

A Theatre Time Utilization Survey in a University Teaching Hospital from a Developing Country

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Abstract

Background: Previous studies from the West African sub-region have shown a high cancellation rate of scheduled elective surgeries, but no studies from the same region had looked at the efficiency of theatre time utilisation. Our objective was to identify areas of, and causes of theatre time delay, and suggests solutions based on the identified deficiencies.

Methods: Data on all patients undergoing elective surgeries were prospectively collected using a proforma to determine the duration of each step of patients' surgery starting from when patients were sent for, and ending with when patients left the operating room. The causes for delays were determined.

Results: 279 elective cases were analysed. None of the first-on-the-list cases started as scheduled. The most common cause of delay was delayed transfer of patients from the wards to the theatre, and this occurred in 104 (33.4%) cases. The time spent in transferring patients from the ward ranged between 18% and 54 % of the total time spent from ward to the end of surgery. Most delays were due to poor coordination of patients' movement between the wards and the theatre as well as long distances between the wards and the theatre.

Conclusion: Available theatre time is poorly utilized. To improve the overall efficiency of the theatre, qualitative improvement strategies should be instituted.

Keywords: Theatre; Utilization; Developing country

Introduction

Previous studies from Nigeria have shown a high rate of cancellation of scheduled surgeries on the days of surgeries [1-3]. One of the causes attributed to these delays was inefficient utilization of theatre time, mainly due to long turnaround times; causing lists overrun and postponement of cases lower on the operating lists [3]. Such cancellations inevitably lead to future inefficiency, because they swell the operation waiting list, increases the risk of further cancellations, which may cause patient's dissatisfaction and compromise patient's safety [4]. Economic considerations also suggest that it is desirable to keep operating rooms fully used. Thus, it is imperative that areas of time wastage in the theatre time flow be recognized and their causes identified. This will assist theatre managers take necessary steps to correct the problem.

This study was an investigation of theatre time utilization at the LAUTECH Teaching Hospital (LTH), Osogbo, Osun State in Nigeria. It is hoped that insights gained from the study will be useful not only to the LTH, but to other hospitals in similar resource poor settings.

Method

Setting

This prospective observational study was conducted at the LTH, a 500-bed teaching hospital and a tertiary referral centre in southwest Nigeria. The main theatre consists of three suites serving all non-obstetric, non-endoscopic elective and emergency cases in the hospital, a pre-anesthetic waiting area and a recovery room. All elective lists are scheduled to run between 8.00 am and 4.00 pm daily on weekdays (Monday-Friday). Nights, weekends and holidays are reserved for emergencies. Surgical and gynaecological departments are organized into units with each unit having an allocated time (AT) of 8-hours per week to run a list for its elective cases.

Staffing

There were 7 Porters/Nursing assistants, 13 Theatre Nurses, 3 Anaesthetic assistants, 7 Anaesthetic nurses, 3 Anaesthesia resident doctors, 3 fulltime and one locum Anaesthesiologists and 18 Surgeons in the theatre. These staffs also run the obstetric theatre which is located in another building. The head nurse in the theatre is responsible for the administration of the theatre while the head of anaesthesia. The general theatre activities are overseen by a Theatre Users Committee (TUC), with the head of surgery as the chairman. Other members are from Nursing, Anaesthesia, Administration and Technical departments.

Theatre procedure

Each unit is expected to submit its operation list to the theatre and anaesthesia department before 15:00 hours on the day before its assigned operation day. In the evening before the surgery, anaesthetists and theatre nurses are expected to do a pre-operative ward round on patients who had been scheduled for surgery. They are expected to re-assure these patients, assess their fitness for surgery, and also check to see that these patients have paid the necessary hospital fees.

Patient is not sent for until surgeon arrives in the theatre. Porters

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or nursing assistants are sent to the wards to bring the patient. When patient arrives in the theatre, he/she is received by a designated theatre nurse, who will check to confirm the identity of the patient, see that consent for the surgery had been given and all necessary hospital fees paid. Thereafter, the patient is wheeled to a reception area where he/she is kept on-hold until the theatre room is ready. All other procedures like intravenous access and induction of anaesthesia are done in theatre. After surgery, the patient is taken to the recovery room while the operating room is cleaned in preparation for the next patient.

Data Collection

We surveyed the timing of events in the main theatre using the three operating lists available daily for elective cases in the LTH over a 6-month period. We designed a proforma based on established operating theatre process steps where the following were documented [5].

- A. Patient sent-for (PS): Time when patient was sent for
- B. Patient available (PA): Time the patient arrived in the theatre
- C. Time patient was wheeled to the pre-anaesthesia waiting area
- D. Patient in room (PIR): time when patient enters operating room
- E. Procedure/surgery start time (PST): Time incision was made
- F. Patient out of room (POR): Time at which patient leaves the operating room

From the above times, we derived the following:

Ward to theatre transfer interval: the interval between PS and PA (B-A). This interval is prolonged when it is greater than 20 minutes.

Handing-over time: represents how long it takes the patient to be received by the nurse receptionist in the theatre. It is the interval between patient available and when patient was transferred to the pre-anaesthetic waiting area (C-B). It is prolonged if it is greater than 10 minutes.

Pre-anaesthetic waiting time: the difference between patient's arrival in the pre-anaesthesia waiting area and PIR (D-C). It is prolonged when it is greater than 20 minutes.

Anaesthesia preparation time (APT): the interval between PIR and PST (E-D) and it is prolonged when it is greater than 20 minutes.

Surgery duration: the interval between PST and POR (F-E).

For each interval, the cut-off point between normal and delayed time was based on the mean time observed during one week of pilot study, to which we added 25% of the observed mean time and for convenience, rounded-up the resulting value to the nearest number divisible by five. When a delay has occurred, the hospital personnel involved in such delay were interviewed to determine the causes of the delay. This method was used when the delay occurred outside the theatre. When delays occurred in the theatre, the interviews were augmented with direct observations by the person filling the proforma.

Total transfer time (TTT): This is the combination of PS and handing over time (B-A) + (C-B); it is an indicator of the efficiency of the transport process between the wards and the theatre.

Other data on the proforma included whether there was a delay at any of the stages above and the causes of such delays, the grade of surgeon performing the surgery (consultant or registrar), details of the case (age, sex, planned procedure), number of patients on the list for the

day, patient's position on the list and number of cases done. The data was collated by a non-theatre staff blinded to the objectives of the study.

The data was entered into SPSS 11.5 which was used to calculate the time intervals and for statistical analysis.

Results

We studied 279 elective surgeries on 121 operation lists. The median number of patients per list was 4 with a range of 1 to 7. In 50 cases (17.9%), only one surgery was done on the list, two in 116 cases (41.5%), three in 58 cases (20.7%), four in 35 cases (12.5%), and five in 20 cases (7.2%). All cases were done when only one patient was on the list, this fell to 81.0% and 36.7% completion rate when two and three patients were on the lists respectively. With more than three patients on the lists, the completion rate fell to zero.

Starting time

One hundred and twenty one patients were first on their respective lists. The PS of more than 50% of these patients was after 9:00 hours (Table 1). The earliest incision time was 9:17 hours; most falling between 9:30 and 10:00 hours.

Ward to theatre transfer interval

The mean transfer time from the ward was 18 minutes with a range of 2 to 85 minutes. One hundred and four (37.3%) of the cases had a prolonged transfer time (>20 minutes). Three of the wards (Male Surgical, Female Surgical and Paediatric Surgical) which are in a building approximately 250 metres from the theatre accounted for 89 (85.6) episodes of the delayed transfers while the closest ward (Male Orthopaedic) which is about 15 metres from the theatre had only 3 episodes and all 3 were because of delay in procuring blood from the blood bank. The most common cause of delay in bringing patients to the theatre was either due to the failure of the ward staff to make the patient ready or in combination with long distance from the wards in 76 (73.1%) cases, followed by conflict with duty change-over procedures in the wards in 14 (13.5%) cases, porters went to the wrong wards in 7 (6.7%) cases, blood bank was responsible in 3 cases and patient came late to the ward in one case.

Patient sent-for (PS)	Number (Percentage)	Cumulative percentage
7:30-7:39 Hours	3 (2.5)	2.5
8:00-8:29 Hours	47 (38.9)	41.4
8:30-8:59 Hours	10 (8.3)	49.7
9:00-9:29 Hours	38 (31.4)	81.1
9:30-9:59 Hours	7 (5.8)	86.9
10:00-11:30 Hours	16 (13.1)	100
	121	100

Table 1: Patient sent-for time of number one patient on operation lists

Timing event	Median (Minutes)	Range (Minutes)
Total Transfer Time (TTT) ^a	20	5-84
Duration of surgery	91	30-270
Ward to End of surgery time (TT) ^b	151	80-248
TTT as a percentage of surgery duration	26.4%	5-200%
TTT as a percentage of TT (TTT/TT)x100	15.9%	3-54%

^aRepresents the time spent in transferring the patient from the ward to anaesthesia waiting area. ^bRepresents the time between patient sent for to surgery end

Table 2: Theatre timing events.

Handing over time

The median handing over time was 5 minutes ranging from 2 to 27 minutes. Twenty-one cases were delayed beyond 10 minutes, 13 (61.9%) of these were because consents had not been taken, 5 (23.8%) because patients had not paid for the necessary fees, and remaining 3 cases (14.3%), because the nurse receptionist was not available to receive the patients.

For most patients, the time spent in transferring them from the ward (TTT) was a sizable proportion of the total time spent by the patient from ward to end of surgery (Table 2).

Pre-anaesthetic waiting time

The mean pre-anaesthesia waiting time was 19 minutes and it ranged from 1 to 115 minutes. Sixty-three (23.4%) cases were delayed beyond 20 minutes; 45 (71.4%) of these were due to ongoing surgery and the remaining 18 (28.6%) were caused by OR cleaning and preparation.

Anaesthesia preparation time (APT)

The mean induction time was 19 minutes, ranging from 2 to 78 minutes. In 52 (18.6%) cases, the induction time was prolonged beyond 20 minutes; 43 (82.7%) of these were caused by difficulty with intubation or delay in instituting regional anaesthesia, 7 (13.5%) due to difficulty with establishing an intravenous line and the remaining 2 (3.8%) due to power outage. The mean induction time for spinal anaesthesia was 26 minutes which was significantly longer than the mean induction times for general anaesthesia (17minutes) or local anaesthesia (10 minutes) ($p=0.001$).

Discussion

Our study showed a high rate of delays of OR procedures. Many of these delays were avoidable and could have been minimized by a more effective utilization of OR time and schedule. Previous studies suggested that there is a high incidence of delay in the start time of the first case on the list with some studies reporting incidence of delays above 90% [6,7]. Our data showed that the situation is worse in our hospital; with none of the first-on-the-list procedures starting on time. Even though the official working day starts by 8:00 hours on weekdays, only 6 (2.1%) patients were sent for by that time and the earliest incision time was 9:17 hours. Peri-operative nurses (PON) are very reluctant to send for patients if the consultant surgeon is not in the theatre, and they will do so only on exceptional circumstances. However, we observed that many surgeons arrived in theatre usually after 8:00 hours; reasons adduced included the need to attend morning reviews, emergencies and lectures. It means that many patients are only sent for after 8:00 hours. Thus there is a need to correct this avoidable waste of theatre time schedule by ensuring that good communication between surgeons and peri-operative nurses. Since the mean ward-to-theatre transfer time was 18 minutes, PON and nursing assistants who are on night shifts can be instructed to send for the first patients on the list at least 20 minutes before 8:00 hours, so that by that time, patients are already in the theatre.

More than one-third of the cases experienced delays in transferring patients to the theatre. The hospital layout could have contributed to some of these delays because some wards are far from the theatre that even if there was no delay in the ward, it would still have taken about 15 minutes to go, and come back from them. Findings in literature suggest that proximity of surgical services to one another is crucial to efficient time utilization and the location of hospital services have important ef-

fects on the processes of care [8]. Even then, several causes of delays would have been mitigated if there was good coordination between the wards and the theatre such that the nurses on the wards, being aware of the patient-sent-for time, would have prepared such patients for the transfer. Such cases caused by nurses not being available on the ward, or nurses handing-over would have been avoided. In the alternative the ward nurses can be prompted through intercom the moment a patient is sent for.

Though the handing over period is the shortest interval in patients' transit to the OR, it is a step that could for most patients, be eliminated entirely. Most delays occurring during this period were because consents were not obtained by resident doctors on the ward. These errors could have been corrected if a careful pre-operative round was conducted the previous night by surgeons, PON and anesthesiologists. To ensure that nothing important is missed or omitted during preoperative rounds, the use of a checklists have been suggested [9]. This will ensure that required information are structured to enhance communication of the required information, and to ensure that all team members possess accurate and explicit data, and decisions are made in a context where cross-checking can occur. At that time, patients can be categorized into three: a first group comprising of patients who satisfied all conditions on the list, a second group who were not ready but who could still be made ready before commencement of surgery (e.g. a patient who has not signed the consent form) and a third group who would not be ready (for example, a patient with upper respiratory tract infection). Only the second group would need checking at the handing-over point; the first group should skip this point and the third group need not come to the theatre at all.

We referred to the combination of ward to theatre transfer as the total transfer time (TTT). Our data showed that TTT was responsible for a large proportion of time wastage and delayed procedure start time.

While delays in ward-to-theatre transfer and handing over can be viewed as wastage of time and resources, the delays in the pre-anaesthesia waiting area are more difficult to interpret. For the second and subsequent cases on the list, the pre-anaesthesia waiting time could be used to improve theatre efficiency because it could serve as a holding interval. For example, to compensate for the effects of delayed transfers, the next case could be sent for, and kept in the waiting area when it is estimated that the current surgery will end in about 30-60 minutes. To mitigate the effect of the pre-anaesthesia waiting time delays, this time can be used to prepare the patient for the surgery, for example, intravenous lines can be set-up, patient preloaded and peri-operative antibiotics given. This time could also be usefully utilized for anaesthesia activities so that actual surgery could commence the moment patient is positioned on the operating table. In essence, when the pre-anaesthetic waiting time is optimally utilized as suggested, then the anaesthesia preparation time (APT) is reduced to the barest minimum. This is, however, possible only if there is a separate anaesthesia induction room, which is not available in our hospital.

A more coordinated approach to scheduling would certainly have reduced the average anaesthesia induction time in the study. Seven cases with prolonged induction time were secondary to difficulty in placing IV line. The overall effect of this would have been avoided or minimised if cannulation had been started while the patient was in the pre-anaesthesia holding area. Spinal anaesthesia had a significantly longer induction time than general anaesthesia. Preloading the patients in the pre-anaesthesia waiting area would help to reduce the time.

Our data imply that the hospital will not succeed in improving the-

atre efficiency unless it tackles each problem in the process, beginning with the result-oriented preoperative round by surgical, anaesthetic and nursing staff. Providing more and better equipment and improved staffing in the theatre will be a way of improving the system, but will be insufficient unless all other sources of problems receive attention. Because the OR is a multidisciplinary environment, obtaining meaningful improvement in its efficiency requires the participation of not only the nursing, anaesthesia and surgical services [9], but also other hospital departments like the blood bank, laboratories, emergency services and technical departments. Thus, decisions involving OR efficiency requires coordination of and input from these departments in the hospital. Communication has been identified as being the most important factor influencing surgical care services and team performance [8]. There is a need to coordinate information and care across different parts of the surgical care service so that efficiency is improved. This can be done through the use of theatre managers or through improvement in the function of the existing theatre users committee (TUC).

Currently, there are no procedures on ground to formally identify causes of delays. The TUC should be empowered not only to identify bottlenecks in theatre efficiency, but to enforce adherence to laid down procedures, and to discipline erring personnel. Every hospital is unique in terms of its service, staffing, demographics of the region, work-ethics and culture [6]. Considerable operating theatre time is wasted while patients are transferred to the operating theatre in our hospital. This has implication on hospital income generation and patient waiting list. However, when staff remuneration are not dependent on hospital generated income, and there are no laid down procedures to ensure efficient utilization of resources, the incentives to generate revenue for the hospital may be low [3]. Thus, to improve the overall efficiency of the theatre, a general overhaul of the hospital procedure is required and a quality improvement strategy should be instituted. Our findings provide important data on areas of, and causes of delays in the theatre in our hospital. We are not sure if our observation is similar to what

obtains in other public funded hospitals in Nigeria or other low-mid income countries.

This study should serve as a wake-up call to start instituting quality improvement strategies in many hospitals in low resource countries.

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