Computer Simulation Shows the Effect of Communication on Day of Surgery Patient Flow

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ABSTRACT

To improve patient flow in a surgical environment, practitioners and academicians often use process mapping and simulation as tools to evaluate and recommend changes. We used simulations to help staff visualize the effect of communication and coordination delays that occur on the day of surgery. Perioperative services staff participated in tabletop exercises in which they chose the delays that were most important to eliminate. Using a day-of-surgery computer simulation model, the elimination of delays was tested and the results were shared with the group. This exercise, repeated for multiple groups of staff, provided an understanding of not only the dynamic events taking place, but also how small communication delays can contribute to a significant loss in efficiency and the ability to provide timely care. Survey results confirmed these understandings. *AORN J 102 (July 2015) 60.e1–60.e14.*
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Hospitals are composed of a large number of departmental subsystems with complex interactions and dependencies within and between these components. In particular, complex interactions across the departments that comprise perioperative services occur on days of surgery. To improve the delivery of care by a more efficient flow of patients (ie, reducing the amount of non–value-added time per patient) through perioperative services, we explored using engineering management tools such as process mapping and simulation, which frequently are used to measure workflow efficiency and process flow within a system. These tools rely on detailed data that capture all components of the workflow, though this is not always easy to obtain. Further, these tools allow decision makers and frontline staff to see their process through a lens that is not available in the live system. Given the importance of perioperative services from a health care delivery perspective and as a major source of income for many hospitals, methods that may reduce idle OR time, reduce patient waiting time, and increase the number of on-time case starts are of interest to hospitals.

LITERATURE REVIEW

Perioperative services is one of the most complex departments within a hospital system and is important to staff, surgeons, and patients. Much effort has been expended to understand how the performance of the various perioperative tasks affects patient safety,[1] health, and the quality of the clinical outcomes.[2] All individual processes within perioperative services affect the delivery of surgical procedures and represent a significant opportunity to improve hospital operating margins.[3] Perioperative services is typically composed of three phases: preoperative, intraoperative, and

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postoperative. In preparation for an OR case, supplies and equipment are brought to the OR. In the preoperative phase, staff (coordinated and led by an RN) assess and physically prepare the patient. During the intraoperative phase, various hospital staff and medical professionals (ie, anesthesiologist, surgical technologist, circulating nurse, certified registered nurse anesthetist [CRNA]) assist the surgeon in the surgical procedure. In the postoperative phase, the hospital provides recovery rooms (ie, postanesthesia care unit [PACU], sometimes followed by a phase 2 recovery) and the appropriate level of nursing care until patient discharge or transfer.

Completion of the individual tasks within the preoperative, intraoperative, and postoperative phases affects the patient flow, which in turn affects the patient's (and family members') perception of the quality of care. In addition, task completion affects the surgeon's perception of the hospital's ability to effectively support clinical procedures.[4] Perioperative services consists of small groups of practitioners whose patterns of practice affect the safety environment.[5] The multiple components of perioperative services (eg, staff, facilities) and their interdependent relationships make it complex and difficult to manage because it is not entirely clear how the components interact to affect patient health and safety and the quality of the clinical procedures performed.

Practitioners may not fully understand everyone's role in the complex perioperative services environment[5] because of the constantly changing conditions.[6] Research suggests that improved OR performance depends on synchronizing the functions of key personnel within perioperative services,[7] its support services may affect the workflow of the clinical procedures,[8] and the entire patient workflow through perioperative services needs to be examined to improve patient efficiency and safety and not just the flow in one department.[9]

RESEARCH DESIGN AND PURPOSE

To support our investigation of patient flow in perioperative services, we developed a tool to capture relevant workflow data quickly and seamlessly while observing the process. In particular, we developed an app for use on iPad or iPhone devices that automated the data collection process. The web-based application was developed using hypertext markup language (HTML) 5 and the jQTouch framework. The app's core functionalities consist of the ability to create, pause, resume, edit, delete, stop, and interrupt a task. Behind the scenes, the app automatically records the start and end times of each task, pause and resume times, and interruption times. In addition to the core functionalities, the app includes several features that facilitate data collection efforts. A "notes" feature allows the user to record additional or special observations to each recorded activity to capture special circumstances. While recording data, the app automatically sorts the open, paused, and completed tasks in a manner that is convenient for the observers. Also, the app clearly indicates to the users when there is a task that has an open interruption, and the completion of this task is required before another task can be created. The app includes other checking mechanisms to prevent users from recording data out of sequence. Finally, when data collection for a session is complete, the app provides the users with the ability to e-mail the collected data, in a comma-separated values (CSV) format, to any e-mail account. Additional information about the app can be found in Huynh et al.[10]

The collected data were used to identify patient preparation times and the frequency with which staff were interrupted while performing their primary task. The research team also used output from the data collection tool to develop process maps and a detailed computer simulation model.

Here, we assess the effectiveness of the simulation model to improve day-of-surgery decision making by engaging all levels of staff in tests that make use of the simulation model. Simulation has been used frequently in health care to examine processes. Choon et al[11] used simulation in an emergency department, and Crane et al[12] used it to represent alternative forms of delivery services to patients with glaucoma. We chose to use simulation to understand the reasons for communication and coordination delays and obtain feedback from the service providers regarding the difficulty eliminating these delays. This use has been considered to be a "soft" modeling feature,[13] in which the focus is on the softer skills of communication and problem identification.[14] Thus, the simulation developed and tested here sought to create discussions among practitioners about communication and coordination delays they encountered every day and to understand the difficulties facing perioperative services. A discrete event simulation was used rather than the role-playing simulation that is common in health care.[15] The metrics used to evaluate performance include the percentage of on-time starts[16] and the average lateness of cases. To evaluate the responsiveness of the system to schedule changes, we measured the percentage of patients in preoperative services who were ready when the OR called for them. To measure whether overtime was affected, we tracked the number of ORs still open at 3 PM.