
Scheduling Anesthesia Time Reduces Case Cancellations and Improves Operating Room Workflow in a University Hospital Setting



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- BACKGROUND:** A new method of scheduling anesthesia-controlled time (ACT) was implemented on July 1, 2012 in an academic inpatient operating room (OR) department. This study examined the relationship between this new scheduling method and OR performance. The new method comprised the development of predetermined time frames per anesthetic technique based on historical data of the actual time needed for anesthesia induction and emergence. Seven “anesthesia scheduling packages” (0 to 6) were established. Several options based on the quantity of anesthesia monitoring and the complexity of the patient were differentiated in time within each package.
- STUDY DESIGN:** This was a quasi-experimental time-series design. Relevant data were divided into 4 equal periods of time. These time periods were compared with ANOVA with contrast analysis: an intervention, pre-intervention, and post-intervention contrast were tested. All emergency cases were excluded. A total of 34,976 inpatient elective cases performed from January 1, 2010 to December 31, 2014 were included for statistical analyses.
- RESULTS:** The intervention contrast showed a significant decrease ($p < 0.001$) of 4.5% in the prediction error. The total number of cancellations decreased to 19.9%. The ANOVA with contrast analyses showed no significant differences with respect to under- and over-used OR time and raw use. Unanticipated results derived from this study, allowing for a smoother workflow: eg anesthesia nurses know exactly which medical equipment and devices need to be assembled and tested beforehand, based on the scheduled anesthesia package.
- CONCLUSIONS:** Scheduling the 2 major components of a procedure (anesthesia- and surgeon-controlled time) more accurately leads to fewer case cancellations, lower prediction errors, and smoother OR workflow in a university hospital setting. (*J Am Coll Surg* 2016;223:343–351. © 2016 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)
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Hospitals are faced with the challenge to provide safe, high quality care, and at the same time, the need to control costs. Operating room (OR) departments are among the most important departments of a hospital, accounting

for a considerable amount of workload, revenues, and costs. For this reason, OR inefficiencies should be avoided where possible. In addition, OR inefficiencies are unsatisfactory for all, and there are many parties involved. One way to improve OR efficiency is to optimize surgical case scheduling.

Several previous studies¹⁻¹¹ have concentrated on prediction of total procedure time. Total procedure time is subdivided into anesthesia induction time, surgeon-controlled time (SCT, including patient positioning, prepping and draping), and anesthesia emergence time (Fig. 1). The sum of induction time and emergence time is also known as anesthesia-controlled time (ACT). In the Netherlands, the overall current prediction method is as follows: the surgeon’s prediction of SCT is determined before each procedure. In some hospitals, surgeons

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Abbreviations and Acronyms

ACT = anesthesia-controlled time
 AMC = Academic Medical Center
 OR = operating room
 SCT = surgeon-controlled time
 UMC = university medical center

make a routine prediction of the time needed, and in others, historical times are the point of reference.^{5,11,12} Yet the accuracy of these predictions is limited.¹³ For prediction of ACT, usually a fixed time period, eg 20 minutes (for general anesthesia) or 40 minutes (for a regional anesthetic technique), is added to the surgeon's prediction of SCT. Together, this provides the predicted total procedure time used for OR scheduling.¹⁴

Previous studies focused predominantly on the subject of predicting the time frame used by surgeons, which accounts for the major part of total procedure time. However, in a former study, we found that in a university hospital setting, a minimum of 25% to 30% of total procedure time is engaged by anesthesiologists.¹⁴ In the Netherlands, university medical centers (UMCs) take responsibility for tertiary care, clinical research, innovation, training, and teaching. The complexity of patients with multiple comorbidities and the complexity of surgical procedures usually result in a longer duration of surgery than in general hospitals. This was validated in a Dutch, nationwide OR benchmark study in which 8 UMCs participated, based on 330,258 inpatient elective surgical cases¹⁴: the mean (SD) total procedure time of 158 (119) minutes and the median of 124 minutes reflect the fact that the complexity of procedures is potentially greater than in other (general) hospitals. In the Netherlands, the mean total procedure time of surgical

cases performed in general hospitals is 74 minutes. This number is based on a Dutch benchmark, specifically for general hospitals, organized and hosted by a consultancy firm. In total, 12 general hospitals participate in this benchmark. The level of complexity of the patient case mix in UMCs can make it more difficult to accurately predict surgical duration and complicate efficient scheduling. Based on this OR benchmark database, additional results affirmed that ACT is a considerable component of total procedure time, which should be scheduled just as realistically as SCT. Therefore, we advised that grossing up the SCT by 33% to account for ACT, rather than scheduling a fixed number of minutes, improves the prediction of total procedure time.¹⁴

Even though we demonstrated in this previous study that this recommended scheduling rule leads to more prediction accuracy, a "scheduling deviation" remains. One Dutch UMC, the Academic Medical Center (AMC) in Amsterdam, adopted a new system of scheduling ACT based on predetermined time frames per anesthetic technique. Previous studies suggested that more accurate prediction rules may lead to reducing the amount of under- and over-used OR time, as well as the number of case cancellations.¹⁴⁻¹⁷ For that reason, this study aimed to examine the relationship between this new scheduling method and OR performance.

New operating room scheduling method for anesthesia-controlled time (the intervention)

The AMC is a university hospital affiliated with the University of Amsterdam. It has a close cooperation with the other university hospital of Amsterdam, the VU University Medical Center (VUmc). Like the other 7 UMCs in the Netherlands, the AMC offers a "last resort" (tertiary care) function for patients with complex health care issues

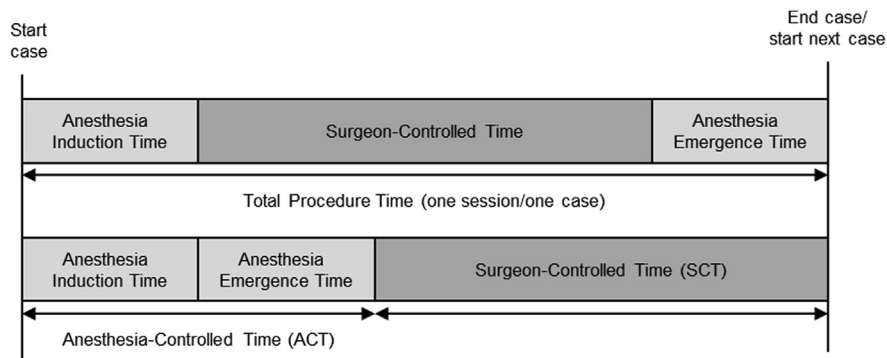


Figure 1. Total procedure time is subdivided into anesthesia induction time, surgeon-controlled time, and anesthesia emergence time. The sum of induction and emergence time is anesthesia-controlled time.

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