Audit of orthopedic trauma theatre usage: Observation from Secondary Regional Referral Hospital, Oman

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ABSTRACT

Background: The operation theatre complex is an important pillar of any hospital and its optimum and efficient functioning reflects on the overall functioning of any busy hospital. There is no study done till date on the operation theatre utilization (OTU) in Oman and its cost effectiveness. This audit is carried out on the utilization of orthopedic trauma theatre, which can be used as reference for other specialty operation theatres and overall theatre efficiency in our hospital. Methods: Prospective audit was carried out over period of 1-year in Department of Orthopedics, Nizwa Hospital and data collected from our hospital were analyzed. All the components of the operation theatre were taken into account to arrive at theatre utilization, end utilization (EU), and operating timing. Results: Totally, 853 cases were electively operated upon during from 1st January 2011 to 31st December 2011 in orthopedic operation theatre, which was run for 261 days electively during that period. 74% cases started later than scheduled time with average of 22.8 min late start time. The total operating time was 81% of the total allocated theatre time with a mean of 05:15 h. The total surgical and anesthesia time (63%) and (15%), respectively. Changeover time was 70.39 h (4%) with average of 22.6 min and no useful activity amounted to total of 310.32 h (18%)based on above calculations it amounted to EU of 94% and OTU of 81.8%, respectively. 4.2% cases were cancelled for various reasons. **Conclusion:** The various reasons for underutilization of the orthopedic operation theatre are due to delay in starting list, increase changeover time, anesthetic, surgeon, and administrative factors. The corrective measures which can be applied to improve this have been discussed.

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Received: March 21, 2015 **Accepted:** April 02, 2015 **Published:** April 10, 2015

KEY WORDS: Audit, orthopedic, operation theatre, trauma

INTRODUCTION

Trauma is a leading cause of admission to our hospital and its unpredictability along with mismatch in demand and supply requires more use of resources and system streamlining. The operation theatre is described as the engine room of the hospital [1]. To run this engine efficiently and to maximum utilization requires coordinated activity between all personnel involved. It also represents large proportion of the hospital budget and its maximum utilization is therefore important to ensure optimum cost benefit [2]. The cost of the healthcare is increasing every year and the situation for orthopedic trauma surgeon is complicated by increasing trauma in this part of world which in turn increases the demand on orthopedic operation theatre.

There is no audit from Gulf region on the orthopedic operation theatre usage. The present study is undertaken to assess theatre utilization in our hospital and identify areas where improvement could be done, which in turn can be applied to other surgical specialties in our hospital.

METHODS

This prospective audit was carried out in 303 bedded regional referral Nizwa Hospital in the Department of Orthopedics. The hospital has fully dedicated one orthopedic operation theatre working 5 days a week (Saturday to Wednesday), with one anesthetist and three operation theatre personnel separately assigned to it. The operation electively is operational from 07:30 h to 14:00 h with no scheduled break amounting to 390 min/day. The same is used for emergency trauma surgery between 14:00 h to 7:00 am following day. The operation theatre complex is located on the same floor as the surgical wards and consists of four operation theatres along with one common patient recovery room. There are 2-3 porters for the whole operation theatre complex responsible for moving the patients to and fro from the ward to operation theatre.

A total of 853 cases were electively operated upon during 12 months period from January 1, 2011 to December 31, 2011 in orthopedic operation theatre, which was run for 261 days electively during that period. Cases performed on public

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holidays or during weekend (Thursday/Friday) and after 14:00 h were excluded and classified as emergency procedures. The data were recorded from the time the patient entered the operation theatre (Enter operating time [OT]) to the time he left (Exit OT). The data were recorded for surgical, anesthesia, change over, total OT, respectively and calculations made for other variables as shown in [Table 1].

RESULTS

The orthopedic operation theatre in our hospital was functioning for 261 days during year 2011 and total of 853 cases were operated upon during this time [Table 2]. 632 cases (74%) started later than scheduled time with average of 22.8 min late start time. Delay in starting the list was due to late arrival of surgeon (22.2%) or anesthetist (28%) 50.2% cases. Delay due to late or incomplete preparation of the patient or transportation of patient accounted for 44.4% cases. Other causes of delay such

Table 1: Definition of various terminologies used in audit

ATT	Time from schedule start to finish of theatre session
ST	Time from start of incision to closure of incision
	(End surgery-start surgery)
AT	(Exit OT-Enter OT)-ST
СТ	Time when one patient exits the OT and next patient enters
LST	Time lost at start of OT list due to delays
NUA	Difference between the schedule finish time and the actual
	time the last patient exits the operating theatre.
	NUA 1-(AT+ST+CT+LST)/ATT×100%
0T	ATT-CT
EU	AT+ST/0T×100%
OTU	AT+ST+CT/ATT×100%

ATT: Allocated theatre time, ST: Surgical time, AT: Anesthesia time, CT: Changeover time, LST: Late start time, NUA: No useful activity,

0T:	Operation	time,	EU:	End	utilization	. 0 U T:	Operation	theatre	utilizatior
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Table 2: Operations	done during	period from	1 st Janua	ary to 31°
December 2011				

Month	Number of working days	Total N operations	Mean of operations	
January	23	64	2.7	
February	19	65	3.4	
March	23	65	2.8	
April	22	93	4.2	
May	23	65	2.8	
June	22	67	3.0	
July	23	57	2.4	
August	22	74	3.3	
September	20	66	3.3	
October	23	89	3.8	
November	18	67	3.7	
December	23	81	3.5	
Total	261	853	3.24	

Table 3: Time distribution in operation theatre

as physician or anesthesia review prior to surgery accounted for 5.4% of the delay.

The total OT was 1403.02 h accounting for 81% of the total allocated theatre time (ATT) with a mean of 05:15 h. The total Surgical and anesthesia time was1 076.35 h (63%) and 256.28 h (15%), respectively. Changeover time was 70.39 h (4%) with average of 22.6 min and no useful activity (NSU) amounted to total of 310.32 h (18%) [Table 3]. Based on above calculations it amounted to end utilization (EU) of 94% and operation theatre utilization (OTU) of 81.8%, respectively. The period between end of one surgery to start of next surgery averaged 51 min. 11.9% (102/853) cases finished before 14:00 h accounting for 151:44 h (8% of the ATT). This loss can be avoided if standby cases are kept fasting tentatively to be done instead of cancelled cases. Total of 36 cases (4.2%) were cancelled for various reasons as enumerated in [Table 4].

DISCUSSION

The efficient utilization of the operation theatre complex in any hospital is important for many reasons. First for clearing the waiting lists, second for financial considerations, and last if not least it serves as the index of surgeon's efficiency. Theatre time as per NHS release is said to cost 400 sterling pounds/h excluding consumables [3]. The audit will help to understand the scheduling of elective operation list, shortcomings, and measures to make it more cost efficient.

Late starting of lists (LST)

This problem is acknowledged worldwide. In the present study, 74% cases started late with average of 22.8 min after scheduled time which is unacceptable. The main reason for LST was anesthetics related problem and nonstandardization of start time. Vinukondaiah et al. [4] and Ricketts et al. [5] have reported 40% and 94% delay in starting surgery respectively. The average delay in starting time of 22.8 min in our series was unacceptable as induction of anesthesia should start at the scheduled start time and hence LST should be zero. Other authors [5-7] have also reported average delay of 26.5, 18, and 18.8 min, respectively. This problem needs multidisciplinary approach with involvement of Ward/theatre in charge, senior surgeon, anesthetist preferably of consultant grade to ensure that the OT list starts on time [7]. It has been observed that anesthetists are unhappy to anesthetize a patient unless the surgeon is around [5]. Presence of consultant anesthetist and surgeon at the start of operation list and during it will surely decrease the delay in starting the list. Pre-operative discussion with

Year (2011, January-December)	ATT (h)	Total OT (OT=ATT-CT) (h)	ST (h)	AT (h)	CT (h)	Time wasted (NUA) (H)
Total (%)	1713.34	1403.02 (81)	1076.35 (63)	256.28 (15)	70.39 (4)	310.34 (18)

ATT: Allocated theatre time, ST: Surgical time, AT: Anesthesia time, CT: Changeover time

Table 4: Reasons for cancellation

Reason	Ν	%
Lack of time	23	63.9
Lack of fitness	8	22.1
Emergency surgery	4	11.1
Consent delay	1	2.8
Total	36	100

the ward and OT staff about the scheduling of cases and pre-operative preparation will go a long way in preventing delay in smooth starting and subsequent delay between cases thereby increasing the utilization of operation time.

Operating Timing

The total OT in our series was 81% of the total ATT, which is comparable to other studies 91.5% [4], 60% [5], 48% [7], and 82% [8]. The mean total OT in our setup was around 05 h 15 min per day which is short. This can be attributed to shortage of anesthetist, only one available OT and many public holidays and weekends, which in turn decrease the availability of operating room.

Changeover Time

The general observation is that longer the duration of surgery the associated changeover time is also longer [2]. The changeover time ranges from 3.6 min in pediatric surgery to 23.4 min for cardiothoracic surgery with average time of 14.1 min [2]. For trauma surgery which is usually longer the approximate standardized changeover time is set around 15 min. Our changeover time of 22.6 min is more than the acceptable standardized. Changeover time can be quicker by the presence of consultant surgeon [5]. Architectural changes in operation theatre complex in form of having OT with inbuilt induction and early recovery room so that the anesthetist can induce in induction room and early recovery from anesthesia takes place in recovery room from where the patient after some time can be transferred by nursing staff to main recovery area without need of anesthetist to accompany the patient and he can proceed with preparation of next patient in neighboring anesthetic room [9]. By such architectural changes it has been found that non-operative time (anesthetic and changeover time) was reduced by 29 min. Other commentators have suggested to improve this problem by having surgeon run two operation theatres simultaneously [7].

End Utilization

Audit commission UK has set77% as standard target for EU time [10]. In our study, it was 94% compared to other studies Ricketts *et al.* 60% [5], Durain 75% [6], and Delaney *et al.* 78.8% [7]. The only problem is that surgical and anesthetic times are overestimated in arriving at EU time as we are adding the time taken in positioning, preparation of patient as positioning, draping, dressings, plaster application, and transfer of patients onto bed in our calculations. Therefore further

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refinements in auditing are required to consider these variables in order to arrive at accurate EU time [7].

Operation Theatre Utilization

In our study, the operating theatre utilization was 81.8%, which is less than set standard of 85-90% (8) taken however with standard changeover time of 15 min, which shows that extra average 7.6 min changeover time in our series needs to be deducted from each changeover time which would leave us with final theatre utilization of around 70.2% which is much below the standard.

Day of Week

There was no significant statistical difference about the number of operations performed during the days of week Saturday to Wednesday. There was however the late start of list on Wednesday by around 20 min due to morning departmental CME on that day.

Grade of Surgeon and Anesthetist

In our series, 82% of the operations were done with the Senior surgeon of the rank of senior specialist scrubbed. There was no difference in timing of surgery performed by a specialist and junior specialist. Complicated procedures took more time, but if carried out by senior surgeon timing was reduced due to their faster operating speed. Turnover time was shortest for senior surgeons and senior anesthetist. Specialist and junior specialist administered anesthesia in 73% cases. Delay in starting the list was found to be more with junior anesthetists.

CONCLUSION

Operation theatre being area of maximum and complex activity in any hospital, it needs multipronged strategy to improve its utilization continuously with regular theatre committee meetings to discuss and anticipate problems, chalk out new ideas, strategies the foremost among them being to start OT list in time, minimize changeover time to acceptable15 min, aligning demand and supply, maximizing theatre utilization within the existing resources.

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Source of Support: Nil, Conflict of Interest: None declared.