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# APPLYING LEAN PRINCIPLES TO IMPROVE OR EFFICIENCY

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## ABSTRACT

LEAN is a set of operating philosophies and methods that, when applied to the healthcare setting, can help create maximum value for patients by reducing waste and unnecessary waits. An emphasis is placed on the customers' needs, employee involvement and continuous improvement.[1]For the purposes of this article the customer is the patient.

In April 2017 the Adult Surgery Program at the IWK Health Centre was involved in a comprehensive initiative to help improve efficiency in the Adult Surgery OR. Using LEAN principles, the patient's surgical journey was examined closely by a multidisciplinary team where, multiple initiatives were identified. One of the first initiatives explored was the turnaround time between OR cases. By integrating LEAN methods in workflow, improvements in turnaround times were recognized.

## INTRODUCTION

### What is LEAN?

The term "LEAN" was introduced in the mid-1980s in the manufacturing industry (initially at Toyota and later further developed by Ford). It has recently expanded for use in other workplace thinking. Its overall goals are to:

- Apply improvement tools to every process, one at a time, with the assumption that if every part works better, the entire process should perform better; and
- Organize operations to maximize flow of value to customers by implementing continuous improvement from workers in order to minimize waste.

LEAN methodology is based on two themes:

1. Respect for all people; and
2. Elimination of waste or non-value-added activity (continuous improvement).[1]

The five steps of LEAN are:[2]

- Identify value;
- Map the value stream;
- Create flow;
- Establish pull; and
- Seek perfection.

## DEFINITION OF THE LEAN STEPS

### Identify Value

Determining what actions are valuable and not valuable to the customer (in this case the patient) helps to identify the wastes in the process. Each action that is performed in a process falls in to one of three categories:

1. Activities that add value;
2. Non-value-added activities that are necessary; and
3. Non-value-added activities that are not necessary and are considered waste.

Value added is defined as any activity that contributes directly to satisfying the needs of a Customer (in the case of the examples in this article, the customer would be the patient). Non-Value Added is defined as:

> "any activity that takes time, space, or resources, but does not contribute directly to satisfying the needs of the "customer."[2]

As an example, imagine you are a patient coming in for surgery. You are admitted in pre-op, go to the OR, then the Post Anesthesia Care Unit (PACU), and then are discharged home. As a patient you may consider the value-added activities to be having your surgery & the pre-discharge teaching. Non-value added activities that are necessary would include completing paperwork. And non-value added activities that are not necessary (considered waste) may include waiting for three hours and/or moving from pre-op to the lab and back to pre-op waiting room.

### Map the Value Stream

This step involves mapping out the process and identifying waste.[3]

Organizations experience various types of waste. The acronym DOWNTIME is used to break down common organizational waste:

**D**owntime
**O**verproduction
**W**aiting
**N**on-Utilized Talent
**T**ransportation
**I**nventory
**M**otion
**E**xtra Processing

During this initiative we were able to identify several examples of operational waste in our process. Examples included:

**Waiting:** Waiting until after the patient has exited the OR before phoning housekeeping and the anaesthesia technician to let them know the room was available for cleaning. This creates gaps in OR availability.

**Non-utilized talents:** The scrub nurse was responsible for taking the instruments down to the soiled room for processing instead of preparing the room and equipment for the next case. Processing instruments may be more fitted for another role instead of nursing (i.e. unit aide).

**Transportation:** Patient is processed in a pre-op room, escorted to the waiting area, asked to come to another room to meet with surgeon, returns to the waiting room, then goes to another room to speak with anaesthesia, then back to waiting room, then the OR nurse takes the patient to another room before taking them to the OR. Each of these steps involves time and requires the patient to arrive earlier and wait longer.

**Motion:** The example of the patient going from room to room could also fall under motion. But another example that was identified was the OR nurse checking in the patient in pre-op and then walking back to the OR to see if the room was ready for the patient to enter, then to turn around and go back to pre-op to get the patient and escort them to the OR!

**Extra processing:** The patient undergoes a 30-45 minute assessment in pre-op but is then interviewed by the OR

Nurse who goes through the chart and looks for the information that was already reviewed by the pre-op nurse and recorded on the pre-op checklist.

**Create Flow / Establish Pull / Seek Perfection**

Once waste has been identified the system needs to be adjusted to eliminate the waste. This involves the final 3 steps in the LEAN Methodology.

**Create Flow:** Flow ensures value-added steps occur in sequence. Flow allows value to be delivered continuously in a standardized way. Examining every detail of each gap in flow helps identify wastes. Anytime work stops, waste is present. Creating standard work for each role is pivotal in maintaining flow. Standard work is a step-by-step guide to performing a certain role/task[2]. For example standard work for a scrub nurse might include:

1. Don mask;
2. Scrub hands;
3. Enter the OR, don gown and gloves; and
4. Continue setting up the sterile field etc.

**Establish Pull:** Pull requires that work is only performed when there is a true need and ensures the patient pulls value from each step.

**Seek Perfection:** We seek perfection by trying to make processes defect/waste free. Continuously observing the process and taking corrective action each time. There is no end to the process of reducing effort, time, space, cost, and mistakes.[2] Continuous improvement is a key step in maintaining the current state (the current state would be the improved process with less/no wastes.) Continuously improving also means identifying other areas of waste or improvements in the process and taking action.

**THE IWK INITIATIVE**

The IWK Health Centre is tertiary care hospital that provides highly specialized care to women, men, children, youth, and families from Nova Scotia, New Brunswick and Prince Edward Island.[4] The adult perioperative program has three operating rooms that provide the following services: gynecology; urogynecology; and breast health. There are over 3,600 surgeries performed each year.

The initial LEAN event was held, in the Adult Perioperative Services department of the IWK Health Centre, in April of 2017. Major stakeholders including management, surgeons, anaesthesia, OR/PACU nurses, housekeeping, distribution, support staff, and three patient advisors were brought together to map out a value stream.

> "The Value stream mapping process allows you to create a detailed visualization of all steps in your work process."[2]

The value stream in this event was identified as the process beginning with the patient signing consent and ending with the patient being discharged post-operatively. The process was closely analyzed and numerous wastes were identified. Wastes were broken down into categories and groups were assigned to participate in Kaizen event(s).

Kaizen events are short duration projects with a specific aim for improvement. They are, typically, week-long events led by a facilitator. The implementation team usually includes members of the specific areas as well as support areas or management.[1]

In this LEAN event, the following Kaizens were identified:

1. OR turnaround time;
2. Best Practices for SSI;
3. Optimize Block scheduling;
4. Standard Work for booking;
5. Standard work for OR scheduling; and
6. Standard work for Preadmission clinic.

During each Kaizen, projects were identified to eliminate wastes in specific areas. Looking at improving the process for one area led to finding other opportunities for improvement for another. For example, working on improvements for turnaround time required an improvement in surgeon picks.

The following projects were identified in relation to the Kaizens listed above:

1. Standard work for preference cards;
2. Standard work for case cart picking;
3. Standard work for Pre-op;
4. Optimize Supply chain (5S event);
5. Optimize forms/documentation; and
6. Pathology Turnaround time.

*Note: The five S methodology helps a workplace remove items that are no longer needed (sort), organize the items to optimize efficiency and flow (straighten), clean the area in order to more easily identify problems (shine), implement colour coding and labels to stay consistent with other areas (standardize), and develop behaviours that keep the workplace organized over the long term (sustain).*[3]

A timeline was established for completing all of the Kaizen events. The timeframes for completion of the Kaizen's were scheduled close together. This was important to keep the momentum going and keep improvements opportunities in the forefront (see Figure 1).

## Kaizen Events

For each Kaizen event a team of staff from respective areas was created. There was a consistent group of people present for the entire process and others were asked to join in ad-hoc. It was **vital** that all disciplines were involved, as any changes being made would affect multiple groups. For each proposed change a representative had to take changes back to their group.

Each team established general goals and made observations about the current

**Figure 1.** Gyne Perioperative Action Plan

GYNE PERIOPERATIVE ACTION PLAN

*Updated: June 26, 2017*

| TYPE | Jun-17 | Jul-17 | Aug-17 | Sep-17 | Oct-17 | Nov-17 | Dec-17 | TO BE SCHEDULED (TBS) | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KAIZEN (RIE) | OR Turn Around Time | | | Standard Work for Picking | | Standard Work for Pre-Op | | Standard Work for Recovery | Best Practices for SSI | Optimize Block Scheduling | Standard Work for Booking | 11 |
| | | | | | | | | Standard Work for Scheduling | Optimize Supply Chain (5S) | Standard Work for Pre-Admission | Standard Work for Sterilization | |
| PROJECT | | Standard Work for Preference Cards | | | | | | | | Optimize Forms / Documentation | Pathology Turn Around Time | 3 |
| QUICK WINS | | | | | | | | | | | | |

***Recommended Order Following Month 7: *Note: To be Updated***

| | | | |
|---|---|---|---|
| March '18 | Best Practices for SSI (KAIZEN) | Jan '19 | SW for Scheduling (KAIZEN) |
| May '18 | SW for Preference Cards (PROJECT) | March '19 | SW for Pre-Admission Clinic (KAIZEN) |
| July '18 | SW for Picking (PROJECT) (May not be required) | May '19 | Optimize Supply Chain (5S Event) |
| Sept '18 | Optimize Block Scheduling (KAIZEN) | July '19 | Optimize Forms/Documentation (PROJECT) |
| Nov '18 | SW for Booking (KAIZEN) | Sept '19 | Pathology Turn Around Time (PROJECT with NSHA) |

*Courtesy IWK Health Centre*

state. When working toward solutions the groups first looked at the ideal state (what process would exist in a perfect world where there are no barriers, no technological challenges, etc.) before considering the future state (the state that can be achieved by removing current barriers).[1] Identifying what the process would ideally look like helped to shape the future process without the wastes.

**Turnaround time (TAT):**

The Kaizen event for turnaround time improvements ran for 3 days in June of 2017. It involved the following members: Executive Sponsor, Physician Lead, Anaesthesia Lead, Director of Nursing, Manager of Perioperative Services, Clinical Leader, Perioperative Nursing Anaesthesia Technician, Anaesthesia Assist, Ward Clerk, Unit Aide, Clinical Educator, Medical Device Reprocessing Department , Surgical Supply Manager, Manager of Housekeeping & Laundry, Manager of Distribution, Biomedical, Infection Control, LEAN Facilitator, and Improvement Lead & Director.

The turnaround time (TAT) Kaizen began with establishing general goals that were identified during the Value stream (as described above). The following goals were identified:

- Improvement in turnaround time in hopes of possibly adding another case to the OR list each day
- Reduce variability within individualized roles by defining roles using standard work to ensure each person knew their responsibilities;
- Establishing a "pull system" to identify when work is needed across all roles;
- Replace a culture of double-checking work with a defect-free flow; and
- Elimination of unnecessary rework.

Note: Applying a pull system allows you to start new work only when there is a customer demand for it. It allows work to be delivered "just in time" and not "just in case".[4]

**Observations of the current state:**

The following observations were made:

- Patient nurse looking through the chart for information already reviewed by pre-op nurse results in time wasted and re-work;
- Scrub nurse spending time taking case cart to soiled room and spraying instruments;
- Time wasted waiting for surgeon as surgeon is only called after patient intubated;
- Time wasted when housekeeping only called as patient is exiting the OR;
- Discussions required between nurses in each OR regarding "who is doing what next" (patient nurse, set-up, scrub);
- Inconsistent tasks for each role after patient exits the Operating Room; and
- Time wasted as a result of incomplete case carts resulting in the nurse leaving the room to retrieve missing items.

**Proposed Future State:**

- Significantly reduced variability in roles by creating Standard work. Standardizing roles and responsibilities for each team member during the turnaround time, with visual reminders (see Figure 2), ensures that each team member will know what they are responsible for during the turnaround time (ie. Scrub nurse will have specific tasks outlined for this time frame);
- Decrease the number of people in the room during the turnaround time by assigning specific tasks for each role;
- Decrease waiting and searching for team members to perform specified role. As an example calling the surgeon when the IV has been inserted by anesthesia so they are present and ready;
- Improve turnover time by 9.2 minutes per case. Resulting turnaround time would then be an average of 32 minutes; and
- Reduced rework (i.e. double checking). Nurses would no longer

be going through the chart preoperatively before taking the patient into the OR. This work is already done by the pre-op nurses and is documented on the pre-op checklist.

**Improvements in TAT:**

During the LEAN event, the turnaround time was identified as being from the exit of one patient from the OR to the cut time of the next patient. The average turnaround time prior to the LEAN event was 41.2 minutes, and a goal of 32 minutes was identified. Figure 2 offers a visual reference for the standard work the nursing team would follow during the turnaround time. Each role has clear steps to follow during this period of time.

Important highlights from the standard work that directly contribute to decreasing time include:

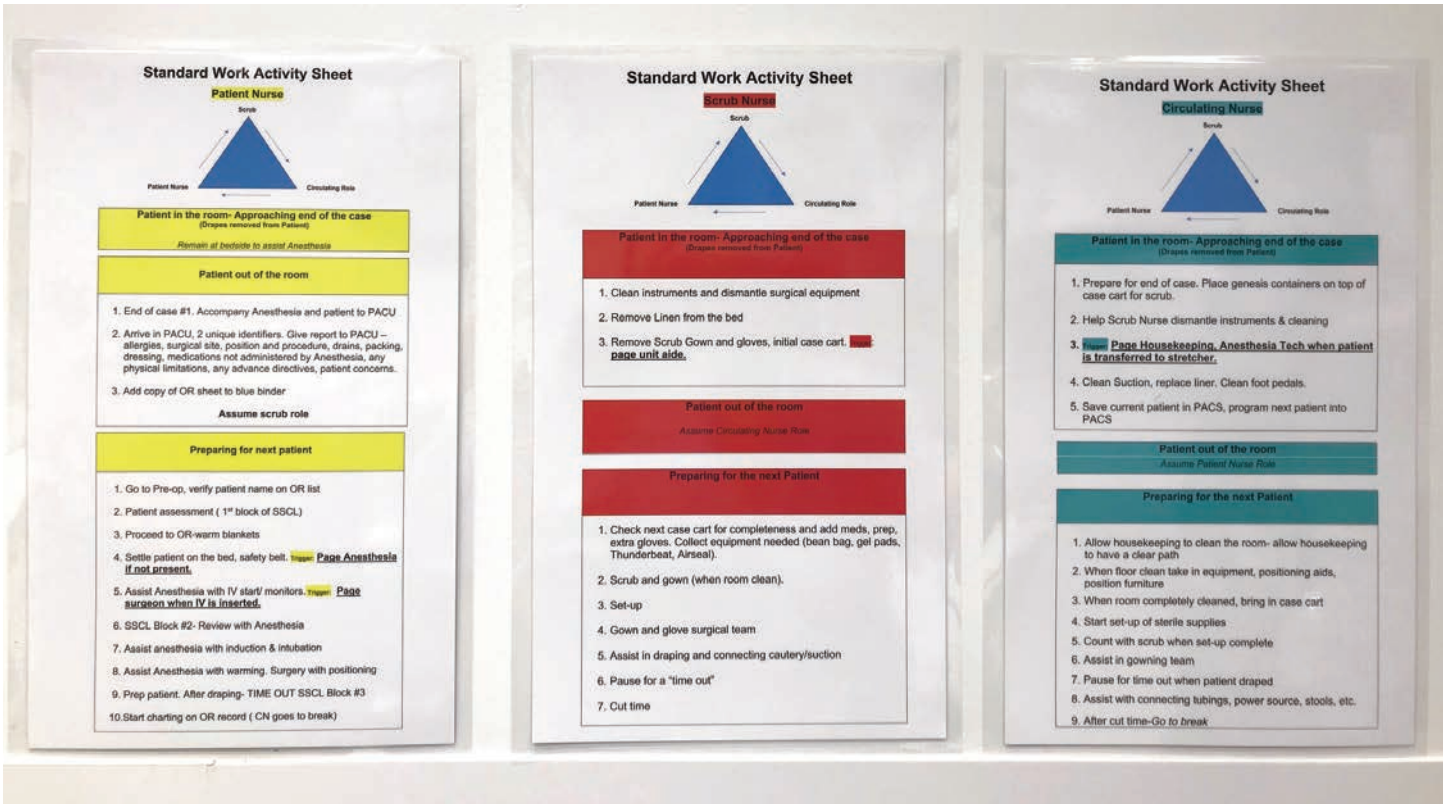
- Having 3 nurses available when setting up the case and at the end of the case;
- Patient nurse doesn't spend time going through the chart during the sign in, for information, as everything is detailed on the pre-op checklist. The resulting check in process takes less than 5 mins;
- As soon as the patient enters the OR anaesthesia is paged if they are not already present;
- The insertion of the IV triggers the surgeon to be paged so they are present for a time out and ready to position as soon as anaesthesia has completed intubation;
- The second circulating nurse assists the scrub nurse in dismantling and putting away instruments at the end of the case;
- Housekeeping, anaesthesia tech, and unit aide are paged when patient is transferred to the stretcher. Housekeeping and unit aide are outside of the door waiting to enter as soon as the patient exits. Anaesthesia tech enters and begins to stock the room and bring in clean equipment; and
- Direction on the nurses' next roles are clearly identified so there is no need for discussion on who is doing what next.

**Measuring Progress:**

Another important key to the success of LEAN is to measure progress. In this LEAN initiative, progress was measured by using a process control board. This board, which was posted outside of the ORs, and updated daily, was used to record and monitor the turnaround time. Data that was captured on the board included the turnaround time and the reasons that caused the time to be out of target for each case in each operating theatre. Daily results were compiled into monthly reports. Reports included reasons for TAT exceeding 32 minutes and the average TAT for each month (see tables 1 & 2). In this month (October 2017), for example, the TAT was an average of 40.4 minutes.

Some examples of reasons for delay included;

**Figure 2.** Visual Reminder of Standard work during TAT- Nursing




Courtesy IWK Health Centre

- Case cart picked wrong or last-minute change in procedure causing the circulating nurse to have to run to gather other supplies/equipment;
- Large case to set up;
- Extra time for patient to speak with surgeon and/or anaesthesia in pre-op;
- Surgeon arriving late; and
- Two operating theatres finishing surgery at the same time which caused a delay in housekeeping.

Data were reviewed each week and trends were identified. Analyzing these trends was important in making further improvements in the TAT. Some trends that were identified above could not be changed or improved, i.e.-extra time for the patient to speak with the surgeon or anaesthesia in pre-op or a last-minute change to the procedure.

But improvements were made in the areas of case cart picked wrong, surgeon coming late, and housekeeping not available if two theaters finished at the same time. This was done by responding to these trends in the following ways:

- Case cart picking errors were collected, complied, and reviewed by the clinical leader and MDR liaison. Errors were reviewed with the MDR tech (picks cases) weekly;
- All surgeons were sent reminder emails from the chief of surgery about their time obligations; and
- Housekeeping hours were changed so that two housekeepers were available during the busiest times in the OR.

The changes above resulted in an improvement over the consecutive months from 40.4 minutes, in October 2017, to 35.8 minutes by January 2018 (see table 2). Eventually, once the average TAT became more consistent and remained close to the target (32 minutes), the process control board was completed quarterly. Currently average TATs are reviewed quarterly with staff at safety huddles and posted on the safety board (see Figures 3 and 4).

**Staff engagement:**

Change can be difficult and engaging all staff is imperative to successfully implementing improvement initiatives. Having a team that champions the LEAN process from the beginning is key to achieving buy-in from other staff. If staff are aware of the wastes that exist in the current process they will be more likely to participate in change. Incentives can also motivate staff to follow the

**Table 1.** Monthly Report from October 2017: Reason(s) turn around time over 32 minutes.

| Reason's Identified: | # of Incidents |
|---|---|
| Anaesthesia factors | 3 |
| Patient delay pre-op | 2 |
| Room changeover, only two nurses | 0 |
| Patient characteristics IV/induction | 1 |
| Patient characteristics positioning | 1 |
| Anaesthesia Assistant availability | 0 |
| Anaesthesia Technician availability | 0 |
| Housekeeping availability | 1 |
| Case cart picked for wrong surgeon | 1 |
| Last minute change in procedure | 1 |
| Patient talking in pre-op | 1 |
| Surgeon late coming to start booked add ons (1230 hrs) | 2 |
| Anaesthesia teaching | 4 |
| Prolonged housekeeping | 3 |
| Two ORs out at the same time | 1 |
| Interpreter required | 1 |
| Add on patient not ready (OR prior finished early) | 1 |

**Table 2.** Gyne OR turn around target time – Monthly tally.

| | July 2017 | Aug 2017 | Sept 2017 | Oct 2017 | Nov 2017 | Dec 2017 | Jan 2018 |
|---|---|---|---|---|---|---|---|
| **Week 1** | | 34.86 | 39.07 | 39.6 | 38.09 | 36 | 33.58 |
| **Week 2** | 31.5 | 36.66 | 35.69 | 41.5 | 39.16 | 40.18 | 35.26 |
| **Week 3** | 34.6 | 39.85 | 38.24 | 42 | 40 | 35.16 | 36.21 |
| **Week 4** | 31.25 | 38.55 | 39.88 | 38.5 | 37.76 | | 36.38 |
| **Week 5** | | 37.14 | | | 39.72 | | |
| **Month Avg** | 32.45 | 37.412 | 38.22 | 40.4 | 39.08 | 37.113 | 35.358 |
| **# of Cases** | 52 | 46 | 95 | 80 | 166 | 107 | 151 |

standard work and make improvements that will benefit them (e.g. informing them that decreasing turnaround time will help to finish the room list faster).

Staff buy-in doesn't happen overnight. A transition period should be expected until the new process becomes the normal process. Visual reminders (see Figure 2) should be located in each operating room. The standard work should also be available for staff to view in a standard work binder (see Figure 5). When new staff are employed they should be directed to review the standard work sheets and follow the visual cues.

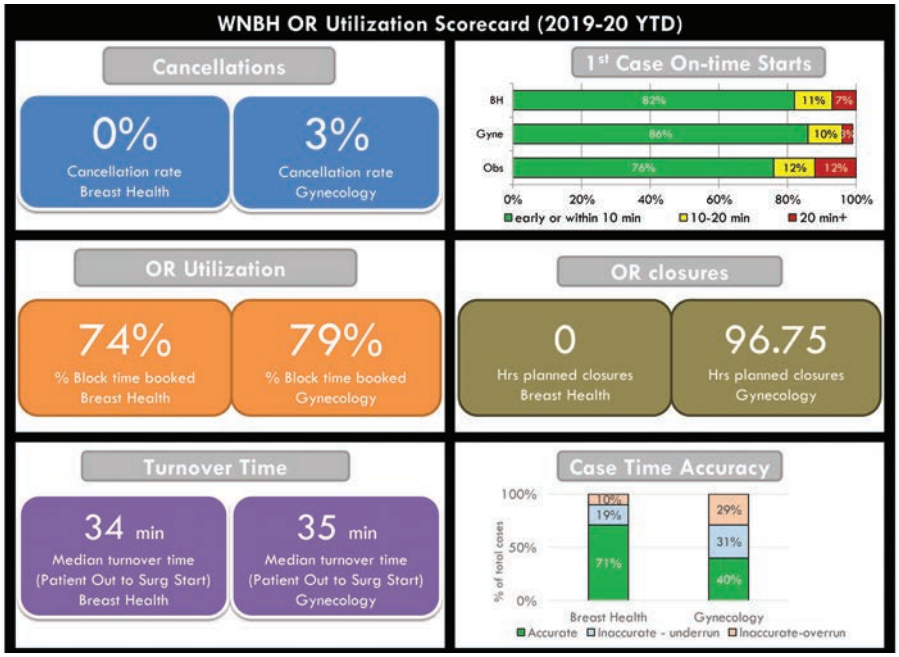
Another important step in engaging staff is involving them in continued work opportunities. Applying LEAN processes to current practice can be contagious and so providing staff an opportunity to identify wastes in the process, give feedback, and make suggestions is an important aspect of keeping engagement at the forefront and recognizing new opportunities.

**Literature Search:**

In searching the current literature there have been other articles describing improvements in efficiency when applying Lean methods. Blouin-Delise at al. (2017)[6] conducted two projects with the goal of increasing efficiency in the OR, without affecting quality of care, by improving the workflow process. They hypothesized that a LEAN project could improve efficiency by reducing length of stay in the recovery ward through the improvement of communication and administrative processes. One project resulted in a 68% decrease in recovery ward time and the other resulted in a 29% decrease. In their conclusion they surmised that taking time to understand links between sectors of a hospital by analyzing their processes can lead to work on sectors that may have an influence on the problematic workflow of other sectors.

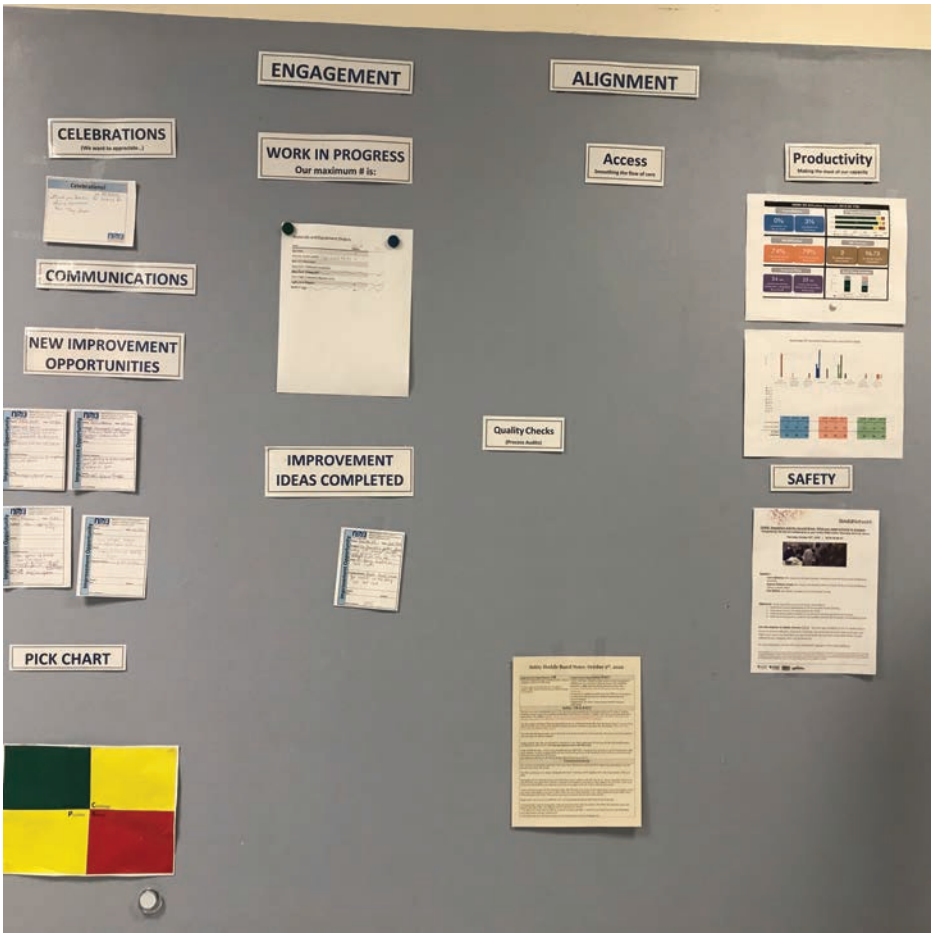
Cerfolio et al. (2019)[7] described the designation of a multidisciplinary stakeholder team as a Performance

**Figure 3.** WNBH OR Utilization Scorecard (2019-20 YTD)




Courtesy IWK Health Centre

**Figure 4.** Gyne OR/PACU Safety Huddle Board




Courtesy IWK Health Centre

**Figure 5.** Standard work for Turnaround- Circulating Nurse Patient OUT of the room

| ***Standard Work Activity Sheet*** | ***Author: Katharine Morrison, Holly Haines, Tanya Vandale, Judy Seward*** ***Rev Date:*** |
|---|---|
| ***Purpose: Circulating Nurse (Patient OUT of the Room)*** | ***Process: OR Turn Around Time*** |

| Seq. No | Task Description: | Key Point / Image / Measure (what does good look like?) | Who | Task Time mm:ss |
|---|---|---|---|---|
| 1 | Continue to dismantle scrub set (if needed) | - Assist scrub<br>- Change suction (new liner) | | |
| 2 | Tidy OR room, i.e. OR equipment, foot pedals, anaes. cart. | - Clean suction and change liner<br>- clean foot pedals, equipment- check<br>- If no AT* available, clean Anaes. Cart. | | |
| 3 | Start Room set up, i.e. equipment | - Program patient in tower†<br>- When floor clean, take in equipment check<br>- Positioning aids – bean bags, gel pads<br>- Position furniture | | |
| 4 | When room clean – bring in clean cart | - Take in cart<br>- Note set up time | | |
| 5 | Start set up of sterile supplies | - Open pack<br>- Open scrub gown<br>- Open basin set | | |
| 6 | Continue to open supplies as indicated by procedure and corresponding Kardex | - Keep “have available” supplies on standby | | |
| 7 | Pause for time out – when it occurs | | | |
| 8 | Count – Note: 7 & 8 may be reversed. | | | |
| 9 | Assist in gowning team | | | |
| 10 | Assist with connecting suction and power source, laparoscopic equipment | - Stools<br>- Chairs<br>- Moving scrub table into place | | |
| 11 | After cut/touch time – go to break | | | |

*Courtesy IWK Health Centre*

**AT = Anaesthesia technician, †Tower = Digital imaging device.*

The turnaround time Kaizen event is now complete at the Adult Surgery Program of the IWK Health Centre.

Improvement Team (PIT crew) in LEAN and value stream mapping with the goal of decreasing operating room turnaround times. They focused on the steps taken by each team member during turn around. The changes implemented included changes to the circulating nurse task list. By having the circulating nurse pick case carts the night before, and complete a checklist, the need for circulating nurse to walk to the supply room multiple times during the surgical case was eliminated.

Following the pilot project it was concluded that LEAN and value stream mapping can be used to successfully decrease operating room turnaround times.

Coffey et al. (2018)[8] also used LEAN methodology to increase the number of on-time starts for first cases of the day. They describe the main goal of LEAN methods in health care is to reduce waste and keep what adds value to the patient. Highlights from their study included the development of the team "huddle board". This "huddle board" was designed so that nursing staff could easily document, track, and display the timelines of first case starts (see Figure 4 for the huddle board used at the IWK).

## CONCLUSION

The turnaround time Kaizen event is now complete at the Adult Surgery Program of the IWK Health Centre. The initiatives identified in this Kaizen are now part of the daily work. At the time of this writing it had been over three years since the Kaizen took place and the average turnaround time is 35 minutes. Even though the goal was originally set for 32 minutes the continued average time of 35 minutes is still considered to be a success three years later. Success is not only the decrease in TAT by at least 6 minutes, but the implementation of standard work to improve work processes and decrease wastes, and the resulting workplace satisfaction for the entire team.

Continued success of this LEAN initiative is considered, by the authors, to be attributable to multiple factors that include: following standard work to promote role clarity; continuously improving; creating a culture of change; and measuring progress.

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