

# Theatre efficiency

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**Keywords:** theatre efficiency, theatre utilisation, OT time, OT cancellations

## Introduction

Productivity and efficiency can be defined in various ways depending on the industry in question. The Agency for Clinical Innovation (ACI) Surgical Services Taskforce defines productivity as “the quantity of *outputs* produced per unit of *input*. It is calculated by dividing average output per period by the total costs incurred or resources (capital, equipment, labour) consumed in that period”.<sup>1</sup> Such outputs in the theatre environment would translate to completed surgery, for instance, hip replacement, aortic valve replacement or total abdominal hysterectomy. This productivity can be measured for a single operating theatre (OT), theatre complex, a surgical subunit or across different hospitals.<sup>1</sup> Efficiency, on the other hand, can be described in two contexts, namely, input-orientated or output-orientated. Input-orientated efficiency is considered when the same output can be produced from fewer inputs, whereas output-orientated efficiency considers whether an output can be produced using the same inputs. In the theatre setting, time is the main focus when defining efficiency, where the reduction of time related to input levels translates into efficiency. The minimisation of wasted time, unused time and maximising output will translate to efficient production of surgical cases.<sup>1</sup>

As OTs account for a large proportion of a hospital's total expenses,<sup>2</sup> inefficiency in the OT is a significant waste of healthcare resources.<sup>3</sup> Efficient management of OTs is essential to ensure that health outcomes are optimised even in the case of limited resources,<sup>3,4</sup> and that costs are contained, patient flow is improved and elective waiting lists are cleared.<sup>2</sup>

## OT efficiency

A focus on OT efficiency enables a greater use of available surgical resources. It allows for the delivery of surgery within the existing resources. Adequate metrics on OT efficiency are required in order to have enough information to adequately monitor and manage OT efficiency. Measures that are useful for OT efficiency include OT utilisation, time (anaesthetic care time, first case on-time start, turnover time, overrun and underrun times) and cancellations on the day of surgery.<sup>1</sup>

## OT utilisation

OT utilisation refers to the ratio of utilised theatre time/total theatre time.<sup>5</sup> It is an important measure to determine whether the available OT capacity is optimally utilised for all the booked cases. Maximisation of OT utilisation reduces cancellations, OT overrunning with resultant overtime staff costs and improves the overall patient flow. OT utilisations measures the productive time over available time. The overall OT utilisation rate can be examined at individual theatre level or speciality units. A number of phases need to be specifically measured to determine OT utilisation. It is dependent on the length of surgical procedures. For example, shorter surgical procedures result in more cases per session and a higher amount of turnover time between cases than longer procedures, meaning the utilisation rate for short procedures will not be as high as longer ones with less turnover time. A utilisation rate of approximately 80% is generally considered reasonable.<sup>1</sup>

## Time and OT efficiency

In the OT setting, efficiency mainly focuses on time, meaning that for each level of input, reductions in time translate into efficiency. Efficient production of surgical cases requires that time use is optimised, wasted and unused time is minimised, and output for a level of inputs is maximised.<sup>1</sup> There are numerous factors in the perioperative space that influence the utilisation of time in the OT. Such factors include: surgical scheduling accuracy, starting on time, minimising procedure time variation, turnover time, interoperative delays and postoperative bed management.<sup>1</sup>

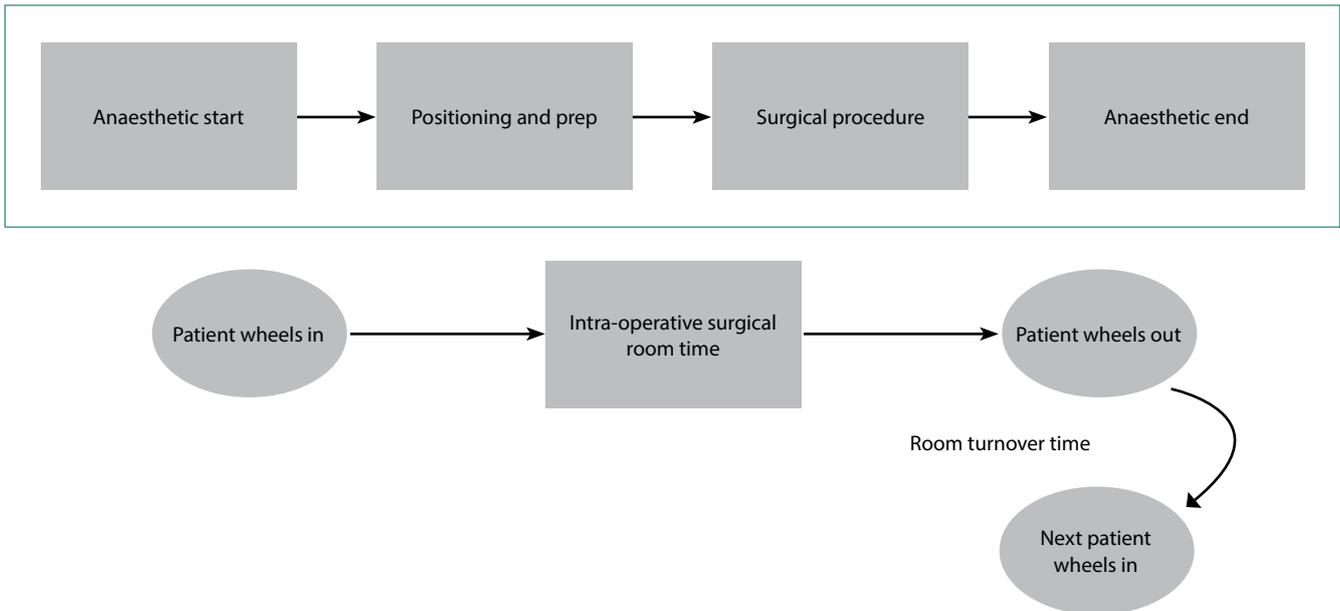
The possible phases outlining OT time are illustrated in Figure 1.<sup>1</sup>

## Anaesthetic care time

This refers to the time from the start of anaesthesia, when the anaesthetist is preparing the patient,<sup>5</sup> to the end of anaesthesia.<sup>1</sup> Anaesthetic care time can be a valuable measure to review if the OT utilisation is significantly below 80%.<sup>1</sup>

## First case on-time start

Delay in starting the first case of the day is one of the factors that contributes to perioperative delays.<sup>1</sup> Starting the theatre list on



**Figure 1:** The phases outlining OT time<sup>1</sup>

time reduces wastage of scheduled theatre time, over-runs and unplanned cancellations.<sup>1,6</sup> Improvements in the starting times are associated with increases in productivity<sup>1,7,8</sup> and theatre list length reductions and overrun times.<sup>1,9-11</sup> First case on-time start measures the difference between the actual time the first patient on the list enters theatre, and the theatre list scheduled start time. Therefore, it acts as an indicator that promotes theatre efficiency.<sup>1</sup>

### **Turnover time**

Refers to the time when the patient exits theatre to the next patient entering the theatre.<sup>1</sup> This time between theatre cases in minutes is sometimes referred to as change-over time.<sup>5</sup> This differs per case and speciality. The longer the turnover times, the lower the OT efficiency.<sup>1</sup>

### **Overrun and underrun times**

Overrun time is the time above the scheduled OT time. This translates into overtime costs. Underrun lists refer to those that run below the scheduled theatre time. This results in the under-utilisation of the total theatre time available, allocated staff time, hence, inefficiency and cost implications. Overruns and underruns in the planned OT time are commonly due to inadequate scheduling, lists starting late, cancellations and increased turnover times.<sup>1</sup>

### **OT cancellations and theatre efficiency**

A focus can be put on a particular aspect of theatre efficiency such as OT cancellations. Measuring cancellation rates and reasons on the day of surgery is a measure to assess OT efficiency and it is internationally accepted.<sup>5</sup> The underlying factors that contribute to cancellations can be examined in order to correct them. An institution can set a target for the overall proportion of cancellations on the day of surgery, for example, a target of < 2%

can be a set target. Reasons for cancellation can be classified into patient-related and hospital-related.<sup>1</sup>

#### **Patient-related factors:<sup>1</sup>**

- Patient failed to arrive
- Pre-existing condition
- Patient unfit for surgery
- Patient not fasted
- Patient not adequately prepared for surgery
- Surgery no longer needed

#### **Hospital-related factors:<sup>1</sup>**

- Out of OT time
- Bed availability
- Equipment problems
- Staff availability
- Blood products shortages

### **Measures and performance indicators of theatre efficiency**

The question of what data should be gathered in order to determine OT efficiency always arises. In order to clarify the data inputs, the measures, performance indicators (PIs) and key performance indicators (KPIs) used to describe efficiency will need to be defined.<sup>1</sup> A measure represents "an agreed concept of quantification",<sup>1</sup> such as the number of open heart surgeries performed in a month. Whereas, a PI is a type of performance measure which "can be compared against acceptable standards, past performance or targets",<sup>1</sup> for example, the weekly OT utilisation rate. A KPI arises from the strategic goals of the organisation or department and is a crucial component of the organisation's success. It is aligned with objectives and strategy of the organisation, and should therefore drive the behaviour that is consistent with those objectives.<sup>1</sup> For example, reducing

the waiting list of elective cases to less than 30 days. The term metrics can be used as an encompassing term for measures, PIs and KPIs.<sup>1</sup>

When selecting metrics to measure OT efficiency and productivity, the practicality of collecting such data should be considered. Surgical specialities have varying OT performance profiles. For example, cataract surgeries done as day cases have considerably different performance metrics than cardiothoracic surgery.<sup>1</sup> Therefore, a performance metric should be speciality-based and aligned to the objectives and strategy of such a

surgical speciality. The metrics selected should enable the department to respond to three simple questions:<sup>1</sup>

- How are you performing?
- How does this compare to your state peer facilities?
- How does this compare to national/international benchmark?

OT performance cannot be described using a single metric. Departments require a minimum set of metrics to best reflect performance and to provide room for improvements.<sup>1</sup> OTs that require a multitude of healthcare professionals and support staff to work in harmony in order to function efficiently. For the OT to

**Table I:** Cardiac theatre metrics and patient mapping (Developed by Drs I Taunyane and HJ Moutlana)

	Theatre	Time (hrs:mins)	Comments
Ward			
<ul style="list-style-type: none"> <li>• Time patient sent</li> <li>• Time left for theatre</li> </ul>			
Theatre			
<ul style="list-style-type: none"> <li>• Time of arrival at theatre reception</li> <li>• Time patient left theatre waiting area</li> <li>• Time on theatre table</li> </ul>			
Scrub nurses			
<ul style="list-style-type: none"> <li>• Preparation time</li> <li>• Preparation readiness</li> </ul>			
Perfusionists			
<ul style="list-style-type: none"> <li>• Time of arrival</li> <li>• Time cardiopulmonary bypass (CPD pump ready)</li> </ul>			
Anaesthesia			
<ul style="list-style-type: none"> <li>• Time of registrar arrival</li> <li>• Time of consultant arrival</li> <li>• Times of invasive lines insertion</li> <li>• Time of induction</li> </ul>			
Surgeons			
<ul style="list-style-type: none"> <li>• Time of registrar arrival</li> <li>• Time consultant called</li> <li>• Urinary catheter insertion</li> <li>• Positioning</li> <li>• Surgical site preparation</li> <li>• Time consultant arrived</li> </ul>			
Procedure			
<ul style="list-style-type: none"> <li>• Cleaning and draping</li> <li>• Skin incision</li> <li>• Sternotomy</li> <li>• CPB started</li> <li>• Aortic cross clamp on</li> <li>• CPB off</li> <li>• Skin closure</li> <li>• Wound dressing</li> </ul>			
Intensive care unit (ICU)			
<ul style="list-style-type: none"> <li>• Time bed ready</li> <li>• Bed outside theatre</li> <li>• Time ICU ready to receive patient</li> <li>• Time patient left theatre</li> <li>• Time of patient arrival in ICU</li> </ul>			
<b>Challenges (record any factors affecting theatre utilisation)</b>			
Interviews			
<ul style="list-style-type: none"> <li>• Nurses</li> <li>• Porters</li> <li>• Cleaners</li> <li>• Theatre reception staff</li> <li>• Anaesthetists</li> <li>• Surgeons</li> <li>• Perfusionists</li> </ul>			

operate efficiently, each team member must provide their skill set in a manner that takes into account time constraints.<sup>12</sup> Table I outlines OT metrics and patient mapping developed specifically for a cardiothoracic theatre at Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) in Johannesburg, South Africa.

Roberts et al.<sup>12</sup> developed a simple intervention tool designed to improve communication between healthcare teams, and concluded that such a tool can have a significant impact on the services provided to patients.

### Conclusion

Theatre efficiency is dependent on various factors and a structured tool to examine those factors is important in improving efficiency. The utilisation of a structured tool that considers metrics such as theatre utilisation, time components and reasons for OT cancellations can help ensure efficient OT use. Involvement of the entire personnel responsible for OT efficiency can help address the possible barriers detrimental to OT efficiency.

### Acknowledgements

The article was submitted as a supplement for the Fellowship of College of Anaesthetists of South Africa Part 2 Refresher Course 2021.

### Conflict of interest

The author declares no conflict of interest that would have influenced the writing of this article.

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### References

1. ACI Surgical Services Taskforce. Operating Theatre Efficiency Guidelines. 2014. Available from: [https://aci.health.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0004/252436/operating-theatre-efficiency-guidelines.pdf](https://aci.health.nsw.gov.au/__data/assets/pdf_file/0004/252436/operating-theatre-efficiency-guidelines.pdf). Accessed 12 Sept 2021.
2. Macario A. What does one minute of operating theatre room time cost? *J Clin Anaesth.* 2010;22:233-6. <https://doi.org/10.1016/j.jclinane.2010.02.003>.
3. Soliman BAB, Stanton R, Sowter S, Rozen MW, Shahbaz S. Improving operating theatre efficiency: an intervention to significantly reduce changeover time. *ANZ J Surg.* 2013;83:545-8. <https://doi.org/10.1111/ans.12013>.
4. Peltokorpi A. How do strategic decisions and operative practices affect operating room productivity? *Health Care Manag Sci.* 2011;14:370-82. <https://doi.org/10.1007/s10729-011-9173-8>.
5. Van As AB, Brey Z, Numanoglu A. Improving operating theatre efficiency in South Africa. *South Afr Med J.* 2011;101(7):444-8.
6. Pandit JJ, Abbott T, Pandit M, Kapila A, Abraham R. Is 'starting on time' useful (or useless) as a surrogate measure for 'surgical theatre efficiency'? *Anaesthesia.* 2012;27:823-32. <https://doi.org/10.1111/j.1365-2044.2012.07160.x>.
7. Foglia RP, Alder AC, Ruiz G. Improving perioperative performance: the use of operations management and the electronic health record. *J Pediatr Surg.* 2013;48:95-8. <https://doi.org/10.1016/j.jpedsurg.2012.10.022>.
8. Russel RA, Burke K, Battis K. Implementing a regional anesthesia block nurse team in the perianesthesia care unit increases patient safety and perioperative efficiency. *J Perianesth Nurs.* 2013;28:3-10. <https://doi.org/10.1016/j.jopan.2012.06.007>.
9. Ahmed K, Khan N, Anderson D, et al. Introducing the productive operating theatre programme in urology theatre. *Urol Int.* 2013;90:417-21. <https://doi.org/10.1159/000345312>.
10. Cyma RR, Brown MJ, Hebl JR, et al. Use of lean and six sigma methodology to improve operating room efficiency in a high-volume tertiary-care academic medical center. *J Am Coll Surg.* 2011;213:83-92. <https://doi.org/10.1016/j.jamcollsurg.2011.02.009>.
11. Bethune R, Sasirekha G, Sahu A, Cawthorn S, Pullyblank A. Use of briefings and debriefings as a tool in improving team work, efficiency, and communication in the operating theatre. *Postgrad Med J.* 2011;11:83-92. <https://doi.org/10.1136/pgmj.2009.095802>.
12. Roberts S, Saithna A, Bethune R. Improving theatre efficiency and utilisation through early identification of trauma patients and enhanced communication between teams. *BMJ Qual Improv Rep.* 2015;4(1):u206641.w2670. <https://doi.org/10.1136/bmjquality.u206641.w2670>.