RESEARCH ARTICLE

Operation theatre time utilization during emergency surgeries at a government institute of trauma in Karachi, Pakistan

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Abstract

Objective: To evaluate operation theatre time utilisation during emergency cases.

Method: The prospective, observational study was conducted at the Shaheed Mohtarma Benazir Bhutto Institute of Trauma, Karachi, from January 17 to April 17, 2020, during which the three dedicated emergency operating rooms at the centre were monitored for time from transferring the patient to the operation theatre till the patient was shifted out after surgery. Data was analysed using SPSS 24.

Results: Of the total 1,287 surgeries performed, 625(48.56%) were included. Of them, 373(59.7%) patients were shifted to the operation theatre once it was ready, while 252(40.3%) were shifted in advance. There were 474(75.8%) male patients, and 151(24.1%) were females. The overall mean age was 32.7±17.4 years (range: ≤1 year to ≥47 years). Mean time of patient transfer to the operating room was 1:17±1:52 hours:minutes. Delay was recorded in 133(35. 6%) cases who were shifted from location when the operation theatre was available. It was caused in 64(17.15%) cases by surgical teams, another emergency surgery in the operating room 24(6.4%) and operating room cleaning 19(5%). The mean waiting time in the holding area was 1:25±1:21hours:minutes, and mean time from induction to surgical incision was 0:34±0:32 hours:minutes. Delays was caused by trainee surgeons in 79(12.64%) cases, and prolonged preoperative patient preparation in 99(15.84%). Mean turnover time was 0:48±0:42 hours:minutes. Delay was caused by post-operative unavailability of ambulance transportation 29(15%), and intensive care unit bed availability 14(7.2%).

Conclusion: Time utilisation of emergency operation theatres can be maximised by improved overall coordination.

Key Words: Government institute, Emergency, Operation theatre, Time utilisation.

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Introduction

Trauma centres are amongst the busiest operation theatres (OTs), and, therefore, efficient utilisation and time management are of utmost importance to ensure that resources are appropriately utilised, delays and cancellations are minimised, and patient care is not compromised. Moreover, major resources of any hospital are invested in its OTs.[1] Effective time utilisation is essential for an efficient OT and depends upon trained staff, adequate facilities, equipment and central sterile services department (CSSD) capacity. Additionally, good communication among surgical, anaesthesia, and OT team members facilitates effective utilisation of available OT hours.[2]

The Shaheed Mohtarma Benazir Bhutto Institute of Trauma (SMBBIT) was established in 2016 to serve the city of Karachi, which has a population of over 25 million.[3] SMBBIT caters mainly to patients belonging to the provinces of Sindh and Balochistan, providing care, free of cost, and is funded by the Sindh government.

Trauma is one of the leading causes of morbidity and mortality in Pakistan.[4] In 2019, 13,885 surgeries were performed at SMBBIT. Two-third of them were emergency surgeries in fields that included general surgery, neurosurgery, orthopaedic, and vascular surgery in trauma and non-trauma cases.

The current study was planned to analyse OT utilisation time and to identify deficiencies at each step of the process.

Methods

The prospective, observational study was conducted at SMBBIT, Karachi, from January 17 to April 17, 2020, and focussed on the 3 dedicated emergency room (ER) OTs that remain functional round the clock; OT Nos 8, 9 and 10. After approval from the institutional ethics review committee, the sample was raised with the aim of selecting one case from each of the 3 OTs from each of the three shifts (morning/evening/night) per day. The

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selection was conducted using electronic computer randomisation. The sample size could not be calculated because studies on OT time utilisation are generally conducted in relation to elective surgeries[5].

Emergencies surgeries in the 3 dedicated emergency OTs regardless of age and gender were included, while elective surgeries were excluded.

At the SMBBIT ER-OT, booking a patient for emergency surgery is initiated by a call from the surgeon requesting OT availability. The time the OT in-charge receives the surgeon's call is noted in the Booking Register along with the patient's name, procedure, surgeon's name, mobile/extension number, department, and OT availability status. Problems that may arise subsequently are also documented. The surgeon is informed when the OT becomes available, and the time of this communication is recorded. Surgeons often shift the patient in advance of OT availability in the interest of saving time.

For the purpose of the study, various time intervals were defined in the light of literature that are recorded in OT registers.[6]

Patient transfer time meant time taken for the patient to be transferred to the OT reception after OT availability was communicated to the surgical team. Time >30 minutes was considered a delay.

Handing-over time was the time taken for the patient to be received by the nurse in the pre-anaesthesia holding area after registration at OT reception. Time >10 minutes was considered a delay.

Pre-anaesthesia waiting time was the time the patient was retained in the holding area for surgery preparation and anaesthesia evaluation. Time >20 minutes was considered a delay.

Anaesthesia preparation time was the time interval from when a patient entered the OT and induction was completed. Time >20 minutes was considered a delay.

Induction to incision time was the time interval from when the anaesthesiologist completed induction and the first incision was performed by the surgeon. Time >15 minutes was considered a delay.

Duration of surgery was the time from the first incision to when the patient left the OT.

Turnover time was the time between one patient was shifted out and the time when the OT was ready for the next patient. Time >25 minutes was considered a delay. This segment was applicable only when the second case was already booked to be operated immediately after the first case on a particular OT table.

Data was analysed using SPSS 24. Data normality was checked for independent continuous variables, such as time intervals. All dependent variables were categorical. The level of significance of the variables were used for inferential analysis. Mean and standard deviation were calculated for continuous variables, while frequencies and percentages were calculated for categorical variables. Student t-test was used to compare mean differences between two continuous variables. Mean time differences were calculated through date and time Wizard by subtracting variables of the recorded time. One-way analysis of variance (ANOVA) test was used to compare the significance of association and mean differences among more than two continuous variables in terms of hours:minutes (h:m). $P<0.05$ was considered statistically significant.

Results

During the three-month period, 1,392 surgeries were reserved for ER-OT, but 105(7.5%) were cancelled, primarily because of reversed decision of the surgical team 27(25.7%) cases, or being declared unfit after anaesthesia evaluation 37(35.2%) (Figure 1). As such, 1287(92.4%) studies were conducted. Of them, 625(48.5%) surgeries were monitored. In 373(59.7%) cases, patients were shifted to the OT once the OT reception communicated the availability to the surgical team, and in 252(40.3%) cases, the patients were shifted in advance to wait in the holding area.

Out of 625 patients, 474(75.8%) were males and

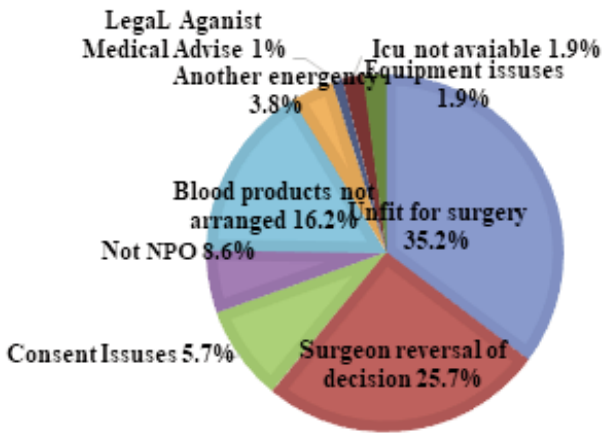

Figure-1: Reasons for cancellation of emergency surgeries.

Table-1: Description of the emergency surgeries studied.

Variables	n (%)
Age (years)(Mean ± SD)	32.7±17.4
≤1-16	96(15.4)
17-46	390(62.4)
≥47	139(22.2)
Gender	
Male	474 (75.8)
Female	151(24.1)
Emergency Operation Room (OR) Utilisation	
OR-8	222(35.5)
OR-9	224(35.8)
OR-10	179(28.6)
Location from Which Patient Shifted to Operation theatre	
Emergency Room (ER)	464(74.2)
Surgical Intensive Care (Institute of Trauma)	28(4.5)
Surgical Intensive Care (Civil Hospital)	06(1.0)
High Dependency Unit (Institute of Trauma)	09(1.4)
Wards (Institute of Trauma)	53(8.5)
Wards (Civil Hospital)	65(10.4)
Type of Surgery	
Trauma	206(32.9)
Non-Trauma	419(67.0)
Specialty Performing Surgical Procedure	
General Surgery	371(59.4)
Neurosurgery	126(20.2)
Orthopaedics	60(9.6)
Ear Nose Throat	34(5.4)
Vascular	13(2.1)
Plastic	9(1.4)
Oral Maxillo-Facial	5(0.8)
Internal Medicine	4(0.6)
Paediatrics	3(0.5)
Type of Anaesthesia	
General	511(81.8)
Spinal	32(5.1)
Nerve Block	26(4.2)
Local	56(9.0)

SD: Standard deviation.

151(24.1%) were females. The mean age of the sample was 32.7±17.4 (range: ≤1 year to ≥47 years). There were 222(35.5%) surgeries performed in OR No. 8, 224(35.8%) in OR No. 9 and 179(28. 6%) in OR No. 10. With respect to the three shifts, 218(34.8%) were performed in morning, 200(32%) in evening, and 207(33.1%) in night shift.

Overall, 464(74.2%) cases were shifted to OT directly from ER, 206(32.9%) were trauma-related, 371(59.4%) were general surgery cases, 126(20.2%) neurosurgery, and 60(9.6%) orthopaedics cases. General anaesthesia (GA) was performed in 511(81.8%) cases (Table 1).

Various time intervals for the 3 ER-OTs showed significant values (Table 2).

The mean time of transfer from the location to OT after it became available in 373(59.7%) patients was 0:46±1:07h:m, with delay recorded in 133(35. 6%) cases, caused in 17(4.6%) cases because the surgical team could not be reached, and in 28(7.5%) cases the senior surgeon or the surgery residents 19(5.1%) arrived late to OT after being informed.

The mean handing-over time from OT reception to the pre-anaesthesia holding area in 373(59.7%) patients was 0:5±0:07h:m, with no delay documented in 360(96.5%) cases.

The mean waiting time in the pre-anaesthesia holding area in 373(59.7%) patients was 0:26±0:45 h:m, with delay in shifting to OR in 64(17.2%) cases. The most common cause of delay was another emergency in 24(6.4%) cases and delayed OT cleaning in 19(5.1%). Among the 252(40.3%) patients in the holding area, the mean waiting time was 1:25±1:21h:m.

The overall mean induction time was 0:18±0:18h:m, with delay in 183(29.3%) cases, caused mostly in surgeries performed by trainees 79(12.6%), and in surgeries conducted during evening and night shifts 56(8.96%).

Mean time from induction to first incision in the sample was 0:16±0:14h:m, with delay in 134(21.4%) cases. Prolonged preoperative patient preparation in OT caused delay in 99(15.8%) cases. The mean duration of surgery was 1:57±1:20h:m.

The mean turnover time was applicable in 193(30.9%) cases, and it was 0:48±0:42h:m. In 102(52.8 %) cases, delay was related to

Table-2: Operation theatre (OT) time utilisation.

Operation theatre Time Intervals	Average Time Utilisation in operation theatre Mean ± SD (Hours: Minutes)	95% CI	*P*-value
Time to transfer patient from location to OT reception once theatre is available	373(0:46±1:07)	0:39-0:53	<0.005
Handing Over Time from OT Reception to Pre-anaesthesia Area	373(0:05± 0:07)	0:04-0:06	<0.005
Pre-anaesthesia Area to Operation Room	373(0:26±0:45)	0:22-0:30	<0.005
Time to Induction by Anaesthetist in Operation Room	625(0:18±0:18)	0:17-0:20	<0.005
Time from Induction to First Incision	625(0:16 ± 0:14)	0:15-0:17	<0.005
Turnover Time	193(0:48± 0:42)	0:42-0:54	<0.005

SD: Standard deviation, CI: Confidence interval.

Table-3: Cause of delays in emergency operation room (OR).

Time Utilisation with delays	Hours: Minutes (Mean ± SD)	Mean delay time (Hours: Minutes)
Time to transfer patient from location to OT reception once theatre is available ≥30 minutes		
No reason documented	(1:22±1:20)	(1:45±1:25)
Another Emergency	(2:54±2:09)	
ICU bed post-op not available	(1:20±0:46)	
Long distance from CHK	(1:37±1:36)	
Poor coordination between surgeon and OT or ward staff	(1:23± 0:54)	
Surgical resident not available	(1:41± 0:59)	
Surgeon not responding to call when theatre became available	(1:42±0:58)	
Senior surgeon not available	(1:19±0:33)	
Handing Over Time from OT Reception to Pre-Anaesthesia Area ≥10 minutes		
No reason documented	(0:36±0:00)	(1:9±0:18)
Staff Nurse not informed by receptionist	(0:30±0:05)	
Bed not available in the holding area	(0:40±0:15)	
Patient shifted without information	(0:30±0:05)	
Delay receiving by staff nurse	(0:25±0:00)	
Pre-anaesthesia Area to Operation Room ≥20minutes		
Another Emergency	(2:20±1:41)	(1:28±1:15)
Operation Theatre Under Cleaning	(0:43±0:08)	
Pre-anaesthesia Evaluation	(1:15±1:30)	
Consent from Patient	(1:04±0:26)	
Labs awaited	(1:01±0:17)	
Blood Products not arranged	(1:09±0:44)	
Surgeon not available in the holding area	(1:15±0:42)	
Time to Induction by Anaesthetist in Operation Room ≥20minutes		
No reason documented	(0:36±0:11)	(0:39±0:21)
Anaesthesia trainees	(0:44±0:17)	
Anaesthetist busy in other surgery	(0:31±0:34)	
Difficult intubation	(0:38±0:10)	
Inadequate anaesthesia equipment	(0:54±0:31)	
Anaesthesia Technician Not available	(0:35±0:07)	
Difficult venous access	(0:34±0:08)	
Time from Induction to First Incision ≥15minutes		
No reason documented	(0:45±0:08)	(0:36-0:17)
Pre-operative preparation	(0:35±0:14)	
Surgical trainee	(0:35±0:11)	
Supplies issues	(0:45±0:08)	
Required surgeon not available	(1.16±1:07)	
Turnover Time ≥25minutes		
No reason documented	(0:50±0:00)	(1:16±0:41)
Patient Transportation from OT	(1:31±0:43)	
ICU Bed not available	(1:32±0:44)	
Surgeon Not available	(1:21±0:36)	
OT Cleaning	(0:41±0:09)	
Blood Products not ready	(1:43±0:57)	
Labs awaited	(1:07±0:32)	

OT: Operation theatre, ICU: Intensive care unit, CHK: Civil Hospital, Karachi.

postoperative patient transportation from OT back to Civil Hospital, Karachi (CHK), in 29(15%) cases it related to waiting for the ambulance, and ICU bed availability was the cause in 14(7.2%) cases (Table 3).

The time to transfer 133(35.65%) patients from location to OT reception once the OT was available was higher (105mts) delays in the other time intervals (Figure 2)

Discussion

OT utilisation and monitoring are key performance indicators, with delays indicating poor efficiency and wasted resources.[7] Most studies on OT time utilisation have been in the context of scheduled elective surgeries. Veen-Berkx et al. reported that dedicated ER-OTs, as is the case with SMBBIT, are ideal for OT utilisation and minimising case cancellations.[8]

In the current study, transfer of patient from the original location to OT reception area once the OT was available was the most common cause of delay. A Nigerian study reported similar findings.[9] This can be prevented with improved communication amongst the multidisciplinary teams in OT and ensuring that surgeons are present at the time of OT availability.[10] Parasyn AD et al. reported that provision of on-site consultant-driven surgical leadership in a public-sector hospital improved ER-OT utilisation from 57% to 69% during the day, with overall more efficient use of the entire OT block.[11] A study in India reported that the most common reason for delay was related to shifting of the patient from the original location to OT.[12] Availability of ICU beds post-operatively is also essential for smooth patient flow.[10]

The current study noted that once the patients reached the OT reception area, they were processed expeditiously and admitted to the pre-anaesthesia holding area,

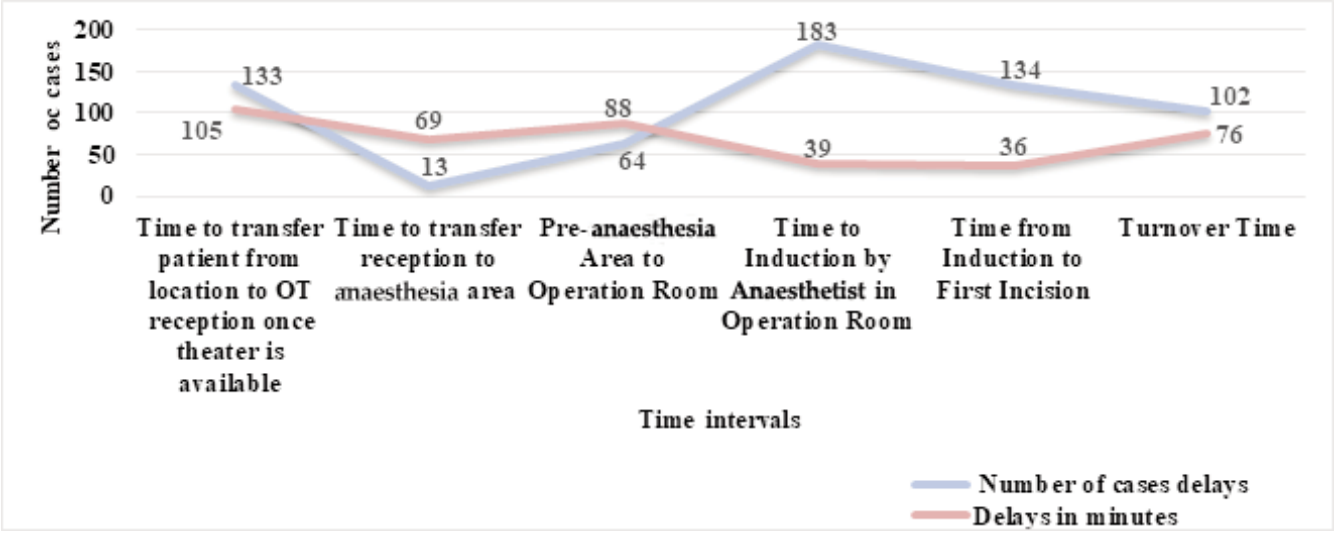

Figure-2: Comparison of delays in emergency surgeries..

though a shortage of beds in the holding area was encountered in a few cases. It is commendable that many patients were sent in advance to wait in the holding area in the interest of saving time.

Deficiencies were also identified in the pre-anaesthesia holding area, suggesting that patient evaluation by anaesthetists, proper screening, arranging blood supply, and obtaining consent was not done in a timely manner and must be rectified. A study in Nepal estimated an average time of 717 minutes from patient arrival at ER to start of surgery, and factors associated with delays included non-availability of OT (59.8%), preoperative interventions (23.9%), logistics/finances of the patient family (13%), arrangement of blood (10.9%) and other supplies (9.8%), obtaining consent (5.4%) and nursing staffing issues (3.3%).[13]

The SMBBIT has recently taken steps in the right direction by hiring more anaesthetists, and conducting most pre-anaesthesia assessment of ER patients in the pre-anaesthesia holding area. In 2021, a blood bank was inaugurated on the premises, improving the efficiency of blood supply. The most appropriate time for taking consent from a patient for surgery should be before arrival at the OT, and this should be a pre-requisite for further processing at the OT reception. The current study identified the need for further expansion of the pre-anaesthesia holding area. A study found that OT utilisation is affected by the non-availability of beds in the recovery room (18.6%), emphasising the need in our OT for a separate post-anaesthesia recovery room for greater efficiency.[14]

Further, a study described how the introduction of a separate induction room in 2006 at a trauma centre, along with an improved care process, resulted in a 23.1% reduction in non-operative time in OTs and a 9.7% increase in efficient utilisation.[15] A study in Rwanda noted that a quarter of elective surgeries had delays in the induction time due to unavailability of equipment and supplies, insufficient staffing, difficult spinal and intravenous (IV) lines, and medical students performing the intubation.[16]

In teaching hospitals, the duration of surgery is prolonged by 70% owing to the presence of residents and trainees. The teaching of an anaesthesia resident has been associated with delays in anaesthesia procedures.[7] At SMBBIT, senior anaesthesia consultants were not always available during evening and night shifts, but, fortunately, enhanced consultant coverage in all the three shifts is available since early 2021. Further studies are needed to see how this element has an impact on efficient OT utilisation.

Time from completion of induction to the first incision was delayed in about a fifth of the current cases. Preoperative patient preparation, which is presently done by a surgical team once the patient is on the OT table, was a significant contributing factor to the delay, emphasising the importance of a separate room for induction and preoperative preparation, as has been shown earlier.[14] A study in the United Kingdom recommended using a preoperative checklist, and also that junior staff should be encouraged to talk freely to the seniors, thus overcoming hierarchical barriers.[17]

The turnover time indicated delays in most of the current cases, with a mean duration of over one hour. A well-functioning OT should ideally have <10% prolonged turnovers of >1 hour.[18] Talati et al. in India recorded a mean room turnover time of 25.86mts.[19] Fletcher D et al. achieved a 45% reduction in turnaround time in planned surgeries by introducing interventions in a step-wise approach.[20] Mohinder Kumar et al. found that turnover time increases in ER surgeries due to surgeon changes, more involved anaesthesia assessment, high-risk consent, procurement of drugs and equipment for anaesthesia, and prolonged OT cleaning time.[21] The current study did not find any delay occurring in procuring necessary drugs and equipment, which is commendable for a public-sector institution in a developing country. Though there is an OT cleaning policy in place, it requires review for improved efficiency in the context of ER surgeries.

In the current study, most of the cancellations were due to a lack of fitness for surgery or reversal of a decision by the surgical team. A study in Saudi Arabia reported that cancellations were patient-related in 42.81%, facility-related in 20.03%, improper work-up in 9.45%, anaesthesia-related in 1.45%, surgeon-related in 7.19%, and change in the treatment plan in 1.29% cases.[22] Masood et al. also found that 14.4% cancellations were due to the un-optimised condition of the patient.[23]

In addition to the suggested interventions, OT staff should be motivated by various incentives to minimise the delay in OT utilisation.[10] Providing lunch to OT staff was shown to lead to shorter turnover time, and would certainly be highly appreciated by the staff.[24] Recently, Employee of the Month appreciation has been introduced at SMBBIT and has been well received.

Though our manual registers are well-maintained, computerisation of data regarding time intervals with training of staff in its proper maintenance will allow for more efficient monitoring with improved standards.[25]

The limitation of the current study is that it relied on a manual review of multiple registers with the possibility of errors and missing information that a robust computerised data system could have obviated.

Conclusion

Time utilisation of ER-OT could be maximised with improved coordination with the surgical team and enhanced consultant coverage. A separate induction and pre-operative preparation room, efficient OR cleaning between cases, and a dedicated OT ambulance service were found required.

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