



The cost of trauma operating theatre inefficiency



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HIGHLIGHTS

- Delays in operating turnaround time result in substantial financial waste.
- Causes of delays are reported in this study.
- Trends between age, ASA score and senior clinician presence with delays were found.
- Resolving this issue could potentially save an estimated £350,000/theatre/year.

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ABSTRACT

The National Health Service (NHS) is currently facing a financial crisis with a projected deficit of £2billion by the end of financial year 2015/16. As operating rooms (OR) are one of the costliest components in secondary care, improving theatre efficiency should be at the forefront of efforts to improve health service efficiency. The objectives of this study were to characterize the causes of trauma OR delays and to estimate the cost of this inefficiency.

A 1-month prospective single-centre study in St. Mary's Hospital. Turnaround time (TT) was used as the surrogate parameter to measure theatre efficiency. Factors including patient age, ASA score and presence of surgical and anaesthetic consultant were evaluated to identify positive or negative associations with theatre delays. Inefficiency cost was calculated by multiplying the time wasted with staff capacity costs and opportunity costs, found to be £24.77/minute.

The commonest causes for increased TT were delays in sending for patients (50%) and problems with patient transport to the OR (31%). 461 min of delay was observed in 12 days, equivalent to loss of £951.58/theatre/day. Non-statistically significant trends were seen between length of delays and advancing patient age, ASA score and absence of either a senior clinician or an anaesthetic consultant. Interestingly, the trend was not as strong for absence of an anaesthetic consultant.

This study found delays in operating TT to represent a sizable cost, with potential efficiency savings based on TT of £347,327/theatre/year. Further study of a larger sample is warranted to better evaluate the identified trends.

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1. Introduction

Operating room (OR) inefficiency is a common and well recognised source of financial waste within health services [1]. Currently, the National Health Service (NHS) is facing an unprecedented financial crisis with a projected deficit of £2billion by the end of financial year 2015/16 [2]. Moreover, ongoing austerity measures

within the United Kingdom have further increased financial pressure on healthcare expenditure [3]. Although recent health policy has called for efficiency savings of £22billion by 2020 [4], this figure is viewed to be overly ambitious owing to the limitations in productivity within existing NHS services [5]. New evidence-based methods are needed to increase healthcare efficiency so that health services can remain financially viable.

As OR is one of the costliest components in secondary care [6], improving OR efficiency should be at the forefront of efforts to improve health service efficiency. Current recommendations to optimise OR efficiency include improved staff managements and

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judicious compliance with OR start time [8–10].

A single-centre service evaluation reported potential savings of approximately £3000/day in its hospital if delays of only 16 min per operation could be avoided [7]. In terms of supply management methods, regulated procurement procedures could also achieve potential savings of £500 million [11,12].

Whilst several studies have proposed different approaches to improve efficiency within different surgical specialties [13–16], there is an absence of research evaluating the cost of orthopaedic trauma OR inefficiency to the hospital. The aims of this study were to characterize and quantify delays in orthopaedic trauma ORs, as well as to estimate the cost incurred as a result of OR inefficiency.

2. Methods

2.1. Study design

This prospective study was registered as a healthcare service evaluation at Imperial College NHS Trust. An orthopaedic trauma OR was observed by a study author for 12 days during August 2015, on Mondays, Wednesdays and Fridays for 4 weeks. Data was collected using a self-designed recording sheet. Data collected included patient information (ASA, age, procedure), OR staff involved in the operation, surgical time records and reasons for delays. Surgical timing records included time patient sent for, time patient arrived for anaesthetic, time patient arrived operating room, knife to skin time, time of end of surgery and time patient left the operating room. All operations were carried out under general anaesthetic.

2.2. Data analysis

For the purpose of this study the authorship agree that turnaround time would be the surrogate measure used to evaluate inefficiency, and was defined as the time period in between one patient leaving and a subsequent patient arriving the OR. Turnaround times, TT were split into two groups: turnaround times of more than 25 min (TT > 25 min) and less than 25 min (TT < 25 min), with TT > 25 min considered a delay. ASA score, patient age, presence of a surgical consultant and presence of an anaesthetic consultant were evaluated, as individual factors, to determine whether there was a positive or negative association with turnaround time. ASA was categorized into 2 groups: ≤ 2 or ≥ 3 . Age was also categorized as either ≤ 65 or > 65 . Independent *t*-test was conducted to identify any significant differences between patient characteristics. Value of $p < 0.05$ was considered to be statistically significant.

2.3. Capacity cost of staff and opportunity cost

Capacity cost of each staff involved in the operations was calculated, with costs derived from the Unit Costs of Health and Social Care 2014 [17]. In addition to the capacity cost for the staff we also added an additional £15/min of opportunity cost to calculate the total financial loss after a delay of >25 min. Opportunity costs are the loss of income that would have been generated from utilization of the OR by national reimbursement tariffs and this has been estimated to be approximately £15/min from existing health policy research [7].

3. Results

33 surgeries were observed within the 12 days, averaging to 2.8 operations a day per OR. There were 6 days (50%) when the planned trauma list was not completed and 5 days (41.7%) of late starts

(>0900a.m.). 21/33 surgeries observed had measurable turnaround times. Surgical procedures that did not have a measureable turnaround time were those cases that were performed at the end of the day. Of the 21 turnaround times, there were 16 with TT > 25 min and 5 with TT < 25 min. The individual reasons for the 16 cases of delays are as presented in Table 1. There were 3 delays in the anaesthetic room (AR), 8 delays in sending for patients and 5 delays in patient arriving.

Mean patient age was 47.9 (4–87); mean ASA was 1.9 [1–3]; mean turnaround time was 45.7 min (13–104 min). A surgical consultant was present in 15/21 of the surgeries whilst an anaesthetic consultant was present in 14/21 of the surgeries. Individual patient data are shown in Table 2. Results of the independent *t*-test are shown in Table 3, which shows there are no significant differences between the subgroups across all 4 factors.

All operations were designated to have 9 dedicated OR staff, although it is to be noted that there were occasions where not all 9 OR staffs were present in theatre; either due to staff on sick leave, unavailability of a senior clinician or that a senior clinician chose not to be present to oversee the operation. The designated 9 OR staff included: consultant anaesthetist, trainee anaesthetist, consultant orthopaedic surgeon, trainee orthopaedic surgeon, operating department practitioner (ODP), two scrub nurses, health care assistant (HCA) and a radiographer. The overall unit cost of the OR staff would be £9.77 per minute, as shown in Table 4. The staff capacity cost in proportion to the total turnaround time is shown in Fig. 1 and illustrates the overall relationship of cost capacity with time. To quantify the overall cost of inefficiency, we have also taken into account the opportunity cost (£15/min) alongside the staff capacity cost for turnaround times exceeding 25 min. This amounted to a financial loss of £24.77/min after the 25-min turnaround. The total cost of inefficiency for delayed turnaround times is shown in Fig. 2 whereby staff capacity costs within the initial 25 min have not been included. By considering the minutes after the 25-min turnaround cut off as delays, over a 12-day period, we observed a total of 461 min in delays of turnaround times, equivalent to an overall cost of £11,418.97 or £951.58/OR/day.

4. Discussion

This study found a number of factors contributing to OR inefficiency which represent a sizable cost to the hospital. Over a 12-day period, we observed a total of 461 min in delay of turnaround times, equivalent to an overall cost of £11,418.97 or £951.58/OR/day. Extrapolation of this value would amount to £347,327/OR/year. This suggests that a hospital with 10 ORs could potentially save up to £3million annually by better control of OR turnaround time.

OR inefficiency can generally be categorized into hospital-wide or doctor-related factors. Hospital-wide factors such as availability of ward beds, transfer of patients and poor pre-operative preparations have been found to contribute the most to delays [18]. A few studies have cited doctor-related factors such as the unavailability of surgeons, anaesthetists and nurses as the primary cause of delay [19,20]. In this study, by using turnaround time as a measure for theatre efficiency, our results found both doctor-related and hospital-wide factors to be substantial, with delay in sending for the patient and delay in the patient arriving in the OR being the main causes of delay. These were due to absent consent forms, incomplete pre-operative assessment and lack of theatre staff, as shown in Table 1. Our finding that delay in sending for patients was a significant cause of delay has never been previously described in existing research. The underlying reasons for these delays were poor communication between staff and absence of a senior clinician to manage the team effectively. Difficulties with patient transport, which was a common problem at our hospital, seems to

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