which was refined and validated using the Delphi consensus methodology. A prospective cohort study of the 22 included processes was performed in 315 patients across 5 acute hospitals.

Results

Prospective study of the 22 selected processes demonstrated omission of 1130/5668 (19.9%) processes. Only 6 (1.9%) patients had all relevant processes performed correctly. Administration of oxygen to hypoxic patients (82/129, 64%), consultant review (202/313, 65%) and administration of antibiotics within 3 hours for patients with severe sepsis (41/60, 68%) were performed particularly poorly. There were significant differences in the mean number of omissions per patient between hospitals (ANOVA: $F=11.008$, $p<0.001$) and this was strongly correlated with hospitals' median length of stay (Spearman's $\rho = 0.975$, $p=0.005$).

Conclusions

Reliability of admissions processes in this study was poor, with significant variability between hospitals. It is likely that improvements in process reliability would enhance EGS patients' outcomes. This will require engagement of the entire surgical team and the implementation of multiple interventions to improve the effectiveness of the admission phase of care.

1.

2. INTRODUCTION

Emergency general surgery (EGS) comprises of about half of all operations but 80-90% of all in-hospital deaths [1]. EGS has an increasingly frail, elderly population of patients, often with multiple co-morbidities and, unlike elective care, patients have deranged physiology prior to arrival in the operating theatre. Optimal early management of these patients is therefore critical to improve physiology and subsequent outcomes. As the intensity of medical care has increased, so the number of processes and procedures involved in the care of acutely unwell EGS patients has risen too. It is the responsibility of the admitting team of surgeons and other healthcare professionals to ensure that processes are performed optimally but we know that errors and omissions are common [2,3].

Reliability in healthcare is defined as failure-free operation over time [4]. Unfortunately healthcare is far from failure-free and this has important implications for patients. The majority of healthcare processes are performed very unreliably with few systems and strategies to reduce the risk of failure embedded in the system. Most are performed with a failure rate of about 10% [4]. There is increasing evidence that improvements in the reliability of the process of care can make a significant difference to patient outcomes, especially when evaluated as a group of complementary processes. This has been demonstrated on the surgical ward and in the operating theatre, using the SURPASS [5] and

WHO checklists [6] and in the intensive care unit, using care bundles to reduce ventilator associated pneumonia [7] and central line sepsis [8]. Improvements in reliability of this type have the power to produce huge changes in patient outcomes but they remain underutilised, especially in the setting of emergency surgery.

The normal pattern of EGS admission is via the emergency department (ED), either through direct general practitioner referral or self-presenting patients who are referred to surgery by ED physicians. In addition to patients requiring urgent operations, the surgical team will treat around 65% of admissions non-operatively, typically with pancreatitis, cholecystitis and diverticulitis [9]. New admissions are usually reviewed by junior and senior resident surgeons and by a consultant within 24 hours [10]. As a result of these sequential reviews of new patients there are ample opportunities to ensure that important clinical processes are performed. The admissions process typically culminates with a morning “post-take” ward round of patients arriving in the preceding 24 hours by the admitting consultant.

The aim of this study was to identify those processes of care most likely to improve outcome during EGS admission and investigate the reliability with which they are performed.

3. METHODS

3.1. Design

This study consisted of a literature review and semi-structured interviews to identify potentially important processes, a Delphi consensus process to consolidate and validate these processes and a prospective multicentre cohort study to evaluate the reliability of the chosen processes.

3.2. Literature Review and Interviews

Due to the lack of robust evidence for many of the processes performed during the admission of an EGS patient it was necessary to use a variety of sources to develop the initial list of

processes that may affect patient outcome. Literature review of journals, textbooks, guidelines and publications from professional bodies were used to generate an interview protocol. Eighteen semi-structured interviews with nursing and medical staff from wards, theatres, intensive care, anaesthetics and surgery were undertaken by a surgeon and a psychologist with backgrounds in patient safety. From transcripts of the interviews and the results of the literature search, a preliminary list of care processes undertaken during the admission of emergency general surgical patients was developed (Table 1). This preliminary list was piloted by 10 surgical research fellows prior to submission to the Delphi process.

3.3. Delphi Process

Delphi is a consensus methodology, commonly used in healthcare for establishing treatment guidelines and setting quality standards [11]. The Delphi process consists of a series of rounds of anonymous, independently completed questionnaires, in which participants are asked to score their agreement with a number of statements on a numerical (Likert) scale. Results are tabulated and median and interquartile ranges of participants' responses calculated. Statements that have a narrow interquartile range (indicating consensus between participants) and a median score above a predetermined threshold for inclusion in a final list are accepted. Items with a narrow interquartile range and a median below the cut off for inclusion are discarded. Statements without consensus, based on interquartile range, were submitted, along with any new statements suggested by the respondents, to a further round of questionnaires, in which the results of the preceding round are available to the participants.

Delphi was undertaken by 15 experienced surgical healthcare staff with equal representation from surgical consultants and registrars, intensive care and theatre based anaesthetists and surgical ward nurses (mean 5.9 years in existing role). Purposive sampling was used to ensure equivalent participation from all parts of the multidisciplinary healthcare team.

A cut-off value for inclusion in the final list of processes was set as a median score of 8 on the nine point (1-9) Likert scale used. Consensus was considered to be achieved once the interquartile range fell below 1.5. After two rounds of Delphi questionnaires, 21 out of 28 processes surveyed were accepted for inclusion into the list of admission processes (Table 1).

3.4. Reliability of care processes

Included patients were limited to those with acute abdominal symptoms, including rectal bleeding, because this represents a discreet group of patients that were easily identified by investigators and make up the majority of EGS admissions in the UK. Patients with vascular surgical, trauma, gynaecological or urological diagnoses were excluded and patients under the age of 50 were also omitted from the study. Younger patients were excluded to ensure a cohort of patients with greatest potential to benefit from high quality process of care, to exclude large numbers of patients with non-specific abdominal pain or uncomplicated appendicitis and to maximise the chance of identifying a correlation between admissions process reliability and outcomes. Patients who died before the post-take ward round were excluded, as were those patients admitted directly to the intensive care unit (ICU). ICU patients were excluded because the type and intensity of care provided to these patients differs markedly from that available on an open ward and, as a result, process of care adherence is not easily comparable between patients in these different locations.

Patients were identified for inclusion in the study at the “post-take” handover, in the morning following their admission. Basic demographic data were collected from the casenotes and, following the post-take ward round, adherence to the 21 included processes were assessed as either performed correctly, not applicable or not performed. In addition to the original 21 processes, the use of thromboprophylaxis was also assessed, despite its omission from the original Delphi list. This was done because of the strong research evidence in favour of its use and National Institute for Health and Care Excellence (NICE) guidance that prophylaxis

should be used in “acute surgical admission with inflammatory or intra-abdominal condition”, which covers almost all the patients in this study [12]. A second data collection was performed at discharge, regarding final diagnosis, procedures and operations performed, length of stay and morbidity or mortality.

3.5. Participants

Participating hospitals and local collaborators were identified through the London Surgical Research Group (LSRG (www.lsrp.org.uk)). The LSRG is a collaborative group of surgical trainees that perform and support clinical surgical research in London and south-east England. Local investigators helped to design the reliability analysis phase and were provided with study literature and training in the use of data collection sheets.

3.6. Ethical approval, data collection and analysis

Following discussion with the National Research Ethics Service helpdesk the study was performed as a service evaluation and as an extension of a previous ethics application (08/H0715/112). Anonymised data were entered into an Excel spreadsheet (v2010, Microsoft Corp., Redmond, Washington, USA) and summary statistics calculated. Statistical tests were performed using SPSS statistics (v20, IBM Corporation, Armonk, New York, USA). The chi-square test was used for analysis of discrete categorical data. For continuous data ANOVA was used for parametric tests and the Kruskal-Wallis test for non-parametric data. Spearman’s Rank Correlation Coefficient was used for analysis of non-parametric correlation. $p < 0.05$ was considered significant. Data has been reported in line with STROBE criteria [13].

4. RESULTS

The study was conducted at 5 hospitals in London and south-east England (Table 2). Two of the included hospitals have medical schools on the same site and were designated as teaching hospitals for the purposes of this study. Four hospitals used an “on-call” daily consultant rota

and one used a “surgeon of the week” system (Table 2). Two of the five hospitals had a surgical admissions unit and in others patients were admitted directly to a ward.

A total of 315 patients were included in the study across a variety of EGS diagnoses (Table 2). Gallstone related pathology and diverticulitis were particularly common. There were no significant differences between hospitals in terms of diagnosis. Hospital B performed more operations other than laparotomy and hospital D more endoscopy than others, as demonstrated by standardised residual values greater than 2 following chi-squared test (Table 2). The mean age of patients was 69 years and there was no statistical difference in mean age between hospitals (ANOVA: $F=1.15$, $p=0.335$). There were 152 males (48.3%) and there was similarly no difference in the proportion of male patients between hospitals ($\chi^2=7.355$, $p=0.118$)(Table 2).

There were 5 deaths across 3 hospitals and the median length of stay was 4 days (interquartile range (IQR) 3-8 days). Median length of stay varied significantly between hospitals from 3 days (IQR 2-6) at hospital D to 7 days (IQR 4-20) at hospital E (Kruskal-Wallis: $H(4)=27.81$, $p<0.001$)(Table 3).

A total of 5668 processes were considered by the investigators to be indicated and, of these, 1130 (19.9%) were omitted by the treating team. The mean number of admissions processes omitted was 3.59 per patient (SD 1.76, range 0-9) and only six patients (1.9%) had all relevant processes performed. On univariate analysis there was no significant effect of age ($p=0.28$), diagnosis ($p=0.40$) or procedure ($p=0.65$) on the number of omitted processes per patient. A number of processes were performed particularly poorly. These include documentation of a plan for vital signs observation (76/312, 24%), retrieval of old casenotes (163/290, 56%), administration of oxygen to hypoxic patients (82/129, 64%), consultant review by the end of the post-take ward round (202/313, 65%) and administration of

antibiotics within 3 hours for patients with severe sepsis (41/60, 68%)(Table 3). In 17/22 admission processes there was significant difference between hospitals in reliability, demonstrating variability in the quality of care at a process level.

There was also a significant difference in the overall mean number of process omissions between hospitals (ANOVA: $F=11.008$, $p<0.001$)(Table 3). Process omissions ranged from 2.42 per patient (SD 1.25) at hospital D to 4.20 per patient (SD 1.83) at hospital E. There was a strong positive correlation between the mean number of process omissions at a hospital and patients' median length of stay (Spearman's $\rho = 0.975$, $p=0.005$).

There was no significant correlation between the time to review by a surgeon, which might be considered a proxy measure of how busy the surgeon or emergency department was, and adherence to admission processes (Spearman's $\rho = 0.046$, $p=0.562$). Similarly, there was no significant difference in admission process adherence between weekend and weekday admissions (Mann-Whitney U test, $p=0.330$) nor for patients admitted outside weekday normal working hours (8am-5pm)(Mann-Whitney U test, $p=0.900$).

Teaching hospitals omitted significantly more processes than non-teaching hospitals (4.00 vs. 3.27, $p<0.001$). There was no difference in the number of missed processes between patients treated in hospitals with a surgical admissions unit and those treated elsewhere (Mann-Whitney U test, $p=0.680$). The hospital with fewest process failures was the only site that ran a "surgeon of the week" consultant duty rota. Patients treated at this hospital had significantly fewer missed processes than the remaining patients treated in a consultant "on-call" system (Mann-Whitney U test, $p<0.001$).

5. DISCUSSION

This study has demonstrated poor adherence to admission processes in the care of emergency general surgery patients. The mean number of process failures was 3.59 per patient and the

overall failure rate was nearly 20%. It is highly likely that these omissions in the process of care will have resulted in worse outcomes for these patients. Unfortunately, the harm caused by omitted processes may not be immediately apparent and can be easily attributed to the patient's underlying disease.

In addition to poor reliability there was significant variability between hospitals in terms of the overall completion of admission processes and the adherence to individual processes themselves. This finding corroborates the recent statements on variability in care by surgical associations [10,14,15]. There was a significant correlation between hospitals that performed poorly on process reliability and those with a longer median length of stay. Though this study does not demonstrate causality, it is possible that poor process adherence reflects a lack of organisation of the treating clinical team or institution and that this is reflected in increased lengths of stay in hospital.

The hospital that ran a "surgeon of the week" model of care performed very well on process completion. The surgeon of the week paradigm has the potential to improve patient care by ensuring continuity of care for emergency patients, at least at the consultant level [9,16]. Conversely, the volume of patients accrued by a surgeon of the week may hinder reliability and the kind of attention to the process of care described in this paper. Optimal organisational structures for EGS warrant further study and may not be the same in all institutions.

Some processes were performed well and these tended to be those that were routine. Examples include establishing intravenous access (301/311, 97%) and performing basic blood tests (289/292, 99%). Conversely, processes that were not required routinely and were done at the discretion of treating staff were performed much less robustly. Administration of oxygen to hypoxic patients (82/129, 64%), antibiotics for patients with severe sepsis (41/60, 68%) and appropriate use of nasogastric tubes (49/69, 71%) were all done poorly.

One process, documentation of a plan for vital signs monitoring, was an outlier with only 76/312 (24%) correctly performed. It is likely that, despite recent recommendations [17], clinicians do not consider this necessary unless they want an abnormal regimen of observations to be performed.

The study was performed across 5 typical NHS hospitals with diverse infrastructure, procedures and protocols and anecdotal evidence would suggest that similar results to those found in this study would be present in the majority of NHS institutions.

Surgical care requires a foundation of solid and reliable processes of care with excellent adherence and predictable results. This study has demonstrated that this foundation is frequently lacking in the admission of EGS patients.

5.1. Improving the reliability of basic care processes

Stevenson et al. assessed reliability of a shorter list of generic processes as well as some disease specific processes for emergency general surgery admissions [18]. They found similar poor adherence to basic admissions processes and found that interventions that raised doctor's awareness of the processes expected in each scenario improved reliability. They also found that reliability improvements reduced adverse events in their study population, which suggests that there may be a direct effect on patient outcomes. Such an effect has been demonstrated by checklists in other parts of the emergency care pathway. For example, the WHO patient safety checklist has demonstrated that implementation of a perioperative checklist resulted in a more than 50% reduction in mortality and greater than one third reduction in major complications in emergency surgical patients [19]. Similar checklists in elective surgery have also shown a reduction in mortality approaching 50% [5,6]. Given the high mortality of EGS patients and the importance of the initial phase of treatment, it is likely that the type of checklist used in this study could produce a significant improvement in patient outcomes. A potential future study could assess the impact of this, or a similar

checklist against control hospitals to see if its utilisation led to improved patient outcomes. Caution should however be used in the introduction of new checklists to ensure that “checklist fatigue” [20] is not exacerbated and that the beneficial communication and teamworking effects of checklists are not omitted [21,22].

Improving the reliability of healthcare will require sustained effort over time however, there are some steps that could be taken immediately. Firstly, a clear understanding of the importance of the basic processes of care described in this paper should be emphasised to all junior surgeons and completion checked during the consultant review. This study has demonstrated that the completion of basic clinical care by junior staff cannot be assumed. Secondly, local audit of these processes and feedback to the surgical team on performance is likely to improve overall reliability and may identify outliers who consistently omit one or more admission processes. Finally, the delegation of this type of care to the most junior member of the team will undoubtedly result in poor reliability. Making all surgical staff responsible for the completion of basic processes of care should result in the type of quality assurance checks by more senior surgeons that are routine in other safety-critical industries.

5.2. Limitations

This study has a number of limitations. Primarily, the inclusion and exclusion criteria disqualified patients that died prior to the post-take ward round or were admitted to ICU. These are the very patients most likely to benefit from this type of checklist; however, it was necessary to exclude them to allow fair comparison between patients treated in similar environments and between different institutions.

A second limitation is the potential lack of reliability between investigators at different sites. It is possible that investigators had different thresholds for considering processes such as urethral catheterisation to be indicated or for when they considered a process to be completed adequately. To attempt to counteract reliability issues, experienced surgeons were recruited

as investigators. These investigators were given training in the use of data collection instruments and process descriptions were made as objective as possible.

The admission processes selected by the Delphi panel inevitably lack empirical evidence demonstrating their effect on patient outcomes, however all are recommended by healthcare bodies and form part of standard surgical care.

A final limitation was the lack of consecutive patient inclusion. This was due to investigators being part of each hospital's surgical team and therefore not able to collect data on patients that they had treated themselves, in addition to other investigator absences. The study attempted to avoid inclusion bias by recruiting all suitable patients on days in which recruitment occurred.

6. CONCLUSION

This study has demonstrated the poor reliability of admissions processes for EGS patients and shown significant variability in the effectiveness of care between the hospitals involved. It has also demonstrated that hospitals that have greater numbers of process omissions have a longer median length of stay. Interventions such as improving surgeon's awareness of these admissions processes or the use of an admission checklist or aide memoire may improve the reliability and effectiveness of this facet of care and have the potential to improve patient outcomes.

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CONFLICT OF INTEREST STATEMENT

Conflict of interest: none

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Table 1: Processes considered for inclusion and results of Delphi consensus

Included Processes	Round One		Round Two	
	Median Score (1-9)	IQR	Median Score (1-9)	IQR
All patients with severe sepsis or septic shock should have blood cultures taken and antibiotics administered within 3 hours of admission [22].	9	0.5*	-	-
Resuscitation or maintenance with intravenous fluid should be instigated where appropriate [23].	9	0.5*	-	-
Emergency surgical admissions should be to a ward which is appropriate for their clinical condition in terms of required specialty, level of care and presenting complaint [16].	9	1.0*	-	-
Patients who are bleeding or at risk of bleeding should have a group and save sample taken.	9	1.0*	-	-
A clear treatment plan should be documented in the casenotes [16].	9	1.0*	-	-
A clear handover should be made to the incoming surgical team, including patient name, location, diagnosis and investigations [16,24].	9	1.5*	-	-
By the time of the post-take ward round a preliminary diagnosis should have been made.	8	0.5*	-	-
The initial assessment of patients should include a doctor of sufficient experience and authority to implement a management plan [16].	8	1.0*	-	-
Adequate intravenous access should be secured.	8	1.0*	-	-
Appropriate analgesia should be administered and titrated as necessary [25].	8	1.0*	-	-
Patients with haemodynamic instability should have a urethral catheter placed to monitor fluid balance.	8	1.0*	-	-
Patients with persistent vomiting and signs of obstruction should have a nasogastric tube placed.	8	1.0*	-	-
Documentation of the first consultant review should be clearly indicated in the casenotes [16].	8	1.0*	-	-
Vital signs observations, including fluid balance, should be recorded in line with the physiological monitoring plan and not less than twelve hourly [26,27].	8	1.5*	-	-
Basic bloods (U&E, FBC, CRP where appropriate) should have been performed.	8	1.5*	-	-
Casenotes for patients previously treated at the hospital should be obtained.	8	1.5*	-	-
Casenote entries should be legible, dated, timed and signed [16].	8	2.0	8	0.5†
Patient's allergy status and routine medication should be transcribed onto the medication chart unless contraindicated.	8	2.0	8	1.0†
Patients admitted as an emergency should be seen by a consultant at the earliest opportunity. Ideally this should be within 12 hours and should not be longer than 24 hours [16].	8	2.0	8	1.5†
A clear physiological monitoring plan should be made and documented for each patient (e.g. 4 hourly observations) [1,16,26].	8	2.0	8	1.5†
Patients with reduced oxygen saturation or PaO ₂ (usually less than 95%) should have supplemental oxygen administered [28].	-	-	8	0.5†
Excluded Processes	Round One		Round Two	
	Median Score (1-9)	IQR	Median Score (1-9)	IQR
A plan for oral intake should be documented in the casenotes.	7	1.0*	-	-
If a significant concurrent medical illness is apparent then the appropriate medical team should be involved.	7	1.5*	-	-
Appropriate plain radiology should be complete.	7	1.5*	-	-
If NBM, important oral medications should be converted to an alternative route.	7	1.5*	-	-
All suitable patients should have appropriate thromboprophylaxis [12].	7	2.0	7	1.5†
Excessive transfers both within and outside the hospital should be avoided [16].	7	2.5	7	1.5†
Patient's exercise tolerance and functional status should be clearly documented in the casenotes.	-	-	7	1.5†

IQR interquartile range; U&E urea and electrolytes; FBC full blood count; CRP C-reactive protein; PaO₂ partial pressure of oxygen

* items achieving consensus in round 1, † items achieving consensus in round 2

Table 2: Demographics, diagnoses and management of study population

Hospital Structure	Hospital A	Hospital B	Hospital C	Hospital D	Hospital E	Total	p value	
Number of patients included	80	75	61	50	49	315		
Teaching hospital status	No	Yes	Yes	No	No			
Surgical consultant rota type	On-Call	On-call	On-call	Weekly	On-call			
Surgical admissions unit	Yes	No	Yes	No	No			
Demographics								
Mean age ((SD) years)	71 (13)	70 (11)	67 (11)	69 (12)	69 (13)	69 (12)	0.34	†
Number of males (%)	34 (42.5%)	44 (58.7%)	32 (52.5%)	24 (48.0%)	18 (36.7%)	152 (48.3%)	0.12	χ
							0.26	χ
Diagnoses								
Biliary conditions	16 (20%)	9 (12%)	10 (16%)	8 (16%)	6 (12%)	49 (16%)		
Pancreatitis	7 (9%)	13 (17%)	4 (7%)	7 (14%)	7 (14%)	38 (12%)		
Diverticulitis	13 (16%)	6 (8%)	5 (8%)	5 (10%)	6 (12%)	35 (11%)		
Small bowel obstruction	5 (6%)	8 (11%)	1 (1%)	4 (8%)	7 (14%)	25 (8%)		
Incarcarated/strangulated hernia	5 (6%)	7 (9%)	3 (5%)	6 (12%)	2 (4%)	23 (7%)		
Other	34 (43%)	32 (43%)	39 (64%)	20 (40%)	21 (43%)	146 (46%)		
Procedures								
None	60 (75%)	44 (59%)	39 (64%)	24 (48%)	32 (65%)	199 (63%)	<0.01	χ
Endoscopy including ERCP	9 (11%)	11 (15%)	5 (8%)	14 (28%)*	7 (14%)	46 (15%)		
Laparotomy	4 (5%)	11 (15%)	3 (5%)	7 (14%)	8 (16%)	33 (10%)		
Other	7 (9%)	9 (12%)	14 (23%)*	5 (10%)	2 (4%)	37 (12%)		

SD Standard Deviation; ERCP Endoscopic Retrograde Cholangiopancreatography

† = ANOVA, χ = Chi-square test, * = cells with standardised residual value >2

Table 3: Patient outcomes and reliability of key processes

	Hospital A	Hospital B	Hospital C	Hospital D	Hospital E	Total	p value	
Number of patients included	80	75	61	50	49	315		
Outcomes								
Number of deaths	0	2	2	1	0	5		
Median length of stay ((IQR) days)	4 (2-6.75)	5 (3-10)	4 (2-7)	3 (2-6)	7 (4-20)	4 (3-8)	p<0.01***	†
Mean time from admission to surgical review ((SD) minutes)	260 (149) n=34	201 (172) n=46	171 (101) n=40	NA	219 (211) n=40	210 (165) n=160	p=0.14	‡
Processes								
Clear handover	80/80, 100%	73/75, 97%	61/61, 100%	50/50, 100%	48/49, 98%	312/315, 99%	p=0.310	X
Admission to an appropriate ward	80/80, 100%	61/75, 81%	60/61, 98%	48/50, 96%	20/49, 41%	269/315, 85%	p<0.001***	X
Consultant review at or before PTWR	34/78, 44%	51/75, 68%	43/61, 71%	41/50, 82%	33/49, 67%	202/313, 65%	p<0.001***	X
Intravenous access established	79/79, 100%	71/74, 96%	57/60, 95%	46/50, 92%	48/48, 100%	301/311, 97%	p=0.070	X
Appropriate intravenous fluids given	68/69, 99%	68/73, 93%	47/49, 96%	49/50, 98%	40/44, 91%	272/285, 95%	p=0.261	X
Catheterised if haemodynamically unstable	6/6, 100%	26/33, 79%	10/14, 71%	34/36, 94%	6/12, 50%	82/101, 81%	p=0.007**	X
Nasogastric tube inserted if vomiting and signs of SBO	6/10, 60%	14/18, 78%	6/7, 86%	21/23, 91%	2/11, 18%	49/69, 71%	p<0.001***	X
Vital sign observations performed at least 4 hourly	77/78, 99%	68/75, 91%	35/61, 57%	44/50, 88%	37/49, 76%	261/313, 83%	p<0.001***	X
Antibiotics within 3 hours for severe sepsis	2/4, 50%	4/10, 40%	1/5, 20%	31/31, 100%	3/10, 30%	41/60, 68%	p<0.001***	X
Appropriate analgesia administered	69/70, 99%	52/73, 71%	47/59, 80%	48/50, 96%	45/49, 92%	261/301, 87%	p<0.001***	X
Oxygen administered when appropriate	7/23, 30%	13/25, 52%	13/27, 48%	41/43, 95%	8/11, 64%	82/129, 64%	p<0.001***	X
Patient's routine medication prescribed	72/76, 95%	44/75, 59%	54/61, 89%	31/50, 62%	43/48, 90%	244/310, 79%	p<0.001***	X
Suitable patients given thromboprophylaxis	72/77, 94%	59/71, 83%	55/61, 90%	31/49, 63%	45/48, 94%	262/306, 86%	p<0.001***	X
Documentation legible, dated, timed and signed	40/79, 51%	65/75, 87%	34/61, 56%	46/50, 92%	23/49, 47%	208/314, 66%	p<0.001***	X
Registrar review within 4 hours of junior surgeon	57/68, 84%	47/73, 64%	37/60, 62%	46/50, 92%	45/49, 92%	232/300, 77%	p<0.001***	X
Preliminary diagnosis made by time of PTWR	72/78, 92%	71/75, 95%	46/61, 75%	44/50, 88%	34/48, 71%	267/312, 86%	p<0.001***	X
Treatment plan documented	79/80, 99%	74/75, 99%	61/61, 100%	49/50, 98%	43/48, 90%	306/314, 98%	p=0.006**	X
Plan for vital signs observation documented	5/78, 7%	19/75, 25%	30/61, 49%	20/50, 40%	2/48, 3%	76/312, 24%	p<0.001***	X
Basic blood tests performed	79/80, 99%	73/75, 97%	61/61, 100%	27/27, 100%	49/49, 100%	289/292, 99%	p=0.487	X
Blood group and save performed where appropriate	35/38, 92%	12/14, 86%	38/38, 100%	48/50, 96%	3/3, 100%	136/143, 95%	p=0.233	X
Documentation of first consultant review performed	45/79, 57%	52/55, 95%	48/49, 98%	41/41, 100%	37/39, 95%	223/263, 85%	p<0.001***	X
Old casenotes found for readmissions	63/76, 83%	18/73, 25%	4/46, 9%	43/50, 86%	35/45, 78%	163/290, 56%	p<0.001***	X
Mean number of key process omissions (SD)	3.24 (1.61)	4.09 (1.80)	3.89 (1.69)	2.42 (1.25)	4.20 (1.83)	3.59 (1.76)	p<0.001***	‡

NA Not Available; SD Standard Deviation; PTWR Post-Take Ward Round; SBO Small Bowel Obstruction; IQR Interquartile Range

† = Kruskal-Wallis test, ‡ = ANOVA test, X = Chi square test. ** p<0.01, ***p<0.001

HIGHLIGHTS

- 22 key processes for the admission of emergency surgical patients were identified
- Reliability was poor, with 19.9% of processes omitted, 3.59 omissions per patient
- There were significant differences in reliability between the 5 hospitals studied
- Process reliability per hospital was significantly correlated with length of stay