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Original research

A surgeon-led model to improve operating theatre change-over time and overall efficiency: A randomised controlled trial☆

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HIGHLIGHTS

- The change-over period between operative cases is a significant source of lost time.
- Implementation of a standardised strategy can significantly improve this change-over time.
- This study trials an easy to follow surgeon-led team-based model to improve this time.
- The results and the estimated potential to save significant amount of resources is presented.

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ABSTRACT

Background: The non-operative time during the process of patient change-over between operating theatre cases is a significant source of delay and overall theatre inefficiency. The aim of this study was to integrate and trial a working strategy to improve this change-over time.

Method: This was a single-blinded, randomised controlled intervention study comparing a surgeon-led, team-based model of strategies *versus* routine patient change-over. This model was trialled by a single surgeon, and the primary outcome was the difference in change-over times compared with 4 other surgeons who were blinded and served as controls. Secondary outcome measures included overall differences in complications between the groups, and the number and differences in operative case cancellations due to inadequate theatre time.

Results: 1265 patients were randomised into 5 general surgical lists, and included all major and minor cases. Median number of operative cases were 214 per surgeon, with an overall median change over time of 17.9 ± 3.7 min. Surgeon A in the intervention group had a median change-over time of 12.1 ± 5.4 min ($p < 0.001$), with a median difference of 8.5 min ± 21.4 min ($p < 0.0001$), translating to a 58% reduction in median change-over time between the intervention and control groups. There were no differences in complication rates amongst the groups. The intervention group had no cancellations due to lack of time, compared with 37 cancellations in the control group.

Conclusion: This study demonstrates a statistically significant improvement in median change-over times using this model. This re-design can be implemented without incurring extra costs, staff, or operating theatres.

1. Introduction

The performance of the operating theatre governed within a given healthcare model is a highly complex system combined with multiple variables which poses many challenges to the healthcare provider and the individual patient. As a result, inefficiencies and delays ultimately leading to cancellation of operating cases becomes an inevitable outcome which plagues most if not all operating theatres [1]. Standardisation of processes have been introduced to the running of operating theatres in order to adopt a production line approach in order to boost efficiency, and this practice may vary according to local protocols [1–3].

Working strategies to implement a more efficiently performing

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theatre environment should be of significant relevance and increased focus as elective surgery waiting times in Australia continues to increase. In 2012–2013 there were 673,000 patients on waiting lists for elective surgery, with 1 in 4 of these on general surgery wait lists. Elective surgery admissions have been steadily increasing approximately 1.2% per year [4]. There is an increasing burden on the healthcare system as these waitlists continue to grow, and there is a growing body of research in the literature aimed to identify shortcomings and optimise theatre performance [1].

There has been research conducted aimed at improving the efficiency of theatre workflow by implementing structured practises and recommendations [1,5,6], however there is a paucity of data examining and quantifying the benefit of improving theatre efficiency by incorporating specific steps during the stage of parallel processing at the individual operator level. Parallel processing is a method where a separate room is used for the induction and/or the emergence from anaesthesia and is utilised in some countries, and aims to reduced non-operative time, however this has been associated with utilising additional staff and incurring extra costs [6–9]. Studies have examined the redesigning of this process and have shown positive results in improving the patient change over time, which has exceeded an average of 60 min in some institutions [7,9]. Although being a crucial step in preparation of the room and patient for the smooth transition to the next case, the variability in processes and case complexity and general disorganisation can lead to significant time lost, which leads to theatre cancellations and wasted resources.

The aim of this study is to prospectively trial a standardised surgeon-led model of specific strategies during the stage of parallel processing that can be implemented by all members of the operative team that will reduce the patient change over time, and its impact on theatre efficiency. This set of strategies can be generalised to any surgical discipline and potentially increase the case load performed on the allocated elective surgical list without the extra costs associated with creating more theatre rooms or employing extra staff.

2. Methods

2.1. Trial design

A single-blinded randomised controlled trial was conducted to evaluate a consultant surgeon led model using parallel processing in order to reduce the patient change over time in between operative cases. The patient change over time is defined as the time taken during when a patient leaves the operating room (OR) to the time the next patient enters the OR from the anaesthetic holding bay. A twelve month trial during 1st July 2014 to 29 June 2015 was performed across all general surgery elective lists at a single institution. Participants were allocated to one of 2 arms of either the treatment group consisting of a single surgeon, or a control group consisting of 4 surgeons, with an allocation ratio of approximately 1:5 (Fig. 1).

2.2. Participants and setting

Eligible participants were patients referred to the General Surgery Outpatients Department at Caboolture Hospital, Queensland. Inclusion criteria were any participants who consented for surgery, and proceeded to have a surgical procedure during the trial period. The only exclusions were patients who were not considered for surgery, or were officially consented and allocated to a surgical list but did not proceed to surgery due to cancellations or non-attendance. Caboolture Hospital is a regional secondary referral hospital, and at this institution there are 5 full-time consultant surgeons who each have weekly 1 full-day elective lists. There are no specific subspecialty units and the range of surgical services provided are evenly distributed amongst the surgeons, which includes general laparoscopic abdominal and colorectal surgery, general breast and endocrine, gallbladder, hernia and skin cancer surgery. Enrolment began at the surgical outpatient department appointment with the surgeon initiating the consenting and enlistment of the eligible patients requiring surgery. Each list assigned to the respective consultant is organised by the elective surgery bookings coordinator and even distribution is made based on a point based system with consideration of time and case complexity in order to standardise the same case-mix of minor and major cases across the consultant surgeons.

2.3. Interventions

The intervention trialled was a re-designed model based on a set of steps applied methodically during the non-operative time between the patient change-over. Table 1 summarises the main steps performed that were consistently applied to the list of Surgeon A, who would oversee each step and prompt the surgical registrar and other members of the operating theatre. All the usual routine theatre duties were performed, and there were no omission of any tasks. Although due to variability in the complexity of cases, the nature and type of the patient and procedure, there may be some variation of steps. However the basic structure of the methodology was strictly adhered to. The comparison group were Surgeons B, C, D and E, who were unaware of the trial taking place, thus blinding them from the study and would routinely perform their operating theatre lists, and in this way served as controls. The control surgeons conducted their own lists and would perform most of these steps, but there was variability in the order, the different time intervals or stages of the peri-operative process, and most of the change-over tasks were performed by junior trainee surgeons.

The model was based on a constructed set of steps that the surgeon, the surgical trainee, and all other members of the theatre could perform together, so the activities that usually occur during non-operative time were streamlined and more efficient. The sequence of events would start toward the anticipated end of the case, and communication with the anaesthetic team would take place at this stage. Notifying them of commencement of skin closure and discussing the use of any further muscle relaxants or anaesthetics prompted the anaesthetists to either avoid giving further doses, or even begin the recovery process in a safely controlled manner as the skin was being closed. The next patient will have arrived in the anaesthetic holding bay by this stage. This stage was treated as the crucial time during the parallel processing of patients that could be utilised for maximum reduction in change-over time. An intravenous cannula, if not already placed by a nurse in the Day Surgery Unit, will have one placed here, as well as any cardiac or neurological monitoring devices, blood pressure cuffs, and other monitoring instruments that may be required. Certain types of anaesthesia could be performed here, including infiltration of local anaesthetic for skin procedures, as well as regional anaesthesia such as epidural and spinal blocks could be started before the end of the skin closure in the currently active operation.

Whilst skin closure was being performed by one member of the surgical team, the other would de-gown and will complete the operative notes, then proceed to the anaesthetic holding bay to perform a surgical safety checklist, review the case and perform marking of the site. All consent forms were routinely signed in the surgical outpatient office, and only a discussion of the operation and clarification of questions was needed to be performed. Before