Improving Nurse Scheduling in Operating Rooms using Lean Principles –

How It Can Optimize Costs
The objective of this study is to understand how Lean and Six Sigma can provide the necessary framework to rethink care delivery processes and improve Nurse Scheduling in Operating Rooms.
Introduction

Operating room management is the science of how to run an Operating Room Suite. Operational operating room management focuses on maximizing operational efficiency at the facility, i.e. to maximize the number of surgical cases that can be done on a given day while minimizing the required resources and related costs. For example, what is the number of required CRNA’s, RN’s, scrub techs, etc., that are needed next week to accommodate the expected workload or how can we minimize the time between cases in the Operating Room? Strategic operating room management deals with long-term decision-making.

- Ensure patient safety and optimal patient outcome
- Provide surgeons with appropriate access to the OR so that patients can have operations in a timely manner
- Maximize the efficiency of operating room utilization, staff, and materials
- Minimize down time for staff; ie resources being paid without cases being performed
- Decrease patient delays
- Enhance satisfaction among patients, staff, and physicians

This management science as applied to the surgical suite is gaining more attention because of increasing market pressures on hospitals from competitors (e.g., other surgical suites including office based surgery) and from payers seeking lower prices. The surgical department is often the most profitable hospital operations unit. As such, surgical suites also comprise an important fraction of hospital budget spending.

Causes of time wasted in OR and their proportions:

1. Surgeon Unavailability: 8%
2. Inappropriate patient preparation: 12%
3. Unavailable room or staff: 50%
4. Cleaning time: 10%
5. PACU space and transport: 10%
6. Spill over time: 10%
What should not be overlooked in OR Scheduling?

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. Improving scheduling in OR 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 needs to be explored.

What is generally the roadblock in OR Scheduling:

- 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.

Principles of operating room management

The decisions made by OR management should have a clear and definitive purpose in order to maintain consistency. In order of priority, governing principles of OR managers are to:

1. Ensure patient safety and the highest quality of care;
2. Provide surgeons with appropriate access to the OR;
3. Maximize the efficiency of operating room utilization, staff, and materials to reduce costs;
4. Decrease patient delays; and
5. Enhance satisfaction among patients, staff, and physicians.

If OR management is properly performed ahead of time, all that doctors and nurses have to think about on the day of surgery is the patient. If management is poor, then the medical and nursing staff may waste efforts and resources to rush/delay cases, scramble pulling staff and adjusting schedules and thus compromising attention to patient satisfaction.

Operating rooms are one of the biggest revenue generators for a hospital. But unpredictable case schedules, physician availability, a multitude of staff specialties with varying shift times and lengths, limited resources and on call issues also makes it one of the most difficult areas for staff scheduling, thus resulting in significant overtime, staff wastage and premium labor spend. Although difficult, it is possible to optimize OR staffing through a data-driven lean approach.

The basic tenets of Lean and Six Sigma is to lay the groundwork and identify necessary processes and tools to implement the program in any area of a healthcare system.
Major Challenges across Surgical Services

Unique complexities and lack of customized scheduling solutions drives most operating rooms to adopt manual/paper scheduling processes

- Complex scheduling challenges
  - Multiple parallel shifts (E.g.: 7a-3p; 8a-4p; 9a-5p); multiple shift lengths, (24, 16, 12, 8 hour shifts)
  - Extensive on call usage and limited resources, High OT usage as scheduling is closely correlated with patient cases and last-minute changes in patient case schedule

- Expensive resources spend significant time on manual scheduling
  - On an average, managers in each unit spend 3 hours every day for scheduling. Considering that OR RNs and CRNAs are highly paid resources, organizations spend $15-25K per month on OR scheduling
  - Further, senior manager is heavily dependent and almost held hostage by a few people for scheduling and have little to no control over the labor spend

- Lack of Data Analytic – As most of the schedules are prepared on paper, there is no means to get analytic insights. E.g: how many times on call employees were called-in, what is the overtime scheduled for upcoming week, etc

- Non availability of scheduling software that suits the unique needs of OR scheduling – As traditional scheduling software’s have to be significantly customized for the Operating Rooms, most of the vendors have little to no focus in this area
Laying the groundwork generally needs the consideration of variables like:

- **Cost and Quality**: Many programs being put into place today are fundamentally based on the assumption that higher quality ultimately leads to lower costs.

- **Targeting Excess costs**: Organizations with strong continuous improvement programs will be the best prepared to reduce excessive costs.

- **Demand patterns in the industry**: New demands from patients are forcing the redesign of the way care is delivered in nursing practices.

- **Readiness Assessment**: Before embarking on a process improvement program, it is critical to ensure that the necessary infrastructure is in place so that you can make the most of limited resources.

- **Change Continuum**: The culture must be regularly assessed in order to ensure that it is continuing to move up the continuum.

- **Measure and analyze**: Lean and Six Sigma offers additional analytical rigor and provides tools to achieve desired results by effectively managing the areas of opportunity, organizations can realize measurable improvements within the nurse scheduling.
Lean and Six Sigma

Many organizations are turning to Lean and Six Sigma as tools to address cost and quality simultaneously. They are complementary and often overlapping philosophies that make the patients’ needs the top priority.

By Definition- Lean

- Considers any activity that does not directly create value for the customer to be a target for improvement or elimination.
- Often known for the principle of “waste reduction.”
- Valued as a tool for cultural change as well as cost reductions.

By Definition-Six Sigma

- Targets perfection by identifying the causes of errors and reducing process variation.
- Focused on quality improvement, with cost reduction as a benefit of reaching that goal.
- Establishes a threshold of acceptable performance at the “six sigma” level (i.e., 3.4 defects per million opportunities)

Readiness Assessment

As Lean and Six Sigma are deployed, organizations are having mixed results. There is great potential, but organizations are frequently unprepared, lacking the infrastructure necessary for success. Before embarking on a process improvement program, it is critical to ensure that the necessary infrastructure is in place so that one can make the most of limited resources.

“Readiness Assessment” is part of the groundwork that has to be done to ensure the alignment of Lean and Six Sigma process. And to set up the necessary infrastructure, organizations need to make sure of the fact that they have the following in place in the operating rooms:

- Leadership commitment
- Project management
- Nurse alignment
- Project prioritization
- Easy access to reliable data
Change Continuum

Once an improvement program is in place, an operating room slowly shifts its culture along the change continuum during the transition to a culture of continuous improvement.

Measure and Analyse

By effectively managing these areas of opportunity, organizations can realize measurable improvements within the operating rooms.

- **Operational Processes:** Improve scheduling accuracy/ ownership, Balance operating room schedules to better utilize resources, Evaluate clinic building space allocations and Reduce duplicative processes.

- **Care Model:** Identify appropriate staffing models, Evaluate staffing levels and licensure mix, Clarify expectation of nursing roles in operating room, Promote team-based accountability for patient experience.

- **Systems:** Develop robust and intelligent systems to adjust staffing based on current and future volumes. Real-time dashboards to help monitor house-wide staffing status and hours per patient-day for optimum labor productivity.
The 3 major components of scheduling a workforce are:

<table>
<thead>
<tr>
<th>Scheduling process</th>
<th>Scheduling practices</th>
<th>Scheduling technology</th>
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The Hallmark Lean six sigma consultants conduct a thorough analysis of the above components to identify gaps and recommend solutions. As part of the project, our consultants can help assess the current staffing and scheduling processes used in operating rooms and recovery rooms and propose a 360 degree perspective to help tackle challenges with people, process, and technology.

**Scheduling Process**

**Define**

This step is to clearly understand and articulate the problem areas in the current scheduling process; clarify actualities and set objectives. During this phase, in addition to assessing the scheduling process, related inputs like case scheduling, physician block time, case duration is also assessed.

The output from this phase include:

- High-level process maps of current scheduling process
- Internal and external contributors affecting the process
- Definition of critical process outputs (CTQs) and controllable variables
- Project targets or goal
- Project boundaries or scope
Measure

This step is to meaningfully institute current baselines as the basis for process improvement. This is a data gathering step, the objective of which is to establish process performance baselines. Key metrics measured include workforce spend, skill mix, status mix, experience mix, frequency/type/duration of OR cases, physician block times, and OR utilization.

In this step the team

- Identify the gap between current and required performance.
- Collect data to create a process performance capability baseline for the project metric
- Assess the measurement system for adequate accuracy and precision
- Establish a high level process flow baseline

The study on the time spent in scheduling is measured based on the frequency of late day/call duty utilization, emergency cases during the night, overtime and agency utilization and the allocation of budget for each module. The measurement also takes into consideration the turnover based on the delay, emergencies and just in time scheduling.
Analyze

The purpose of this step is to identify, validate and select root cause for elimination. A number of potential root causes are identified via root cause analysis. A data collection plan is created and data are collected to establish the relative contribution of each root cause to the project metric, Y. This process is repeated until "valid" root causes can be identified. For e.g: Overtime is incurred primarily when late day is utilized in cardiothoracic surgeries because cardio cases are taking longer than the blocked time.

Of the "validated" root causes, all or some can be:

- Listed and prioritized for potential causes of the problem.
- Prioritized as key process inputs to pursue in the Improve step
- Analyzed how the process inputs (Xs) affect the process outputs (Ys). Data is analyzed to understand the magnitude of contribution of each root cause, X, to the project metric, Y. Statistical tests using p-values accompanied by Histograms, Pareto charts, and line plots are often used to do this.
- Detailed process maps can be created to help pin-point where in the process the root causes reside, and what might be contributing to the occurrence
The gaps identified while measuring is analysed in this step. It is seen that a lot of time is spent in doing the manual scheduling in the operating rooms. The manual and paper scheduling process gives no analytical insights and no back up happens for specific roles like clerks and CSRs which causes significant issues in call-ins or census changes.

The purpose of this step is to identify, test and implement a solution to the problem; in part or in whole. It is important to ensure that each solution is targeted at resolving specific problems identified in the earlier phases. In the previous example on cardiothoracic surgeries, one of the solutions may be to pre-schedule a non-overtime employee based on the actual average duration of such surgeries.

Various project management and planning tools can be used to implement these new processes.

- Implement process changes.
- Review outcome and CTQ performance in order to understand the impact of changes
Based on the previous steps of measurement and analysis the following improvements are suggested to eradicate the gaps and make the process more efficient:

- Use automated AI system to create core schedule based on organization policy, budget and department specific rules.
- Implement AI reporting tool to not only track historic trends but also to help make informed predictions.
- Create an optimized float pool system with employees in bench to facilitate OR throughput without spending on call duty/premium pay.
Control

The purpose of this step is to sustain the gains. Monitor the improvements to ensure continued and sustainable success. Create a control plan. Update documents, business process and training records as required. A Control chart/ AI systems can be useful during the Control stage to assess the stability of the improvements over time by serving as a guide to continue monitoring the process and provide a response plan for each of the measures being monitored in case the process becomes unstable.

### Scheduling Practices

Scheduling practices focuses on the various policies and rules applicable to workforce staffing and scheduling in operating rooms. Policies deemed necessary under certain circumstances can soon become practices which are manipulated to result in significant spend for the organization. Six sigma enables continuous oversight to avoid such scenarios.

Define

This step is to understand the current policies and practices which influence OR workforce staffing and scheduling. It will help articulate the intent of the different policies and the actual practices which are followed by employees. Interviews with the OR nursing, recovery teams, CRNA and ancillary teams, and case scheduling teams will provide “on the ground” understanding of the policies and practices.
Measure

This step is to measure the impact of the different practices on the overall labor spend. Establishing the current impact would help set up the baseline for future improvements. This step would involve significant data gathering and data slicing from payroll and finance team to quantify the impact of each staffing policy and practice.

After the scheduling process in place, we need to measure the best scheduling practices. As in the below exhibit measurement for three different practices were taken - Critical shift, Call Duty and On Call shift. This helps in further steps of analyzing and controlling. As measured it can been seen that 47% was the overtime spend, 22% spend was due to overstaffing and the rest 31% was the call duty spend. Based on these measurements the operating rooms in any health system can now plan its resource expenditure with a better scheduling process and practice as well.
Analyze

The purpose of this step is to analyze the impact of eliminating or modifying existing practices to reflect best practices. Correlation analysis is used to study the inputs (Xs) and outputs (Ys) from modifying the different practices. Scenario analysis is conducted to study the end game resulting from the changes. In addition to hard numbers, the impact on cultural change for employees is also considered during the scenario analysis.

Key Metrics to be Analyzed for Resolving People and Process Efficiencies in Operating Rooms

- Analyze OT usage – by skill, by specialty, by shift
- Analyze on call and call duty usage – by skill, by specialty, by shift
- Revisit budgeted numbers to identify core staff required for each shift
- Identify bench size based on historic trends (E.g: Mondays and Thursdays are the busiest)
- Identify cross training needs between specialties
- Revisit education and orientation program for employees who can be cross-trained
- Analyze process for physicians to block cases
- Analyze allocation of block times to physicians by specialty
- Analyze blocked time vs. utilized time for each physician
- Identify physicians who constantly exceed blocked time
- Identify patterns for last minute add ons
- Analyze various scenarios for last minute add ons and how cases must be scheduled in each scenario
- Identify patterns which creates bottle necks and make recommendations for the same

Improve

The best practices and policies identified in the previous phases are implemented in this step. Based on the extent of impact, practices may be changed throughout the organization or in a phased manner. Various project management and change management tools are used to implement the new policies. Throughout this step, AI tools are used to monitor the impact of policy changes in both inputs and outputs, especially based on their correlation. For example: reduction in overtime should not lead to increased agency usage.

There are various tools to improve the scheduling process as well as the scheduling practices in the health organizations.
Some of them are described below:

**Goal Deployment/Strategic A3X**

The GDP utilizes an “X matrix” as a strategic planning tool to align improvement efforts with the most critical business objectives.

**Implementing Goal Deployment**

- The matrix is read by following the “X”s around the square (see highlighted route).
- The A3X is developed at the highest organizational level (e.g., medical group).
- The improvement targets from the top A3X become the breakthrough objectives for the next level.
- This process continues until the point at which action plans can be developed.
Many organizations are utilizing GDP as their only strategic planning tool and aligning all initiatives, including but not limited to Lean/Six Sigma, to one of their top-level objectives.

**Value Stream Mapping**

A value stream map (VSM) is a tool used to assess work flow, identify waste, and plan for the reduction/elimination of the waste within a given time frame. All process steps are identified from start to finish.

- VSM provides a common language that helps stakeholders visualize the future vision.
- Identifies value-added and non-value-added time for the patient.
- Identifies deviations between the actual process and the intended process.
- This tool is useful as part of a process-mapping exercise.

To improve a process, organization should focus on establishing flow, eliminating waste, and adding value to the patient.
**Rapid Improvement Events:**

A rapid improvement event (RIE) is a 3- to 5-day event that brings together a team of stakeholders with the objective of improving a specific process. The goals of the event are to identify improvement opportunities, develop solutions, and implement them quickly.

**Features are:**

- May be integrated into existing projects
- Can obtain leadership buy-in with quick results
- Can be condensed if resources are needed on clinical duties
- Are an efficient use of client resources

<table>
<thead>
<tr>
<th>Goal</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>• Scope the problem&lt;br&gt;• Select a team&lt;br&gt;• Collect outcomes data&lt;br&gt;• Observations&lt;br&gt;• Stakeholder interviews</td>
</tr>
<tr>
<td>Day 1</td>
<td>Identify the current state&lt;br&gt;• Current-state VSM&lt;br&gt;• Observation and time studies</td>
</tr>
<tr>
<td>Day 2 to 3</td>
<td>Identify opportunities to improve the process&lt;br&gt;• Turnover reduction&lt;br&gt;• Fishbone diagram&lt;br&gt;• Five whys</td>
</tr>
<tr>
<td>Day 4 to 5</td>
<td>Design and test the future state&lt;br&gt;• Future-state VSM&lt;br&gt;• Pilot/trials&lt;br&gt;• Potential problem analysis</td>
</tr>
<tr>
<td>Action Plan</td>
<td>Clarify required next steps to achieve the desired future state&lt;br&gt;• Action plans</td>
</tr>
</tbody>
</table>

RIEs can provide immediate benefits, but the organization must develop an action plan and arrange for ongoing monitoring in order to ensure sustainment.
Control

As part of this step, controls are implemented for continuous monitoring of policies/practices on financial spend. Analytic reporting customized for each level of management can provide real-time data for actionable steps. AI systems can also help set up automatic alert notifications when control limits are exceeded. For e.g.: notifications can be sent to OR Director if a department exceeds overtime limits consistently or if cases are cancelled constantly due to staff unavailability. Control plans are drafted on actions to be taken for policy deviations and communicated to all employees.
Scheduling Technology

Gap Analysis

Hallmark strategy and technology consultants assess the differences between the current and desired performance levels of the healthcare systems' scheduling applications. The gap analysis will also help determine how to meet the appropriate technology requirements for scheduling efficiency and scalability.

Key requirements for an efficient scheduling system include:

- Automated schedule creation capability, but with flexibility for managers to make manual adjustments
- Proactive alerts and notifications when schedule results in overtime, premium pay, and/or any policy conflicts
- Centralized view of schedule and open needs across ORs; ability to match cross-trained employees to open needs automatically; data-driven floating across locations (from Main hospital to outpatient surgery centers)
- Scalable easily to meet the organization's future growth
- User-based custom analytic reporting to facilitate each level of management make data-based actions
- Interoperable with other staffing systems like payroll, Time & Attendance, and HR for comprehensive reporting

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software has &quot;skeletons&quot; to record work patterns of employees</td>
<td>Employees cannot view schedule or provide availability/ unavailability through the software, thus making the scheduling process paper-intensive</td>
</tr>
<tr>
<td>Comprehensive report builder allows staffing office to generate customized reports</td>
<td>System does not guide scheduling based on case schedule. Units have to manually adjust the same.</td>
</tr>
<tr>
<td>Checks for credentials at the time of scheduling.</td>
<td>Difficult to staff based on budget levels</td>
</tr>
<tr>
<td></td>
<td>Does not aid standardization as there are no in-built alerts for overtime or other staffing rules (e.g. cannot be booked for 5 consecutive days, etc.) at the time of scheduling</td>
</tr>
<tr>
<td></td>
<td>Units are dependent on the staffing office for generating reports, thus increasing work for the staffing office.</td>
</tr>
<tr>
<td></td>
<td>At-a-glance dashboards providing information on the staffing status in each unit not available. Management team has to view individual schedules or “after-the-fact” reports to know the house-wide staffing status</td>
</tr>
<tr>
<td></td>
<td>Servers are maintained in-house – Dependent on hospital IT team for upgrades and disaster recovery</td>
</tr>
</tbody>
</table>
The gap analysis will also help determine how to meet the appropriate technology requirements for scheduling efficiency and scalability.

The following gaps in technology have to be addressed for scheduling efficiency and scalability:

- Core scheduling completed automatically through artificial intelligence
- Automatic open needs creation and adjustment for proactive right-sizing
- Real-time labor productivity monitoring based on census and schedule
- Customizable reporting including Hours per Patient Day report
- Cloud technology for scalability, security, and no hardware investment
- Transparency; horizontal and vertical views of house-wide staffing status
- Predictive modelling of staffing needs for future volumes, seasonal trends, and disaster planning
Key requirements for an efficient scheduling system include:

- Automated schedule creation capability, but with flexibility for managers to make manual adjustments.
- Proactive alerts and notifications when schedule results in overtime, premium pay, and/or any policy conflicts.
- Centralized view of schedule and open needs; ability to match eligible employees to open needs automatically; data-driven floating across locations and departments.
- Scalable easily to any number of locations, departments, skill to meet the organization’s future growth.
- User-based custom analytic reporting to facilitate each level of management make data-based actions.
- Interoperable with other staffing systems like payroll, Time & Attendance, and HR for comprehensive reporting.

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**Technology – What is Required?**

<table>
<thead>
<tr>
<th>Department</th>
<th>Location</th>
<th>Role</th>
<th>Shift</th>
<th>Start Time</th>
<th>End Time</th>
<th>Experience</th>
<th>Availability</th>
<th>Skills</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing</td>
<td>New York</td>
<td>RN</td>
<td>AM</td>
<td>7:00 AM</td>
<td>3:00 PM</td>
<td>10 Years</td>
<td>Full-time</td>
<td>NURS</td>
<td>Available</td>
</tr>
<tr>
<td>Nursing</td>
<td>New York</td>
<td>LPN</td>
<td>PM</td>
<td>3:00 PM</td>
<td>11:00 PM</td>
<td>5 Years</td>
<td>Part-time</td>
<td>LPN</td>
<td>Available</td>
</tr>
<tr>
<td>Administration</td>
<td>New York</td>
<td>Admin</td>
<td>Day</td>
<td>8:00 AM</td>
<td>4:00 PM</td>
<td>15 Years</td>
<td>Full-time</td>
<td>Admin</td>
<td>Available</td>
</tr>
</tbody>
</table>

Employees should be able to view needs across locations and add availability from home.

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<table>
<thead>
<tr>
<th>Employee</th>
<th>Work Hours</th>
<th>Availability</th>
<th>Skills</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jane</td>
<td>8:00 AM - 4:00 PM</td>
<td>Full-time</td>
<td>Admin</td>
<td>Available</td>
</tr>
<tr>
<td>John</td>
<td>9:00 AM - 5:00 PM</td>
<td>Part-time</td>
<td>Nurse</td>
<td>Available</td>
</tr>
</tbody>
</table>

Employees should be able to view their complete schedule across locations/ departments.
About Hallmark Healthcare Solutions

Hallmark is a global healthcare solutions and information technology firm comprised of nearly 400 employees; with offices located in New Jersey, New York, Michigan, Texas, Dubai and India. As of 2014 we have conducted more than 4000 engagements for more than 1140 clients nationwide. Over the years, we have helped organizations optimize and save millions in labour expenses, improve their efficiency, and achieve fiscal responsibility through our best-in-class software and strategic workforce solutions.

Visit: www.hallmarkhealthcareit.com

For more information, please feel free to contact:

Tel: 856.231.5340
Fax: 856.273.6913

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