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USING LEAN SIX SIGMA METHODOLOGIES TO IMPROVE THE PATIENT EXPERIENCE AT A LOCAL HEALTH CENTER

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Honors Thesis

USING LEAN SIX SIGMA METHODOLOGIES TO IMPROVE THE PATIENT EXPERIENCE AT A LOCAL HEALTH CENTER

by
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ABSTRACT

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Lean Six Sigma is a methodology originally designed for a manufacturing context but has process improvement applications that can be used in many fields including medical and business. These tools were applied to addressing issues at a local Health Center with the aim to help patients receive better medical treatment and have a more positive overall experience. Initial baseline data was collected to identify the core problems patients were experiencing with the health center. Adjustments were made in the survey process to capture more accurate results about the patient experience, which led to the creation of a patient-focused action plan of improvement that relied on a Six Sigma DMAIC framework. Process flow charts were created and data collected to monitor the system before kaizen events were initiated. An implementation plan for suggested improvements based on initial findings is proposed in this report for the health center to carry out if desired at a future time under the direction of the executive leadership team.

ACKNOWLEDGEMENTS

I would like to thank the executive team at the health center for making the project possible. I would also like to thank brave medical staff members for leading the change and inspiring others to raise the level of care for patients. Finally, I would like to thank my advisor Britt Berrett for helping me get passionate about healthcare and for my professors in the manufacturing and statistics departments for teaching me the skills used in this thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Data Privacy Statement

Some of the data collected in this study came from real patients that were treated at the health center in 2023-2024. Data was also collected on real health care providers and other staff that are currently employed at the center. In order to maintain data privacy for those patients and employees, all patient names were removed from the associated data points and values were averaged or aggregated into groups. Even with the personal identities removed, the health center would like to keep results from this study confidential so true performance of the center and quality of physician care are not released to the public without written consent. Data within this study is meant to be used for academic purposes to complete this Honors thesis project only and not to be published elsewhere.

INTRODUCTION

In recent years patient experience has become a key area of focus to healthcare providers and institutions. Studies have shown an association between patient experience and both perceived and real health outcomes, clinical quality (Isaac et al. 2010), and overall patient satisfaction (El-Haddad et al. 2020). Improved patient experience has also been seen to impact health provider job satisfaction, lead to fewer negative reviews online (better PR and reputation for health centers), and fewer lawsuits against providers (Prakash. 2010). Patient experience measures can also impact financial outcomes at healthcare institutions by increasing patient retention, reducing employee turnover, and reducing costs associated with addressing patient complaints.

Six Sigma and Lean Manufacturing methodologies are becoming increasingly popular for non-manufacturing applications. Six Sigma is a term that broadly encompasses a standardized skill set that employs statistical tools and a structured problem-solving framework to tackle continuous improvement challenges with technical expertise. Lean methodology was developed originally from the Toyota production system in Japan and focuses on improving process flow while simultaneously eliminating waste and improving productivity/efficiency (Womack, 2007). In the last decade, Six Sigma and Lean tools have been brought into the healthcare industry, including at Intermountain Healthcare facilities in Salt Lake City (Crowell, B. 2017). This thesis will likewise apply these tools to a healthcare environment but in this case, it will be for a local health center in Utah.

Six Sigma methodology is used frequently in healthcare because of its ability to solve problems effectively. At the heart of Six Sigma is the DMAIC problem solving

framework, which stands for Define, Measure, Analyze, Improve, Control. By defining the problem with stakeholders, the right direction for the project is taken from the very beginning. By quantifying the problem, it helps increase understanding and translates the issue into something that can be solved by non-subjective tools. Analyzing the problem allows the root cause to be found so that any improvement actions taken will result in a true change. Improve is the step where solutions can be implemented and verified. Finally, "control" refers to maintaining the solution so that it has lasting impacts on the organization and remains in effect after the initial project is over. This step-by-step process guides any researcher to getting precise, effective results. If applied to the patient experience in a hospital, it can identify the root cause of patient dissatisfaction or complaints—and then inform the healthcare institution how to prevent those issues from recurring in the future.

One commonly used tool within the Six Sigma toolkit is a process flow chart. Flow charts are used to map out each individual process step in the sequential order they occur. The objective in doing this exercise is to identify unnecessary process steps that slow down the system flow and create waste. A similar map-like tool often used in lean six sigma is called "Value Stream Mapping", where the objective is to add another layer of detail to the process map so a distinction can be made between value added and non-valued added steps. Visualizing the steps in either a flow chart or value stream map can highlight inefficiencies more clearly and help a viewer quickly draw connections between key steps. Flow charts are used in manufacturing industry settings but also in published research papers, such as seen in the example below:

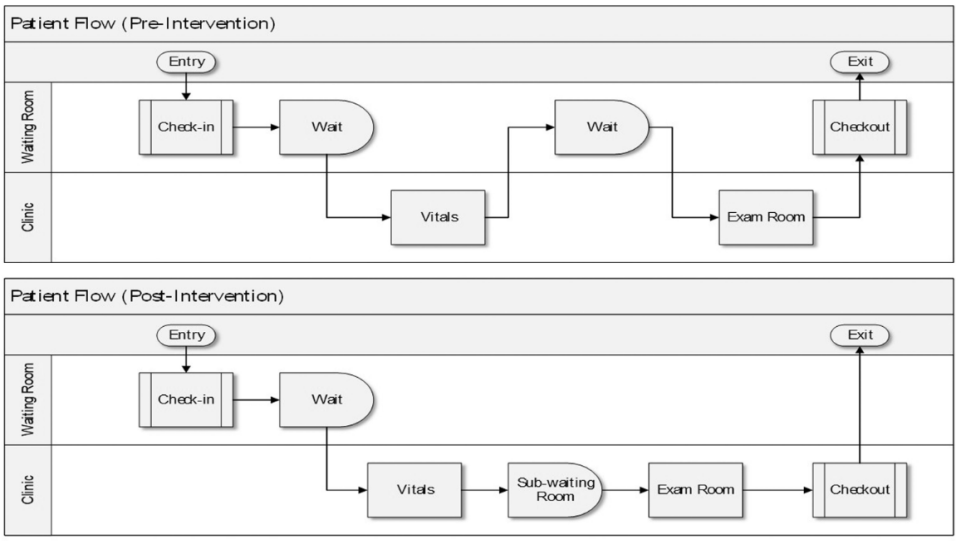


Figure 1.1 Example flow chart from a published patient flow study (Source: Pashankar et al. 2022)

Technological advances have made data collection on the patient experience more readily accessible and has greatly increased the amount of patient involvement in collecting that data. Patient experience feedback typically is gathered through clinic-generated surveys, national standardized surveys (such as the Hospital Consumer Assessment of Healthcare Providers and Systems survey), focus groups, or online/google reviews. Research-proven statistical methods are used in conjunction with these survey tools to gather the most representative sample and analyze the results properly to draw accurate inferences. Greater access to data has led to stricter standards on data privacy and the creation of new regulations on reporting that data to the public. Under the HIPAA (Health Insurance Portability and Accountability Act) privacy regulations, hospitals are authorized to conduct "quality assessment and improvement activities" as part of the hospital's health care operations (AHA, 2024).

A key to providing a positive experience for patients is to first understand and meet their expectations. Several studies have been done to understanding and measure patient expectations of health care, enabling institutions to improve patient satisfaction and deliver "better patient-centered care." (El-Haddad et al. 2020). Some of these studies have reported interventions aimed at patient access, care providers, and improving wait times in ambulatory settings to improve patient experience. This same study (El-Haddad et al. 2020) determined that patients create their expectations around three distinct areas: expectations of health outcomes, expectations of individual clinicians, and expectations of the health-care system as a whole. In the study, patients viewed improvement in their health as the most important outcome of their hospital visit. Another study (Chen et al. 2019) found that patient satisfaction is associated with factors outside of ones that can be controlled by a health center such as the patient's own mental health.

Prolonged wait time in the clinic is often a source of frustration for patients and can significantly impact patient experience scores negatively on surveys (Pashankar et al. 2022). In another study (Nyce et al. 2021), 3,278 emergency department patients in the Cooper University Hospital (New Jersey) were studied. Multiple wait time metrics were compared and of them, "Door-to-doctor" time had the highest impact on the patient's experience. Focusing on patient experience and reducing wait time can help patients have a more positive outlook on the institution where they get their health needs taken care of. This leads to a higher likelihood of going to the doctor when they need to and then getting treatment to improve their health.

At the health center, a concern about negative patient experiences was the primary driver for initiating this research study. In recent years this health center received significantly low google review ratings (average 2.47 out of 5 stars) compared to other centers like Revere Health Urgent Care (3.5 stars), Riverwoods Urgent Care (3.9 stars) or Utah Valley Clinic InstaCare (4.4 stars). The rating has hovered around 2 stars for the last four years, reaching an all time low in 2020 with an annual average of 1.62 out of 5 stars. These details raised concern for the health center's administrative leadership team and prompted a desire for rigorous internal evaluation to determine if the ratings truly reflected what was going on inside the center.

In January 2023 the executive director reached out to the Marriot School of Business, asking for patients to help research the root cause and propose solutions to turn the ratings around. If the ratings were true, the patient experience would be suffering and further adjustments would need to be made to improve that as well, which would eventually also reflect back in the google reviews.

All the research that was conducted in this study was done under the direction of the administrative team. The primary goal initially was to use a "secret shopper" model for discretely collecting information about the employees, quality of care, and overall patient experience in the center. This would require research participants to go "under cover" and act as if they were "patients" without informing receptionists, nurses, physicians or any other staff that they were evaluating and observing them. In consideration of possible ethical issues with this approach, a quick literature search produced some helpful insights. In 2012 Rhodes and Miller published a study called "Simulated Patient Studies: An Ethical

Analysis” in response to public controversy about the use of deception with human subjects without soliciting their informed consent. The study concluded since risks are minimal compared to the benefit of the knowledge gained, the “secret shopper” technique can be ethically justified.

The research project occurred in stages with the first round of data collection taking place between January and May 2023. Data analysis happened gradually throughout 2023, and a follow up discussion for future studies started up in January 2024.

The initial scope of the study was to gather minimal data with a few patient research assistants, but once the research opportunity was repurposed for use in this honors thesis the complexity and project duration increased to meet both the program requirements and the needs of the health center. The DMAIC (“Define”—”Measure”—”Analyze”—”Improve”—"Control”) process was followed for this study but not in its entirety. A standard Six Sigma project will often have a period of research and data collection in early stages (“Define”, “Measure” & “Analyze”), implement changes (Kaisen events) to improve the process (“Improve”) and then have a prolonged period of monitoring the system to maintain the new efficiencies (“Control”) using tools such as SPC (Statistical Process Control). The whole project including monitoring system stability over time could take up to several years. With the short time frame available for this project, the primary focus of the research was to complete the first three steps in the DMAIC process and propose suggestions for future projects. The data collection also is scaled down to a small level due to the high cost of each sample/data point, as the center absorbed the cost of the resources expended during the simulated doctor’s appointments (including the cost of the

health care providers time). Due to the limitations in size, this study was largely used to model feasibility of using new measurement methods to evaluate employees and flow on a small scale, rather than obtain conclusive statistically significant results for a publishable study. If the methods prove successful in being able to measure the target desired outcomes, the test procedures can be scaled up in a later study with a larger sample size in which at that point conclusive results could be drawn.

Definitions to note:

Six Sigma – Statistically-rooted methodology developed for continuous improvement initiatives in manufacturing and business applications

SocialClimb – A marketing company that produces automated text messages sent to patients after their visits to solicit survey feedback

ANOVA – Short for “Analysis of Variance”, a standard statistical test that detects differences in means of multiple groups

CAHPS or HCAHPS – Short for “Hospital Consumer Assessment of Healthcare Providers and Systems”. It is a standardized assessment comprised of ~31 questions aimed at evaluating a wide variety of areas within a health center/hospital.

METHODOLOGY – RESEARCH PROCEDURES

The research for this project was executed in two phases. The first phase was intended to document in depth potential critical areas for improvement within the health center, and the second phase built off the first, narrowing in on improving a single aspect within the patient experience. Taking this approach was done with the intent of mirroring the concept in engineering of running a screening experiment (DOE) to filter out lower priority factors and then follow up with a more detailed study, analogous to a full-factorial experiment.

Because data was to be collected at the health center's physical location under the direction and approval of the Executive Director, the first completed step was to clarify and align the research objectives with the administration team. A project charter was written and used in the place of a standard research proposal to adapt to an industry (non-academic) audience. In preparation for drafting the charter, participating patient research assistants were assembled and briefed on the initial project idea. "Patients" were volunteers from the Marriot School of Business' introductory healthcare leadership course (MSB 289R). Five research assistants collaborated on the charter and participated through the duration of phase 1 of this research project. The charter was sent to the Executive Director for review and the general objectives were then determined. They are as follows:

1. Improve the patient experience
2. Increase patient flow and efficiency of the health center
3. Improve the Public Relations/Public view of the health center

These objectives were not intended to be strict project success measures but rather a guideline for general areas to explore for potential improvement mechanisms. An additional requirement established by the health center leadership and the faculty advisor was to maintain a level of secrecy about the Phase 1 research activities so patient confidentiality would be maintained and employees would be unaware of data collection so there would be no bias.

Phase 1 – "Secret Shopper" Study

Overall scope and specific Phase 1 project objectives were further defined based on the general objectives and written into a research plan document. The specific project objectives guided decisions on what would be measured during the experiments.

Flow:

A standard method for identifying inefficiencies in a process is to carefully document detailed information about all process steps through observations, time studies on individual process steps, or creating visual maps (e.g. flow charts). Baseline information on current-state patient flow was to be collected in order to create a comparison metric to be measured against itself after a future improvement intervention would be implemented. To gather this information, patient research assistants acted as "simulated patients" and scheduled appointments at the health center through the online appointment scheduling site. The "simulated patients" technique was approved of by the Executive Director prior to starting.

To get an accurate timestamp on when certain activities began and ended during the visit, the patients were instructed to begin an audio recording on their cell phone

shortly before walking in for their appointment and keep the recording on for the duration of the appointment. Phones were inserted into bags to muffle and distort sounds so no voices would be recognizable. Following the appointment, the recordings were sent to the lead researcher to extract time stamps and then deleted from the patient's personal devices. From the recordings, background sounds such as doors closing were used to mark the start and end times of when a patient entered or left an exam room. Conversations between health care providers and patients were not analyzed, and no true personal information was released in the conversations captured in the audio recordings because patients were instructed to use false, pre-determined information about "symptoms" and reasons for being admitted in the center. Times for each process step were documented in a table (see results section Table 1) and then all copies of the recordings were deleted. From the list of time stamps, a process flow chart was created (see results Figures 3.1 and 3.2). A different flow chart was created for each appointment type, as type of appointment impacted process steps (e.g. some patients required a pharmacy visit, others did not.)

Other observations about patient flow were captured in meeting notes during a focus group debrief with the research assistants after all simulated patient visits had concluded. Research assistants documented additional observations about flow in brief journal entries that were submitted to the lead researcher.

Patient experience:

As stated previously in the literature review, there are many factors that go into measuring the "patient experience". For the purpose of this study, only a few of these factors were

selected. They include measuring the quality of care provided, patient activities and reactions during the appointment scheduling process, behavior of employees the patients interacted with, and patient interactions with the atmosphere/environment of the center. In a manufacturing context most data about the quality of an individual process step can be collected objectively with the use of calibrated measurement equipment or built-in microcomputers. In healthcare settings measuring outcomes related to patient experience must be measured subjectively and can be analyzed through tools that translate qualitative data into quantitative data, such as surveys or standardized rating scales.

Google Surveys:

Surveys are a widely practiced method of collecting patient experience data. Before this research project was conducted, the health center was not sending out regular surveys to their patients. To get baseline information, the only available information was through google reviews posted publicly online. At the start of this study in January 2023, the average rating of the center was 2.47 stars and the comments behind those stars were overwhelmingly negative. The comments ranged from mild situations such as frustrations with appointment cancellations to serious problems such as incorrect prescriptions given at the pharmacy or false diagnoses given by doctors. Comments also included non-medical issues such as incorrect billing charges to accounts or disrespectful receptionists.

To analyze the information, first all google reviews were imported as raw data into a spreadsheet. Each row/entry in the spreadsheet contained the date the review was posted, number of stars (out of 5), patient name, and comment description (if any). Each comment was coded/subjectively assigned to a category identifying the general complaint type

(Categories were: Appointment, Receptionist, Test Results (lab), Financial, Quality of Care). Multiple research assistants checked over each other's work to ensure agreement on the subjective category assignments so that there was a degree of inter-rater reliability. Counts for most frequent complaints were totaled by category. Summary findings on google reviews are in Table 3 in the results section. The number of star ratings was compared year by year to look for trends in improving or declining quality of patient experience over time.

With many survey type data, there is often a bias where only those with extreme opinions will be motivated to fill out a review online without an incentive. With limited data available for the google reviews (n=276 total reviews), there is possibility that the available information is not representative of experience of the total population. A standard way to reduce bias is to increase the sample size, but seeing that is not possible with the historical data available in this data set the researchers instead sought to identify potential bias and account for it. A suspected source of bias was in the case that certain reviewers that typically leave a large number of google reviews online would be more likely to leave an inaccurate rating for the center. In other words, if a person leaves many negative reviews for other companies/services online, they are suspected to leave a lower star review. People who have a large total number of google reviews on their profile can be considered a type of "influencer" as they are active on sharing opinions online and gather lots of attention. The total number of reviews a person leaves across google is visible on their google profile, in a way identifying them as active online or not. The number of total reviews each reviewer left online was compared with the number of star rating that same

person posted for the health center. Results for the statistical comparison are included in the results.

"Secret Shopper" Undercover Data Collection:

As stated earlier, several research assistants went undercover and posed as patients that paid visits to the health center for fake ailments. The intent was to document their experience in detail and evaluate their interactions with the staff. Part of the intention was to get up to date, unbiased data to compare to the google review feedback as evidence to either validate or invalidate the strong negative claims made by reviewers. The executive director worked with the financial department to ensure all medical fees were waived for the research assistants after their visits were complete. No staff members besides the administrative leadership were aware the research assistants were not true patients.

The documentation on their experience was done in the form of post-visit journal entries, meeting notes from a post-visit focus group discussion and screenshots saved throughout the appointment scheduling process. Screenshots of every automated text message or email sent as an appointment confirmation or reminder were gathered. Screenshots were stored in a google folder shared among the research assistants. In addition to observations, research assistants were trained to evaluate receptionists and health care providers during their visit. A detailed data collection method and toolkit were designed for this study before any of the undercover visits started. All research assistants involved in the study were trained to the method.

To capture a wide range of data, each research assistant was instructed to have different "ailments" so that assistants would be able to interact with different caregivers

and different departments during the observation process. Each research assistant was given a pre-determined “patient case file” that included instructions on when to arrive, what the “symptoms” were and how to act. Some case files gave instruction to intentionally come late to their appointment so they could capture the experience of rescheduling. Other case files included “symptoms” that would require lab tests or X-rays, intentionally causing the patient researcher to visit other areas than the general exam rooms. Patient case files used in this study are included in Appendix B for reference.

All evaluations of both receptionists and health care providers were done within a custom designed google form that was filled out by each research assistant immediately after their appointment. The google form acted as both a survey to gather simple experience data (such as transportation method to the center or whether appointments were scheduled by phone or website) and acted as an evaluation tool as it included a variety of industry standard measurement questions.

Questions in the google form evaluating the receptionists rated their behavior as they interacted with the research assistants. Categories for evaluation were selected based on criteria outlined in a performance management section of a human resources textbook used by professors in BYU’s Marriot School of Business. Some of the evaluation categories included attitude, cooperation, aggressiveness, courtesy, helpfulness. Each category was rated on a standard Behaviorally Anchored Rating Scale (BARS), which is used commonly in industry by Human Resources departments. Instructions for how to use the scale were taken from a publication by Purdue University’s business school and given to the research assistants during the initial training meeting. An adapted version of the same rating scale

(BARS) was used for evaluating the health care providers. The scale used in the evaluation was taken from an article published by the Academy to Innovate HR (McCoy, 2021) who rewrote the scale for the specific context of nurses interacting with patients. Additional questions were included in the google form to evaluate other behavior areas. The questions were taken from a Massachusetts Health Quality Partners report titled "How Does Your Doctor Compare?" (Santa, 2012), but many of them are identical to items found in the Consumer Assessment of Healthcare Providers and Systems (CAHPS) survey. These surveys are published by the government Agency for Healthcare Research and Quality (AHRQ) and are trusted metrics in the healthcare industry. The google form that research assistants filled evaluations out in contained no custom-written questions. All questions used came from one of the above-mentioned industry-standard evaluation tools.

After all patient visits were complete, google forms were filled out and data from there were collected. Data was reviewed during a debrief meeting with all the research assistants and then compiled into a PowerPoint to present to the health center's administrative team.

In May 2023 the initial findings from the google review data and in-person observations were presented to the Executive Director and his director over medical staff. The presentation was video recorded and presented to the rest of the leadership team in a later training meeting.

Shortly after the initial study, the center implemented a new intervention for collecting more accurate data from patients. The leadership team decided to hire a healthcare marketing company called "SocialClimb" to lead what a recent news article

called an “aggressive and decided media outreach to patients.” The marketing platform sends automated text messages to patients after each visit with a photo of the provider and prompts to leave feedback on multiple sites using provided URL links.

At the same time that SocialClimb was being rolled out, a new procedure for responding to negative comments on google reviews was adopted by the center. A member of the administrative team now reads through all google reviews and when a negative comment is left, a personalized response is sent to give the patient an opportunity to voice their opinion over the phone so the center can have specific feedback on what to improve.

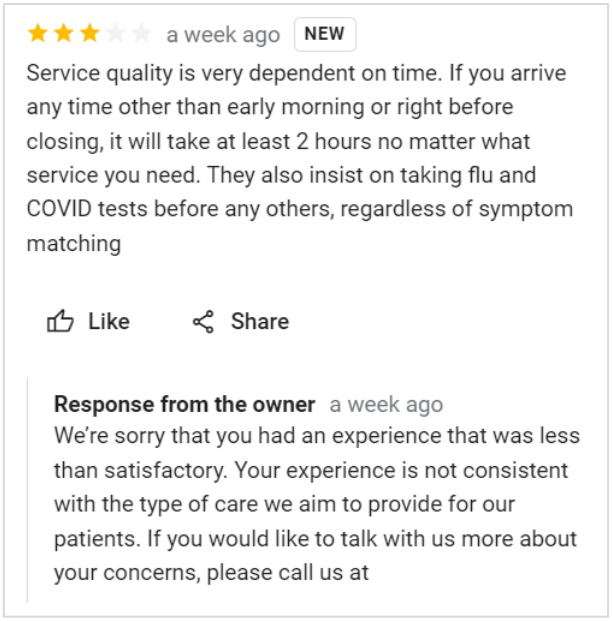


Figure 2.2 Screenshot of a recent negative google review with a response from a staff member.

Reviews that have positive comments are also responded to by a health center staff member, however the positive responses are not tracked with as much scrutiny as the negative ones and not every positive comment gets a direct response.

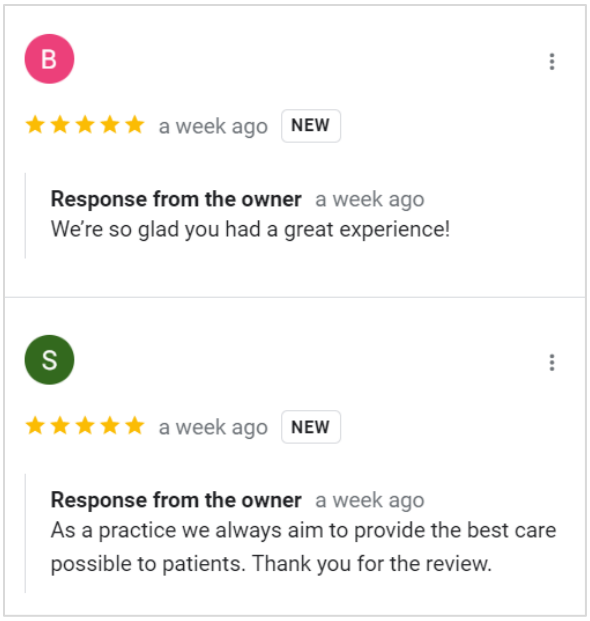


Figure 2.3 Screenshot showing two recent positive reviews and their responses.

The intervention of using SocialClimb described above was not implemented by the patient researchers who gathered the initial google review data but it is included in this report to provide context for readers on what the intervention was. Data on the impact of the introduction of Social Climb to the center's public google ratings is listed in greater detail in the results section.

Phase 2

In October 2023 Phase 2 of the research began. Phase 2 was aimed at identifying a single specific area of improvement within the broader patient experience and then make the needed changes. A second literature search was conducted at the start of Phase 2 and the information gathered in Phase 1 was used to narrow down the search. With now a greater understanding of the center's specific needs, the new focus was to find research

conducted on other ambulatory care centers that experienced similar challenges as the health center. During the search, measurements and studies done by other research teams that were relevant to the center's situation were gathered and summarized. A list of ten ideas were compiled into potential project proposal topics (included in Appendix A) and were reviewed by the faculty advisor before being submitted to the executive director for review.

In January 2024 the health center directors determined the most important area for short term improvement to them was automating appointment scheduling. The IT specialist for the center was appointed as the project liaison for this new initiative because the goal was to fully automate appointment scheduling and check in through potentially a new website or mobile app. The center has experimented with different software vendor technologies in the past but has not yet done a thorough comparison on the features they offer. In an initial meeting with the IT specialist, information gathered from prior study was collected. The number of clicks it takes for a patient to schedule an appointment online will be charted in a flow chart with each process step being represented as a new webpage landing or dialogue box that pops up prompting action on the part of the user. This will be done to understand where greater efficiencies in the scheduling process could be made.

RESULTS SECTION

Results from Phase 1 Data Collection Activities

Flow charts

Typically in flow improvement studies the final report will present flow charts from both pre and post intervention to show improvement through elimination of inefficient steps. In this study the initial flow information was gathered but no intervention to change the process was initiated due to the focus of the research being redirected towards a non-flow related project. Thus “pre” intervention flow charts are included without “post-intervention” flow charts to act as a comparison. In the place of the improved flow charts, recommendations for future improvement based on observations are included in the discussion section.

Documenting patient flow at the Health center varies depending on the patient’s reason for their visit. In this study only two visit types were documented: One was a routine physical exam and the other an urgent care visit to address a medical injury. Each flow chart lists the major steps the patient stopped at during their visit and is separated into waiting time (which is considered a non-value-added step) receiving care or interacting with providers (which is valued added).

Figure 3.1 and Figure 3.2 below both represent the experience of a single “patient” (n=1), based on notes captured in the “secret shopper” experiment and may not reflect the experience of all patients but should be used as an approximation to estimate other’s experiences.

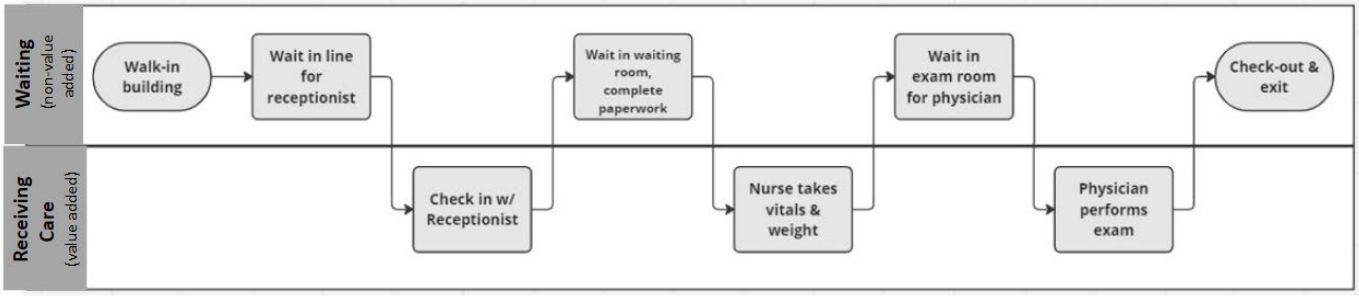


Figure 3.1 Patient flow chart for a routine physical exam visit. Patients visiting the center that may reflect this type of flow chart may include youth filling out mission papers, patients needing medical exams prior for going on study abroad trips, or patients needing physical exams for certain jobs/internships.

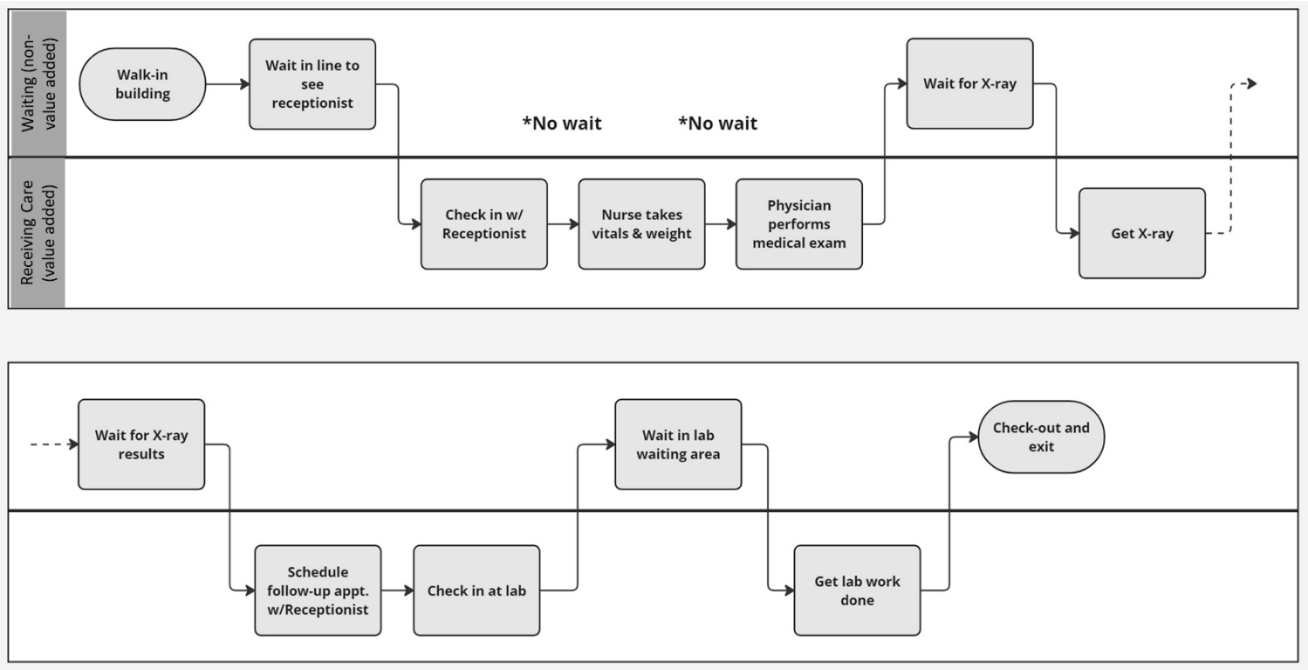


Figure 3.2 Patient flow chart for an urgent care visit where patient has an orthopedic medical injury. Note: there was no wait time in the waiting room for this one individual, but that is not representative of the average patient.

Average duration of waiting time at each of the waiting areas displayed in the flow charts is included below in Table 3.1.

Table 1

Average wait time in waiting rooms

Location	Average wait time
At main entrance, before receptionist desk	1.0-1.5 min
Lobby waiting room	<2min
Exam rooms	7min
Lab waiting area	6.5min

Time spent one-on-one with physicians (value added time) was also captured. Out of the six visits documented in the study, the average one-on-one time with the physician was 11.7 minutes during an average length 46.2 min appointment (~25% of total visit was spent with physician).

Data Collected from Google Reviews

An intervention (introduction of SocialClimb™) was implemented during the study so unlike the flow charts, both pre and post intervention data is presented in this results section.

Pre-Intervention Data

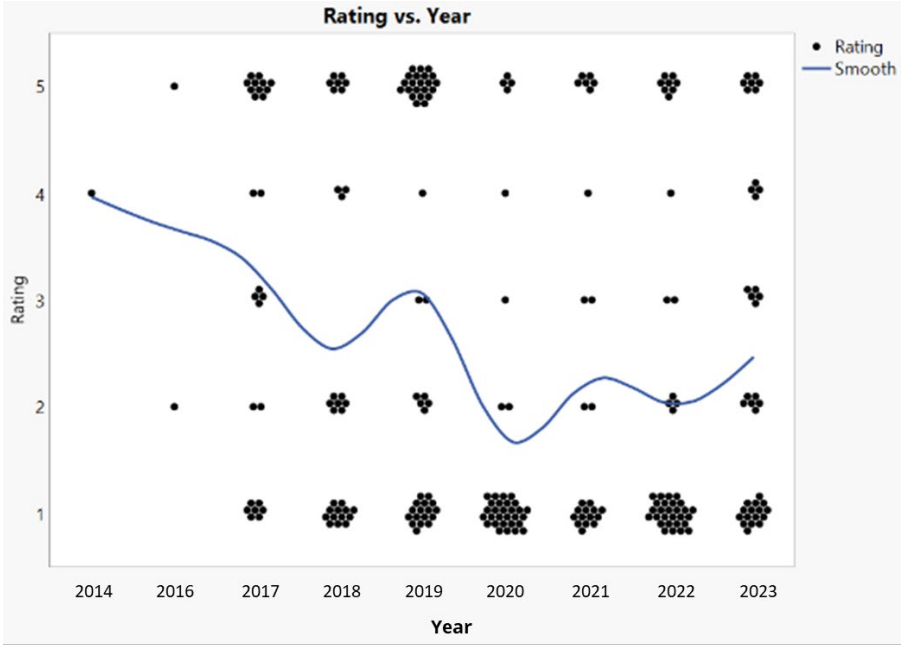


Figure 3.3 Ratings on health center google reviews by year (pre-intervention), n=276

Black dots in this scatter plot identify a single person who left a google review online. The blue line marks the average rating. The larger clusters at both the 1 and 5 ratings (y-axis)

compared to the smaller dot clusters in the middle indicate that the majority of reviewers were on the extremes. Overall google rating at the start of this study was 2.47 stars.

Table 2
Counts of complaints in google reviews by type

Type of complaint (category)	Count	% of total*
Appointment Scheduling	36	19%
Receptionist's Behavior	16	8%
Poor Quality of Medical Care	53	27%
Financial Issue (billing)	25	13%
No complaint (positive only)	64	33%

*Of the 276 google reviews, only 194 had comments attached with the rating. The remaining 82 reviews included the rated number of stars but no additional notes with it (no notes available to be coded or analyzed).

The largest category of negative complaints was "Poor Quality of Medical Care". Included among the comments were mentions of:

- Pharmacists or Pharmacy technicians giving out incorrect prescriptions and/or incorrect amount of medication in the refills
- Health care providers incorrectly filling out medical records or losing them entirely
- Unprofessional behavior and language spoken by physicians

The second largest category of negative complaints was Appointment Scheduling. Among the comments in that category included mentions of:

- Large number of appointments getting rescheduled by the health center even when patients were ready for their appointment on time
- Patients were unaware of strict tardy-cancellation policy (the center did not inform patients of it prior to enforcing it)

Hypothesis Test Results

This test was conducted to better understand the demographic of reviewers and evaluate the reliability of ratings, by looking for unusual relationships between data about the reviewer and the rating they gave the center. All calculations and graphs were done in Statistical Software JMP Pro 17.

Before running the test, a graphical summary of the data was made to check for any unusual data patterns. In both a scatter plot (bottom left) and plot of the residuals (bottom right), a single data point is higher than and far outside the main cluster of data.

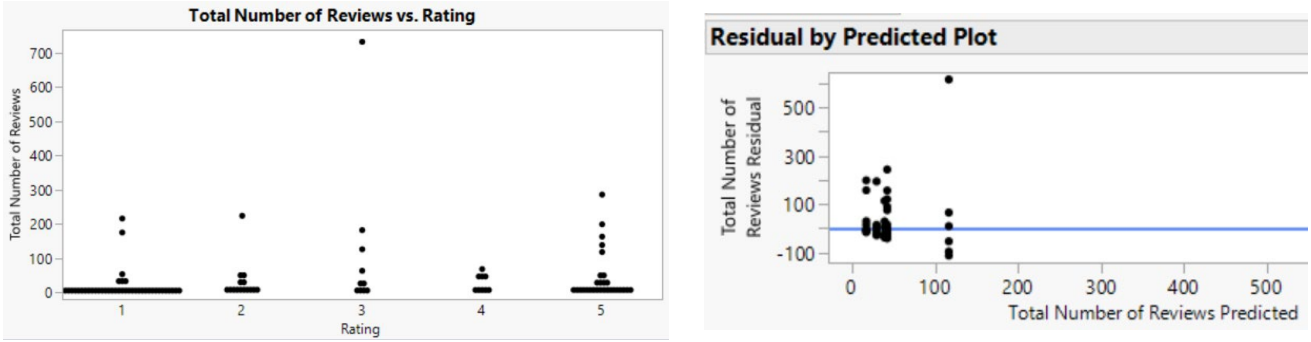


Figure 3.4 Graphical summary of data points (Scatter & Residual plots)

This data point is a potential outlier, and it was evaluated further to determine if is an influential case. The data point was an individual patient who gave a 3-star rating, but who also left 733 total google reviews at other places around town, making that person over 20 times more active online posting reviews than the average person in this data set. Cook's procedure was used to evaluate this point. A graphical summary of the Cook's procedure results are below in Figure 3.5. The Cook's distance for that data point is 1.292. Anything above a distance value of 1 (or above the red line in the graph) is considered influential, or able to significantly impact or sway the results. Since the data point

represented one individual who does not fit with the rest of the population, it was removed before proceeding with the rest of the analysis.

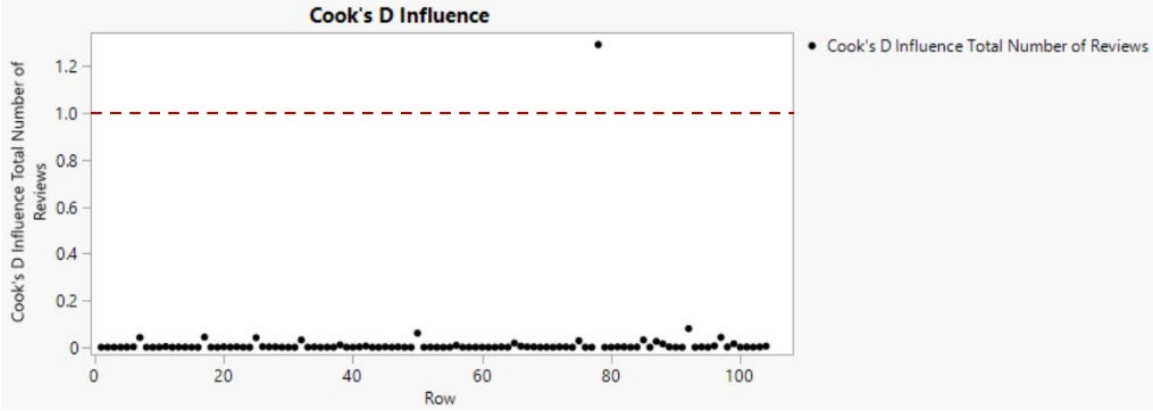


Figure 3.5 Cook's distance values for all data points

After the outlier was removed, a One-way ANOVA was run to test for difference in means of the different groups of ratings.

Oneway Anova

Summary of Fit

Rsquare	0.046791
Adj Rsquare	0.008278
Root Mean Square Error	55.41337
Mean of Response	30.98077
Observations (or Sum Wgts)	104

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Rating	4	14922.48	3730.62	1.2149	0.3093
Error	99	303993.48	3070.64		
C. Total	103	318915.96			

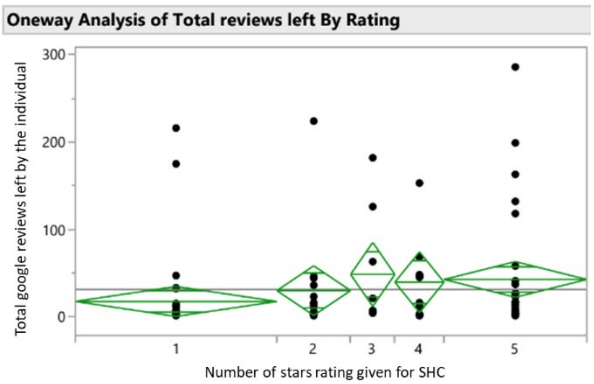


Figure 3.6 One way ANOVA hypothesis test on total google reviews left vs rating given

The One Way ANOVA has a p-value of 0.3093, indicating there is no statically significant difference between groups. This can be interpreted as a lack of significant relationship between the type of reviewer (measured by online activity reviewing rate) and reviews posted.

Post Intervention Data on Google Reviews

Two months after the introduction of SocialClimb to the health center, a news article was published describing the impact (Rust, 2023). The article reported an increase of 0.43 stars in less than two months (from 2.47 to 2.9). Additionally, the response rate increased from 3.2 reviews per month (before SocialClimb) to currently 47.3 per month (9 months after SocialClimb), which is a 1,378% increase in response rate.

At the time that this thesis was written, SocialClimb has only been in effect for nine months. During those nine months the overall rating increased by 1.33 stars.

Table 3

Google Review Summary Data

	2 Months Before SocialClimb (February 26, 2023)	9 Months After SocialClimb (February 12, 2024)
Overall Star Rating	2.47	3.9
Total Reviews	276	656

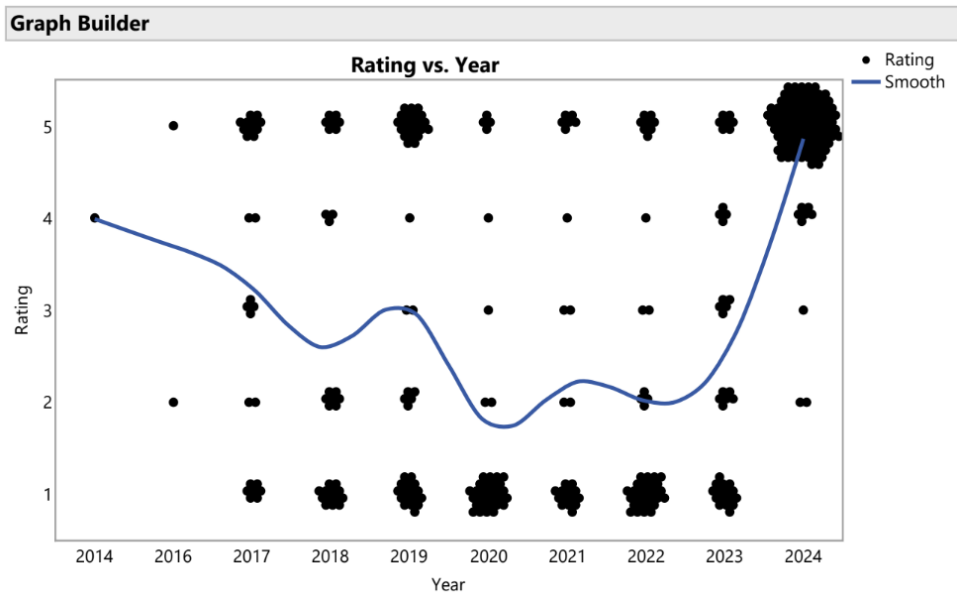
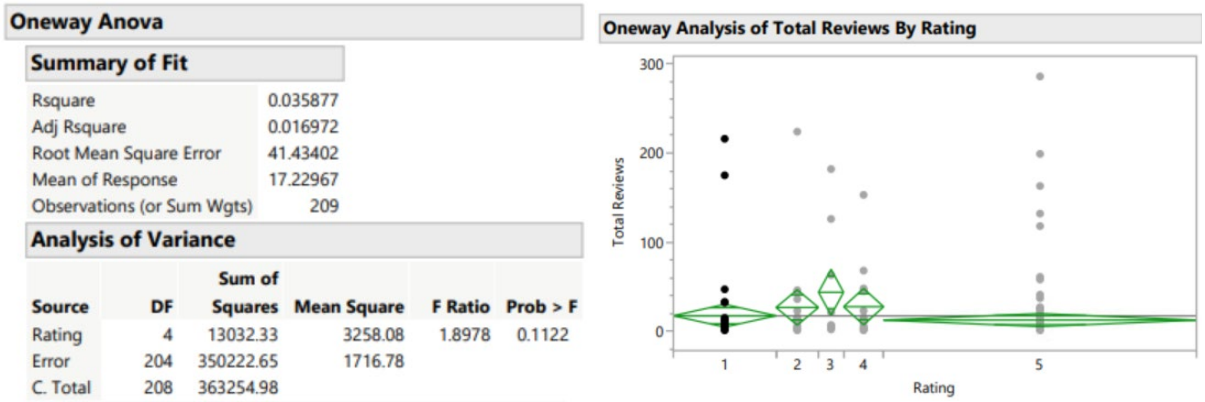


Figure 3.7 Ratings on Health center google reviews by year (post-intervention)

The year-by-year average (separate from the overall average) is tracked in Figure 3.7. In 2024 (currently two months into the year at the time this was written) the average rating is 4.87 stars. The graph shows a large cluster of black dots (individual ratings) on the 5-star rating, which is pulling the average up.

After the intervention, the hypothesis test searching for irregular relationships between the google reviewers and the ratings they left was repeated.



Oneway Anova

Summary of Fit

Rsquare	0.035877
Adj Rsquare	0.016972
Root Mean Square Error	41.43402
Mean of Response	17.22967
Observations (or Sum Wgts)	209

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Rating	4	13032.33	3258.08	1.8978	0.1122
Error	204	350222.65	1716.78		
C. Total	208	363254.98			

Figure 3.8 One-Way ANOVA test on total reviews vs rating given at post-intervention

Even with the major disproportionate increase in 5-star ratings, results from the hypothesis test indicate no evidence that the patients now leaving 5-star reviews are significantly different than the other reviewers before the intervention (p=0.1122). This is not testing if there is an increase in positive reviews, this is testing to see if the demographic of reviewers has changed (measuring how active they are on google review sites by looking at total number of reviews they post).

Before SocialClimb, patients who left reviews were 4.8 times more active on google review sites than the patients who posted reviews after (average google rating activity

decreased from 17.3 to 3.6 external reviews), however due to the large overlap in confidence intervals this difference is not statistically significant. The new demographic of patients that leave reviews are first time users of google review sites and likely would not have used the sites in general without being prompted to by the health center.

Observed Quality of Care & Employee Behavior Data

Data in this section comes from subjective evaluations performed by patient research assistants after their visits to the as "simulated patients". The sample sizes are very low (n=4) for all of these charts. Each chart uses industry standard rating scales as already described in the methods section.

Behavioral Evaluation of Receptionists

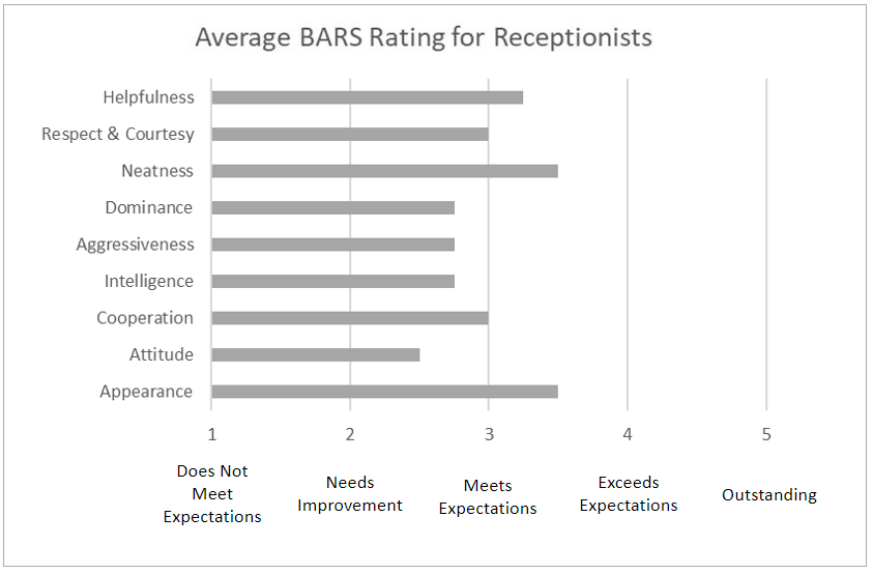


Figure 3.9 Results from Behavior Anchor Rating Scales evaluation for the receptionists.

Performance competencies (Y-axis) in this graph are part of the standard measurement tool and patient evaluators were trained on it. As a measure of inter-rater reliability, the average standard deviation in each category was 0.599 across four patient evaluators.

Behavior Evaluation of Healthcare Provider

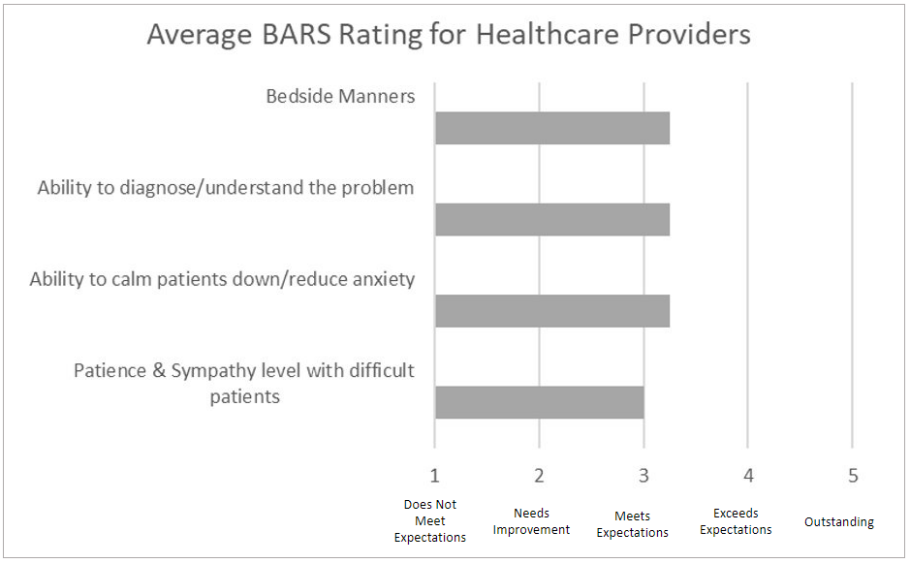


Figure 3.10 Results from Behavior Anchor Rating Scales evaluation for providers.

The ratings of providers based on the Behavior Anchor Rating Scale above were aggregated into one overall rating, so figure 3.10 does not provide any evaluation of specific providers and is more of a broad view quick summary of the experiences had by the “simulated patients”. The average standard deviation for the ratings was 0.842 across four patient evaluators.

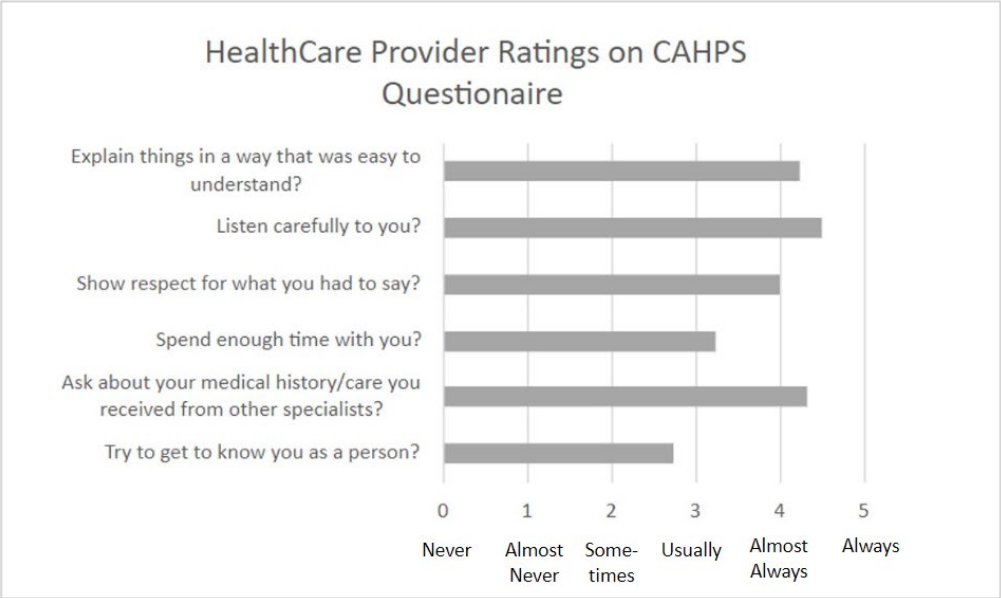


Figure 3.11 Results from selected CAHPS questionnaire items evaluating providers.

Figure 3.11 contains results from Consumer Assessment of Healthcare Providers and Systems (CAHPS) survey Version 3.1, as subjectively rated by the patient researchers. The results are an aggregate of the providers, so the results are not intended to provide a definitive evaluation on a single person. Only six questions were included in this study of the original 31 that are part of the standard questionnaire. The 25 questions not included here ask demographic or other information not relevant to the goal of this study, which was primarily focused on capturing the patient's experience/personal interactions with their providers. The standard deviation of the responses was on average 0.948 across the four evaluators.

Additional Observations

Outside of the quantitative evaluations, additional observations and notes were collected from the patient research assistants after their visits. These observations were recorded in meeting notes during a group debrief. Observations were summarized into the following:

- No post-visit documentation was provided. The patient research assistants expressed that they expected to be handed a paper or receive an electronic copy of a brief summary from the visit, as is a common practice in other health centers. One patient received a follow up phone call.
- Patients were still filling out intake forms on the clipboard the receptionists gave them by the time the doctor came into their exam room. The amount of paperwork was a pain point in the experience and patients expressed they wished it could have been done on their phones or online before coming in.
- One patient arrived 6 minutes late to their appointment due to the bus they took getting delayed by snow. The patient entered the building and waited 2 minutes in the line in front of the receptionist desk. Once at the desk, the receptionist said since the cutoff for late arrival time is 8 minutes past the scheduled appointment time, the patient needed to reschedule the appointment. The patient was not informed of the late policy prior to arriving in any text, email or in content on the scheduling site.
- Most of the patients felt “rushed” and were given “one-line responses”, although the brief responses were not described as rude.
- The patient who went to get the X-ray and do lab work (depicted in the flow chart Figure 3.2) was the only patient in the room with no line to see the lab receptionist, yet had to wait seven minutes before being allowed to check in.
- One patient described it as “Nobody asked how I was doing. It was no Chick-fil-A experience”.

- Two patients received a text message reminder for their appointment after it had happened. There was an error in the automation.

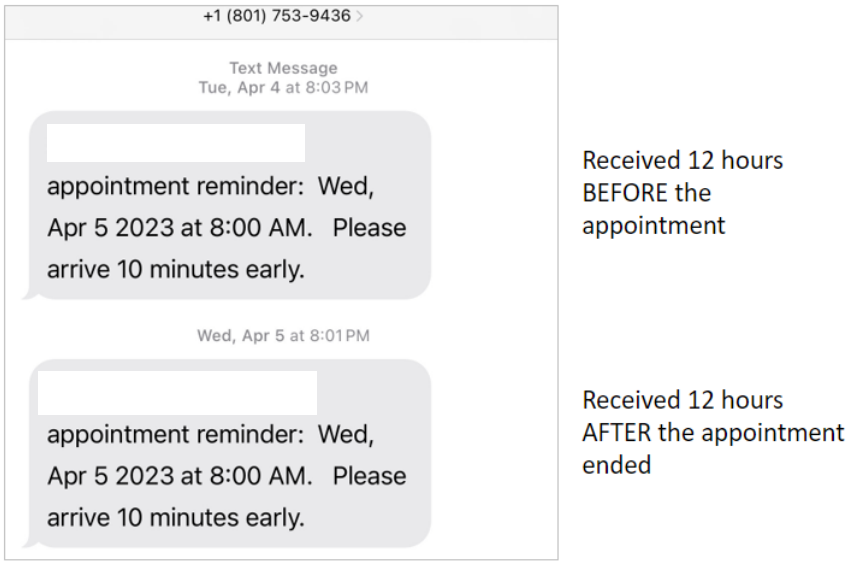


Figure 3.12 Screenshot of text messages for appointment reminders.

DISCUSSION SECTION

Discussion on Flow Charts

Very limited data was available to create the flow charts in this study. Both figures 3.1 and 3.2 (flow charts 1 and 2) only represent a single study participant, meaning that there was no replication of the experiment. However, since most patients follow a similar process of checking in at the reception desk before going to an exam room, etc, the flow chart provided should be reasonably representative of the population. The process steps may be very similar patient to patient, but the time spent at each processing step (such as those in Table 1) will vary significantly with a small data set. Factors observed that impacted wait times include: time of day—late afternoons appeared less busy than mornings, number of last-minute cancellations, number of available providers on a given day, and complexity of medical condition—causing appointments to exceed their budgeted time length. In the second flow chart (Figure 3.2), the patient was the last scheduled patient of the day, arriving 20 minutes before closing time. There is a suspected confounding variable of staff members rushing the process so they could end their work day sooner, so wait times in both the flow chart and Table 1 may not be representative of the average population. The patient described feeling rushed and mentioned being ushered past waiting rooms patients might usually stop at.

Discussion on Google Review Data

Of all the parts of this entire study, the google reviews provided the largest quantity of available data but even still it was not fully representative. In a director's meeting during

the study, the executive director mentioned there are on average 30 appointments per day at the center, yet before 2024 on average only 34 patients filled out google reviews each year. This means the google reviews include less than half of one percent of the total population. Even though the sample size was small, the comments in the reviews online included true issues that patients really did experience. Some of the negative complaints contained concerns that were quite serious that impacted patient health or imposed excessive financial burdens on them (due to overcharge billing error). The qualitative and quantitative data gathered from the google reviews is not conclusive enough to provide a definitive total evaluation of the center's performance but it includes enough information to identify true issues that can be addressed in later studies.

Most surveys will have a degree of bias, and this study attempted to understand some potential biases to the best of its ability with the limited data available. The analysis of variance hypothesis test was conducted to attempt to identify biases relating to users with a highly active online presence influencing the results, but it did not find a significant relationship between variables.

On the bottom of google reviews there is a "like" button 

. Anybody in the world with access to google can hit the "like" button which sends a notification saying: "I found this information helpful". An observation documented by one of the researchers during the study was that negative comments that highlighted unprofessional behavior of employees tended to get more "likes" by public viewers than the positive comments. The increase in "likes" on a comment increases its visibility and draws more attention to it,

which in turn creates a more negative public view of the health center. The number of likes can cause negative comments to be more weighted heavily than positive comments, and this should be considered if a very thorough analysis is ever to be done in the future on google review data. The data collected on google reviews up to this point has met the scope of the initial project charter, but further monitoring on future trends in reviews may continue to yield helpful information. The results in this report showing the increase in positive ratings with the implementation of SocialClimb are encouraging and at this time the trend is increasing daily toward a relatively exponential increase.

Discussion on Quality of Care & Employee Behavior Data

The Behavior Anchor Rating Scales and CAHPS surveys were designed to measure employee behavior and performance, and the results gathered for evaluating an individual employee may be reasonably accurate since the tools have been tested in industry. The patient research assistants were trained on how to use the scale by reading through the instruction sheet and given an explanation by an instructor that was familiar with the rating systems, but they were still not experienced evaluators. Also, the patient research assistants were not able to view every employee equally and some were distracted with the role play acting of their ailments that there may have been variability in what the patient noticed verses did not notice about their provider. Furthermore, these tools are best used when measuring a single person and rather than giving an overall average of multiple people. For the purpose of this simple exploratory study, an overall average may be considered sufficient to at least capture an estimate of whether or not the health center

should investigate employee behavior in a later study. The standard deviation in the patients' evaluations of the provider's behavior was greater (almost double) that of the standard deviation in the receptionist evaluations. This indicates there may be a wider range of behavior among providers than receptionists. There are at least quadruple the number of providers than receptionists, which might be a main factor. The patients also spent more time with the doctors and nurses, giving them more time to observe behaviors.

CONCLUSIONS AND RECOMMENDATIONS

The initial scope of the project intended to do an initial screening experiment, followed by a full experiment with implementing an intervention, and then having enough time to monitor (control) the process afterwards (thus following all of the steps of the DMAIC process). Later, the scope was reduced to just the initial exploratory observational study due to time and resource constraints. The results from the initial study provide enough information to point future researchers in a focused direction on what areas to target improvement activities in so they will have the greatest impact. This section includes a list of recommended future studies. If patients are to be involved in future projects, it is recommended that the health center leadership find patients with specific skill sets and a pre-determined time commitment. For example, if a project on improving automation for appointment scheduling is desired, an information systems patient looking for an internship to fulfill a graduation requirement could be an ideal candidate.

1. Due to the flow study on wait times having a small n-size, a larger time study should be conducted with at least 30 participants. Also, for those studies a reliable HIPAA compliant measuring method should be determined so that all wait times can be recorded accurately, legally, and ethically. For each observation, data on the time of day, number of providers on that shift that day, and number of appointment cancellations/ vacancies should accompany the process time data. By accounting for these additional potential co-variates or other lurking variables in the data collection, they can be factored out when doing the final analysis. This flow study should be done prior to and independent from any other new improvement

interventions (such as moving to online forms instead of clip boards). If the administration team wants to implement a significant change to the patient intake process, the flow study should be done before it, with a second flow study after it so that the pre-post comparison can be made.

2. The appointment scheduling process can be analyzed in greater detail. An improvement on automated text message reminders for upcoming appointments can be made by ensuring the back-end automation code does not cause messages to be sent after appointments are past.
3. Automate or at least digitize the patient intake form so that patients do not need to use a paper and clipboard in the waiting room/exam room while they are waiting to be cared for by a provider.
4. Some patients expressed interest in having access to post-visit summary notes. A future study could conduct a focus group of former patients asking them what types of information they would need to have access to after an appointment, and which method they would like it be able to access it on (health center site, scheduling app, paper copy, alternative website).
5. More surveys are being taken now, but if surveys could contain more useful information included in the standardized CAHPS surveys, they might be able to be analyzed using standardized procedures as outlined by the Agency for Healthcare Research and Quality. The results would also be able to be more easily standardized for comparison against other centers using the same CAHPS scale.

6. To increase the quality of future studies/projects, refer to the Agency for Healthcare Research and Quality site https://www.ahrq.gov/cahps/quality-improvement/index.html, which is a resource with many resources about determining sample size for improving the patient experience. Included on the site are training videos, research papers, example research questions, as well as guides on how to doing sampling, data collection and analysis on CAHPS surveys.
7. **See Appendix A for a more detailed list of proposed future project ideas.

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Appendix A

(This document was originally presented to the Executive Director after Phase 1 activities were complete, so a project for Phase 2 could be selected from this list. It is included here for reference.)

Potential Improvement/Research Projects

Ideas based on studies done in published research articles found/collected by Marshall Butler

1. **Overall Flow Study**
   a. Patient flow Patient flow: Door to doctor, mean wait time
   b. Healthcare provider flow: Doctor to Discharge time
2. **Specific task study**
   a. Benchmark the health center's metrics against other medical centers in the industry
      Visit Revere Health/IHC or other similar facilities and gather metrics such as number FTE's per physician or number of staff/nurses per physician, and then compare those to the center
   b. Appointment scheduling
      Data on number of appointments missed or rescheduled, Focus group Interviews, evaluate UI design (number of clicks to schedule), training for receptionists, Patient survey on reasons late, patient experience survey & total the number of complaints about appointment problems
   c. Financial/Payment study
      Data on mean time from discharge to when patient receives the bill & number of payment issues, Focus group Interviews, evaluate UI on website, patient experience survey
   d. Auxiliary Department Experience: Lab Results/Pharmacy
      Data on mean time to fill a prescription/get lab results, patient experience survey
   e. Medical records
      Data on amount of time from appointment end until records available, Evaluate UI design (for healthcare provider interface, & for patient interface), evaluate patient views on accessibility of records
   f. Physician – Patient Relationship
      Compare current performance & employee training to research-proven best practices from published studies
3. **Overall Patient Experience**
   Take current survey results and recode them as a CAHPS survey format so it can be compared to performance in other ambulatory centers. Use published studies to identify a standard procedure that has proven to improve other hospitals.
4. **Patient Expectations Study**
   Collect information on patient expectations (lots of research already done on this, just not for the local patient population)

Appendix B – Fake Patient Case Files

Instructions:

If we want to be fake patients, we will need fake symptoms so the employees there will not immediately detect we are fake and be skeptical if our stories don't make sense.

We might want a doctor to look over these and make sure they are correct and that they approve of this idea before moving forward.

<table>
<tr><td>(#1) Your name:</td><td></td></tr>
<tr><td>Illness: (the doctor should figure this out without you explicitly saying it)</td><td>Concussion (but don't tell them that. Just say you got in an injury from snowboarding like you had a hard fall)</td></tr>
<tr><td>Symptoms:</td><td>Concussion Signs Observed
• Can't recall events prior to or after a hit or fall.
• Appears dazed or stunned.
• Forgets an instruction, is confused about an assignment or position, or is unsure of the game, score, or opponent.
• Moves clumsily.
• Answers questions slowly.
• Loses consciousness (even briefly).
• Shows mood, behavior, or personality changes.

Concussion Symptoms Reported
• Headache or "pressure" in head.
• Nausea or vomiting.
• Balance problems or dizziness, or double or blurry vision.
• Bothered by light or noise.
• Feeling sluggish, hazy, foggy, or groggy.
• Confusion, or concentration or memory problems.
• Just not "feeling right," or "feeling down".</td></tr>
<tr><td>How to act:</td><td>When you walk in the clinic, maybe walk in slowly? Act dizzy slightly, but don't fall over or anything too crazy.</td></tr>
<tr><td>Extra info:</td><td>Come exactly 12 minutes late. That way we can test if they try to cancel your appointment. If they ask why you are late just say you got caught in traffic or something. If they make you sit to wait, start a stopwatch on your phone and record how long the wait was.

Just a heads up, The doctor should ask detailed questions about your injury, and then he or she may perform a neurological examination. This evaluation may include checking your:</td></tr>
</table>

	• Vision • Hearing • Strength and sensation • Balance • Coordination • Reflexes For more info see this website

(#2) Your name: Spencer Hawes	
Illness: (the doctor should figure this out without you explicitly saying it)	Injured/painful shoulder
Symptoms:	• Pain • arm/shoulder is stiff, you don't want to move it • Weakness in arm • Inability to rotate or raise arm through normal range of movement
How to act:	Have a story about a recent injury/surgery ready so they understand why you have the pain. You don't have to walk weird or talk differently. Maybe remember to wince/complain when they touch your shoulder. You could also try to ask them not to touch it too much since it "hurts".
Extra info:	Come exactly 10 minutes early. See what they do if you come early. If they make you sit to wait, start a stopwatch on your phone and record how long the wait was.

(#3) Your name:	
Illness: (the doctor should figure this out without you explicitly saying it)	Diarrhea
Symptoms:	The main symptom of diarrhea is passing loose, watery stools three or more times a day.

	People with diarrhea may also have one or more of the following symptoms: • an urgent need to use the bathroom • cramping • loss of control of bowel movements • nausea • pain in the abdomen People with diarrhea caused by some infections may also have one or more of the following symptoms: • bloody stools • fever and chills • light-headedness and dizziness • vomiting Diarrhea may cause dehydration and malabsorption.
How to act:	Act pretty normal, but don't smile a ton or be overly friendly cause you still have to act sick. Be ready to answer questions about your symptoms.
Extra info:	Come in exactly on time for your appointment. If they make you sit to wait, start a stopwatch on your phone and record how long the wait was. There are many causes for Dirrhea and some are short term (like food poisioning) and others are long term (like having a chronic illness like Irritable Bowel Syndrome or by having a food allergy/celiacs disease (gluten free)). I suggest making up a story and going with it. Like maybe if you choose the food poisioning one then come up with specific foods you ate like undercooked chicken or expired mayonnaise). If you choose the chronic illness/allergy one, make up a story about how the dirrhea has persisted for months or even years. Then explain why you haven't come in sooner than now.

Patient #4

- Issue: Nerve pain in right arm
    - Feels tense at times (particularly in the morning)
    - Sometimes is very sensitive to the touch

Appendix C – Original Project Charter

<table>
<tr><td colspan="3">Project name: Health Center Patient Process</td></tr>
<tr><td>Project description:</td><td colspan="2">Document pain points in the patient experience and highlight areas for future improvement for increased flow in the overall health center patient intake process.</td></tr>
<tr><td>Project objectives:</td><td colspan="2">• Document the entire process from scheduling the appointment to patient receiving treatment/leaving the center
  ○ Identify inefficiencies in the process and identify which ones should be prioritized for improvement first
• Collect information on and summarize high-level pain points that detract from the patient experience
• Identify specific actions the health center can take to eventually make their mission statement/ goal achieved</td></tr>
<tr><td>Project is considered successful when:</td><td colspan="2">Success is identifying deficiencies and determining which would be the highest yield for the health department to improve on.</td></tr>
<tr><td rowspan="2">Project participants:</td><td>Title:</td><td>Name:</td></tr>
<tr><td>Professor
Patient Researcher
Patient Researcher
Patient Researcher
Patient Researcher
Patient Researcher</td><td>Dr. Berrett
John Bennion
Marshall Butler
Spencer Hawes
Jameston Millar
Tavia Harding</td></tr>
<tr><td>Resources we will need access to in order to be successful:</td><td colspan="2">• HIPPA training
• People from the Health Center Leadership Team and a regular recurring meeting time scheduled (Need regular collaboration with leaders so we can maintain alignment between our research and the organization’s goals)
• Access to several rooms in the building (to observe)
• Data from the patient online booking site
• Data from the front desk (number of patients coming in and out, wait times, etc. No personal health information will be collected).</td></tr>
</table>

<table>
<tr><td></td><td colspan="3">Data on number of employees (patient to physician ratio, ratio of number of receptionists to number of incoming patients).
Data for back end metrics (Were there any issues with the billing process? Did patients receive necessary medical reports from the visit in a reasonable time frame after the visit?)
Data on business outcomes (Revenue, costs, etc. One of the emails mentioned an interest in improving revenue. Is this still a goal?)
Permission to speak with physicians/medical staff on their experience and info about day to day tasks
Permission to create a qualtrics (or equivalent) survey to collect feedback from patients</td></tr>
<tr><td rowspan="2">Milestones:</td><td>Status:</td><td>Due:</td><td>Deadline:</td></tr>
<tr><td>TBD</td><td></td><td></td></tr>
<tr><td>Potential risks:</td><td colspan="3">Suspected HIPPA violation, we slow down the process for patients (as we collect data on site we may get in the way of the patient intake process)</td></tr>
<tr><td rowspan="2">Approval:</td><td colspan="2">Title and name:</td><td>Date:</td></tr>
<tr><td colspan="2"></td><td></td></tr>
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