

Complexities in the Operating Room

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Abstract

Surgery Departments in the U.S. generally account for over 60% of the hospital's total revenue. Misjudging the amount of revenue surgery departments account for is a common mistake among the majority of hospital executives. The revenue is overlooked due to the focus on the 20-40% of cost created by the surgery department, causing most hospital executives to cut surgery department costs [1]. Cutting the costs minimizes resources and supplies available within the department, contributing to the department's already existing inefficiencies and complexities. Improving these inefficiencies will allow the hospital to work towards achieving the 4 main objectives as follow:

1. Improving patient satisfaction
2. Improving worker satisfaction
3. Maximize revenue
4. Minimize cost within the surgery department

The 5 main inefficiencies of operating room turnaround time and scheduling tend to be:

1. Inaccurate length of surgery estimation
2. Inadequate staffing
3. Unstandardized worker responsibilities
4. Poor communication
5. Deficient teamwork

Identifying the areas of improvement in effort to reduce operation room turnaround time and the inaccuracy of operation scheduling is explored through case study examples including first person observations from the University of Pittsburgh Industrial Engineering case study at UPMC Presbyterian and Montefiore Surgery Departments.

1. Defining Turnaround (Turnover) Time

Turnaround time or turnover time can have different meanings and implications for the different roles within an operating room. For example, the surgeon may describe turnaround time as the time between the "incision close" of patient n to the "incision open" of patient $n+1$. Whereas, the anesthesiologist may describe turnaround time as the time between transporting patient n who just finished surgery to the Post-Anesthesia Care Unit (PACU) and beginning the anesthesia induction process of patient $n+1$ [2]. The variation of turnaround time can be seen in figure 1 below.

¹ This work is a result of a project lead by Professors Dr. Bopaya Bidanda and Dr. Bryan Norman and included Angela Litvin, Julia Lynch, Kate Cloonan, and Stephanie Small; students of the University of Pittsburgh Industrial Engineering Department.

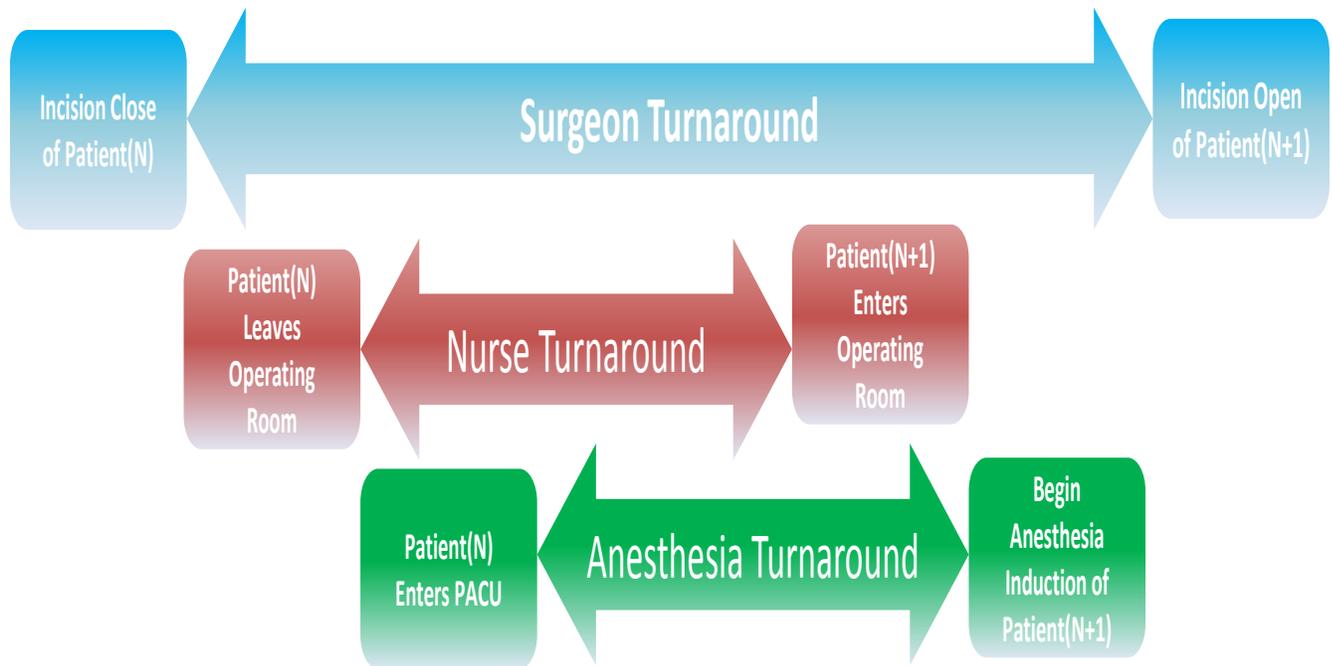


Figure 1. Variance of Turnaround Time Definitions

Developing a precise definition for turnaround time within the surgery department is extremely important. It allows everyone to view turnaround time from the same perspective. For the purpose of this paper, we define turnaround time as the time between “incision close” of patient n and “incision open” of patient $n+1$. This definition captures the surgeon’s perspective of turnaround time and allows us to see the delay between the most expensive value-added times in the surgery department. In most OR’s in the United States, the cost of each wasted minute can range from \$60-\$100.

Therefore, the first step in the analysis of operating room times is the development of a common definition and scope of turnaround time. Next, each discrete process step and personnel that contribute to turnaround time must be identified. The turnaround process steps of the surgeon, anesthesiologist, nurse, housekeeping, and members of the team must be completed before the next surgery can begin. In an ideal surgery department all process steps would occur in parallel, however, in practice this is unlikely due to standard hospital regulations, lack of communication, unstandardized roles, disorganization, and other complexities within the department. A few of the different pathways explored within the University of Pittsburgh Case Study at UPMC Presbyterian and Montefiore Surgery Departments can be seen below in figure 2.

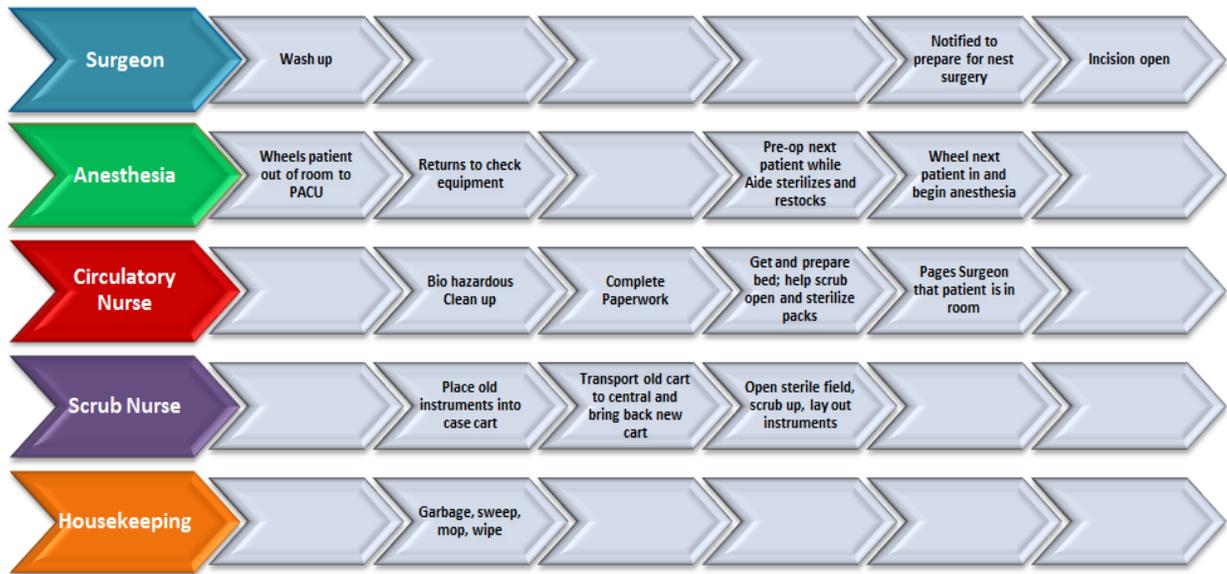


Figure 2. Process Steps within Turnaround Time

Multiple process steps create a complex situation due to the multitude of interacting and intertwined procedures that are required in order to begin the next surgery. A lack of defined timely roles and communication in the operating room turnaround can thus create prolonged delays in the process.

2. Turnaround and Scheduling Importance

An argument can be made that reducing turnover (turnaround) time will most likely not increase revenue nor decrease costs within the operating room [3]. This argument is strong under the following circumstances:

- Turnaround time is not extraordinarily long,
- Reducing work time other than overtime, and
- Case load is not high enough to fill the OR every staffed day.

Therefore, turnover time must have an opportunity to be reduced enough so that an extra case may be scheduled without increasing the resource cost. However, scheduling an extra procedure for the present day on the present day is not practical. Most ORs however have the possibility of adding a one hour case every day, which can increase the profit margin up to \$500,000 [4]. In a recent study, at a major hospital, it was found that the surgery schedules were delayed 98% of the time, 2% on time were merely due to the first surgeries of the day beginning on time, and the average turnaround time was 45 minutes long. Being able to reach an average target turnaround of 30 minutes would grant an extra 15 minutes per operation. However, a 15 minute turnaround time reduction may not yield enough time to add an extra case with only 3 cases scheduled per operating room on average. Additional time reduction is possible from improving upon scheduling accuracy. Underestimating surgery lengths cause cases that follow to be shifted to other OR rooms, in essence of avoiding delay. Although, shifting cases to a new OR on such short notice still delay the surgeries due to:

- Finding an operating room that has resources suitable for the surgery,
- The transfer of already prepared tools and supplies to the new operating rooms, and
- Worker confusion regarding the room change [5].

The schedule should be reviewed earlier to target underestimated surgery lengths ahead of time. These surgeries then can be altered on the schedule before surgery preparation begins. This creates a schedule with more streamline

flows minimizing delays. Moreover, being able to use both turnaround time reduction and accurate scheduling allows the opportunity to schedule additional cases, driving the profit [5].

Previously mentioned was the 98% of time that the schedule was delayed. These delays will push back all operations that follow, creating high patient and worker dissatisfaction. Occurrences were observed when staff, including surgeons and anesthesiologists had to stay 2-3 hours past the scheduled day. Creating an accurate and achievable schedule can alone create higher department morale along with allowing for a safer environment. Forcing staff to work an extreme amount of hours a day is unsafe for the patient undergoing the surgery when the fatigue starts to take over the staff. This alone provides a strong rationale to improve scheduling efficiency.

3. Methodology and Analysis Procedures

The following 9 step process was established for the project:

1. Establish project goals, objectives and performance metrics
2. Observe and become familiar of the process
3. Develop process flow
4. Data collect and gather already available data
5. Analyze the data
6. Identify bottlenecks and constraints
7. Develop recommendations
8. Implement solutions
9. Measure performance metrics

3.1 Establishing Goals and Objectives

Establishing goals and objectives is essential to create direction regarding the project team's motives. Performance metrics should also be developed in this phase. They will help measure the project team's progress throughout the project. Monitoring the progress creates awareness of when to revisit and/or revise goals and objectives, if needed. Continual monitoring of goals, objectives, and performance metrics will keep the project team moving in the right direction.

3.2 Data Collection

When approaching a new case study, it is important to first gain domain knowledge of the process. Further, establishing a single point of contact that can explain and answer questions about all parts of the process is a great start. Using flow charts and value stream mapping to visualize the information from the points of contact is helpful. During the case study, the team developed a flow chart of the entire turnaround procedure. The flow chart highlighted each process step, as seen in figure 3 below.

This flow chart was continually updated throughout the observation and data collection process. As outsiders the team was able to incorporate parts of the process that may be overlooked during the first draft of the flow chart.

The hospital was able to provide historical "turnaround time" time stamp data that is continuously collected. This was useful information but was difficult to understand the big picture that the numbers show without observing where the data comes from. Data collection is important to validate the accuracy of other data sources and to understand how the numbers describe the process through data analysis. For instance, the data analysis may show an extremely long anesthesia prep time; understanding the possible causes that may drive this long prep time can only be understood by observations.

UPMC PUH/MUH OR Turnaround Process
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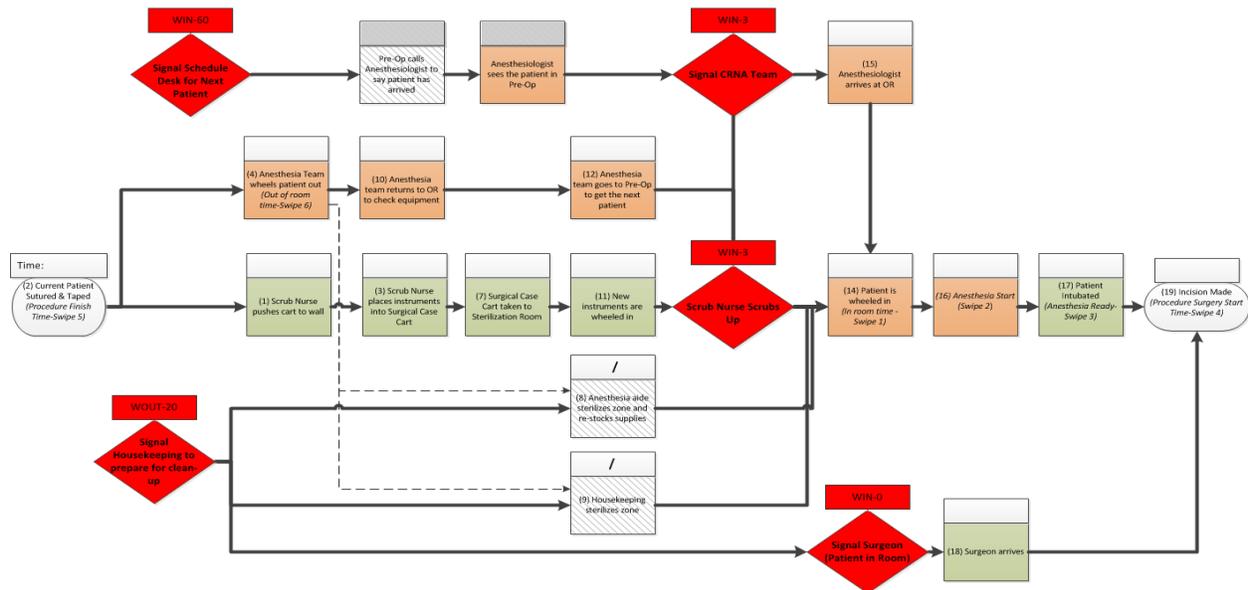


Figure 3. Operating Room Turnaround Process

3.3 Data Analysis

The focus area of data collection is likely to change throughout the case due to findings from data analysis. Analyzing the data will show parts of the process that need more samples to achieve a higher accuracy but more importantly it will highlight problem areas of the process. Highlighting the problem areas of the process as early as possible will help re-direct the focus of data collection. This also enables a project team to highlight the inefficiencies. For instance, the University of Pittsburgh case study redirected the primary focus of observations towards the anesthesia pathway. Anesthesia was deemed a bottleneck 40% of the time, more than any other pathway. The focus on improving inefficiencies was then redirected to Anesthesia work processes that happen outside of the operating room because our analysis showed that the majority of their prep time was spent outside of the operating room.

Data analysis will come in to play again when implementation begins. It is important to keep this in mind when developing key metrics because tracking progress and maintaining continuous improvement is essential after implementation.

3.4 Discussion of Results

At the completion of the data analysis major inefficiencies were within the process. The UPMC project team analyzed self-collected data for over 50 operating room turnarounds, along with additional analysis of the surgery department’s historical time stamp data from September 2010 to April of 2011. At the completion of the data analysis, the main inefficiencies were identified. These consisted of:

- Inaccurate length of surgery estimation due to an hour’s worth of pre and post-surgery time on average left unaccounted for.
- Non-standard worker responsibilities leading to task delays because of time spent deciding who should complete it.
- Poor communication leading to process delays, such as delaying the next patient being wheeled in due to not being aware of when the surgery prep was completed.
- Deficient teamwork due to staff that is not cross-trained to aid with tasks outside of their area when time permits.

Recommendations should now be developed and labeled with priority. Implementing solutions for problem A may be essential for the implementation of solutions for problem B. For instance, the first recommendation essential to

begin the improvement process at UPMC required the scheduling team to account for the whole process, in order to allow for accurate scheduling and accurate performance measures. The times missed were on average almost an hour's worth of unaccounted pre and post-surgery time. Also, the surgery length estimation model was based on the surgeon's personal estimation. Therefore, surgery length was recommended to be forecasted by using the historical time data identifying the surgeon and type of surgery.

Many solutions can improve more than one of the problems. It is important to highlight the underlying problems using the concept of the Pareto's 80/20 rule, allowing for more efficient recommendations that can be elaborated to solve multiple problems. The majority of the times, 80% of the problems are caused by 20% of more significant problems. This tends to be very common within almost any situation, including those in the operating room. In the University of Pittsburgh case, communication breakdowns occurred in several critical locations in the turnaround flow pathways creating lag time. For example, the anesthesia team did not have a signal of when the patient arrived causing lag time between patient wheels in and anesthesia induction. Our Industrial Engineering team recommended using communication triggers, within the determined time frame, at location of the communication breakdowns. An example of the communication triggers² and can be seen in figure 4 below.

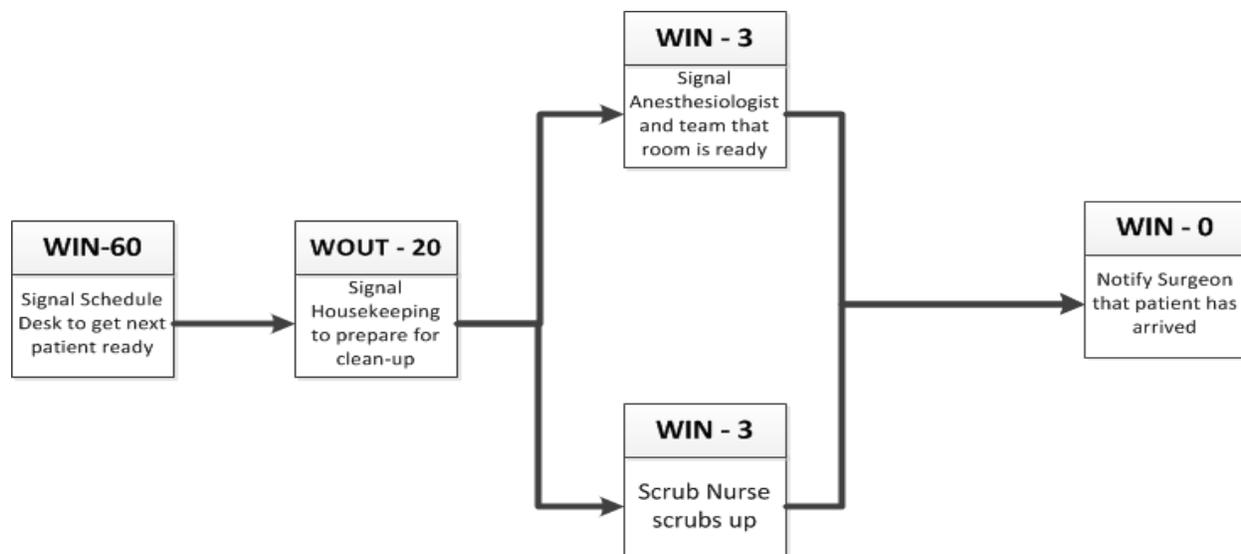


Figure 4. Communication Triggers

It was recommended that the circulatory nurse and the CRNA be designated as the project managers who are responsible for initiating the communication triggers. These triggers help create better defined job roles for the circulatory nurse, CRNA, and the staff being signaled. This essentially linked into the next recommendation of standardizing responsibilities due to constant confusion of who is responsible for which tasks. To create this “synchronization” with standard responsibilities, it was suggested that the OR staff have training sessions for all current staff members and continue training sessions with new incoming staff. Once the staff is aware of the designated responsibilities, performance can be measured and further improvements can be made. The training sessions also allows for cross functional team work, as all staff should be aware of what all job responsibilities are, leaving no task unaccounted for. Furthermore, developing recommendation priority and creating solutions that lead to multiple problem improvement is important. It creates methodology that is straightforward for the client to follow.

²Communication triggers are based on the time before WIN- Wheels in of patient (N+1) & WOUT- Wheels out of patient (N). (e.g. WOUT-20 = communication trigger before 20 min estimation of patient(N) wheels out)

3.5 Implementing for change

Implementing the recommendations can prove to be the most difficult part of project. It tends to be a long process and deems extremely difficult due to the staff's reluctance to change. The solutions that the University of Pittsburgh project team had recommended in spring 2011 are still not fully implemented. Since then, Stanley Healthcare Solutions has taken over the implementations [5].

Stanley Healthcare Solutions has agreed with the previous recommendations and also has begun working on new projects within the Surgery Department. They range from the continuation of the turnaround time project to developing 24 hour supply carts for the operating rooms. However, a special focus has remained towards developing an accurate schedule for the surgery department in belief that this is the most important problem for the same reasons discussed within the "Discussion of Results" section. Since the spring of 2011, the surgery department has started to account for the pre and post-surgery times and has started using historical data to estimate the surgery time improving their time estimation. Stanley Healthcare Solutions have discovered that the surgeon preference cards³ are inaccurate and have been leading to other problems such as the OR being unprepared with supplies that the surgeon uses, leading to rework. Stanley Healthcare Solutions also recognized that that surgery schedule is not reviewed until the day of the surgeries. Some surgeries are shifted around or specially prepped when it is realized that there are patients or surgeons who need special resources for a surgery. An example of this would be a patient who is larger in size that needs a larger surgical table. This leads to rework delays. Earlier schedule reviews would alert the staff of the special prepping beforehand and eliminate the rework day of the surgery. Improving the accuracy of these cards and developing a timelier schedule reviewing method is now the primary focus of continual improvement of the surgery schedule [5].

After discussion with Stanley Healthcare Solutions, the key to implementation is gaining the cooperation of the staff that is incorporating these solutions. Educating the staff and convincing them that the solutions being implemented will lead to positive results is difficult to do with just charts and graphs. It is important for the staff to see concrete examples, simulations, or any type of technique that can help them visualize how the changes will affect them positively. Most importantly, the staff should be a part of the entire project, from initial process documentation to implementation. Gaining staff support is difficult but can prove to be very effective when implementing for change.

Pam Murphy, registered nurse and director of surgical services at Piedmont Newnan, led a great example of gaining staff support. She knew from her 23 years of experience that the staff would be susceptible to change. Knowing that lean implementation means "doing more with less" drove fear into the staff and she knew that implementing new solutions would never work without the staff's support [6]. Fear of change is common in almost any workplace when asking staff to change their working methods after years of doing it a certain way. In order to gain staff support, it is essential to educate them on the methods that will be used and how the methods are going to be used in a positive way that will not negatively affect the staff. This is exactly what was done at Piedmont hospital, creating a supportive staff allowing everyone involved to have the same motives, increasing the effectiveness of the solution implementations. Using everyone involved a value-stream map was created of the entire turnaround process. The major problems in the turnaround process were decided by the group and attacked with the lean principles, resulting in a projected savings of \$118,000 annually [6].

Challenges and Conclusions

The ongoing day to day operation room processes can be very complex. It is important to keep in mind that not every surgery department is the same. The usual operation room complexities are always similar but the underlying problem causes are almost always different. The 5 main inefficiencies of operating rooms should only be used as guidelines because each surgery department is unique and can have unique problems. Identifying these underlying complexity problems is not an easy task one can accomplish by oneself. As mentioned before, all stakeholders that are affected by the changes should be involved throughout the entire project.

It is important for everyone involved to have a clear understanding of what the objectives are and how reaching these objectives will contribute to the whole department. As previously discussed, training sessions and visual management are great tools to keep the entire staff up to date. This also intrigues the staff to work with the project team rather than against the project team, creating a sense of team work and department unity. In return, the staff

³ The preference card has the preferences of the surgeon and the type of surgery they perform. The tools and surgery items are prepared based on this card.

has a sense of comfort, allowing the project team to gather observations, ask questions, and implement solutions more effectively.

It is also important to note that solutions created are sometimes difficult to justify with cost. For example, an efficiency improved operating room will sometimes still not be able to schedule another surgery. Although profit may not be increased right away, having control over the process and defined roles help control the process and easily identify any difficulties. This allows for continuous improvement of operation room efficiency. This improved operating room efficiency will more than likely start driving surgery department profit through increasing surgeries scheduled but it will take time. Most importantly, optimal schedules and operation room processes create a better work environment and in turn a highly satisfied staff contributing to improved patient care.

Finally, it is extremely important to benchmark against past performance of your own surgery department and possibly even other surgery departments. OR Benchmarks Collaborative, a partnership of OR Manager and McKesson Corporation, has partnered to provide OR directors and health care executives with a web-enabled dashboard that will provide monthly trended outcomes on OR key performance indicators [7]. Benchmarking data has been being captured as far back as 1996. In the June 2000 publication of OR Manager, data from various benchmarking studies, consisting of 7,664 cases and 22 different OR procedures, was shared. Whatever method chosen to track the surgery department's performance, key performance indicators must be tracked for continuous improvement. It requires patience and cooperation to see the long term benefits and results but it will happen if the applied methodology is used.

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