



International Journal of Surgery Science

E-ISSN: 2616-3470

P-ISSN: 2616-3462

© Surgery Science

www.surgeryscience.com

2021; 5(3): 101-105

Received: 28-06-2021

Accepted: 30-07-2021

Ahmed Elshiekh

Doctor at University Hospitals
Coventry and Warwickshire,
United Kingdom

Mohamed Abdelkhalek

Doctor at University Hospitals
North Midlands, United Kingdom

Ahmed Mabrouk

Doctor and Head of the
Department of Renal Medicine,
Tanta Health Insurance Hospital,
Egypt

Ahmed Mohammad Hassan

Doctor at University Hospitals
Coventry and Warwickshire NHS
Trust, United Kingdom

Ahmed Mostafa Ali

Doctor at Nottingham University
Hospitals NHS Trust, United
Kingdom

Doha Beltagi

Medical Administrator at Yardley
Green Medical Centre,
Birmingham, United Kingdom

Corresponding Author:

Ahmed Elshiekh

Doctor at University Hospitals
Coventry and Warwickshire,
United Kingdom

Review article: Strategies to improve emergency theatres efficiency

**Ahmed Elshiekh, Mohamed Abdelkhalek, Ahmed Mabrouk, Ahmed
Mohammad Hassan, Ahmed Mostafa Ali and Doha Beltagi**

DOI: <https://doi.org/10.33545/surgery.2021.v5.i3b.748>

Abstract

Efficiency is the optimal use of the available resources. In the case of the theatres, this includes the maximum use of the theatre time allocated to the list. Delays negatively impact the theatres efficiency, but more seriously affects the patient's safety specially in the emergency setting and can lead to serious patient safety incidents. Multiple strategies can improve the emergency theatres efficiency. In this review article, we will describe the available strategies aimed at increasing the emergency theatres efficiency.

Keywords: strategies, emergency theatres efficiency

Introduction

Efficiency is the optimal use of the available resources. In the case of the theatres, this includes the maximum use of the theatre time allocated to the list. 23,503 last minute surgical procedures cancellation happened in the UK National Health Service (NHS) in the last four months of 2019 for non-clinical reasons [1]. The concept of the theatre efficiency is therefore critical in the current day medical practice affecting both the patient safety and the efficiency of utilisation of tax-payers money [2].

Theatre inefficiency includes both non complete utilisations of the available theatres time and resources as well as overrunning [3]. Overrunning is associated with apparent costs such as staff overtime, the extra use of consumables and the disruptions to other services and also the hidden costs including damaging staff morale and problems with recruitment and retention of theatre staff if overruns are recurrent [4].

Inefficiency is associated with a huge financial burden on the healthcare system. Theatre inefficiency is especially problematic since theatres spending are estimated to be more than 40% of a hospitals total spending [5]. Also, a north Ireland study found a heavy €9880 per patient per day of delayed access to emergency theatres for an urgent surgical treatment [6]. Thus, at a time of scarce resources and increasing financial challenges on healthcare systems increasing theatres efficiency is rather essential for survival.

In this paper we will review the available literature about the best strategies to maximise the theatre efficiency.

Materials and Methods

A data base search in three databases including PubMed and Google Scholar was performed. The search words included "Emergency theatres efficiency". All the papers in English literature discussing strategies to increase the emergency theatres efficiency were included. Papers discussing the strategies for improving elective theatres efficiency were included if they were found to be applicable in the emergency setting. Papers not in English language or addressing strategies not applicable to emergency settings were excluded. Also observational studies and retrospective studies were excluded.

Strategies to improve theatres efficiency

1. On time start: Tackling theatre start time delays increases theatre utilisation time and in turn maximises the theatre team efficiency. Delayed starts negatively impacts the theatres efficiency but more seriously affects the patients safety specially in the emergency setting and can lead to serious patient safety incidents [7].

Multiple strategies have been described to facilitate the early start of the theatres. These included the golden patient initiative, maximising communication, equipment and supply prompt checks. Also, electronic system based techniques, staff education and financial incentives have been described^[8].

The golden patient initiative was first described in the emergency orthopaedics trauma theatres. The initiative involves identifying the first patient of the trauma list and assuring he is medically optimised and ready for theatres with a clear surgical plan and up to date investigations ready for theatres as well as communicating that to the theatres and anaesthetic teams well in advance^[9, 10]. Implementing this strategy was shown to reduce delays to operating lists starting time and increasing theatres efficiency in multiple occasions with a significant reduction in delays ranging from 33 min ($p \leq 0.001$)^[9] up to 72.3 minutes ($p < .0005$)^[11].

An impressive 19 to 61% ($p < 0.001$) improve in theatres start time was gained by introducing financial incentives to theatres staffing linked directly to their theatre efficiency which included early starts in an academic tertiary hospital in the United States^[12]. The financial costs of giving staff incentives is negligible in comparison to the financial savings for increased theatre efficiency. In a striking example, a total of \$210 000 savings were made after only \$8340 were given away as staff incentives during a two month period in a freestanding trauma hospital in the USA^[13].

Communication in the form of team briefings before the operating list have a great role in reducing delays. This also has the added effects of improving the team culture and overall team dynamics^[14, 15]. Late staff arrival including the surgical and the anaesthetic teams is associated with theatre start time delays^[16] and effective communication could help reduce this issue.

A clear pathway for the patients that is well known by all the team members in the form of a protocol is essential for a smooth and delay free patient journey. This protocol needs to be continuously updated to avoid issues that could reduce its efficiency and cause delays. Introducing such a pathway have improved the start time by 37% ($p < 0.0001$) in a series studying the start time delays in 1,557 patient transfers^[17].

Staff education through posters, memos and meetings was associated with a 22 min earlier start in a research based at a 550-bed hospital in the USA. In their approach they educated the staff about theatre efficiency, target times and the causes of delays and the ways to overcome them^[18]. This proved to be a valuable tool as it increases staff awareness and involvement in the management aspects of service provision and increases their motivation, sense of self-importance and team working.

2. Simulation based training (SBT)

Aviation industry model, being one of the safest industries in the world nowadays, has been used a lot in the healthcare for enhancing safety^[19]. One of the key aspects of safety in aviation was the human factors management. A key way of addressing that was the SBT and although it was initially aimed at increasing the safety profile, it also resulted in increased efficiency.

SBT can improve the efficiency at the individual surgeon level, the operative theatre team as well as the healthcare system as a whole.

SBT improves both the technical and the non-technical skills improving the overall performance and efficiency of a surgeon. High quality data from more than one randomised controlled trial showed a 29% reduction in the surgical time after simulation training^[20, 21]. Also, non-technical skills during both

the peri-operative as well as the intra-operative phases of surgery significantly improves with SBT^[22].

For the teams, simulation based team training provides a basis for a focused feedback during the training on both technical as well as non-technical team working skills^[23, 24]. It also helps improving the theatre ergonomics such as the instrument handover time between the surgeon and the scrub nurse, the travel paths of the team members and a general improvement in the team dynamics resulting in a positive impact on overall theatre efficiency^[25].

System-level improvements can be achieved following in situ simulation by identifying and highlighting system issues that reduce efficiency or affect the patients safety during these sessions and enabling a team discussion to reach the possible solutions which involves all of the team members in the shared decision making^[26].

3. Minimising distractions

“Sterile cockpit” is a term used by the aviation industry which is applied to the flight deck environment reducing the unnecessary noise and conversations during the safety critical periods with the aim of completely eliminating potentially dangerous distractions and maximising the situational awareness.

In a normal theatre, lots of barriers to communication exist such as the noise from the suction or the laminar flow, telephones and pagers, and the enhanced Personal Protective Equipment (PPE) specially during the COVID time. Also, music, although potentially improving the surgical performance offering a calming effect, has a negative effect on the communication clarity^[27].

Surgical efficiency is reduced by the flow disruptions and the communication failures within the team^[28]. In a prospective study, Distractions were found to disrupt surgeons’ task activity, prolonging the mean procedure duration by 26.8%.

As in the aviation industry, we only recommend the sterile cockpit strategy during the critical moments of the procedure where distractions should be minimised, music switched off and the side talk stopped. This should be balanced with maintaining an effective working atmosphere, and maintaining the team morale. Thus, it is recommended that these critical times should be pre-identified and highlighted during the team brief while maintaining a more relaxed atmosphere in between.

4. Booking and morning brief

Booking forms have been developed to facilitate communication and documentation for the emergency theatres workload. A booking form should be viewed as a way of communication and coordination. It should include all the data required by the anaesthetist as well as the theatre team to navigate through the surgical preparation of the case. It should also include the level of urgency to allow the prioritisation of the emergency workload.

A morning briefing is a meeting at the start of the day between the duty anaesthetist, surgeons, theatre nurses, managers and the theatres coordinators to discuss all the present emergency workload and plan the operating list according to the case urgency as well as the available resources.

Both the booking forms and the morning meeting act as a valuable way to facilitate a smooth flow of cases without disruptions and if done appropriately can lead to a total improvement in theatre efficiency by up to 12.9%^[29].

5. Specialist pre-assessment nurses

A pre-assessment nurse is a nurse with special training in pre-

operative physical assessment. This role involves coordinating the whole surgical care process, supporting the anaesthetic, surgical, and nursing teams in prioritising and optimising the patient's condition, including initiating investigation and prompting further treatment to ensure rapid access to surgery. Such a role improves overall patient care and improves the efficiency of the whole system rather than just theatres. It helps identifying the causes of delays to theatres as well as the potential causes of cancellation thus minimising disruptions in the operative lists. Implementing such a role was associated with improvement in the admission to theatre lag time as well as the overall patient hospital stay^[30].

6. Flow coordinator

Flow coordinators have been utilised in the emergency department with great success resulting in improved overall patient journey and decreased waiting times^[31, 32]. Extending this role to the emergency theatres is well perceived to be associated with improved overall patient journey and hospital efficiency.

Emergency theatres flow coordinator duties includes:

- Allocating cases and staff to theatre rooms, anaesthetics and recovery areas
 - Managing resources for emergency surgery allocation
 - Arranging for additional resources as required
 - Problem solving within the emergency theatres
- Receiving booking forms and coordinating morning briefings

Theatre flow coordinator also acts as an information centre for all the theatre team members and serve as a neutral decision-making body in the emergency theatres area.

As such theatres flow coordinator has a great role in maintaining theatre flow and improving overall system efficiency.

7. Optimising transport

The "sending" is the process in which the theatres team summons the patient for the procedure. Once a sending request has been made, nurses on the ward should ensure the patient is ready to be transported and then porters transfer the patient inside the hospital to the theatres complex. In doing so, they may move between buildings or use lifts. Some patients specially paediatrics or sick patients may need extra measures, a member of the family to reduce their anxiety or a highly qualified medical practitioner to accompany and oversee the transfer. Each of these steps can be a point of delay causing a significant increase in the theatre patient change over time and subsequent over runs and cancellations.

Doubling the time between the actual sending and the time the patient is required to be in theatres from twenty to forty minutes has been found to significantly improve the process^[33].

Early communication between the theatre staff and the ward staff started early in the day will ensure that the patient is ready on the ward before sending and also that special transfer requirements are readily available on time^[17].

Changeover times between porters was found to be associated with delays as porters wait for the next shift colleagues before starting the transfer^[33]. A way to tackle that is by giving instructions to move the patient first and then getting the new colleagues to take over during the transfer.

Discussion

Productivity is 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 consumed. In the emergency theatres setting, the output unit is a completed operation while the input unit is complex as it involves the available theatre time factoring the trained staff time and the available resources. Labour productivity on the other hand is the rate of output per staff member per unit of time. In simple terms: efficiency is gaining the maximum output while utilising the least input or in our situation medical resources. Thus, efficiency in the emergency operating setting is directly related to reducing the delays and wasted time while maximising the output per surgical theatre and team members.

When looking at the emergency work efficiency, one should step back and look at the whole picture as emergency work as its name implies involves a lot of unplanned and unforeseen circumstances that are not necessarily controlled by the surgical team. External factors could include natural disasters or major incidents, filled hospital beds where there is no place to discharge the patient safely to an inpatient bed from theatres thus blocking theatre space. Other factors such as staff sickness and unavailability of equipment. Management factors as well as the whole organisation strategy and targets influence heavily availability of resources and support for theatres emergency work^[34].

Running costs for an operating theatre average approximately £1,200 per hour. Thus, maximising efficiency is not a luxury. Addressing multiple contributing factors for delays can finally lead to a large-scale improvement. Thus, knowing the different strategies and implementing as much of them as possible is essential in facilitating smooth and efficient operating rooms performance.

Some strategies would give better results if coupled with other strategies to produce the optimum outcome. For example, Early sending can result in the patients arriving too early and have to wait outside the theatre complex. Here, comes the handy role of the holding bay which is a dedicated two or three beds area in the theatres overseen by one of the nursing staff in which the patients can be safely kept in the theatres complex areas while waiting for the theatre to be ready for their arrival.

Human factors and emotions cannot be overseen while aiming at high efficiency. Staff members should always be valued and respected and before that appreciated. Staff motivation and education alone resulted in much improved start time and theatre flow efficiency^[12, 18]. Caution while applying these strategies should be taken to avoid affecting staff morale. For example, the sterile cockpit strategy can be double bladed as some research has shown that if overused can result in negative feelings from the theatre staff sensing arrogance from surgeons asking everyone to shut up^[35]. Keeping a balance and allowing social staff interactions in non-critical times help avoid that. Also, discussing these strategies with the staff well before implementing them such as in the morning briefing so that the staff understand what and when things will be implemented help them understand and cooperate towards the success of the strategies.

Conclusion

Theatre's efficiency is critical to the patient care and safety. When used together multiple strategies can significantly optimise efficiency. Individual teams should identify the strategies that best suits them and adopt them to improve their overall efficiency.

Funding: There was no external funding for this paper.

Conflict of interests: None of the authors declared any conflicts of interest.

References

1. Statistics » Cancelled Elective Operations [Internet], [cited 2021 May 3]. Available from: <https://www.england.nhs.uk/statistics/statistical-work-areas/cancelled-elective-operations/>
2. Faiz O, Tekkis P, Mcguire A, Papagrigoriadis S, Rennie J, Leather A. Is theatre utilization a valid performance indicator for NHS operating theatres? *BMC Health Serv Res* [Internet]. 2008;8(1):28. Available from: <https://bmchealthservres.biomedcentral.com/articles/10.1186/1472-6963-8-28>
3. McIntosh C, Dexter F, Epstein RH. The impact of service-specific staffing, case scheduling, turnovers, and first-case starts on anesthesia group and operating room productivity: A tutorial using data from an Australian hospital. *Anesth Analg* [Internet]. 2006;103(6):1499–516. Available from: <https://pubmed.ncbi.nlm.nih.gov/17122231/>
4. Sivia DS, Pandit JJ. Mathematical model of the risk of drug error during anaesthesia: the influence of drug choices, injection routes, operation duration and fatigue. *Anaesthesia* [Internet]. [cited 2021 May 2], 2019;74(8):992–1000. Available from: <https://onlinelibrary.wiley.com/doi/abs/10.1111/anae.14629>
5. Financial Recovery Plans in the NHS [Internet], [cited 2021 May 2]. Available from: [https://www.hfma.org.uk/online-learning/bitesize-courses/detail/financial-recovery-plans-in-the-nhs-\(2005\)](https://www.hfma.org.uk/online-learning/bitesize-courses/detail/financial-recovery-plans-in-the-nhs-(2005))
6. O’Leary DP, Beecher S, McLaughlin R. Emergency surgery pre-operative delays - Realities and economic impacts. *Int J Surg* [Internet], [cited 2021 May 2], 2014;12(12):1333–6. Available from: <https://pubmed.ncbi.nlm.nih.gov/25462705/>
7. NHS England » Organisation patient safety incident reports [Internet], [cited 2021 May 2]. Available from: <https://www.england.nhs.uk/patient-safety/organisation-patient-safety-incident-reports/>
8. Halim UA, Khan MA, Ali AM. Strategies to Improve Start Time in the Operating Theatre: A Systematic Review. Vol. 42, *Journal of Medical Systems*. Springer New York LLC, 2018.
9. Key T, Reid G, Vannet N, Lloyd J, Burckett-St Laurent D. “Golden Patient”: A quality improvement project aiming to improve trauma theatre efficiency in the Royal Gwent Hospital. *BMJ Open Qual* [Internet], [cited 2021 Apr 29] 2019;8(1):e000515. Available from: <http://bmjopenquality.bmj.com/>
10. 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 Reports* [Internet], [cited 2021 May 2] 2015;4(1):u206641.w2670. Available from: <https://pubmed.ncbi.nlm.nih.gov/26734340/>
11. Tulloch I, Forrester J, Gosavi S, Grahovac G. Reducing neurosurgical theatre start time delays by seventy minutes through application of the ‘Golden Patient’ initiative, *Br J Neurosurg*, 2020;
12. St. Jacques PJ, Patel N, Higgins MS. Improving anesthesiologist performance through profiling and incentives. *J Clin Anesth* [Internet], [cited 2021 May 2] 2004;16(7):523–8. Available from: <https://pubmed.ncbi.nlm.nih.gov/15590256/>
13. Scalea TM, Carco D, Reece M, Fouche YL, Pollak AN, Nagarkatti SS. Effect of a novel financial incentive program on operating room efficiency *JAMA Surg*. 2014;149(9):920–4
14. Mathews L, Kla KM, Marolen KN, Sandberg WS, Ehrenfeld JM. Measuring and improving first case on-time starts and analysis of factors predicting delay in neurosurgical operating rooms, *J Neurosurg Anesthesiol* [Internet], [cited 2021 May 3] 2015;27(3):203–8. Available from: <https://pubmed.ncbi.nlm.nih.gov/25272065/>
15. 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* [Internet], [cited 2021 May 3] 2011;87(1027):331–4. Available from: <https://pubmed.ncbi.nlm.nih.gov/21273358/>
16. Quaty J, Berkenstock MK. Identifying operating room delays for the first case in an ophthalmic ambulatory surgery Center *Perioper Care Oper Room Manag*. 2020;21:100107.
17. Brown MJ, Kor DJ, Curry TB, Marmor Y, Rohleder TR. A coordinated patient transport system for ICU patients requiring surgery: Impact on operating room efficiency and ICU workflow, *J Healthc Qual* [Internet], [cited 2021 May 3] 2015;37(6):354–62. Available from: <https://pubmed.ncbi.nlm.nih.gov/23773630/>
18. Overdyk FJ, Harvey SC, Fishman RL, Shippey F. Successful Strategies for Improving Operating Room Efficiency at Academic Institutions *Anesth Analg*. 1998;86(4):896–906.
19. Navigating towards improved surgical safety using aviation-based strategies- *Clinical Key* [Internet], [cited 2021 May 20]. Available from: <https://www.clinicalkey.com/#!/content/playContent/1-s2.0-S0022480407000881?returnurl=null&referrer=null>
20. Grantcharov TP, Kristiansen VB, Bendix J, Bardram L, Rosenberg J, Funch-Jensen P. Randomized clinical trial of virtual reality simulation for laparoscopic skills training, *Br J Surg* [Internet], [cited 2021 May 20] 2004;91(2):146–50. Available from: <https://pubmed.ncbi.nlm.nih.gov/14760660/>
21. Seymour NE, Gallagher AG, Roman SA, O’Brien MK, Bansal VK, Andersen DK *et al*. Virtual reality training improves operating room performance results of a randomized, double-blinded study. In: *Annals of Surgery* [Internet]. *Ann Surg*; 2002 [cited 2021 May 20], 458–64. Available from: <https://pubmed.ncbi.nlm.nih.gov/12368674/>
22. Nguyen N, Elliott JO, Watson WD, Dominguez E. Simulation improves nontechnical skills performance of residents during the perioperative and intraoperative phases of surgery, *J Surg Educ* [Internet], [cited 2021 May 20] 2015;72(5):957–63. Available from: <https://pubmed.ncbi.nlm.nih.gov/25911460/>
23. Moorthy K, Munz Y, Forrest D, Pandey V, Undre S, Vincent C, *et al*. Surgical crisis management skills training and assessment: A stimulation-based approach to enhancing operating room performance. *Ann Surg* [Internet], [cited 2021 May 20] 2006;244(1):139–47. Available from: <https://pubmed.ncbi.nlm.nih.gov/16794399/>
24. Moorthy K, Munz Y, Adams S, Pandey V, Darzi A. A human factors analysis of technical and team skills among surgical trainees during procedural simulations in a simulated operating theatre. *Ann Surg* [Internet], [cited 2021 May 20] 2005;242(5):631–9. Available from: <https://pubmed.ncbi.nlm.nih.gov/15590256/>
25. Neumann J, Angrick C, Höhn C, Zajonz D, Ghanem M,

- Roth A *et al.* Surgical workflow simulation for the design and assessment of operating room setups in orthopedic surgery. *BMC Med Inform Decis Mak* [Internet], [cited 2021 May 20] 2020;20(1). Available from: [/pmc/articles/PMC7333415/](https://pubmed.ncbi.nlm.nih.gov/3333415/)
26. Armenia S, Thangamathesvaran L, Caine A, King N, Kunac A, Merchant A. The Role of High-Fidelity Team-Based Simulation in Acute Care Settings: A Systematic Review. *Surg J* [Internet], [cited 2021 May 20] 2018;04(03):e136–51. Available from: [/pmc/articles/PMC6089798/](https://pubmed.ncbi.nlm.nih.gov/3089798/)
 27. Weldon SM, Korciakangas T, Bezemer J, Kneebone R. Music and communication in the operating theatre. *J Adv Nurs* [Internet], [cited 2021 May 20] 2015;71(12):2763–74. Available from: <https://pubmed.ncbi.nlm.nih.gov/26243722/>
 28. Wiegmann DA, ElBardissi AW, Dearani JA, Daly RC, Sundt TM. Disruptions in surgical flow and their relationship to surgical errors: An exploratory investigation. *Surgery* [Internet], [cited 2021 May 20] 2007;142(5):658–65. Available from: <https://pubmed.ncbi.nlm.nih.gov/17981185/>
 29. Williams JP, Spernaes I, Duff E, Argent M, Frankish J, Dinham H. Development and implementation of a theatre booking form and morning briefing meeting to improve emergency theatre efficiency. *J Perioper Pract* [Internet], 1 [cited 2021 May 20] 2017;27(10):217–23. Available from: <https://journals.sagepub.com/doi/abs/10.1177/175045891702701003?journalCode=ppja>
 30. Radford M, Abbassi A, Williamson A, Johnston P. Redefining perioperative advanced practice. Scope of practice: measuring impact and sustainability. *Br J Perioper Nurs* [Internet], [cited 2021 May 20] 2003;13(12). Available from: <https://journals.sagepub.com/doi/abs/10.1177/175045890301301201>
 31. Oliveira MM, Marti C, Ramlawi M, Sarasin FP, Groscurin O, Poletti PA *et al.* Impact of a patient-flow physician coordinator on waiting times and length of stay in an emergency department: A before-after cohort study *PLoS One*. 2018;13:12.
 32. Thomas K, Marcum J, Wagner A, Kohn MA. Impact of scribes with flow coordination duties on throughput in an academic emergency department. *West J Emerg Med* [Internet], [cited 2021 May 20] 2020;21(3):653–9. Available from: <https://pubmed.ncbi.nlm.nih.gov/32421515/>
 33. Haldar R, Gupta D, Pandey H, Srivastava S, Mishra P, Agarwal A. Patient transportation delays and effects on operation theatres' efficiency: A study for problem analysis and remedial measures. *Anesth Essays Res* [Internet], [cited 2021 May 20] 2019;13(3):554. Available from: [/pmc/articles/PMC6775839/](https://pubmed.ncbi.nlm.nih.gov/3333415/)
 34. Goeschel CA, Wachter RM, Pronovost PJ. Responsibility for quality improvement and patient safety: Hospital board and medical staff leadership challenges. Vol. 138, *Chest*. American College of Chest Physicians; 2010. p. 171–8.
 35. Pal A, Lal R, Frizelle F. Aviation-based teamwork skills work for surgeons: time for an 'aviation bundle'? *ANZ J Surg* [Internet], [cited 2021 May 20] 2018;88(12):1231–5. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/ans.14892>