

ORIGINAL ARTICLE

OPERATING ROOM EFFICIENCY IN A TERTIARY CENTER IN ETHIOPIA

Abraham Genetu¹, Yonas Ademe¹, Tsegazeab Leake², Habtamu Aderaw³, Abebe Bekele^{4,5}

ABSTRACT

Background: Operating room (OR) efficiency is a measure of how well time and resources are used for their intended purposes in the operating room. Commonly used parameters are cancellation rate, first case start-time, turnover time, and utilization rate. While previous similar study from our hospital showed inefficient OR utilization, the difference in performance among available ORs has not been described.

Methods: A cross sectional study was done at Tikur Anbessa Specialized Hospital, 550 bed tertiary teaching hospital, from November 2, 2020, till Jan 22, 2021. Out of total 9 operating rooms, four, i.e., Gastrointestinal, Gynecology, Pediatric Surgery and Endourology operating rooms were studied for efficiency parameters.

Results: Out of the 570 patients listed for surgery, 404 were operated. The average cancellation rate was 27.3%, the highest being for Gynecology OR (41.5%) and lowest for Pediatric Surgery OR (18.2%). Average start time was 8:43am (SD = ± 25min). Start time was delayed by 43 minutes from the agreed 8:00 am. Only 2.5% of OR days were started within agreed time. Mean turnover time for all ORs was 25.2 minutes, the highest being for Gynecology OR (35min) and lowest for Pediatric Surgery OR (14min). Average OR utilization was 6hrs 30 min, which was 72% of the daily allocated 8hrs time.

Conclusion: Our operating rooms have a high cancellation rate and delayed start time. Turn over time and OR utilization were in general acceptable. There were significant differences in efficiency parameters across the four ORs. The OR manager in collaboration with all teams should work on improving start time and cancellation rates, and also identify why some ORs performed better than others while in the same institution.

Keywords: Operating Room, Efficiency, Cancellation Rate, Turn over time, OR Utilization, Start time, Surgical Volume

INTRODUCTION

Operating room (OR) is one of the most resource-intensive service areas in hospitals which can represent up to 40 - 60% of total hospital supply expenditure (1). Having efficient ORs can have implications in reducing surgical waiting lists, improving the hospital's financial status, and overall patient satisfaction (3). An efficient OR is one that starts early, finishes on time, uses minimal time in between the cases, and has a low cancellation rate (2).

Different metrics have been suggested to measure OR efficiency. The commonly used efficiency assessment parameters include cancellation rates, first case start-time, turnover time (the time between two consequent cases), turnover time, prediction bias, post-anesthesia care unit delays, OR utilization time, and excess staffing cost. Improving some of these efficiency metrics is one of the strategic pillars of the Ethiopian Save Lives through Safe Surgery Initiative (4).

So far, there is no validated list of efficiency parameters that can be replicated in different setups. A scoring system utilizing some of these parameters to assess the quality of OR suite functioning from the hospital's perspective was suggested by Macarino (5). It utilizes the above-mentioned parameters with score points given to each. However, the scoring system has not been reproduced and validated by other studies.

Except for the cancellation rate, assessment of other efficiency parameters remains uncharted territory in the literature (6–8). The majority of studies from Ethiopia also focused on cancellation rate only (6,9,10). The first study that used five efficiency parameters was from Tikur Anbessa Specialized Hospital by Negash et al (2). While they studied all the elective operating rooms in the hospital and reported compiled findings, the possible efficiency difference in each operating surgical unit was not described. In the current study, we described the efficiency of four of the nine ORs which can be helpful for future quality improvement programs.

The objectives of this study were to use four efficiency indicators in selected ORs and assess differences in efficiency among them. This study can also be an addition to the growing list of studies focusing on the efficiency of OR, so that eventually a comprehensive list of efficiency assessment tool can be developed.

¹ Assistant Prof. of Surgery, Cardiothoracic Unit, Department of Surgery, College of Health Sciences, Addis Ababa University, Ethiopia.

² Associate Prof of Neurosurgery, Department of Surgery, College of Health Sciences, Addis Ababa University, Ethiopia.

³ Chief Urology Resident, Department of Surgery, College of Health Sciences, Addis Ababa University, Ethiopia.

⁴ Professor of Surgery, Cardiothoracic Unit, Department of Surgery, College of Health Sciences, Addis Ababa University, Ethiopia.

⁵ Deputy Vice-Chancellor, Dean, School of Medicine, University of Global Health Equity, Rwanda.

Corresponding Author: Abraham Genetu, Email: abraham.genetu@aau.edu.et Phone: +251939095075

METHODS

Study setup:

This study was done at Tikur Anbessa Specialized Hospital, which is a 550-bed tertiary teaching hospital in Addis Ababa, Ethiopia. The hospital has 9 operating rooms for elective surgery. Each room is assigned to a specific surgical unit or department. Data were collected for a period of three months from November 2, 2020, till Jan 22, 2021 (199 OR days), from four of the nine operating rooms; Gynecology, Gastrointestinal Surgery, Pediatric Surgery, and Endourology.

Study design

A cross-sectional descriptive study design was used.

Sampling:

Among the nine ORs, 4 were taken by a draw because of the limited resources available to study all the nine ORs.

Operational Definitions

For this study, we utilized first-case start time, turn over time, OR utilization time and cancellation rate as indicators of efficiency.

- **Start time** – is the time first case entered into OR. The hospital's agreed start time is 8:00 am for patient entry. Delayed start time is defined as first case entry into OR after 8:15am.
- **Turnover time** – is the time it takes from the previous patient out till the next patient comes into OR. We used a turnover time of <25 minutes to show good performance (5) .
- **Operating Room utilization** - the proportion of time within the working hours in which a patient was in the operating room (does not include turnover time). We used 70 - 80% OR time utilization as efficient utilization(11). This was calculated as used OR time during the day divided by the hospital's working hour (8hrs).
- **Cancellation rate** – is the proportion of cases canceled from those scheduled to be operated on each day. We used a rate of <2 - 5% to consider efficient OR utilization. Cancellation data were collected daily by OR coordinators.

Data collection, quality and analysis

Data collection format was developed by authors and pretested. Data collection was made by assigned nurses and monitored by the operating rooms coordinator. Authors had performed weekly random cross checking for correctness and reliability. First case entry, first case incision time, first case out of OR time, next case(s) entry time and out of OR time, last case out of OR time and cancellations of the day were collected for each OR. Data were entered and analyzed using SPSS version 22. Descriptive statistics was applied to show the results of different efficiency parameters.

Ethical considerations

Ethical approval was obtained from the department of surgery research committee.

RESULTS

3.1 Overall OR Performance and Cancellation Rate

Data were collected from Nov 2, 2020 till Jan 29, 2021. There were a total of 89 days, out of which 24 were weekends and 3 were public holidays leaving 62 working days. This equates to 248 OR days for the four ORs studied. Among these, 199 OR days (80.2%) had patients scheduled, and at least one patient operated on, while 49 OR days (19.8%) were missed. 14 OR days were missed by Gynecology OR because no patient was scheduled. Twenty one and eight OR days were missed by Gynecology and GI teams, respectively because all patients were cancelled, and no other patient was replaced for surgery on the day of surgery. Maximum number of cases operated per day was four. {table 3.1}

During the study period, out of the 570 patients listed for surgery, 404 were operated on 199 OR days making the overall cancellation rate 27.3%. Cancellation rate was the highest with Gynecology OR at 41.5% and lowest with Pediatric surgery OR at 18.2%. (figure 3.1)

Table 3.1. Operating room performance during the study period among four operating units

Endourology OR	2.3	144	45	23.8
Pediatric Surgery OR	2.8	152	29	18.2
Gynecology OR	1.2	35	29	41.5
Gastrointestinal OR	1.4	73	34	38.1
	Average number of cases per day	Number of Operated cases	Cancelled cases	Cancellation percentage

Figure 3.1. Overall OR Performance Across Four Operating Units

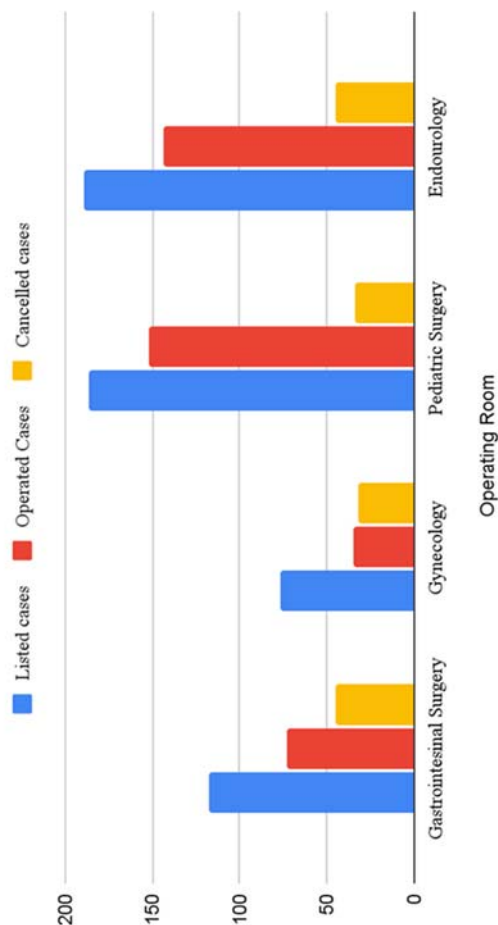
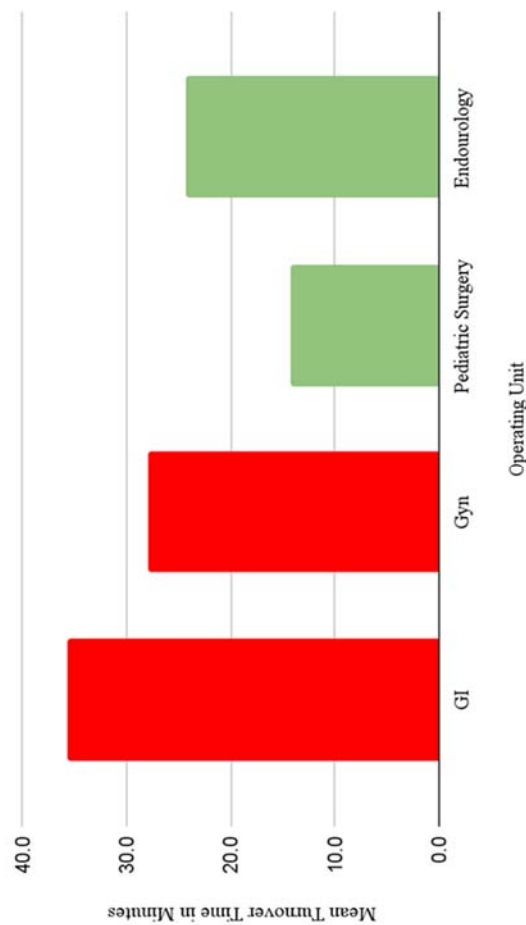


Figure 3.2. Mean turnover time in minutes across the four operating rooms



3.2. Start time

In this study, the average time across the four operating rooms patients entered theatres was 8:43am ($SD = \pm 25\text{min}$). Start time, as defined by first case entry into OR, is delayed on average by about 43 minutes from agreed 8:00 am. Segregated by operating theatre, the start time for the four operating units (GI Surgery, Gynecologic surgery, Pediatric Surgery and Endourology) were 8:51am, 9:13, 8:37, and 8:36 am, respectively. Start time was within 15 minutes of agreed time in only 2.5% of OR days, and the difference between start times was statistically significant (ANOVA $p = 0.001$).

3.3. Turn over time

From the 199 OR days, 131(65.8%) had more than one case, and hence turn over time was calculated. Mean turnover times for Gastrointestinal, Gynecology, Pediatric surgery and Endourology units were 35min, 28min, 14 min and 24 minutes, respectively. Total mean turnover time for all ORs was 25.2 ± 31 minutes. An ANOVA test showed a significant difference between ORs (p -value of 0.048). {Figure 3.2.}

3.4. OR Utilization

Mean OR utilization time for Gastrointestinal, Gynecology, Pediatric surgery, and Endourology units was 6hrs 31min $\pm 91\text{min}$, 6hrs 46min $\pm 109\text{min}$, 7hrs $\pm 14\text{min}$ and 5hrs 48min $\pm 46\text{min}$ respectively. Average OR utilization was 6hrs 30 min $\pm 83\text{min}$, which is 72% of the daily allocated 8hrs time. Lowest utilization rate was 15.6% by Gynecology OR and the highest utilization rate was 133.2% by Pediatric Surgery OR.

DISCUSSIONS

Cancellation causes anxiety, stress, and disruption of life for patients and families in addition to the obvious impact on the overall efficiency of the ORs and wastage of resources(7,12). In our study the cancellation rate was 27.3%, which was lower than findings from previous studies (33.9%, 35.8%)(2,10). This could be explained by the fact that we excluded OR days on which all patients were canceled.

The striking finding in our study was that the cancellation rate varied from 18.2% to 41.5% in between different OR tables in the same institution. While the hospital should work on reducing the cancellation rate to the recommended level (2 - 5%), it is worth noting that any improvement projects should consider the variable efficiency of the different OR tables and address the reason for the issue (5,13,14).

Different institutions define start time differently. Some use the time first case when given anesthesia medications, and others first case incision time, but the most widely accepted definition of start time is the time of first case entry into OR(15). Starting on time reduces wastage of scheduled theatre time, associated overtime costs, unplanned cancellations and increases the capacity to have more elective surgery (13). There are two ways of assessing start time tardiness, one is calculating average start time and comparing the time of delay from the agreed start time for the OR assessed, and the second is to calculate the percentage of OR days when start time was delayed from agreed start time. Macario suggested a definition of late start time when OR starts at least 45 minutes, others allow only up to 15 minutes of grace time(5,13). In our study, only 2.5% of OR days started within 15 minutes of the agreed start time, which is comparable to a previous study (6.6%)(2). Meantime of start time was also 8:43 am, which is 28 minutes late beyond the grace period. Assessing the reasons for delay could be important to improve start time.

While up to 25 min of turnover time is recommended for cleaning of the OR and preparation for the next patient, prolonged turnover time can be a significant source of delay and overall theatre inefficiency (16). The average turnover time of our ORs was found to be 25.2 minutes which is similar to that of the previous study from the same institution(2). This is an acceptable finding, but there is still a statistically significant difference between different OR tables turnover time that requires further study to identify the reasons.

Start time and turn over time show how early the OR was started to be used, and how quickly subsequent patients were wheeled into OR, respectively, however, they fail to describe for how long during the day the OR was in service. For this reason, the addition of OR utilization as another parameter can help fill this information gap. Acceptable OR utilization by most institutions is 75 – 80% and American Hospital Association has set a value of 75%(13,15). Overall OR utilization in our study was 72% but ranges from 15.6% to 133.2%. A previous study from the same hospital also reported a wide range from 10.5%—174% (2).

Even though the average OR utilization of 72% is acceptable according to international recommendations that suggest 70 - 80 % utilization as efficient, our findings show that there were underutilization and overutilization whose average could deceive as a good utilization rate (3,5). Both underutilization and overutilization should be discouraged. OR utilization should also be interpreted along with other parameters to have a better picture. For example, a delayed start time with good OR utilization could mean that staff are working after the normal working hours to finish the already started or scheduled cases. For this reason, the addition of another parameter, the 'last case out of OR time', could help differentiate whether the OR utilization is within or beyond the normal working hours.

CONCLUSION

Our operating rooms have a high cancellation rate and delayed start time. Turn over time and OR utilization were acceptable. There were significant differences in efficiency parameters across the four ORs. The OR manager in collaboration with all teams should work on improving start time and cancellation rates, and also identify why some ORs in same institution performed better than others. While OR is a complex environment to assess its efficiency completely, continuous monitoring using at least few of the available parameters could have a positive impact on overall performance. Future studies should also focus on development of easily reproducible and scorable OR efficiency assessment tools.

LIMITATION

The data analysis included only if at least one patient was operated at the selected OR during the day. However, during data collection we noticed that there were days when no patient was listed or when no patient was operated on because all listed patients were cancelled. Excluding these data may undermine the actual efficiency metrics like cancellation rate. Above all, literature in evaluating OR efficiency is not robust. Utilized efficiency metrics are not yet validated.

CONFLICTS OF INTEREST

Authors declare no conflict of interest.

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