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Original research

Emergency surgery pre-operative delays – Realities and economic impacts

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HIGHLIGHTS

- Acute surgery is now being managed according to published guidelines.
- Specialty performance with regard to time to theatre (TTT).
- Economic implications of failure to comply with TTT guidelines.

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ABSTRACT

Background: A key principle of acute surgical service provision is the establishment of a distinct patient flow process and an emergency theatre. Time-to-theatre (TTT) is a key performance indicator of theatre efficiency. The combined impacts of an aging population, increasing demands and complexity associated with centralisation of emergency and oncology services has placed pressure on emergency theatre access. We examined our institution's experience with running a designated emergency theatre for acute surgical patients. **Methods**: A retrospective review of an electronic prospectively maintained database was performed between 1/1/12 and 31/12/13. A cost analysis was conducted to assess the economic impact of delayed TTT, with every 24hr delay incurring the cost of an additional overnight bed. Delays and the economic effects were assessed only after the first 24 h as an in-patient had elapsed. **Results**: In total, 7041 procedures were performed. Overall mean TTT was 26 h, 2 min. There were significant differences between different age groups, with those aged under 16 year and over 65 having mean TTT at 6 h, 34 min (95% C.I. 0.51–2.15, $p < 0.001$) and 23 h, 41 min (95% C.I. 19.6–23.9, $p < 0.001$) respectively. 2421 (34%) waited greater than 24 h for emergency procedures. The >65 years age group had a mean TTT of 23 h, 41 min which was significantly longer than the overall mean TTT Vascular and urological emergencies are significantly disadvantaged in competition with other services for a shared emergency theatre. The economic impact of delayed TTT was calculated at €7,116,000, or €9880/day of additional costs generated from delayed TTT over a 24 month period. **Conclusion**: One third of patients waited longer than 24 h for emergency surgery, with the elderly disproportionately represented in this group. Aside from the clinical risks of delayed and out of hours surgery, such practices incur significant additional costs. New strategies must be devised to ensure efficient access to emergency theatres, investment in such services is likely to be financially and clinically beneficial.

1. Introduction

Provision of acute emergency surgery services has undergone major change over the last number of years. Many centres have now incorporated acute surgery guidelines into their practice in an effort to improve treatment and subsequent outcomes for acute surgical patients [1,2]. The need for such guidelines is highlighted by data which suggests that up to 90% of general surgery patient deaths are within the emergency setting and an observation that there is a 2–4 fold increase in morbidity rates within the emergency setting when compared to similar elective procedures [3]. The demands on major hospitals have increased significantly in recent years. The centralisation in particular of major, complex and oncology services has impacted upon access to services at all levels.

A key principle of provision of an acute surgical service is establishment of an efficient emergency theatre dedicated to acute surgery [4]. Ideally the emergency theatre should provide adequate

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theatre facilities to cater for acute surgical cases separate from elective theatre lists [5]. The rationale behind establishing emergency theatres includes improving the ease of access to theatre for acute surgery and to cut-down on the amount of unnecessary out of hours emergency surgery being conducted when there are limited numbers of staff available [6].

The dual effects of reduced resources and increased service demands have put emergency services under considerable pressure. Competing demands for resources have resulted in emergency department delays, reduced bed availability and reduced emergency theatre access. Paradoxically lack of prioritisation of emergency services may in the longer term prove to be more expensive due to increased length of stay and increased complications due to treatment delays.

The efficient running of an emergency theatre is dependent upon appropriate assessment and prioritisation of acutely ill surgical patients in order to determine the priority of one case over the other. Published guidelines have set-out appropriate time-frames for time-to-theatre (TTT) according to a patient priority system. TTT is also a key performance indicator set out in the Irish acute surgery guidelines [7].

With this in mind we aimed to examine our institutions experience with running a designated emergency theatre for acute surgical patients, using TTT as a key performance indicator. Following this, we performed a cost analysis to demonstrate the economic impact of TTT delays.

2. Methods

University College Hospital Galway (UCHG) is a tertiary referral centre for a population base of 750,000. It provides acute and elective general, orthopaedic, vascular, plastics, urological, cardiothoracic, maxillofacial, ear nose and throat and ophthalmic surgery. These services are in addition to a significant elective oncological and complex benign surgical workload. The hospital has in excess of 60,000 emergency department attendances per annum. There is one dedicated emergency theatre 24 h per day, with additional capacity when available on an ad-hoc basis in the other nine available theatres for these services. The emergency theatre in our institution is used by all the specialities above with the exception of orthopaedics which has a separate parallel emergency system.

An electronic prospectively maintained emergency theatre database was established in UCHG on the 31st December 2011. We performed a retrospective review of this database over a 12 month period between 1st February 2012 to the 31st January 2013. A priority categorisation system was used for the purpose of prioritising cases on our emergency list. Cases were divided into high, medium and low. Any child under the age of 12 was immediately categorised as high. Immediately life threatening cases that needed an operation within 30 min were also categorised as high. Medium priority cases were cases that needed an operation within 6 h and low priority cases were cases that needed an operation within 24 h.

Data collected included patient gender, patient age, patient identification number, operation, specialty, time added to list, operation start time and operation finish time. The time added to the list represented the time that the decision was made to go to theatre by the operating surgeon. Further data analysis was performed in the <16 age group and >65 age group as both of these age groups pose their own unique challenges that may interfere with TTT.

The costs were calculated according to the hospital cost of an overnight bed which currently is €1477 per night. This includes both indirect and direct costs but is exclusive of the cost of the procedure itself. We used a definition of delay as time in excess of 24 h awaiting surgery. Our calculations are based only upon delays calculated as beginning from a point 24 h after being placed on the emergency list. Statistical analysis was performed using SPSS version 20.0. Time is calculated in hours, minutes.

Table 1
Patient demographics.

	Overall	General	Urology	Plastics	Vascular
Procedures	7041	2949	1050	1687	290
Age[a] (range)	45(0–98)	43(0–96)	58(0–96)	27(0–95)	70(13–98)
Male	4243 (60%)	1487 (50%)	803 (76%)	1129 (67%)	173 (66%)
Female	2798 (40%)	1462 (50%)	247(24%)	558 (33%)	117 (34%)
<16yo	1352 (17.6%)	533	64	625	1
>65yo	1943 (27.6%)	772	433	209	203

[a] Median.

3. Results

In the 24 month period we performed the data analysis, a total of 7041 procedures were performed. Overall patient demographics are outlined in Table 1 and are further broken down as per specialty. The overall mean age was 45 years and male to female ratio was 1.5:1. 17.6% of patients were <16 years of age in the overall group and 27.6% were >65 years of age in the overall group.

Table 2 details the overall mean TTT and the mean TTT per specialty. The overall mean time to theatre was 26 h, 53 min. The general surgery mean time was on a par with the overall mean time at 23 h, 23 min. Urology had a longer TTT at 43 h, 56 min. The plastics TTT was 20 h, 8 min. The vascular mean TTT was 37 h, 9 min. However different conditions within each speciality often had markedly diverse mean TTT, with for example within vascular surgery aneurysm surgery being accelerated and amputations having prolonged TTT respectively.

The <16 year age group had a quicker mean TTT, 6 h, 34 min, compared to the overall age group (95% C.I. 0.51–2.15, $p < 0.001$). The >65 years age group had a mean TTT of 23 h, 41 min which was significantly longer than the overall mean TTT (95% C.I. 19.6–23.9, $p < 0.001$).

We next wished to compare the mean TTT for common surgical procedures to priority targets as described in the latest acute surgery guidelines [1]. Table 3 demonstrates that the mean TTT for appendicectomy was 9 h, 16 min which was outside the recommended 8 h window. However scrotal explorations were performed well within the priority target of 4 h.

Finally, having demonstrated delays with TTT in the provision of our emergency theatre, we next wished to calculate the economic impact of delayed TTT. Table 4 details where the additional costs from delays in TTT arise. In total, a figure of €7,116,425 of additional costs is generated from delayed TTT over a 24 month period. This amounted to €9883 per day over the calendar year.

4. Discussion

The development of the acute surgical model to enable improved treatment and care for acute surgical patients is a positive move to ensure that high rates of morbidity and mortality among this cohort are corrected [8–10]. Out of hours surgery and

Table 2
Mean time to theatre including overall and per specialty.

TTT	Overall	General	Urology	Plastics	Vascular
All age groups	26:02:19	23:23:08	43:56:08	20:08:29	37:09:44
<16 years	10:36:24	12:15:35	02:46:20	10:06:26	12:40:00
>65 years	36:52:59	32:12:17	53:52:59	40:56:19	37:25:27

Table 3
Appendicectomy and scrotal exploration compared to priority targets.

Specialty	General	Urology
Procedure	Appendicectomy	Scrotal exploration
No of procedures	1117	81
Priority target	<8 h	<4 h
TTT (mean)	13 h, 04 min	1 h, 07 min

delayed time to theatre are associated with increased morbidity and mortality and can be used as surrogate key performance indicators of quality of care. However there are certain issues surrounding provision of this type of service that need to be addressed. This study highlights a number of these issues.

In the first instance, we highlight the pressures incurred with admission of large numbers of acute surgical patients on a daily basis under a number of different specialties. There are often resource allocation conflicts between elective and emergency surgery. Elective waiting lists are frequently in the spotlight as politically driven targets, but it is seldom that issue is made of the acute surgical patients awaiting a procedure. We demonstrate that in this institution over a two year period for in excess of 7000 patients the TTT is greater than 24 h in over 34% of patients on the emergency list.

Another issue raised from this study is that of prioritisation. A key aspect in emergency surgery is identifying patients that need surgery urgently and determining how quickly [11]. The delays in accessing theatre in a timely fashion is a reflection of the combination of lack of theatre space available combined with a high number of actual high priority cases. The RCSI and NSW guidelines suggest priority targets for TTT, adherence to these targets requires investment in theatre space and resources.

There was a significant difference in the mean TTT per surgical specialty. In the overall age group urology and vascular patients tended to have a mean longer wait than general patients and plastics patients. Age also had a significant bearing on the trends seen in TTT within the respective specialties. Patients <16 years of age had a significantly quicker TTT in the urology group compared to all other specialties. Whilst it is important that younger age groups are prioritised, it is important to ensure the elderly populations are not overlooked when it comes to emergency surgery [12].

The cost implications calculated as a result of TTT delay were quite large. It must be noted that additional overnight bed costs were calculated following the first 24 h TTT delay period, so the overall figure may even be underestimated. At just under €10,000 per day, methods of reducing this significant cost need to be explored. The most obvious solution would be provision of an additional emergency theatre to cater for the delayed cases. In terms of running costs of an additional theatre, the only additional cost would seem to be employing extra nursing and anaesthetic personnel to cover this as the surgical team is already on site during normal working hours. It must also be appreciated that costs of the procedure itself including equipment and indirect costs such as lighting and heating will have to be incurred anyway at some stage during the patient's admission. It is clear that the 3.5 million euro per annum lost due to delays in accessing theatre could be recouped by investing some of this money in improved resources.

Table 4
Costs incurred from delayed TTT.

Hours	No. of patients	Extra nights	Cost (€)
24–48	1342	1	1,983,435
48–72	531	2	1,569,604
72–96	251	3	1,112,911
96–120	129	4	762,632
>120	168	>5	1,687,841
Total			7,116,425

This study does have limitations related to its retrospective design, although it is based upon a prospective database. It is also limited by the fact it is based on data from a single institution. However, to our knowledge this is the first study to attempt to highlight practical issues involved with running of an emergency theatre and to provide an estimate of the economic impact of these issues. We demonstrate how poor compliance to a prioritisation system and delayed TTT incur significant costs. Highlighting these issues and developing solutions will be essential to successful implementation of an acute surgical care model.

5. Conclusion

One third of patients waited longer than 24 h for emergency surgery, with the elderly disproportionately represented in this group. Aside from the clinical risks of delayed and out of hours surgery such practices incur significant additional costs. New strategies must be devised to ensure efficient access to emergency theatres, investment in such services is likely to be financially and clinically beneficial.

Ethical approval

No ethical approval was sought.

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Author contribution

DP O'Leary – Data collection, analysis and writing.
S Beecher – Data collection.
R McLaughlin – Analysis, writing and proofreading.

Conflicts of interest

None.

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