Improving Clinic Flow at an Academic, Safety-net, Surgical Oncology Clinic

by

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DISSERTATION

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ABSTRACT

IMPROVING CLINIC FLOW AT AN ACADEMIC, SAFETY-NET, SURGICAL ONCOLOGY AMBULATORY CLINIC

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Background: A high-volume, academic, safety-net, surgical oncology ambulatory clinic sees patients twice a week. As healthcare systems move towards pay-for-performance, maximum workflow and efficiency become critical to both patient access to care and experience.

Local Problem: The clinic has inefficiencies causing excessive delays leading to high patient dwell times, which negatively affect patient and provider satisfaction. The purpose of this study is to use quality improvement tools to decrease these wait times.

Methods: Quality improvement tools, lean, and DMAIC (define, measure, analyze, improve, control) methodology was used to guide the project. The baseline for the clinic was established with patient dwell times, defined as patient check-in to check-out in the Epic system. A value stream map was created to identify value-add and non-value-add steps. Time studies, interviews, and Pareto charts were designed to assess top non-value-add times. Root cause analysis with a fishbone diagram was used to identify areas of opportunity for interventions. A prioritization matrix was generated to evaluate the most effective solutions, and the interventions were chosen after discussion with clinic staff. After their implementation, data were collected prospectively: Epic tracked dwell time data, and Press Ganey gathered patient satisfaction scores. The datasets before (March 2016 – March 2017) and after (April 2017 – April 2018) the intervention was compared using statistical analysis including t-tests and control charts.

Interventions: Two interventions were chosen: (1) Patients were pre-assigned to residents before clinic start time to reduce the time they spent reviewing the patient chart before the patient visit. (2) A centralized supply cart was introduced to improve clinic flow for procedures.

Results: During the pre-intervention period from March 2016 to March 2017, the Press Ganey survey reported a patient satisfaction score of 87 (n=27). This score is about two standard deviations below the benchmark of 93 (n=1,243). During the post-intervention period of April 2017 – April 2018, the Press Ganey score increased to 88 (n=23), but the response rate was <1%. During the pre-intervention, the mean dwell time in the clinic was 140.67 minutes (n=572) and 123.02 minutes (n=2,802) for new and follow-up patients, respectively. The post-intervention mean dwell times in the clinic were 117.35 minutes (n=589) and 110.64 minutes (n=2,137) for new and follow-up patients, or about a 17% and 10% reduction respectively. The reductions in dwell time were statistically significant with a p-value of <0.001. The control chart also revealed a special cause variation due to the intervention, which represented a trend of decreasing dwell times for patients.

Conclusion: Quality improvement tools can be successfully used in this specific setting to streamline clinic flow and improve efficiency to reduce patient dwell times. The next steps are to continue collecting more robust data and iteratively refining the interventions. As the clinic continues to evolve other interventions will be considered for implementation. The success of these solutions can transfer to other clinics in the academic hospital.

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CHAPTER 1

Introduction

Problem Description

As healthcare burden continues to rise rapidly, the United States is moving toward payment systems that reward quality and lower costs, shifting from volume to value to improve sustainability.[1] Long patient wait times in the clinic can decrease patient access to care and patient experience. Simultaneously, these wait times can also decrease provider satisfaction. As a result, the costs of healthcare can rise, while clogging and slowing down the flow of the clinic.

Available Knowledge

In 2001, the Institute of Medicine defined the domains of quality to include: safety, effectiveness, efficiency, equity, patient-centeredness, and timeliness.[2] Great strides have been made in the fields of safety and efficacy in cancer care, while gaps in the other areas persist.[3] Over 1.6 million people are diagnosed with cancer each year in the United States, and the number of people living beyond a cancer diagnosis is expected to rise to almost 19 million by 2024.[4] As of 2014, cancer was the second leading cause of death in the United States at nearly 600,000 people.[5] Consequently, cancer has become a leading cost-contributor to healthcare expenditures in which they account for 18% of gross domestic product (GDP) and 5.8% of GDP growth as of 2015, which has become unsustainable.[6] To accommodate the growing burden of cancer in the United States, healthcare systems need to find innovative ways to optimize both patient access to care and the patient experience, such as through improvements in the quality of care delivery.

Rationale

One method to improve both patient access to care and patient experience is to apply systems engineering methodologies within the healthcare system. When resources are limited, inefficiencies waste time and disrupt clinic flow, hamstringing the delivery of quality care. It is well recognized that the value in healthcare is the ratio of quality to costs. The quality can be used as a proxy for value in healthcare with the assumption that cost remains static or declines. One crucial quality measure is patient experience measured through patient satisfaction scores. These patient satisfaction scores play a significant role in calculating value-based incentives in payments to hospitals from the federal government.[7]

Every aspect of the patient experience negatively correlates with high wait times including perceptions of information, instructions, and the overall treatment provided by physicians.[8] A study of 1,789 ambulatory care clinics nationwide shows that the time patient spent waiting for care significantly influences patient satisfaction.[9] As a result, one can intuit that increasing clinic efficiency decreases patient waiting times, thereby improving patient satisfaction. Enhanced patient satisfaction reflects improved quality, which increases value. Decreasing wait times also mean shorter clinic days for clinic staff, which would increase provider satisfaction as well.

In the automobile industry, Toyota had developed a management philosophy known as the Lean methodology to optimize their workflow and efficiency by eliminating waste or non-value-add activities in the process.[10] Another quality improvement methodology involves the DMAIC (Define, Measure, Analyze, Improve, Control) method to guide projects, as a set of phases that build upon the previous step.[11] Healthcare has successfully adapted these industry-related methodologies, where they have been utilized to improve efficiency in many patient settings.[12-18]

Lean methodology was applied to improve efficiencies of the surgical oncology clinic in a high-volume, academic, safety-net, environment. The analysis includes examining the current process and identifying resources spent that do not add value to the customer, who in this case is the patient. Through this methodology, the creation of a standardized work process allows the most efficient and effective flow of healthcare services.

Specific Aims

The project aims to reduce the patient dwell time, defined as the patient check-in to check-out time, which based on the literature noted above will positively impact patient and provider satisfaction. The goal of the thesis is to establish that the clinic has ample opportunity for improvements, devise interventions to implement, analyze the results of the solutions, and recommend further iterative solutions. The project was conducted in the multidisciplinary surgical oncology clinic at Parkland Memorial Hospital. The Parkland Hospital leadership, Epic administrators, and entire staff of the clinic were involved including attending physicians, residents, interns, medical students, clinic manager, nurse navigator, licensed vocational nurse, medical assistants, and front desk clerk. The mandate of the hospital is: “To furnish medical aid and hospital care to indigent and needy persons residing in the hospital district.” The mission of the hospital is: “Dedicated to the health and well-being of individuals and communities entrusted to our care.” The vision of the hospital is: “By our actions, we will define the standards of excellence for a public, academic health system.” This project aligns with the hospital's mandate, mission, and vision by serving the needy who have poor access to care, providing exceptional care, and defining the standards of excellence for a safety-net hospital.

CHAPTER 2

Methods

Context

The surgical oncology ambulatory clinic was targeted as a pilot site for the application of Lean methodology. The clinic is part of a larger healthcare setting that includes a safety-net, academic hospital that annually had 65,585 patient discharges along with a total of 1,026,510 total ambulatory visits.[19] Additionally, 27% of patients were uninsured in 2015.[20] The surgical oncology ambulatory clinic is a teaching clinic that sees about 35 patients per day.[21] The clinic staff includes about two attending physicians, one third-year resident, two interns, two to three medical students, one clinic manager, one nurse navigator, two licensed vocational nurses, one medical assistant, and one front desk worker. The clinic runs on Mondays and Fridays in a shared space with other clinics. On Monday, the clinic is occupied only by the surgical oncology team. On Friday, the clinic space is split between the surgical oncology team and the palliative care team, limiting both space and resources that day. Given these factors, the interventions targeted Monday clinic for an initial couple of weeks and was then implemented in Friday clinic about one month later due to early success.

Quality improvement methodology proposes the use of the DMAIC (define, measure, analyze, improve, control) process to guide the project on a macro level. At the micro level, the PDCA (plan-do-check-act) method was used to refine the processes and tasks continually. Starting with the “define” phase, a project charter was created with the project objective of decreasing patient dwell times to improve the value of healthcare delivery. This phase included creating a stakeholder registry and interviewing clinic staff to get a sense of the current state including clinical inefficiencies and to recruit their buy-in for the project.

Intervention(s)

In the "improve" phase, the fishbone diagram was used to identify the causes that had the greatest impact on clinic efficiency. Then, using time studies, clinic observations, and informal clinic feedback, the team brainstormed interventions with a prioritization matrix (Table 2) to determine the most viable solutions. Discussions with the clinic staff with the prioritization matrix yielded two interventions: (1) pre-assigning patients to residents (trainees) the week before clinic start to reduce delays in the workflow; and (2) creating a central, organized supply cart in the physician workroom to improve clinic flow for procedures.

The attending physician would pre-assign patients in a staggered manner to the trainees. For example, the same trainee would not pre-chart two patients who have the same appointment time slot. To the extent possible, the patient complexity would also appropriately match the level of experience of the resident. The licensed vocational nurses would assemble the supplies before clinic start time and place them a central location within the physician workroom. The cart consisted of common surgical clinic supplies from the various supply rooms scattered throughout the floors. The supplies include medical bandages, dressings, tape, sutures, staples, staple removal kits, wound vacuum materials, scalpels, specimen collectors, and so on. After identifying the most feasible interventions, the next step was to obtain buy-in and approval by convincing attending physicians and ambulatory clinic leadership to pilot it in the surgical oncology clinic.

Study of the intervention (s)

In the "control" phase, patient dwell time data and patient satisfaction scores were collected for one year after the clinic implemented the interventions in April 2017. The first intervention was piloted only in Monday clinic then to Friday clinic to limit disruption to the clinic flow. The attending physician pre-assigns patients the week before the clinic starts so that residents have time to review the chart during downtime during the week or weekend. Since the results were promising, the intervention extended to Friday clinic shortly after that. This piloting environment allowed staff to become comfortable with the interventions and new clinic flow. The success of the pilot data was documented via control charts to examine trends in dwell times. Furthermore, two-sample independent student t-tests were used to determine if there was a statistically significant difference in patient dwell times, with probability values <0.5 deemed as significant.

Measures

In the "measure" phase, key measures were identified, and value stream map was created. The measures were: 1) patient dwell time data, defined as the time between check-in and check-out, which Epic collated through the electronic medical record timestamps; and 2) patient satisfaction scores, which the Press Ganey survey collected. Dwell time data is managed through Epic to ensure consistency throughout the dataset, avoiding human bias. The team validated the dwell times with time studies. Baseline data were collected over one year before the intervention. The project used time studies by following patients and staff through the process to document periods of waste and variability. Next, a value-stream map of the process of clinic flow was created with the assistance of clinic staff. Patients, front desk staff, medical assistants, licensed vocational nurses, nurse navigator, clinic manager, trainees, and attending physicians gave input into all separate steps required for the patient visit in the ambulatory surgical oncology clinic. Visio software was used to create the value-stream map. Post-intervention data were collected through Epic and analyzed with excel to quantify statistical significance. Constant communication between the author and clinic staff helped inform of any changes that might affect the accuracy of data. Extreme outliers were also removed from the data using the interquartile range. Naturally, the clinic staff gradually became accustomed to the new changes and improved the interventions iteratively by implementing it consistently over time with more reliability and efficiency.

Analysis

In the "analyze" phase, Pareto charts, fishbone diagrams, control charts, Visio, QI macros tool, Microsoft excel, and two-sample t-tests were used. Pareto charts of the various staff and patients were designed to examine the time spent in their process steps along with their variability. A root-cause analysis was also created via a fishbone diagram to identify causes that lead to inefficiency in the clinic. These clinic process failures represented opportunities for interventions. Interventions were discussed with clinic staff and chosen. Once the intervention was implemented, data was collected and analyzed with the data analysis function in excel for two-sample t-test of the mean dwell times assuming unequal variances to determine any statistical significance due to the interventions. Control charts were used to analyze and understand the effects of time as a variable as well.

Ethical considerations

Ethical considerations include not violating patient confidentiality, disrupting staffing boundaries, violating union contracts, only maximizing profits, reducing patient outcomes, de-optimizing workflow, and developing an undesirable institutional reputation.

CHAPTER 3

Results

The first step is to define the current state using the value stream map shown in Figure 1. The red steps represent non-value-add or delays for the patient, which include seven: waiting to be registered, waiting to be vitalized, waiting to be roomed, waiting to be seen by a trainee, waiting to be seen by an attending physician, waiting to be seen by LVN, and waiting to be discharged. The green steps represent value-add for the patient, which include six: being vitalized, being assessed by LVN, trainee, or attending, and being discharged. The yellow steps represent value-enabling or necessary steps, which include two steps: registering and being called for rooming. Last, the gray steps represent decision points in the clinic, which include four: patient deciding to come into the clinic, whether a trainee is available for assessment, whether the patient requires discharge instructions, and the patient choosing to leave the clinic. Lean methodology dictates minimizing non-value-add (red) while maximizing value-add (green).

Based on the value stream map, the Pareto chart combined the times of all the appropriate non-value-add steps (red) for analysis in both Monday and Friday clinic from the time studies. The Pareto chart included 29 observations, shown in Figure 2. The Pareto chart displays the top five non-value-add steps and their time value. The non-value-add steps are ordered from greatest to least, from left to right. On the left, the most significant delay was when patients wait for an assessment by the trainee, which was about 21 minutes, but this delay accounted for about 33% of all non-value-add time.

The clinic observations, clinic interview comments, value stream map, time studies, and Pareto chart, all fed into the creation of the fishbone diagram (Figure 3), identifying areas of opportunity to maximize value stream for the clinic. The causes or opportunities were divided into seven branches, including the patient, medical assistants, attending physicians, licensed vocational nurses (LVN), trainees (medical students and residents), technology such as Epic system (electronic medical record), and other causes. The purple boxes highlight areas of opportunity that the first intervention—pre-assigning patients to trainees before clinic starts—should impact, affecting the human decision-making element in the clinic. The green boxes highlight areas of opportunity that the second intervention—creating a centralized supply cart should influence, transforming the organization of the clinic.

The author collected and analyzed baseline data (March 2016 – March 2016) and post-intervention data (April 2017 - April 2018) through both the Epic electronic medical records and Press Ganey patient satisfaction survey. **Error! Reference source not found.** displays the mean dwell times for both new and follow-up patients in the clinic at baseline and post-intervention as well as the patient satisfaction scores for the surgical oncology clinic and the benchmark score. At baseline, the mean dwell time in the clinic was 140.7 minutes (n=572) and 123.0 minutes (n=2,802) for new and follow-up patients, respectively. The post-intervention mean dwell time in Monday clinic was 117.4 minutes (n=589) and 110.6

minutes (n=2,147) for new and follow-up patients, or about a 17% and 10% reduction respectively. The two-sample t-test of unequal variances calculated a $P < 0.001$ for both new and follow-up patients. The mean dwell times reveal that patients wait for less in the clinic after the implementation of the first intervention, thus reducing non-value-add clinic time. The baseline patient satisfaction score for surgical oncology clinic was 87 (n=27), which according to the Press Ganey report, was about two standard deviations below the benchmark of 99 (n=1,243). Post-intervention patient satisfaction score for the clinic was 88 (n=23). The surgical oncology clinic had about a 1% response rate to patient satisfaction surveys from Press Ganey.

Additionally, the project designed two control charts for new and follow-up patients (Figure 4 and Figure 5) to compare the baseline data over time and post-intervention data. The charts pulled observations from all patients during each clinic date from March 2016 to April 2018. Results suggest that there was a special cause event around April and May which coincide with the implementation of the intervention and the staff getting used to the new changes.

CHAPTER 4

Discussion

Summary

The interventions and process met the prescribed goals of reducing dwell times for patients in an academic, safety-net, surgical oncology ambulatory clinic while improving the patient experience. Compared to the baseline, there was a 17% and 10% statistically significant reduction in dwell times for new patients and follow-up patients, respectively. The key to this decrease was the use of Lean and DMAIC methodology. The two deceptively simple interventions of pre-assigning patients to trainees and creating a centralized supply cart had a considerable effect on dwell times. The major strengths of this project were that the interventions were quick to start-up, required less than a month for the clinic to become acclimated, and had cost virtually nothing.

Interpretation

The study suggests that pre-assigning patients the week before the clinic starts for residents to review and familiarize themselves with the chart can decrease or even eliminate the need to review the patient chart in the clinic. This new workflow allowed the trainee to see the patients almost immediately after the patient is roomed, reducing the patient waiting time for the trainee assessment, and thus, reducing overall patient dwell time. Creating a centralized supply cart with commonly used surgical clinic supplies contributed to expediting the entire patient visit by reducing wasted movements and streamlining procedures. Waiting less also meant that patients should be more satisfied. Additionally, this increased turnaround time for trainees indicate that the attending physician may almost never wait for a trainee to complete her or his patient visit, which should increase overall value-add tasks and improve staff satisfaction. Furthermore, shorter dwell times amounts to the potential of more patients being seen on a given day, benefiting not only patients and providers but also hospitals and payors.

As the healthcare landscape continually shifts towards pay-for-performance, healthcare providers and hospitals will continue to practice evidence-based care and follow national guidelines. These results and improvements in dwell time are like other studies in different clinic settings as well.[12,22,23] However, from the patient's point of view, the perception of quality care is different. One of the core perceptions of quality by patients is minimum waiting times, as long waiting times negatively affect patient satisfaction.

It is known that other quality improvement initiatives have used Lean methodology to improve clinic efficiency and reduce wait times. Nonetheless, there is limited data on improving patient dwell times specifically in a high-volume, safety-net, academic, surgical oncology ambulatory clinic environment. This type of study can result in positive culture change in the direction of quality improvement for other ambulatory clinics. That said, the success of the project depended on a significant influence of context.

With a safety-net, academic hospital with significant resource constraints comes many challenges to the advancement of this quality improvement project. There was not complete buy-in or support from all the stakeholders, mostly due to time and resource constraints and occasionally tricky personalities. For example, for the project to move forward, the attending physician of the clinic must agree to the proposed intervention, yet the residents raised concerns as this meant possibly working more hours during the week. Fortunately, this was mitigated by the fact that the duty hours were simply shifted from day of clinic to another part of the week. Furthermore, the leadership of the ambulatory clinic and project sponsor changed considerably during the time frame of the project. As a result, the team was at a standstill for a couple of months as new leadership and roles were being finalized. However, as data continued to be collected and clinic staff saw the improvements, the interventions were more readily accepted.

Additionally, there was not an established Epic electronic medical personnel team dedicated to the project. This drawback meant that finding the right Epic hospital members took months, and even once they were found, the data-pull turnaround time was also months, since this project was not a high priority for them. Consequently, dwell time data and patient satisfaction scores were either significantly delayed or required manual data-pull. That said, the response rate for Press Ganey surveys were about 1% over an entire year, which makes the one-point improvement in the patient satisfaction score hard to interpret.

In the longer term, the project essentially was run by a single medical student, which made some data collection and consistent communication difficult. Moreover, there was not a Lean expert or dedicated in-clinic staff working on the project. Instead, the medical student, Chief Quality and Patient Safety Officer of the health system, and UT Southwestern quality improvement office acted as an external consultant to the surgical oncology clinic. These context factors limited the progression of the project.

Limitations

The study had several limitations that may restrict the generalizability of the work. These restrictions included changing staff, variable resources by clinic day, and patient population. The complement of the clinic on Monday and Friday clinic is always shifting. For example, there may be one to two attending physicians or two to three medical students depending on the month. There is also constant staff turnover leading to inconsistent clinic staff experience, especially near the end of the data collection period.

Regarding resource constraints, Monday clinic has the space devoted to surgical oncology, while Friday clinic has the area dedicated to surgical oncology and palliative care, virtually splitting the resources and space in half. And finally, surgical oncologists see a patient population with predominantly gastrointestinal cancers of the liver, stomach, pancreas, or bile duct with a varying ratio of new to follow-up patients each clinic day. There is often a high noshow rate, which requires double or triple booking patients to the same time slot to compensate. The hospital system serves a predominantly indigent patient population, which can make keeping the appointment difficulty, such as patients depending on the public transportation system which runs at an infrequent schedule. Finally, because patient populations differ at every clinic, the interventions will have to adapt to each setting.

Other weaknesses that might limit the internal validity of the data include the small sample size for patient satisfaction scores, manual data collection by one medical student, biases, and the non-automated nature of the intervention. Since there was one medical student collecting the data by using a watch and performing manual data-pulls, there may be human error involved. Furthermore, the clinic is susceptible to the Hawthorne effect—the clinic staff might be performing more optimally when they knew that a quality improvement project was underway. Last, the pre-assigning intervention is currently done manually by a single attending physician without a consistent algorithm, however, fortunately, it is the same attending throughout the data collection period, providing significant consistency. These factors may reduce the strength of the results. Still, these results show promise of a great value buy for the healthcare system in this setting.

Conclusion

In summary, this study demonstrated the usefulness of Lean methodology in improving healthcare value, patient access to care, and the patient experience by reducing patient dwell times in a U.S. high-volume, academic, safety-net, surgical oncology ambulatory clinic. From the literature review, this study is the first to examine the effect of pre-assigning patients to residents and creating a central supply cart in this specific setting.

These findings have implications for hospital administers as this intervention can be directly scaled up to other ambulatory clinics, providing minimum input disruption and maximum value-add. Further, this healthcare system is earnestly examining ways to improve dwell times and patient satisfaction across the board, leading to improved patient access to care and patient experience. The sustainability of this project would require the continued efforts of the attending physician to maintain pre-assigning patients and nursing staff to continue to assemble the centralized supply cart before the clinic. The sustainability can also be achieved if this could be automated in Epic when resources would be available and if the hospital could decrease staff turnover rates. Future study would include implementing additional interventions in the clinic from the brainstormed solutions and assessing their efficacy iteratively with DMAIC.

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Table 1:

Table 1. Current state (baseline) and post-intervention state for mean dwell times in Monday clinic for new and follow-up patients. Current state (baseline) for patient satisfaction score in the surgical oncology clinic (includes Monday and Friday clinic) and patient satisfaction benchmark score for other publically-funded ambulatory clinics.

Clinic Metric	Baseline (Mar 2016-Mar 2017)	Post-intervention (April 2017-April 2018)	P Value
Mean Dwell Time for New Patients (minutes)	**140.7 ± 54.2** (n=572)	**117.4 ± 46.9** (n=589)	**<0.001**
Mean Dwell Time for Follow-up Patients (minutes)	**123.0 ± 55.8** (n=2,802)	**110.6 ± 51.0** (n=2,147)	**<0.001**
Patient Satisfaction Score for Surgical Oncology	**87** (n=27)	**88** (n=23)	**-**
Patient Satisfaction Benchmark Score	**93** (n=1,243)	**93** (n=1,431)	**-**

Table 2:

Table 2. Prioritization matrix for suggested interventions. Highlighted rows indicated implemented suggestions.

		Evaluation Criteria (1-worst to best-5 scale)					
	Possible Interventions for Surgical Oncology Clinic	Effect	Cost	Bureaucratic Feasibility	Time to Effect	Total	Weighted Score
	Weighting	0.4	0.4	0.1	0.1	-	1
1	Pre-assign patient charts for review prior to clinic start	4	5	4	5	18	4.5
2	Have procedure materials in exam room (or crash cart)	4	5	4	5	18	4.5
3	If resident and attending see patient together, have resident put in lab orders/write note in exam room	5	5	1	4	15	4.5
4	Put in lab orders in exam room or during pt. presentation	5	5	1	4	15	4.5
5	Stagger patient appointments for different attending physicians	5	4	3	4	16	4.3
6	Trainee see patients before attending arrives into clinic	4	5	3	4	16	4.3
7	Use LOS in the exam room	4	5	3	4	16	4.3
8	Have dedicated exam rooms for each attending physician	5	4	3	3	15	4.2
9	Attending see patients alone if multiple patients are ready to be seen	3	5	5	5	18	4.2
10	Trainees signal that they have a patient ready to present instead of waiting for attending physician to ask	4	5	4	2	15	4.2
11	Checklist for trainees on how to get phone interpreter online	3	5	5	4	17	4.1
12	Consistently place chart in rack	3	5	5	4	17	4.1
13	Resident should see a patient while waiting to present	3	5	5	4	17	4.1
14	LVN split up duties 1 focusing on discharge and another focusing on NA	3	5	5	4	17	4.1
15	Attending ensures patients are seen in order	3	5	3	4	15	3.9
16	Retire face sheet and used colored dot system	5	3	3	3	14	3.8
17	Give complicated cases to more experienced trainees	4	4	3	3	14	3.8
18	After physician visit, have patients wait discharge waiting room for LVN discharge	3	5	3	3	14	3.8
19	Add scheduling template to prevent overbooking	5	3	1	3	12	3.6
20	Have live interpreter ready at start of clinic	4	3	4	3	14	3.5
21	Have medical assistants clean exam room instead of LVN	2	5	4	3	14	3.5
22	Have 2 medical assistants working	5	2	3	4	14	3.5
23	dot system to indicate readiness	4	3	3	3	13	3.4
24	Schedule new patients to earlier clinic appointment slots	3	4	3	3	13	3.4
25	Have medical assistants walk patients to exam room	1	5	5	5	16	3.4
26	Use level of service for discharge notes in Epic	2	5	3	3	13	3.4
27	Organize tray of materials for procedures	2	4	4	4	14	3.2
28	Reduce patient barcode printing	3	3	1	5	12	3
29	Attending ensures medical students don't spend too much time studying pt.	1	5	1	4	11	2.9
30	Construct sign outside provider room indicating which exams rooms are to the left and which are to the right	3	2	3	5	13	2.8
31	Add comments columns to epic (real-time updates on patient)	2	3	4	3	12	2.7
32	Hire scheduler for the clinic	3	2	3	3	11	2.6

Table 3:

Table 3. Staffing at the Surgical Oncology Ambulatory Clinic.

Healthcare faculty/staff	# per half-day of clinic
Attending Physicians	1-2
Experienced Resident (3rd year)	1
Intern Residents	1-2
Medical Students	1-3
Clinic Manager	1
Nurse Navigator	1
Licensed Vocational Nurse	2
Medical Assistant	1
Front Desk Clerk	1

LIST OF FIGURES

Figures 1:

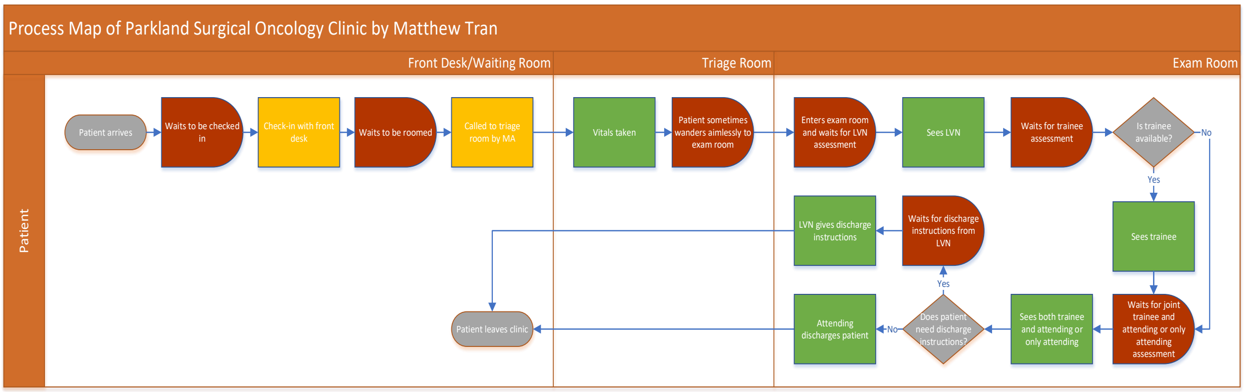


Figure 1. Value stream map. Legend: Red not value added, unambiguous. Green value added. Yellow value-enabling or mandatory. Gray decision point.

Figure 2:

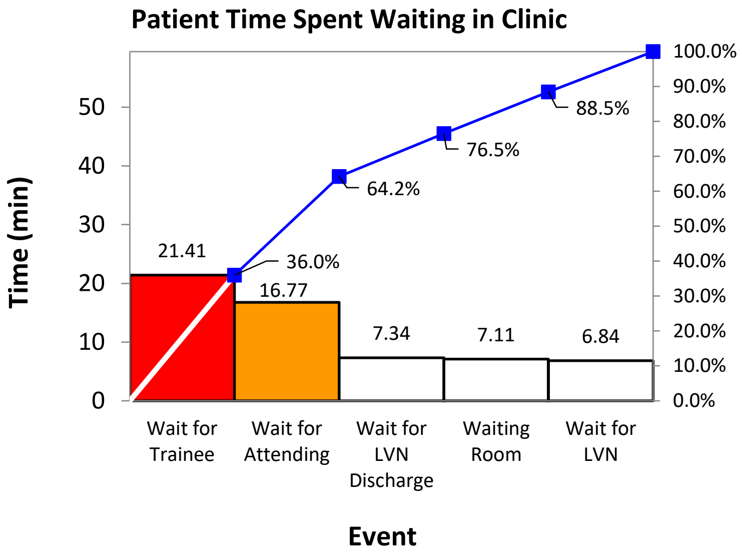


Figure 2. Pareto chart of top five non-value-add times in the surgical oncology clinic for 29 observations.

Figure 3:

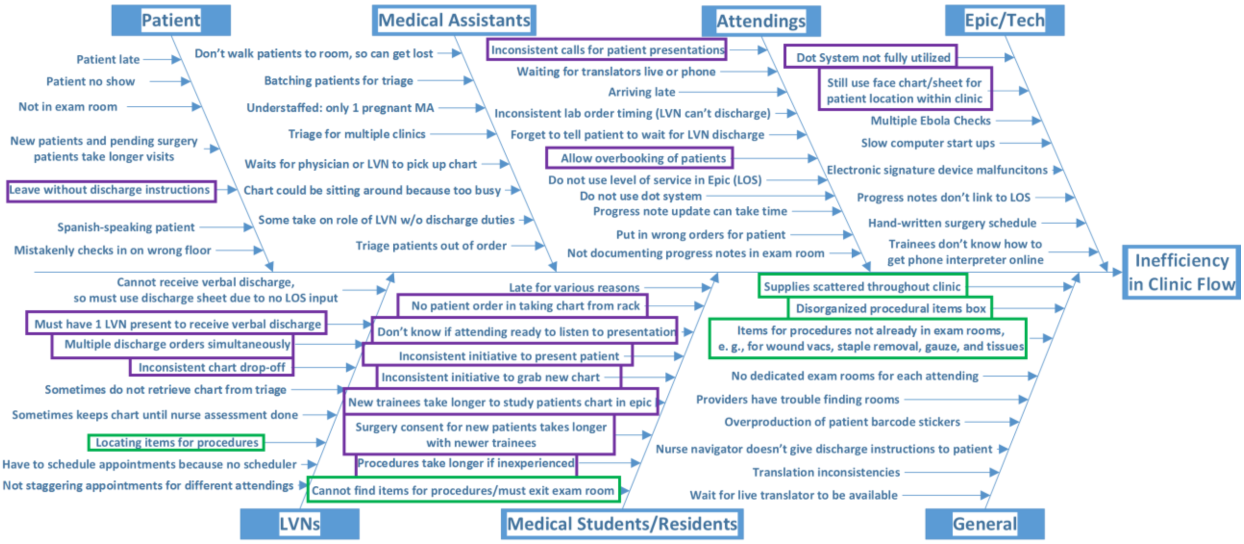


Figure 3. Root cause analysis via the fishbone diagram. The figure represents causes identified in the clinic that may lead to inefficiency in clinic flow. The root-causes are organized into seven larger branches, including the patient, medical assistants, attending physicians, licensed vocational nurses (LVN), trainees (medical students and residents), technology such as Epic system (electronic medical record), and general or other causes. The purple boxes highlight areas of opportunity that the first intervention—pre-assigning patients to trainees before clinic start—should impact, affecting the human decision-making element in the clinic. The green boxes highlight areas of opportunity that the second intervention—creating an organized supply cart—should influence, transforming the organization of the clinic.

Figure 4:

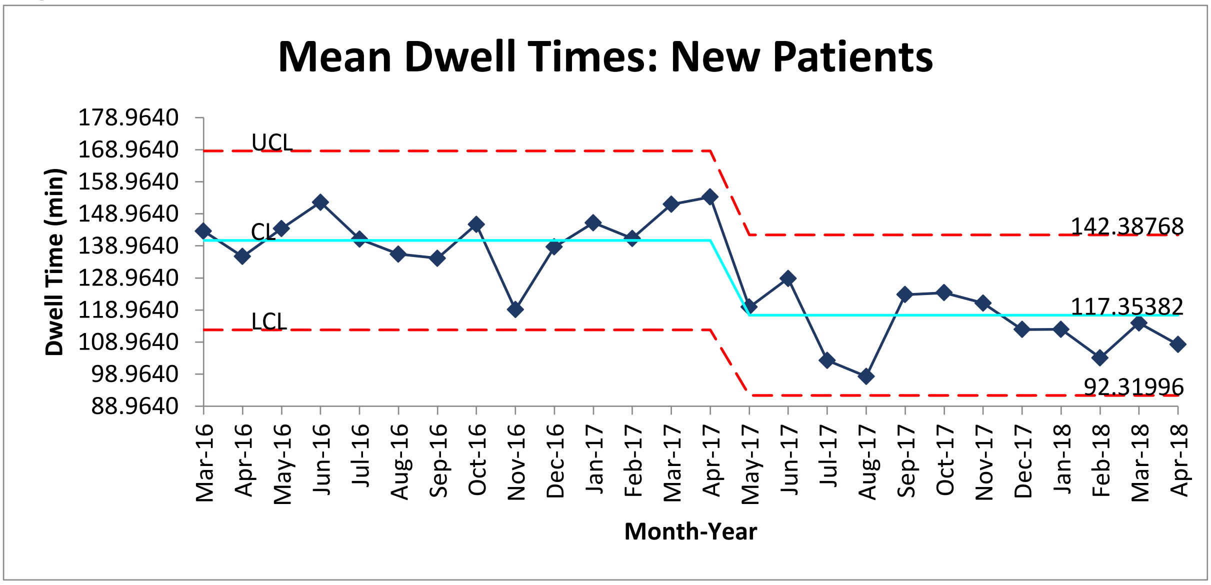


Figure 4. Control chart of monthly mean dwell times in surgical oncology clinic for new patients. The intervention was implemented in April 2017. Around this time a special cause variation occurred, which was the intervention. The mean, upper control limit, and lower control limit was adjusted appropriately.

Figure 5:

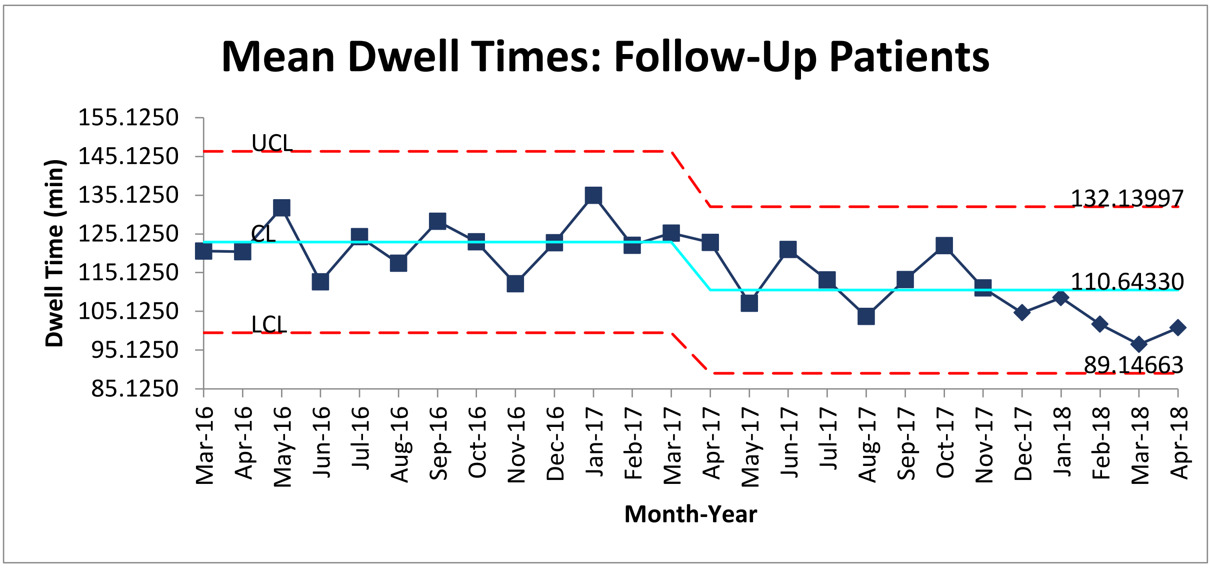


Figure 5. Control chart of monthly mean dwell times in surgical oncology clinic for follow-up patients. The intervention was implemented in April 2017. Around this time a special cause variation occurred, which was the intervention. The mean, upper control limit, and lower control limit was adjusted appropriately.

APPENDIX FIGURES

Figure 6:

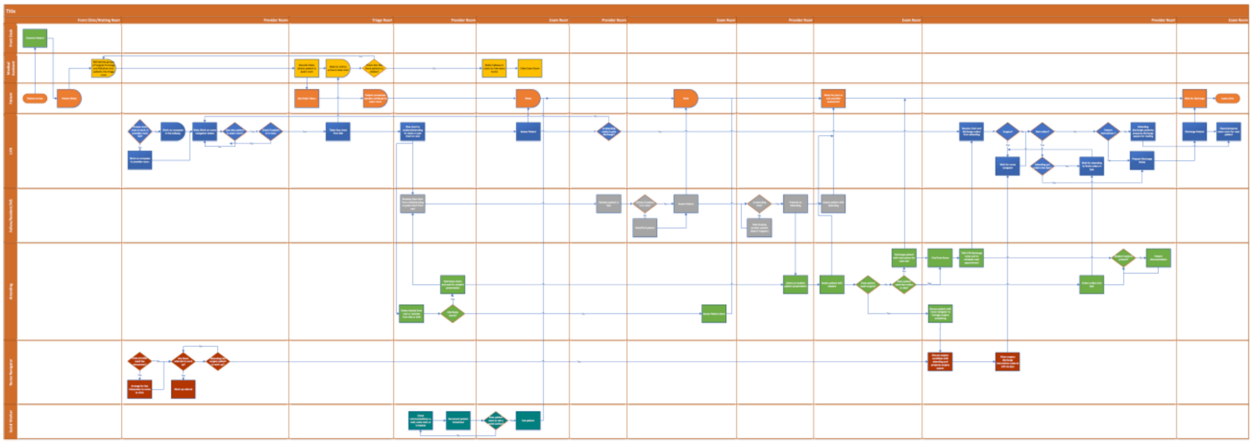


Figure 6. Swim-Lane Diagram of Clinic Process. ***71 Key process steps;*** *Dark green: Front Desk; Yellow: Medical Assistants; Blue: LVNs; Grey: Trainee; Light Green: Attending Physician; Red: Nurse Navigator; Teal: Social Worker*

Figure 7:

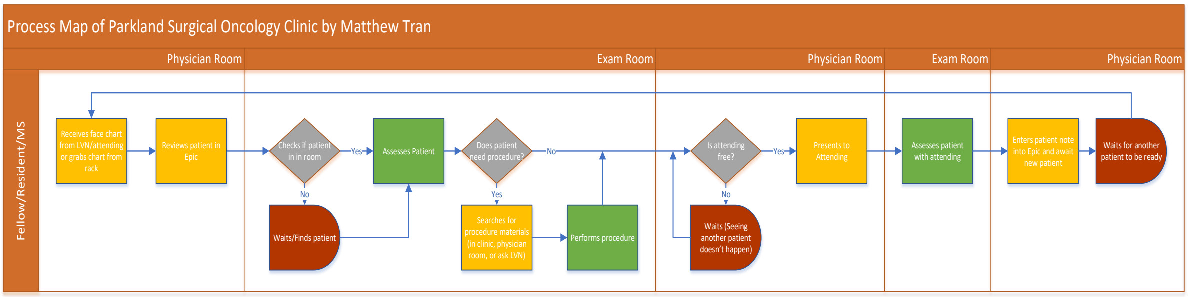


Figure 7. Trainee Value-Stream Map Current State.

Figure 8:

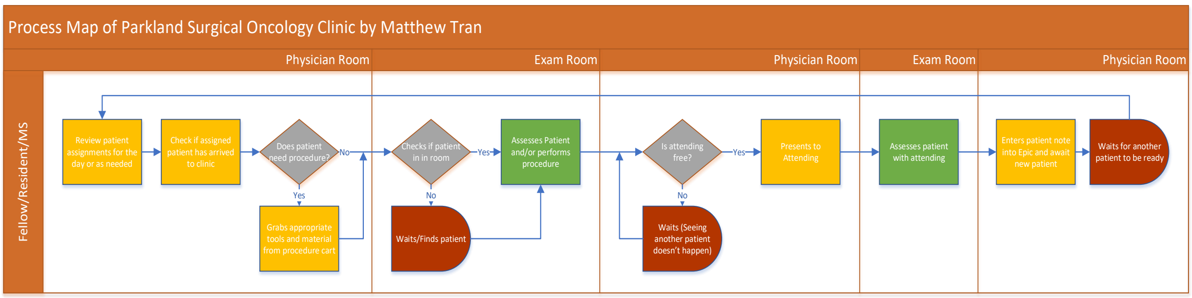


Figure 8. Trainee Value-Stream Map Future State.

Figure 9:

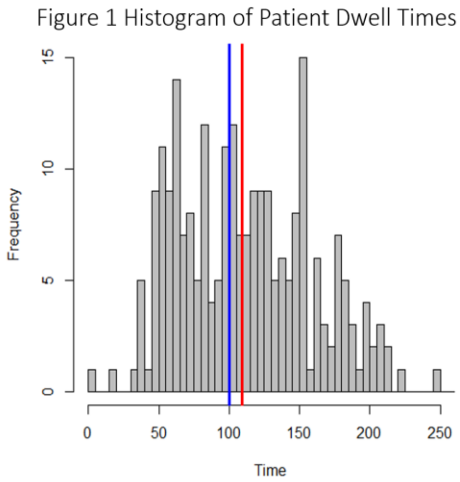
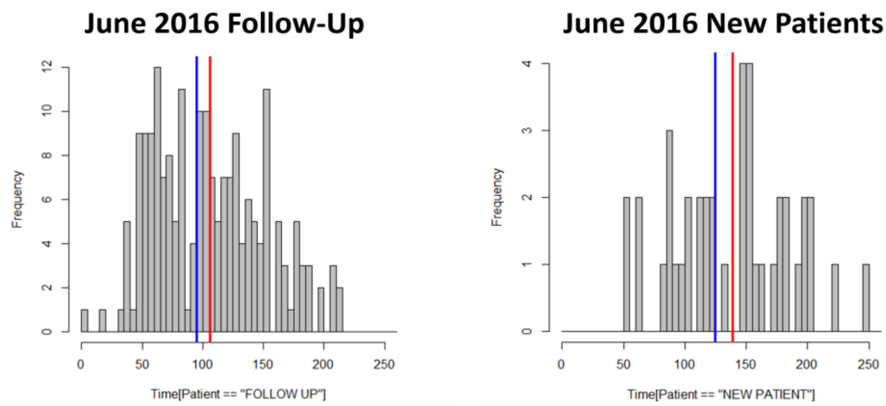


Table 2 Sigma Levels

Sigma Value	1.35
Upper Specified Limit (USL)	100 min
Mean Patient Dwell Time	109 min
Standard Deviation	47.671
Sample Size (pt. encounters)	237
Defects (above USL)	133 (56%)

Figure 9. Dwell times for new and follow-up patients in June 2016.

Figure 10:



Sigma Value	1.32
Upper Specified Limit (USL)	95.49 min
Mean Patient Dwell Time	106.10 min
Standard Deviation	45.38
Sample Size (pt. encounters)	196
Defects (above USL)	112 (57%)

Sigma Value	1.35
Upper Specified Limit (USL)	125 min
Mean Patient Dwell Time	139 min
Standard Deviation	48.18
Sample Size (pt. encounters)	42
Defects (above USL)	23 (56%)

Figure 10. Two histograms of dwell times in June 2016 split between follow-up patients and new patients. Both histograms show that the dwell times vary considerably. Dwell times can be as short as 20 minutes or 50 minutes for follow-ups and new patients respectively, or as long as 4 hours. Of course, these outliers may be due to admissions patients. Still, the data underscore the need to control the variability and provide a standard clinic experience for all patients.

Figure 11:

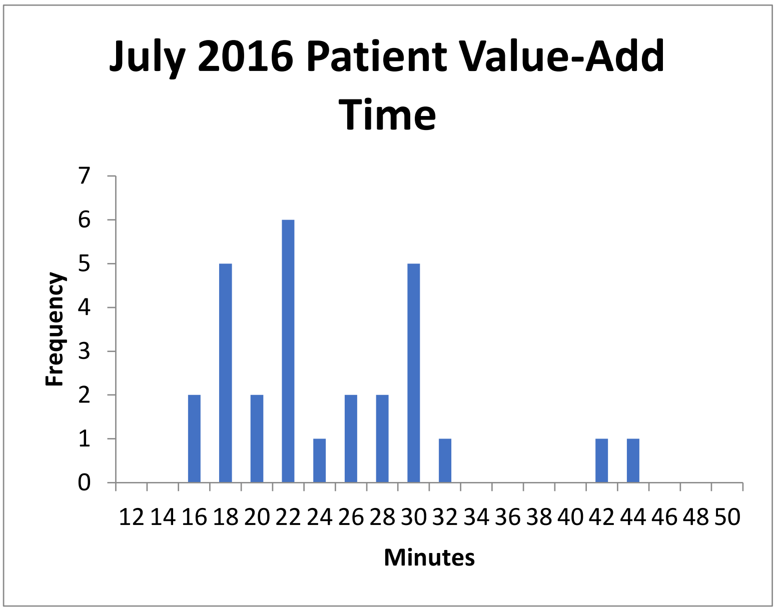


Figure 11. Histogram of value-add times for individual patients.

Figure 12:

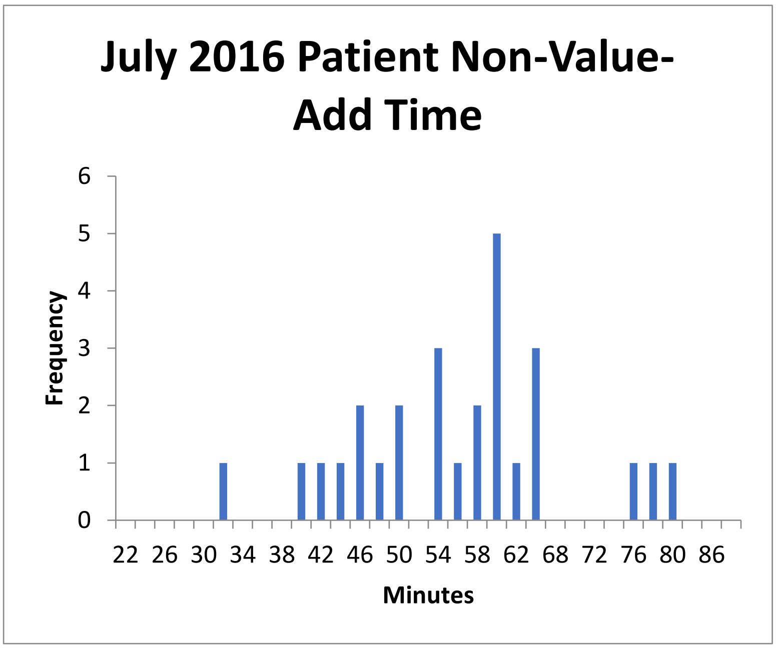


Figure 12. Histogram of non-value-add times for individual patients.

Figure 13:

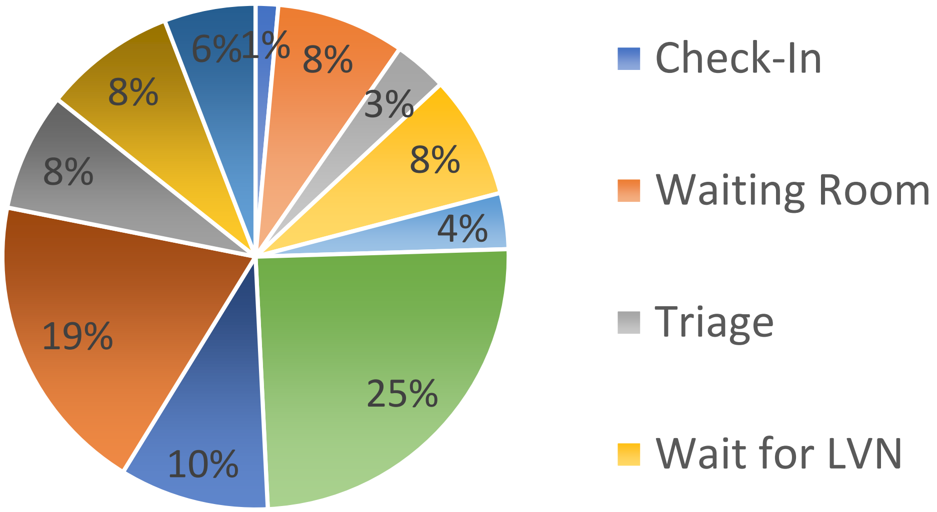


Figure 13. Patient Time Spent in Clinic.

Figure 14:

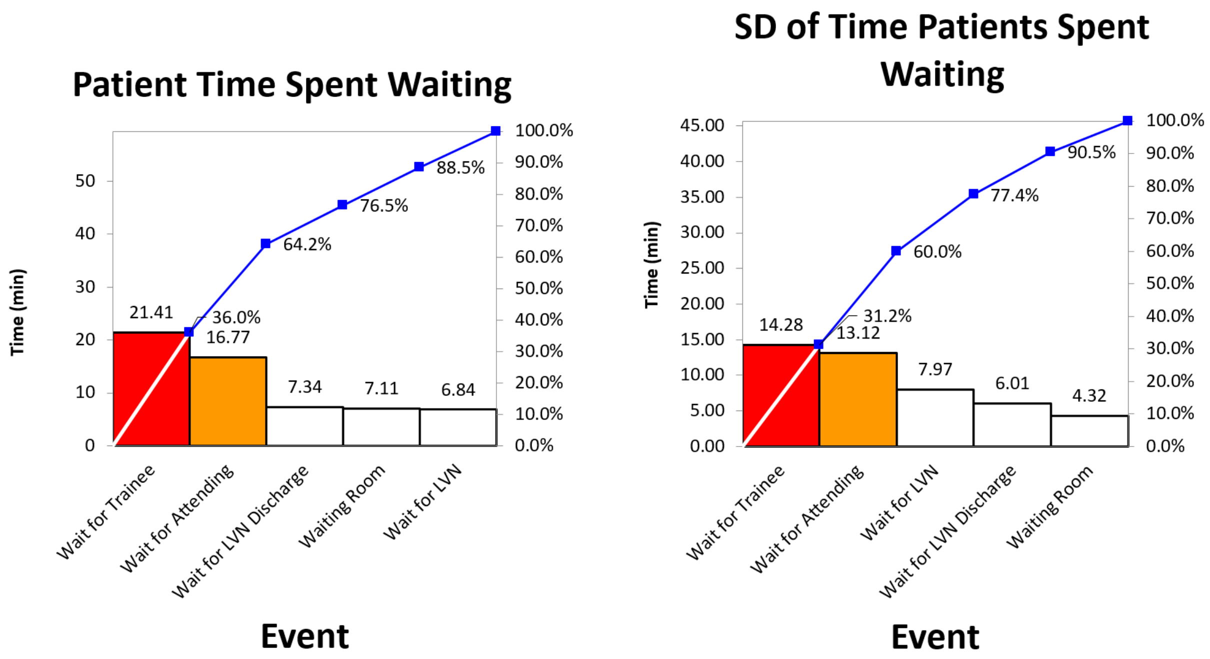


Figure 14. Pair of Pareto charts displaying non-value-add steps and their time value for each step. The non-value add steps are ordered from greatest to least, from left to right. On the left, the most substantial delay is when patients wait for an assessment by the trainee, which is about 20 minutes, but this delay accounts for about 1/3 of all non-value-add time.

Figure 15:

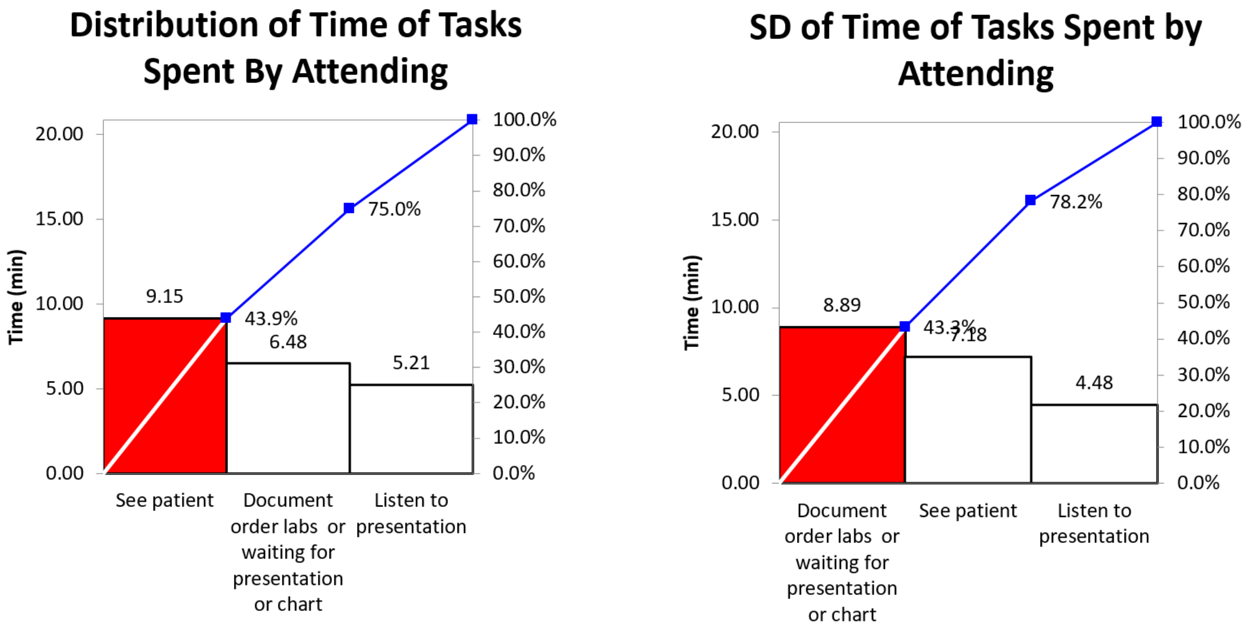


Figure 15. Attending Physician Time Study.

Figure 16:

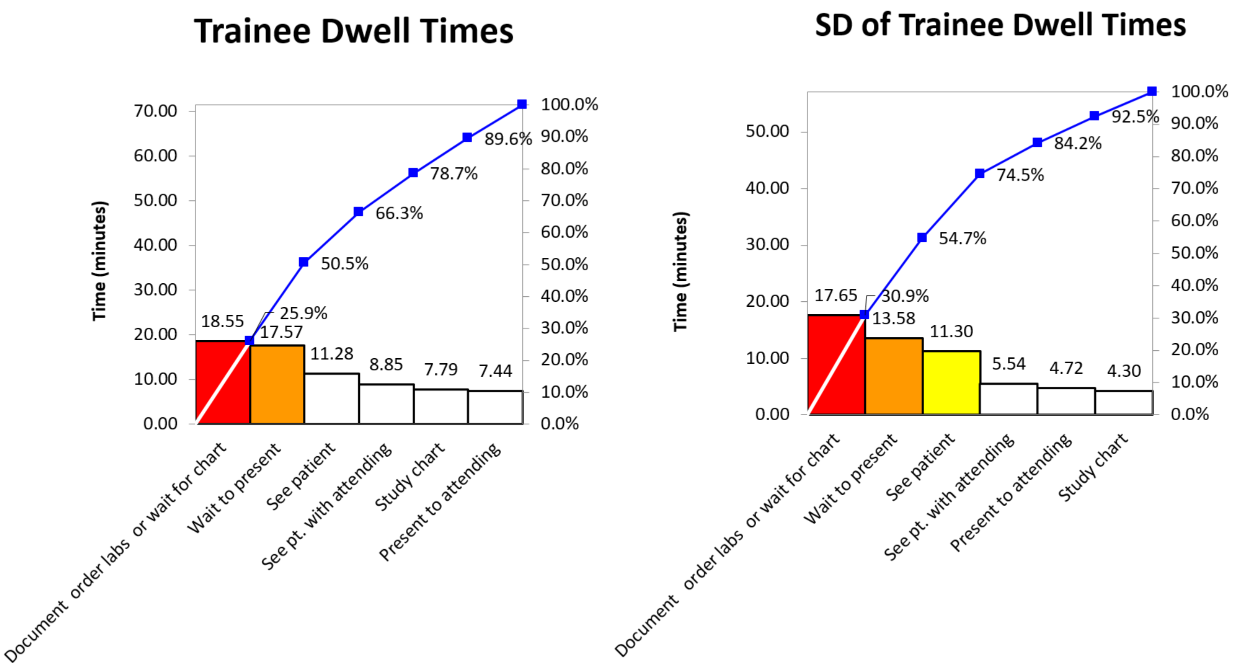


Figure 16. Trainee Time Study.

Figure 17:

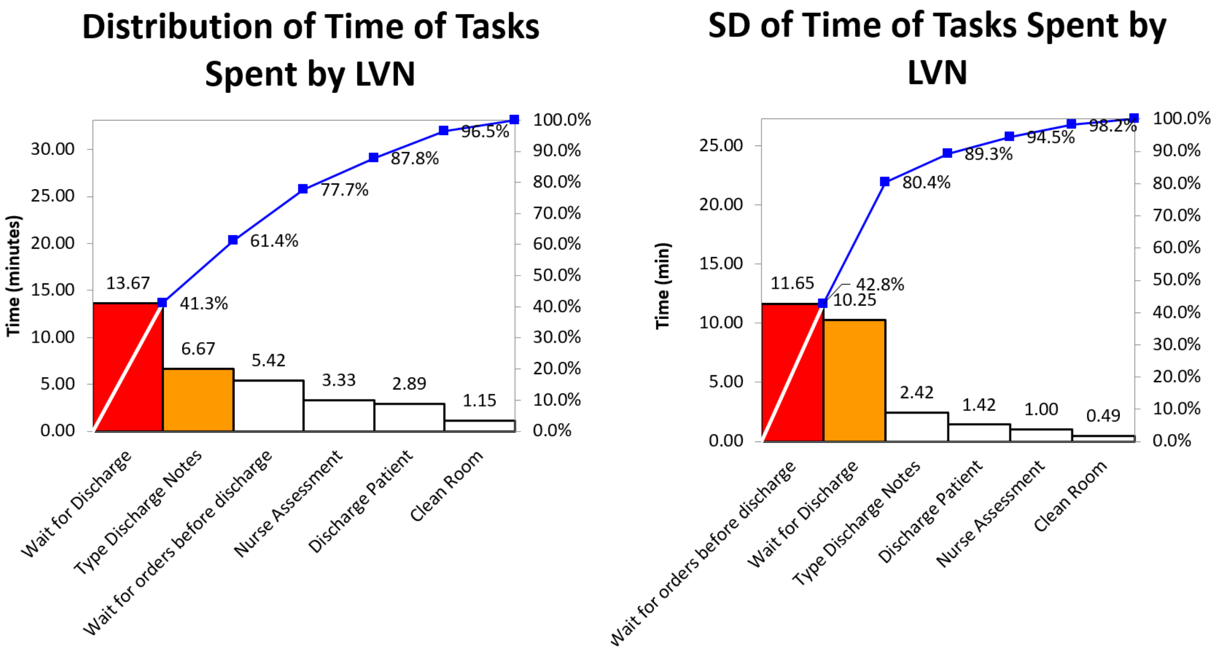


Figure 17. LVN Time Study.

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VITAE

Matthew Tran (1991-present) is a fourth-year medical student whose dream is to be an oar in the water to aid in the transformation of the healthcare system to serve everyone, especially those who need it most. He plans to complete residency in Internal Medicine and then pursue a fellowship in cardiology because the heart is the most provocative organ. He will later marry Linh-Tran Do this May. He plans to eventually plant his roots in Houston and become a leading figure in the community advocating for real change.

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