

The START methodology to work up and manage surgery scheduling inaccuracy

Accurate operating room (OR) case scheduling is a key performance indicator (KPI) that is challenging to manage. Inaccurate OR scheduling is a phenomenon that is so common that performance improvement efforts by OR managers are often dismissed by OR staff who have experienced past efforts that did not result in sustainable improvements to accuracy. Much of the literature focuses on improvements in scheduling algorithms to improve accuracy. This mathematical approach neglects the cultural, economic, behavioral, and process challenges that have an impact on the overall schedule. Like any clinical problem, there is a process to generate a realistic differential diagnosis of scheduling inaccuracy causes. This is especially challenging when the symptoms of the problem are so similar but the causes are not. The risk of not having the correct diagnosis for the scheduling inaccuracy problem can result in a management strategy that may in itself cause more problems than it intends to solve.

Scheduling accuracy is particularly important as a KPI because it is highly associated with optimal block and staffing utilization.¹ The more accurate the schedule and the earlier the schedule is finalized, the easier it is to plan resources accordingly. To understand the relationship between scheduling accuracy and its impact on the operating room it is helpful to analyze scheduling accuracy through the lenses of the following OR stakeholders: patients, surgeons, and essential support services.

For Patients

The assessment of scheduling accuracy begins with respect to the patient's perspective. A lack of unmet expectations is a predictor of patient dissatisfaction.² When an NPO patient is instructed to arrive at 9am for a planned surgery at 11am and is taken back to the operating room at 3pm, patients and their families can be rightfully upset. For the most part, patients understand that surgery schedules vary but what they may not know is that it can be a daily phenomenon at some centers. In an era where healthcare reimbursements are tied to patient satisfaction, hospitals may commit more resources towards addressing scheduling inaccuracy because of its contribution towards patient dissatisfaction.^{3,4}

For patients, the most meaningful measure of the scheduling accuracy KPI is measured by Scheduled Start Time (SST) relative to Actual Start Time (AST). It is sensible to create a time-based error threshold that patients would consider to be reasonable. The rationale for using absolute time as opposed to percent on-time is to maintain relevance to patients. What is relevant to patients is the amount of time in waiting, regardless of the cause of delay. For example, if 30 minutes of scheduling error is assumed to be acceptable, a case with a SST of 11am and an AST of 11:20 (+20 minutes) or 10:40 (-20 minutes) can be classified as on-time. This metric is simple to measure and understand but has limited use in solving the scheduling accuracy challenge. It is the equivalent of an ESR or CRP indicating that patient inflammation exists. However, it is not specific enough to identify the cause of inflammation or in this situation the cause of the scheduling inaccuracy.

SST relative to AST is a metric limited by the fact that case inaccuracies are amplified throughout the day with each subsequent inaccurately scheduled case. For example, although the third case of the day may have an accurately predicted surgical duration, the SSTe may be significantly delayed because the duration of the prior cases was grossly inaccurate. In such a scenario, SST relative to AST would suggest that the problem is the third case rather than a symptom of scheduling inaccuracies from prior cases.

This domino effect of inaccurate scheduling needs to be taken into consideration when analyzing the problem of scheduling accuracy. The effect also highlights the importance in differentiating the prediction of an accurate schedule versus an accurate procedure duration.

For Surgeons

The predication of surgical duration can be skewed based on different perspectives or underlying incentives.^{5,6} The series of events that occur to prepare patients for surgery may be marginalized by surgeons that bias their perspective on what is a reasonable amount of time to budget for a procedure. The surgeon's perspective typically focuses on start of incision to end of incision, or surgical control time (SCT). In the eyes of the surgeon, the surgical duration, which also includes anesthesia control time (ACT), is only the duration in which the surgeon is performing surgery. It is this skewed perspective of time that often gets reported as an estimate for surgical duration. A classic scenario is when a surgeon reports tourniquet time for procedure duration as a tangible foundation for their estimate but neglects the 30-minute induction, positioning, preparation, and draping prior to even the start of tourniquet inflation.

Surgeons often underestimate total case duration,^{6,7} without incorporating needed time for patient induction, positioning, preparation, patient emergence, room cleanup and subsequent room setup. These steps are essential, and though they may not involve the surgeon directly, it is important to budget time to perform each of these steps. Resultant prolonged actual case durations can be particularly frustrating for surgeons, especially when SCT has been shown to be overestimated by surgeons across all specialties.⁸ When ACT and the other necessary steps of surgery preparation, completion, and turnover are added to the SCT, surgeons typically fail to adequately project the entire case duration from patient in-room to patient out-of-room.⁷ In other words, even though the surgical duration estimate may be close to the scheduled, the actual surgery schedule may not appropriately budget time for non-surgical but essential activities. For facilities that primarily use surgeon provided estimates for surgical duration, the scheduling inaccuracies get amplified throughout the day due to underestimations of the total time needed.

One of the more challenging aspects of trying to improve scheduling accuracy for surgeons is that there may be a benefit to underestimating procedure duration. Underestimating times may allow a surgeon to schedule more cases into a given block. The strategy also minimizes the chances of the surgeon having to wait for a patient in the event that the surgeon finishes earlier than expected. This challenge is exacerbated in markets where there are few surgeons and there is significant operating room capacity between competing facilities that try to attract more surgeons to use their facilities. In such markets, surgeon satisfaction is directly linked to OR access and service. Tackling improvements in scheduling accuracy that may limit scheduled case volume or introduce the chance that a surgeon waits on a patient because of inaccurately estimated procedure durations can sour the relationship between the facility and the surgeon. Under such circumstances the problem of scheduling accuracy may seem to be dependent on inaccurate estimates, even though these inaccuracies are a direct result of prioritizing surgeon satisfaction. Scheduling accuracy may get compromised and the degree of compromises an OR manager is willing to take will depend on the competing drivers that shape a given marketplace. Fortunately for patients, scheduling accuracy is gaining more attention given that patient satisfaction can become a differentiator between facilities and that satisfaction may meaningfully influence reimbursement.

For surgeons who do not have guaranteed first case start time, the issue of scheduling accuracy is more relevant because the pain of an inaccurate schedule is more disruptive to his or her workflow. When surgeons are waiting on a prior case to finish from a different surgeon and that case is grossly inaccurate, the waiting surgeon also experiences the negative impact of an inaccurate schedule from the same lens of the patient. These experiences are not that frequent for tenured surgeons who may be accustomed to having first case start times and rarely need to wait on a different surgeon to finish. However, for new surgeons who may not have dedicated OR block time they become much more mindful of scheduling accuracy and how the degree of inaccuracy will shape their own personal schedule on the day of surgery. In such an environment, it is difficult to make changes unless there are enough surgeons who are negatively influenced by inaccurate schedules. Table 1 summarizes challenges to the scheduling process for a surgeon’s caseload.

Scheduling Steps	Challenges
Surgeon decides that patient needs surgery	<ul style="list-style-type: none"> • The actual procedure description used by the surgeon may not be accurately reflected by the codes or procedure descriptors used at the facility in which the surgeon will perform surgery. • The procedure code (e.g. CPT code, unique code) itself does not accurately reflect the procedure that may be performed during surgery. • The nature of the surgery in itself is variable due to the nature of the pathology (e.g. Cancer surgery)
Surgeon may provide an estimate of procedure duration.	<ul style="list-style-type: none"> • Surgeons may provide an estimate of surgical time which his/her assistant will use as the basis for the procedure duration • The forms used to communicate the desired surgical times may not be standardized which may create breakdowns in communication between those requesting the surgery and those involved with the scheduling process. • It is not always clear if the time duration provided by the surgeon (if written at all) is the skin-to-skin time or total time room-in to room-out time. • The procedure may not include all the relevant procedure codes that can be used as a basis to estimate a procedure duration.
Surgery schedulers do their best to select the correct procedures	<ul style="list-style-type: none"> • Sometimes the scheduling codes used do not accurately reflect the case performed. Unless the scheduler works regularly with the surgeon-most schedulers need a clear directive that is both precise and comprehensive in description. • There is significant power asymmetry between the scheduler and surgeon which places the scheduler in a difficult position to clarify the surgery. • Not all systems use standard CPT codes for procedures and unique procedure codes don’t always accurately reflect the correct procedure so “comments” are used to communicate more details about the procedure as a workaround and these times are not actually incorporated into the procedure duration estimate and cannot be used as a data point given the unstructured nature of the data.

<p>Case times are shortened to schedule more cases into block.</p>	<ul style="list-style-type: none"> • Sometimes schedulers face pressure by surgeons to schedule to a numerical case goal (e.g. 4 cases or 3 cases in a given block). In order to do so they shorten the case duration estimates so the cases can fit into the assigned block. • Surgeons can provide a shorter estimate as long as there is accountability. Without accountability, the concern is that surgeons may shorten the cases to fit more cases into the block which places increased afterhours staffing pressure and prolongs patient wait preoperative wait times.
<p>Scheduled is communicated to surgeons</p>	<ul style="list-style-type: none"> • Surgeons are often too busy to look at the schedule too far in advance. Even when there are obvious scheduling inaccuracies to the surgeon, this may not be recognized if the surgeon does not see it. • Gross inaccuracies in scheduling are oftentimes raised on the day of surgery when surgeons have visibility into the timing. Though they may have been able to detect this problem earlier they themselves are too busy to build a financially sustainable process to evaluate the schedule with enough lead time to modify the schedule.

Table 1: Steps involved with procedure scheduling and the challenges associated with each step and impact it may have on accuracy of surgical scheduling

For Support Services

Anesthesia providers, nurses, technicians, surgical supply personnel, pathology, imaging, pharmaceutical services, lab services, and the facility as a whole all support the operating room, and they too feel the direct impact of inaccurate schedule on a daily basis. Essential support services have two customers - the patient and the surgeons. Satisfying the needs of these customers depends on providing sustainable staffing support to cover the unexpected afterhours care. Using the same example of the patient who was instructed to arrive at 9am for a 11am surgery but is taken back to the operating room at 3pm: if the case was originally scheduled to finish at 4pm (5-hour procedure), it would now finish at 8pm, assuming a perfect surgery duration prediction. The ripple effect of this situation requires not only OR staff to stay late, but also extra PACU nurses to remain until the patient is discharged, which might be 11pm or later in this case. The economic impact of scheduling inaccuracies is felt when staff have prolonged calls or when premium overtime is paid to cover unscheduled afterhours care. Thus, the impact of having a more accurate schedule can have significant staff cost savings. The savings come from the reliance on appropriately skilled staff to cover after hour work using shifts as opposed to obligatory overtime which may cost 1.5 to 2x the cost of a schedule shift.

Figure 2 shows that underestimated scheduling duration increases the likelihood of unexpected afterhours work in the OR. Unanticipated afterhours work may create additional personal and professional stressors that impact staff satisfaction and turnover. OR nurses and OR technologists both cite the pressure to work more quickly as a high-impact stressful event.⁹ Training a perioperative nurse costs tens of thousands of dollars, and a meaningful return on investment is achieved only after years of service.¹⁰ Such staff is a precise resource and not easily replaceable given national nursing shortages. An unreliable OR schedule can be a big source of dissatisfaction, ultimately leading to negative morale and increased staff turnover, with decreased safety, quality, and eventually the bottom line.

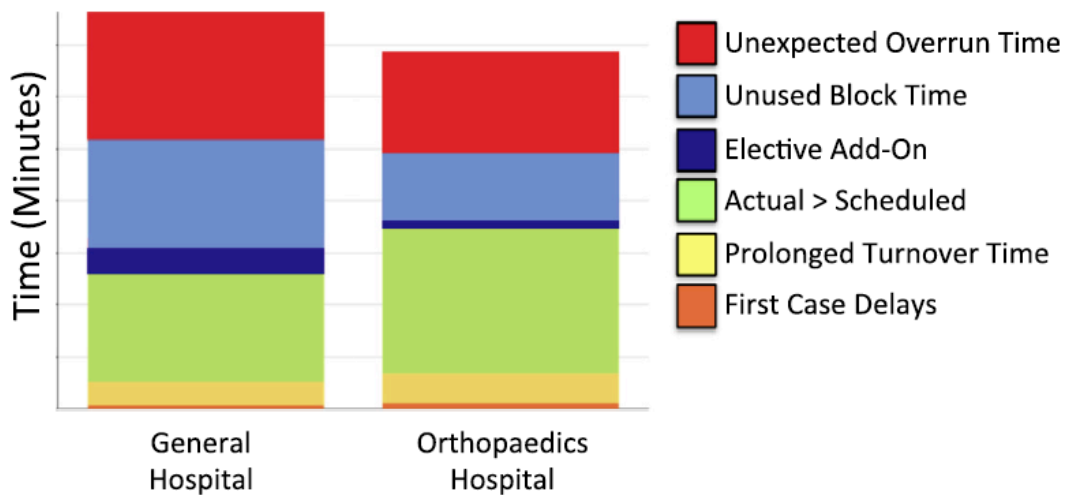


Figure 2: Underestimated scheduling duration can be a significant contributor of unexpected afterhours use of operating room. 11

Stakeholder	Cost of Inaccurate Schedule
Patients	<ul style="list-style-type: none"> ▪ Prolonged wait times may lead to significant patient dissatisfaction. ▪ Rapid on-boarding process (if OR is ahead of schedule, or very behind schedule) may limit the quality of the experience due to haste.
Surgeons	<ul style="list-style-type: none"> ▪ Actual duration longer scheduled duration this can be disruptive to surgeons who have to follow a surgeon in the same room. ▪ Continued delays in the same room may result in no staff to cover late cases because the schedule did not plan sufficient support staff. ▪ Actual duration shorter than scheduled duration can ultimately result in limiting the surgeon's block time - the number of cases scheduled into the block are based off of the inaccurately overestimated procedure durations.
Support Staff	<ul style="list-style-type: none"> ▪ When scheduled durations are significantly longer than actual durations surgeries than there will be an overstaffing problem which can be very costly. This problem is amplified for support services that depend on the volume for professional billing services (e.g. Anesthesia services, perfusion services, etc.). ▪ When the actual durations are significantly longer than the scheduled durations than the pressure to work unexpected overtime or under more stressful circumstances can lead to job dissatisfaction and higher institutional turnover and difficulty with recruitment. It can also can have an impact on quality of care and safety if the workforce is overworked.

Figure 3: Cost of Inaccurate Surgical Scheduling on Stakeholders

Managing surgical accuracy and its impact on stakeholders is a challenging complex task (Figure 3). Addressing the problem requires a systematic approach akin to the workup of any presenting medical chief complaint. A diagnosis is made with the proper use of relevant data and studies, and only then can a therapeutic plan be developed.

The workup of surgical inaccuracy requires the use and understanding of several data elements. Using more precise continuous data measurements of scheduling accuracy as opposed to categorical data measurements of accuracy can be of greater value in troubleshooting causes of inaccurate schedules. Relying on Percent Deviation from Scheduled is a continuous data metric that measures the absolute difference in scheduled duration versus actual duration to the exact minute. A 0% deviation means that if a case is scheduled for 100 minutes and the actual duration is 100 minutes then the Percent Deviation from Scheduled is 0%. This metric is helpful in determining if the case duration estimates are a source of the problem. Furthermore, it helps quantify to what extent the problem occurs. Oftentimes, this metric is a direct measure of the process of how case estimates are created.

Some facilities use software that use various scheduling algorithms to produce estimates. These algorithms base their predictions on various sample sizes to produce numbers based on rolling averages, medians, linear regressions, or more sophisticated machine-learning methods to predict estimates.^{12,13} Others use scheduling prediction models weighted by patient characteristics, procedure type, surgeon, or other OR personnel.¹⁴ The success of any algorithm is firstly dependent on how accurately the scheduled procedure is selected upon scheduling. If the type of procedure scheduled does not match the actual procedure, there is limited capacity to reliably produce an accurate estimate regardless of the algorithm. Furthermore, if the case description is not updated after the procedure is completed then the subsequent estimates may be falsely skewed based on “polluted” data sets that are storing procedure times that are pegged to the wrong cases due to imprecise case selection. These data nuances may often times be ignored but deserve attention in facilities that use electronic systems to help with scheduling.

The Scheduling Accuracy Workup

To begin work up of scheduling inaccuracies, there are a series steps that need to be conducted. We present the START Approach (Figure 4), a systematic manner in which to assess the current state of scheduling accuracy, investigate potential causes for scheduling incongruences, and develop solutions to the problem. The approach includes a Scheduled procedure gap analysis, Time stamp assessment, Analysis of procedural descriptors, Review of algorithm, and Timely feedback and continuous improvement.

Scheduled Procedure Gap Analysis: The first step is to conduct a gap analysis between what procedures surgeons think they are booking versus what is actually being booked. This gap analysis should be conducted by the name of the procedure and by any corresponding procedure codes. It is best practice to use a combination of CPT codes and ICD9/10 codes that in combination can function as a unique identifier to properly describe both the procedure and condition of the patient. Some facilities have implemented their own custom coding taxonomy to schedule procedures and use for surgeon preference card supplies, and if this is the case then the analysis should be done at this level. Understanding these codes and having them appropriately mapped to the procedure in which the surgeon wants is critical. If not, there may be a breakdown in communication between what surgeons think they are scheduling their procedure and what is actually being used as the basis for scheduling the

procedure. If a significant gap exists, managers should invest resources into reconciling the gap between what surgeons want to schedule and what they are actually getting scheduled. If this step is not resolved further efforts will fail.

Time stamp assessment: The second step in this process is to ensure that the correct time stamps are being used for procedure duration estimates. Clearly define which time stamps should be used as basis for surgical duration estimates. Ensure that all stakeholders clearly understand which time stamps are being used as the basis for the estimates and the rationale behind this decision.

It is ideal to use Room-In to Room-Out time stamps to capture the entire workload required to perform the case. This step is an important form of data assurance. If skin-to-skin time stamps are being used as the basis for estimates of scheduling duration, then the amount of time scheduled will continuously be less than what is needed. If time stamps are unreliable or not reported at all, workflows need to be changed to ensure that the data collected is comprehensive and sufficiently reliable to serve as a basis for estimating future procedures.

Analysis of procedural descriptors: After the surgical case is closed, a review of the completed procedures completed. A second gap analysis should be conducted between the scheduled procedure and the actual performed surgery. Corrections must be made to any procedure descriptions that may not have been accurately chose prior to surgery. A procedure descriptor should be precise and comprehensive enough to accurately describe the surgery performed. This analysis is needed to improve the relationship between procedure descriptors and their corresponding surgical durations. Otherwise, if the actual procedure performed differs from the scheduled procedures than subsequent surgeries that depend on the actual durations as a basis for future estimates will have a “contaminated” data set as a basis for the procedure duration.

There must be a process to correct the classification of surgeries if the surgery performed was different than what was initially scheduled. If there is not a process, one must be created. Proper procedure categorization is important because future case predictions would otherwise be based on inappropriately classified surgical procedures. Oftentimes this already occurs for billing purposes – thus, creating a workflow to collect this information for good scheduling data stewardship is ideal. By bundling the two-billing and scheduling, users do not have to change their workflow and the classification of procedures is likely to be more precise. Once achieved, future case durations will now be based on validated data sets that should be more accurate.

Review of algorithm: Review the algorithm used to schedule the procedure and predict surgical duration. Ensure the inputs to the algorithm are precise and comprehensive. Do not proceed with reviewing the process until the gap between the scheduled procedure description and actual procedure description is optimized.

Understanding the minimal sample size required to produce an estimate is important. If the sample size is too small, then there may be insufficient data to produce a good estimate. If the sample size is too large then the amount of data required to build a library of data may prevent an estimate from even being produced because it will take time to build a library of data. Allowing times to be overwritten based on surgeon input is important because having some data as a start is at least better than no data.¹⁵ The calculation method used can vary from average, rolling average, median, linear regression, or more sophisticated machine learning techniques. Each method has its plusses and minuses.¹⁶

Timely feedback and continuous process improvement: It is important to keep stakeholders informed and creating a feedback mechanism to report scheduling process errors in a timely fashion that is relevant to each stakeholder is important to creating a level of awareness to the problem. It is also important to identify the impact scheduling inaccuracies have to each stakeholder.

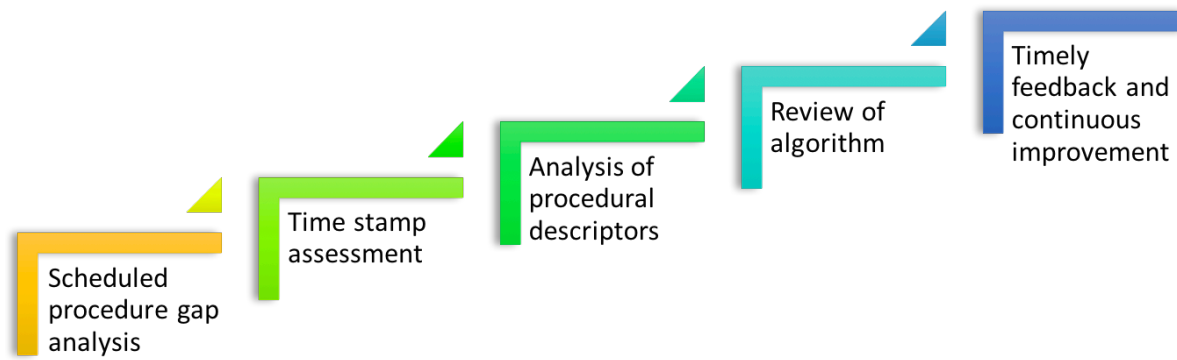


Figure 4: The START methodology to work up and manage surgery scheduling accuracy

Additional Considerations

Good management is key to addressing this problem. This can be difficult depending on the market and politics involved with the organization. Armed with data and analysis, institutional leaders can identify the areas that warrant intervention and find support for potential changes.

Framing the scheduling problem as an options problem may more accurately identify if and when the environment is even ready to address scheduling accuracy. In an environment where there are few surgeons and many health systems competing to attract surgeons it may not be prudent to even approach the scheduling accuracy challenge. The cultural and economic drivers will likely take priority over algorithmic improvements in estimates. In such environments, ensuring that the surgeon is happy is critical to economic survival. Such complexities are beyond the scope of this paper.

In summary, the issue of scheduling accuracy is integral to the performance of an institution's operating rooms. Problems with scheduling inaccuracies can lead to many problems to the many stakeholders involved with patient care. There should be a systematic approach to approaching scheduling accuracy, and we have outlined the START approach as a means to begin analyzing problematic scheduling practices. Implementation of changes can be complex with specific healthcare systems that have unique cultures, personalities, and economic priorities. However, any problem solving begins with a good start.

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