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Reducing Patient wait time in outpatient settings: A lean six sigma approach

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ABSTRACT

Purpose:

The purpose of the study is to decrease patient wait time in a geriatric outpatient seating using Lean Six Sigma Approach.

Design/Methodology/Approach

The research and improvement project discussed in the paper uses LSS DMAIC (Define-Measure-Analyze-Control) approach in an outpatient setting in United States that provides care to older population

Findings:

The study describes how streaming the process and applying lean six sigma concepts improve the average wait time by 10 minutes and improves the patient flow in clinical setting. The decrease in wait-time was statistically significant adding to operational efficiency, better patient flow and higher patient and employee satisfaction.

Keywords: Six Sigma, Lean, Wait-time, Healthcare, Process Improvement

BACKGROUND

The Center for Geriatrics-UNT health is a trusted resource in the community that provides clinical services, research, and educational programs from the past 29 years. The department consists of 28 interprofessional faculty and thirty interprofessional staff including geriatricians, nurse practitioners, physical therapists, neurologists, social workers, and psychiatrists. UNT Health is a teaching facility where the medical students, residents, fellows, and relative healthcare professionals complete their clinical rotations and training. This study was
conducted in one of the two clinics of the geriatric department that serves over 100 patients in a week who are 65 years or older. Define-Measure-Analyze-Improve-Control (DMAIC)
technique, a core methodology of lean six sigma was used to create improvements in the patient wait-times that do not meet patient expectations. The define, measure, and analyze phase have already been done with the actual data, however the improve and control phases are still in progress. The paper discusses all the five stages of DMAIC in detail.

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DISCUSSION

One of Lean Six Sigma's core methodology is DMAIC Define-Measure-Analyze-Improve and Control that is widely used to improve an existing process that does not meet customer or stakeholder specifications (Habidin,& Yusof, 2012; Habidin et al.,2012) DMAIC process relies heavily on statistical analysis of actual collected data. This article will discuss the DMAIC stages that reduced the patient wait time by 10 min

1. Define phase

Identifying the project

To select the most reasonable project, an informational interview was conducted with the stakeholders—frontline staff, customers, and the Director of Operations. The leadership was concerned about the adverse effect of increased wait-times on patient satisfaction scores and the customers wanted to reduce their long wait-time in the clinic. On the day of our team meeting, a patient was also seen leaving the exam room without receiving the care and complaining about the delay in his care. The problem of wait time in the geriatric clinic is longstanding, of a manageable level, and has great potential to enhance patient satisfaction. In order to enhance service excellence to the patients, it is imperative to reduce the patient wait-times that affect the patient-physician relationship and the patient perception of quality of care (Bleustein et al., 2014)

Problem Statement and the Goal

The Problem: On specific days, the average total waiting time for a patient visit is too long (40 min). Consequently, leading to internal work pressure and patient dissatisfaction

The Goal: Reduction of the average total waiting time to 30 minutes in order to meet the expectations of the stakeholders and improve the patient flow by July 2018.

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PROJECT TEAM CHARTER

Project Team Charter	
Project Start Date: 02/20/2018	Project End Date: 07/15/2018
Project Location: Fort Worth, TX	
Business Case: Medicare is the major payor of the health services provided by the geriatric clinic. 2% of the Medicare reimbursements depends on the patient satisfaction scores that are strongly linked to patient wait-times (Bleustein et al., 2014)	
Problem Statement: On specific days, the average total waiting time for a patient visit is too long (40 min). Consequently, leading to internal work pressure and patient dissatisfaction	
Project Goal: Reduction of the average total waiting time to 30 minutes in order to meet the expectations of the stakeholders and improve the patient flow by May 2018.	
Project Scope: The patient wait time is calculated as the total time the patient waits to see his/her assigned provider. The time recording begins when the patients check in at the front desk and stops when he/she checks out and takes the next the next appointment.The project scope is limited to the physical boundaries of the clinic and any care/testing/imaging performed outside the clinic is outside the scope of the project.	
Team Members: Five 1- Consultant 1- Medical Assistant 1- Clinical Supervisor 1- Front desk representative 1- Director of Operations	
Constraints/Assumptions: Constraints: 1) Project duration is short and requires further validation studies. 2)Provider to provider wait times comparison was not established due to limited data and different provider schedules 3)The study considered only the patient perspective; the movement of the provider was not tracked. The team relied on their understanding of the process from the provider perspective. Assumptions: 1) Once the assigned provider enters the vital sign/exam room, there is no patient wait-time. 2) The assigned providers put the correct flags on the exam room to indicate who is treating	
Project Milestones:	
Define phase	02/23/2018-02/27/201
Measure phase	02/27/2018-03/15/201
Analyze phase	03/15/2018-03/30/201
Improve phase	03/30/2018-05/15/201
Control phase	05/15/2018-07/15/201

Voice of Customers (VOC)

To estimate the desired upper specification limit for the process and the desired mean of the patient wait-times, a random voice of customer survey of 35 patients was conducted. Information on Critical to Quality (CTQ) factors was also collected from already available survey responses. Furthermore, interviews were conducted with the business manager and other care providers to learn what they think should be the threshold of the waiting time for a 20-minute physician appointment. After a thorough evaluation of the responses, the team decided to target for 30 minutes as the average total waiting time and 45 minutes as the upper specification limit.

Quality Function Deployment (QFD)

To make the qualitative data collected through VOC into measurable quantitative data, a QFD tool is used. Figure 1 demonstrates the patient's QFD created using TripTych. Clearly, waiting time has received the highest grade in QFD (Absolute adjusted completeness score of 285 and relative adjusted completeness of 48%), implying that it has the highest priority for the patients. Similarly, in "How's" column, physician consultation has received the highest importance followed by NextGen/Electronic Medical Record tracking and routine patient satisfaction surveys. The major findings from the house of quality are summarized in Table 1.

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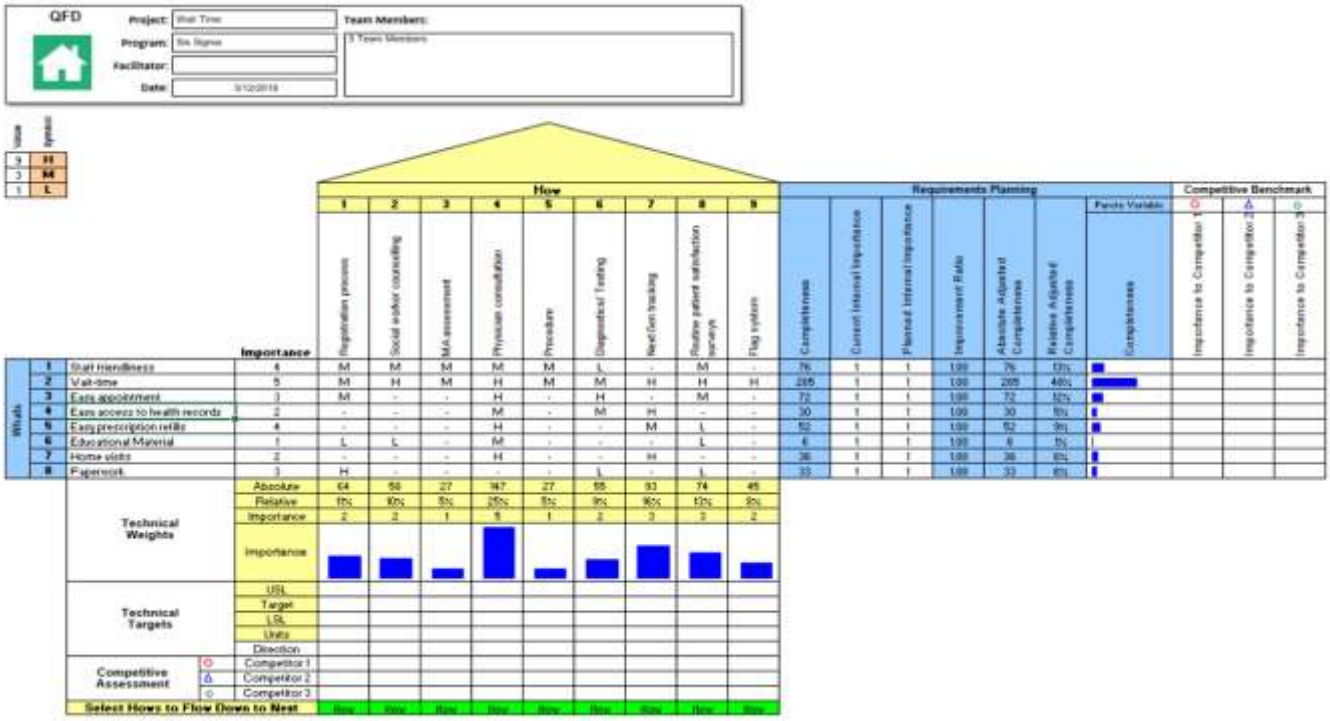

Figure 1. Quality Function Deployment- House of Quality

(Mandahawi et al., 2010)

4

Customer needs	Drivers	CTQs	Internal metrics
Less waiting-time	- Time spent in vital sign room, exam room and lobby - Paperwork is done prior to the visit	- Consultation time with the provider - Standard treatment procedure required by the patient - Customer service skills of the staff - Reduction in unnecessary visits	- Electronic Medical Record Time tracking - Routine patient satisfaction surveys

Table 1. Critical to Quality (CTQ's)
(Faiomy& Shabana, 2012)

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PROCESS MAP

To better understand how the current process operates in the Center for Geriatrics, a process map was also produced by the team (Figure 2).

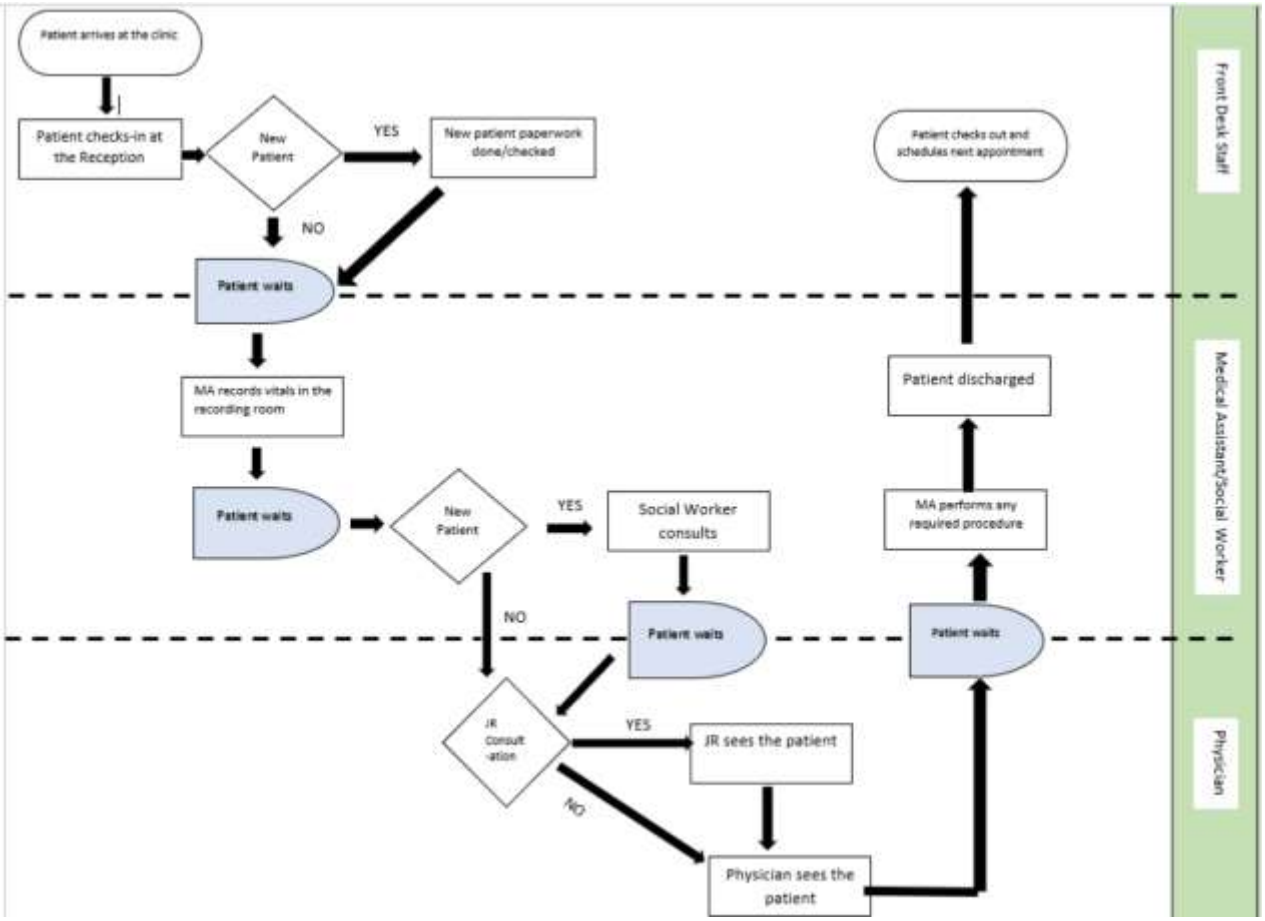

Figure 2: Center for Geriatrics Process Flow Chart (Appendix B)

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2. Measure Phase

NextGen (Electronic Media Record) installed in the clinic allows the tracking of patient wait-times. However, it was found that the technology was never used for tracking. Hence, the observer collected the data through direct observation by following the patients during their entire visit. Data was collected using the time observation form provided in table 2.

Time Observation Form												
Observer:											Date:	
Pt no.	Appt time	Check-in	MA in	MA out	SW in	SW out	JR in	JR out	Phy in	Phy out	MA in	MA out
1												
2												
3												
4												
5												

Table 2. Time Observation Form

During the observation period, it came to notice that the problem of waiting time was significant only during the specific days i.e. Tuesday, Wednesday, and Thursday. Hence the goal was revised to target only those rush hours of the week. Two to three providers usually work during these days along with the rotation of pharmacy and osteopathic medicine students. Additionally, three social workers are also available in the clinic to provide consultation to the new and annual exam patients. Some of the established patients are often referred to the social worker by the physician.

A random sample of 34 patients was measured over a period 15-days. The measured mean time was 40.4 minutes and the standard deviation was 18.9 minutes. The total wait time was calculated by subtracting the time when the next assigned provider enters the room from the time the previous provider leaves the room. Figure 3 shows the distribution of wait-times of 34 patients. The effect of patients arriving too early or too late for their appointment on the wait-times was also considered. Patients arriving within five minutes (before or after) of their appointment time were regarded on-time (Choi, Cook, & Moore, 2010). Figure 4 shows the number of patients who arrived on-time, before time and after time.

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Figure 3. Wait-time distribution of the patients

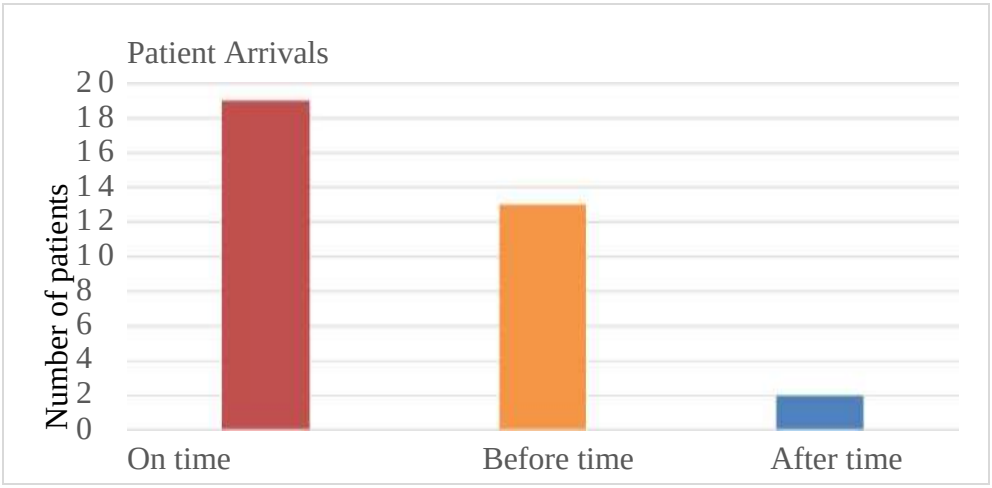

Figure 4. Number of Patients arriving on-time, before-time, and after-time of their appointment

Process Capability

Capability analysis of the current process reveals that the current process has high variation and is likely not centered. Cp value of the process is 0.04 which implying that the process is spread beyond the specification. Cpk value of the process is 0.08 indicating that the current process is incapable. It is approximately 0.20 sigma level process and has a DPMO (Defects Per Million Opportunities) of 903,199 (approx.)

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3. Analyze phase

All the critical factors embedded in the clinical process that can impact waiting time were identified with the help of a cause and effect diagram (Figure 5). Each specific cause was explored to identify specific 'causes of a cause'. The team continued updating the cause and effect diagram as more and more data was collected. The cause and effect diagram laid the foundation for the team to come up with various test theories and ascertain the step in the process that cause the most delays. Our team decided that once that step is identified, we will come back to the cause and effect diagram to ensure that our recommendations for the change align with the identified causes.

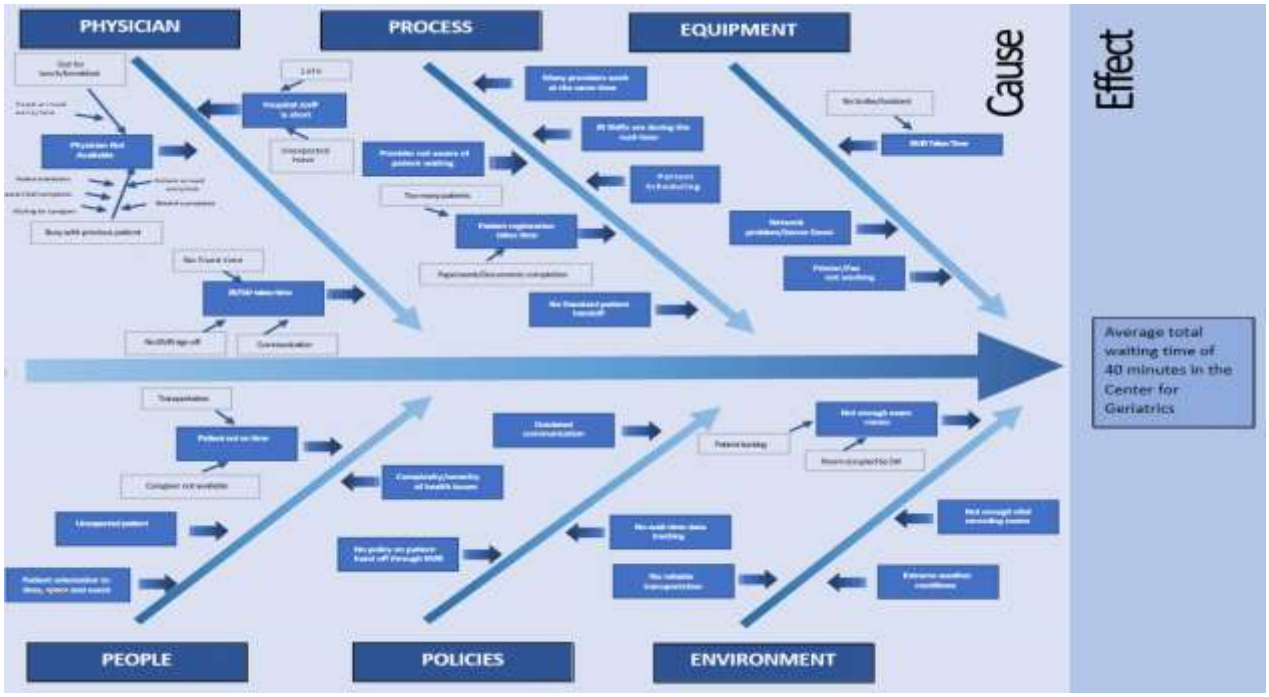

Figure 5. Cause and Effect Diagram (Appendix C)

Test Theories:

1. The major reason for long wait-time is because the patients are not arriving at the time of appointment (Appointment time minus check-in time)
2. The major reason for long wait-time is the wait for the vitals recording (MA Delay1)

3. The major reason for long wait-time is the wait for the social worker consultation (SW Delay)
4. The major reason for long wait-time is the wait for the junior resident consultation (JR Delay)
5. The major reason for long wait-time is the wait for the physician consultation (Physician Delay)
6. The major reason for long wait-time is the wait for the discharge process (MA Delay2)

To find if there is an association between the continuous variables (wait-times) the data was analyzed using correlation and regression analysis in Microsoft Excel 2016. Scatter diagram was used to graphically display and explore the associations between the variables.

Test theory 1- Correlation: Total waiting time; difference in patient check-in and appointment time

Pearson correlation coefficient of total waiting time and difference in patient check-in and appointment time is 0.2669 (Figure 6)

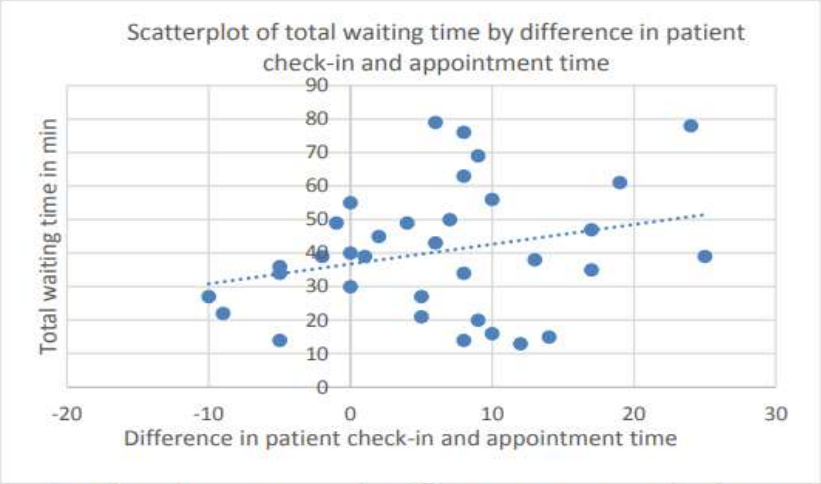

Figure 6. Scatterplot of total waiting time by difference in patient check-in and appointment time

Test theory 2- Correlation: Total waiting time; waiting time for the vital recording (MA delay 1)

Pearson correlation coefficient of total waiting time and waiting time for the vital recording is 0.5704 (Figure 7)

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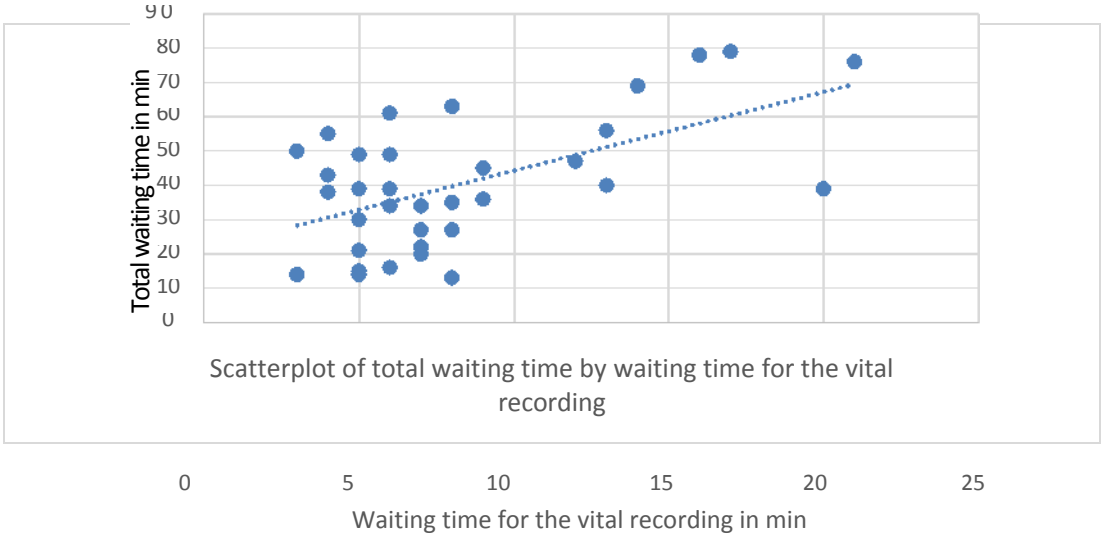
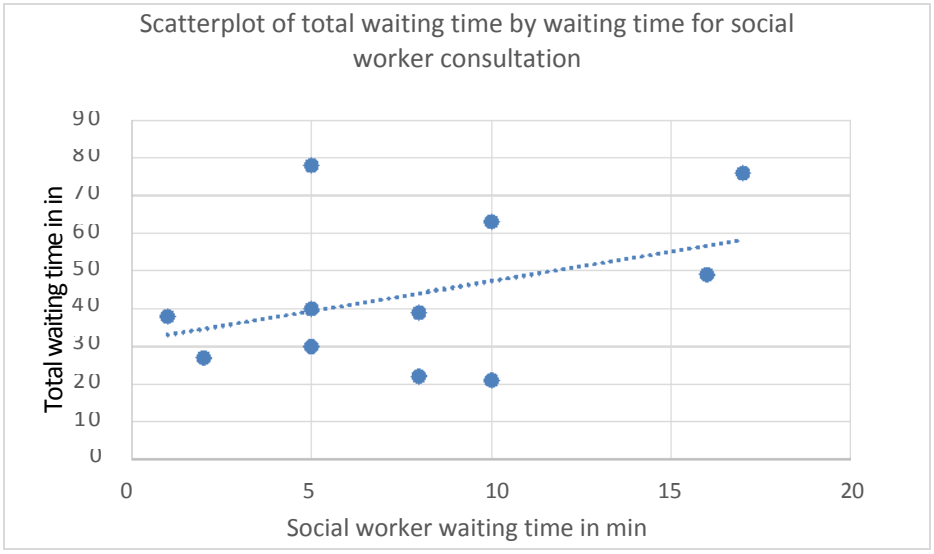


Figure 7.
Scatterplot of total waiting time by waiting time for the vital recording

Test theory 3- Correlation: Total waiting time; waiting time for social worker consultation (SW



delay)
Pearson correlation coefficient of total waiting time and waiting time for social worker consultation is 0.2459 (Figure 8)

Figure 8. Scatterplot of total waiting time by waiting time for social worker consultation

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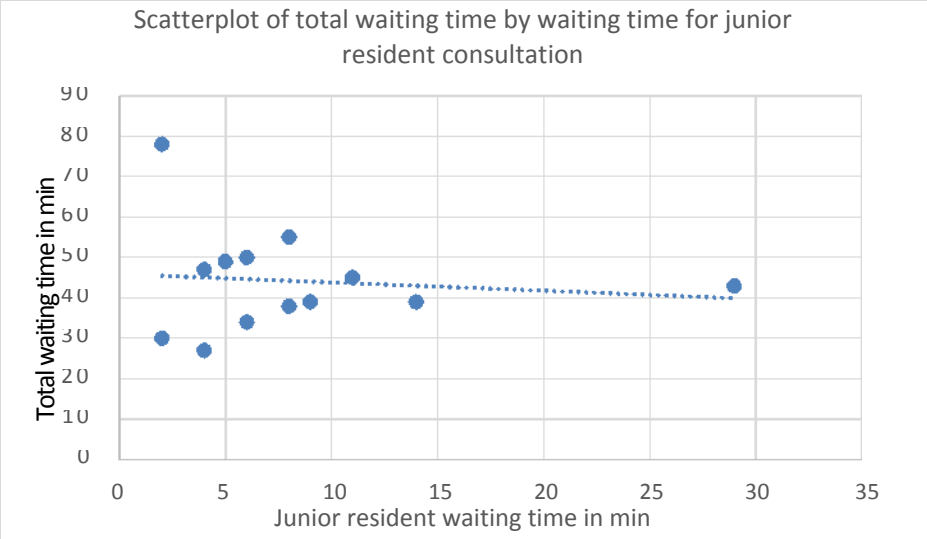
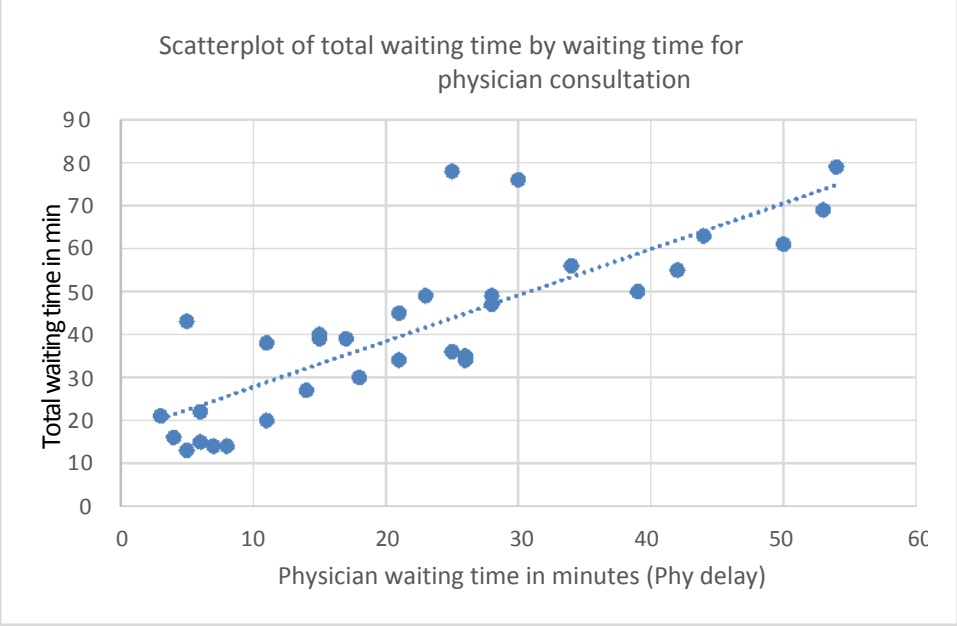
Test theory 4- Correlation: Total waiting time; waiting time for junior resident consultation (JR delay)
Pearson correlation coefficient of total waiting time and waiting time for junior resident consultation is



0.0763 (Figure 9)
Figure 9. Scatterplot of total waiting time by waiting time for junior resident consultation
Test theory 5- Correlation: Total waiting time; waiting time for physician consultation (Phy delay)
Pearson correlation coefficient of total waiting time and waiting time for physician consultation is 0.8239 (Figure 10)
Figure 10. Scatterplot of total waiting time by waiting for physician consultation

Test theory 6- Correlation: Total waiting time; waiting time for the discharge process Pearson



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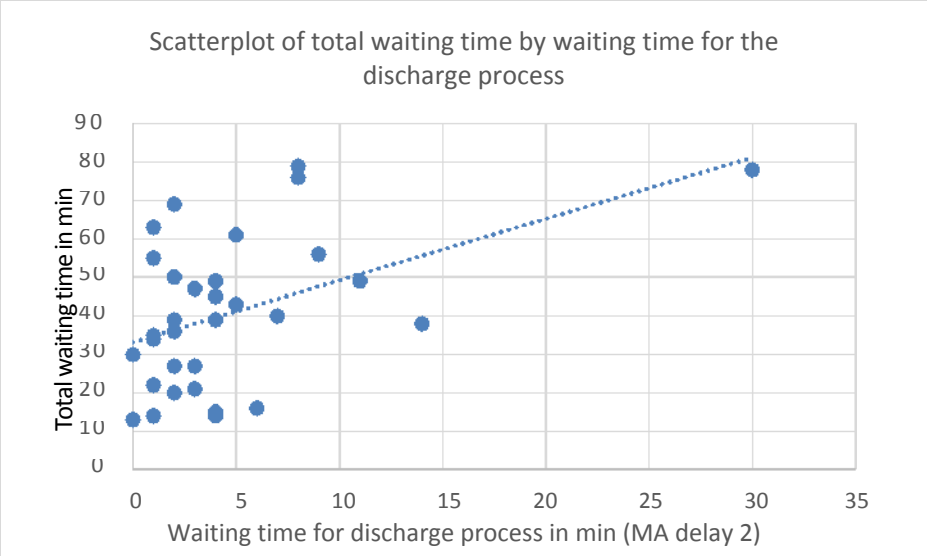
correlation coefficient of total waiting time and waiting time for discharge process is 0.4685 (Figure



11)

Figure 11. Scatterplot of total waiting time by waiting time for the discharge process

From the above graphs and analysis, we found a high positive correlation between the total waiting time and waiting time for physician consultation. To further assess the nature of the relationship that exists between variables, a regression analysis was run for the independent variables (Figure 12 and Appendix A).

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.823911
R Square	0.67883
Adjusted R Square	0.668793
Standard Error	10.89094
Observations	34

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	8022.42918	8022.43	67.6356	2.148E-09
Residual	32	3795.60023	118.613		
Total	33	11818.0294			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Upper 95.0%*
Intercept	17.03494	3.39823382	5.01288	1.9E-05	10.112963	23.9569	10.113	23.95691453
Phy delay	1.068388	0.12990958	8.22409	2.1E-09	0.8037706	1.333	0.80377	1.333004889

Figure 12. Regression Statistics (Dependent variable- physician delay, independent variable: total wait-time)

Figure 12 shows the regression output for the total wait -times and physician wait-time. R square value of 0.678, indicates that 67.8% of the variation in total wait time can be explained by the physician wait times. Furthermore, a p value of far less than 0.05, helped conclude that there is a strong relationship between total wait time and physician waiting time. Data analysis also revealed that the time of arrival had no significant association with the total time a patient had to wait.

Moving to the improve step, our efforts will target and address the issues that lead to increased wait-times for physician consultation.

4. Improve phase

After the analyze phase, personal interviews were conducted with the staff to learn if there are any suggestions they would like to give for the causes of the physician delay. On careful consideration, the team agreed upon submitting the following recommendations to the senior management:

a. Anticipating the length of the actual consultation.

The scheduled twenty-minute appointment of the established patients usually takes more than the actual time. This is mainly because of the two reasons. First, some patients have complex health needs and more than one chief complaint. In such case, it will be helpful if the recently established call center that gives appointment reminder before the visit can briefly ask the patient about the reason for the visit. Predicted variations in a predetermined manner can be better managed rather than simply waiting and reacting to it (Murray, n.d.) Second, rotations of the junior residents coincide with the rush hours. This additional step comes with an added waiting and increased patient turnaround time. More providers work during this time (limited exam rooms) and have additional teaching duties towards the residents. The junior resident consultation is an extra time which is not included in the twenty-minute appointment and leads to a patient backlog because physicians are obligated to give them enough time and discuss the patient diagnosis with them. To enhance the patient experience, and continue the teaching goals, it is recommended that the resident rosters should be adjusted according to the anticipated patient volume.

b. Social worker consultation should take place before the medical assistant checks the vitals.

Social workers provide counseling and education on disease management and can even make a referral for other services needed by the patient. Social workers were often seen at the documentation center in the hallway or near physician offices. It was recommended that for new patients and annual exam visits, the social worker should provide education and counseling to the patient when they are waiting in the lobby area for the medical assistant. By doing this, we will be able to have more exam rooms available during the rush hours.

Thephysician will not have to wait to see the next patient because the exam room is occupied by the social worker and the patient. This will prevent building any backlog of the patients. Additionally, when the education is provided in the lobby patients will feel that are utilizing their time and not waiting for the provider. Eliminating a step happening in the exam room will reduce the associated waiting time and efficiently utilize the other waiting time in the lobby.

c. **Applying the queuing theory**

An area of improvement was identified in appointment scheduling. It was found that the Center for Geriatrics has different appointment types for new, established, and annual exam visits for which the time-slots are already reserved. Waiting time problem is aggravated when the patient for a 20-minute appointment can be adjusted in the open 40-minute slot during the non-rush hours but the front desk is trying to put them into a particular pigeonhole (Murray, n.d.). Applying the queuing theory will allow for "load-leveling" and not allowing the queue to form at the first place and reduce the demand (Murray, n.d.).

d. Enforce and create policies that increase the compliance with a standard communication plan

Some delays in providing care were because the provider was unaware that the patient is waiting. This problem can be minimized by using the existing technology of electronic medical record that enables the provider to sign off and change the patient status to "Waiting for the social worker/physician/nurse". The system creates a notification to the designated provider and also has the ability to track the patient and report their waiting time. Enforcing the policy to sign off on the EMR will make the providers accountable, serve as an effective communication system, and help the senior management to continuously monitor their wait-times. Furthermore, if the provider is running late on his schedule by 1.5-2 hours, having a policy to call the patient upfront about the delay can alleviate their frustration.

Pilot testing- Before adopting the recommendations at a full swing, our team has planned to run a small pilot that could prove the effectiveness of the proposed changes. The proposed changes will be tested for a week by a team of providers starting 9th of April to 15th of April 2018 and the wait-time data will be analyzed.

5. Control phase

clinical processes and culture. Designing an effective feedback loop is in progress (Figure 13). The improved process was checked with the help of control charts (Figure 14 and Figure 15) to ensure that the required standards and customer expectations are met. Statistical process control was effectively used to identify any unusual variation in the process from a common cause variation. The process owner monitored the charts to identify any special causes or trends in the data. For any discrepancy found, a corrective action was taken for controlling the process. The control limits for the process will fulfill the requirements of the stakeholders (patient, provider, management). The results of the control phase were be documented clearly, and audits will be performed quarterly, monthly and yearly. Opening feedback will be promoted to obtain buy-in from all the employees of the clinic.

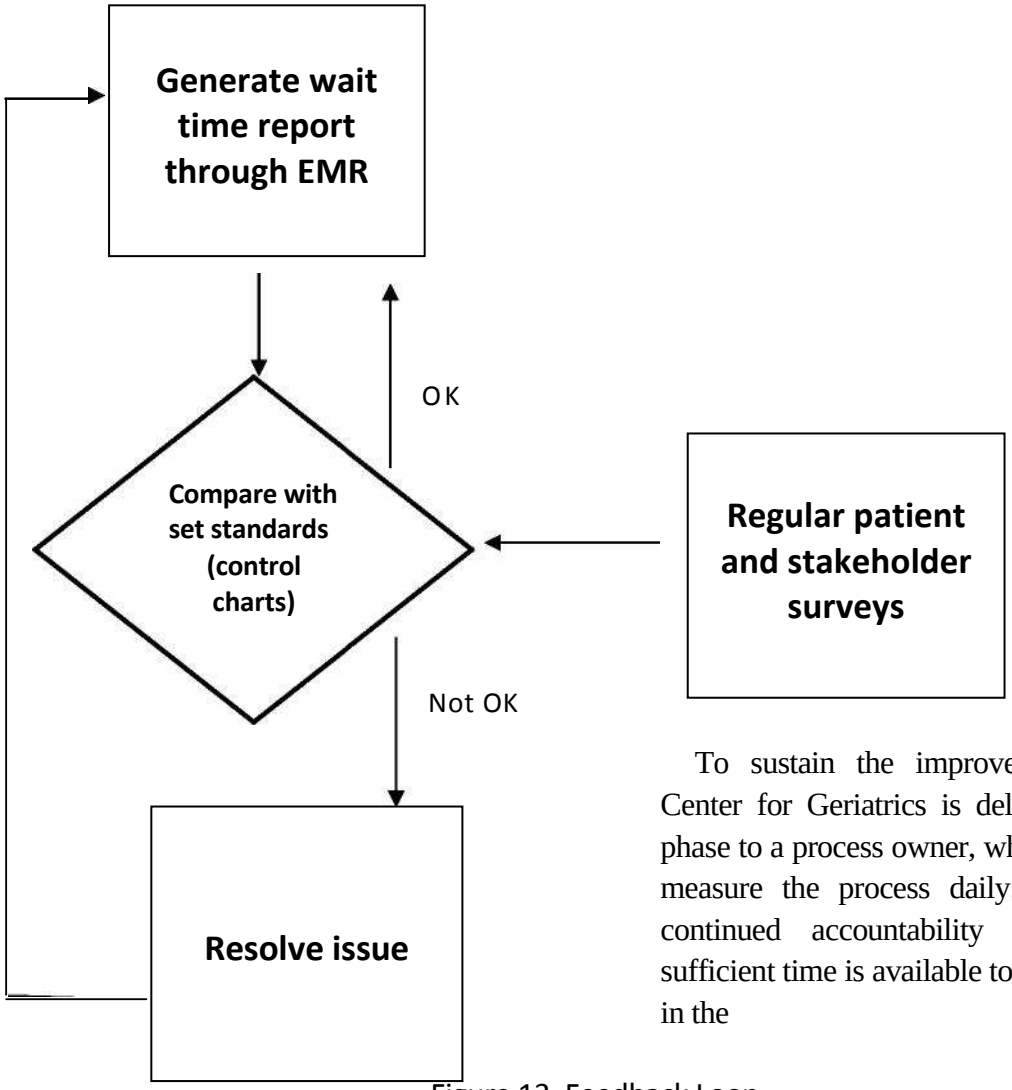


Figure 13. Feedback Loop

To sustain the improvement efforts, the Center for Geriatrics is delegated the control phase to a process owner, who can monitor and measure the process daily. This will allow continued accountability and ensure that sufficient time is available to ingrain the change in the

Figure 14 A control chart of current wait-time at the Center for Geriatrics

Improved Process

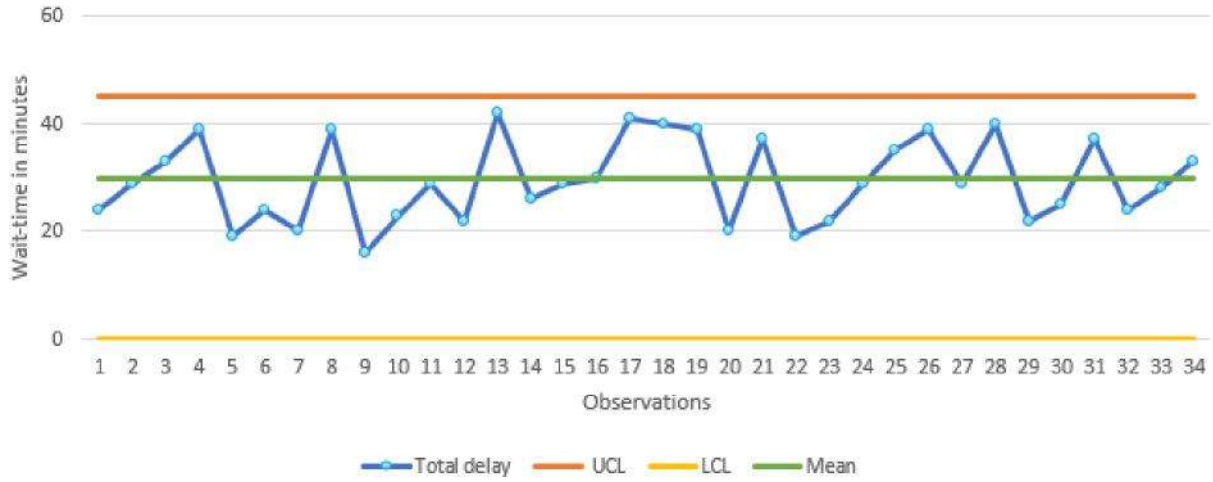


Figure 15. A control chart of improve wait-time at the Center for Geriatrics

CONCLUSION

The success of this project depends on how easily the new process is integrated in normal workflow. If the medical staff trusts the process and continues to control and monitor, subsequent improvements will be realized in patient flow and patient experience. This study thus assists administrators and managers to find and implement the best method for quality management

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APPENDIX A

Test theory 1

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.266992
R Square	0.071285
Adjusted R Square	0.042263
Standard Error	18.51991
Observations	34

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	842.447402	842.447	2.45621	0.1268978
Residual	32	10975.582	342.987		
Total	33	11818.0294			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Upper 95.0%*
Intercept	36.74035	3.93549501	9.33564	1.2E-10	28.724009	44.7567	28.724	44.75669062
App time minus check-in time	0.589658	0.37624207	1.56723	0.1269	-0.1767223	1.35604	-0.1767	1.356037702

Test theory 2

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.5704
R Square	0.325356
Adjusted R Square	0.304274
Standard Error	15.78464
Observations	34

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	3845.07231	3845.07	15.4325	0.0004281
Residual	32	7972.95711	249.155		
Total	33	11818.0294			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Upper 95.0%*
Intercept	21.41261	5.53587341	3.86797	0.00051	10.136407	32.6888	10.1364	32.68881716
MA Delay 1	2.287132	0.58220198	3.92842	0.00048	1.1012253	3.47304	1.10123	3.473038505

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Test Theory 3

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.245998
R Square	0.060515
Adjusted R Square	0.031156
Standard Error	18.62698
Observations	34

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	715.1683	715.168	2.06122	0.1607934
Residual	32	11102.8611	346.964		
Total	33	11818.0294			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Upper 95.0%*
Intercept	37.85032	3.64900384	10.3728	9.2E-12	30.417543	45.2831	30.4175	45.28309773
SW Delay	0.98953	0.68923501	1.43569	0.16079	-0.4143957	2.39346	-0.4144	2.393455831

Test theory 4

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.076323
R Square	0.005825
Adjusted R Square	-0.02524
Standard Error	19.16147
Observations	34

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	68.8429505	68.843	0.1875	0.6679101
Residual	32	11749.1865	367.162		
Total	33	11818.0294			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Upper 95.0%*
Intercept	39.60884	3.74031571	10.5897	5.5E-12	31.990063	47.2276	31.9901	47.22761042
JR Delay	0.243514	0.56237214	0.43301	0.66791	-0.9020002	1.38903	-0.902	1.389028963

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Test theory 6

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.468583
R Square	0.21957
Adjusted R Square	0.195181
Standard Error	16.97714
Observations	34

ANOVA

	df	SS	MS	F	Significance F
Regression	1	2594.88048	2594.88	9.00302	0.005188
Residual	32	9223.14893	288.223		
Total	33	11818.0294			

	Coefficients	Standard Error	t Stet	P-value	Lower 95%	Lipper 9.590wer 95.0.5		Upper 95.0%
Intercept	33.18546	3.77230206	8.79714	4.7E-10	25.50153	40.8694	25.5015	40.86938578
MA Delay 2	1.59931	0.53301397	3.0005	0.00519	0.5135961	2.68502	0.5136	2.685023943