PROJECT

Hospital Wait Time Reduction

LSSGB - Simplilearn Project

By

Venkateswara Rao Banday

Problem statement:

The inefficient scheduling of appointments at ABC Hospital in California, USA, has led to excessive patient wait times, surpassing the industry benchmark, unlike competitors who maintain an average wait time of 30 minutes. This gap results in:

- Patient dissatisfaction: Extended wait times can frustrate patients, adversely affecting their experience and loyalty, potentially leading them to seek care elsewhere.
- Underutilized resources: Unfilled slots, idle staff, and inefficient use of examination rooms represent wasted resources and lost revenue opportunities.
- Financial losses: Missed revenue from unfilled appointments and additional costs associated with rescheduling further erode the financial performance.

Objective:

Implementing the Lean Six Sigma methodology allows for a systematic analysis and improvement of the appointment scheduling process. This can result in:

- Reduction in patient wait times: Improves scheduling accuracy and efficiency, bringing it closer to the industry benchmark of 30 minutes
- Increment in patient satisfaction: Streamlines appointment booking and reduces wait times to enhance patient experience and loyalty
- Optimization of resource utilization: Uses staff and examination rooms efficiently to maximize resources and minimize waste
- Increment in revenue: Reduces missed appointments and improves scheduling processes to contribute to improved financial performance

End goals:

- Analyze the appointment scheduling process and identify the root cause of lengthy wait times
- Reduce wait time to 30 minutes and optimize resource utilization to increase patient satisfaction and boost revenue
- Increase patient satisfaction by 15%

Project charter

As the Green Belt project lead, you initially drafted a project charter and presented it to the project sponsor and champion for approval.

Project title:

Hospital Wait Time Reduction

<table>
<tr>
<td>Business case:

The inefficient scheduling of appointments at ABC Hospital in California, USA, has led to excessive patient wait times, surpassing the industry benchmark, unlike competitors who maintain an average wait time of 30 minutes.

This gap results in :

• Inefficient scheduling of appointments
• Excessive patient wait times
• Patient dissatisfaction
• Underutilized resources
• Financial losses
• Damage to hospital's reputation</td>
<td>Team:

Sponsor: Mr. Jon Doe

Champion: Mr. Sameer Yadav

Project Manager: Xyz

Green Belt: Raghu

Team members: Minakshi, Aditi, Nidhi, and Ilyas</td>
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<td>Problem statement:

The inefficient scheduling of appointments at ABC Hospital in California, USA, has led to excessive patient wait times, surpassing the industry benchmark, unlike competitors who maintain an average wait time of 30 minutes.</td>
<td>Goal statement:

This project aims to implement the Lean Six Sigma Methodology to analyze and improve the appointment scheduling process systematically.

• Analyze the appointment scheduling process and identify the root cause of lengthy wait times
• Reduction wait time to 30 minutes
• Increase patient satisfaction by 15%
• Optimize resource utilization
• Increase in revenue
• Maintain Industry benchmark</td>
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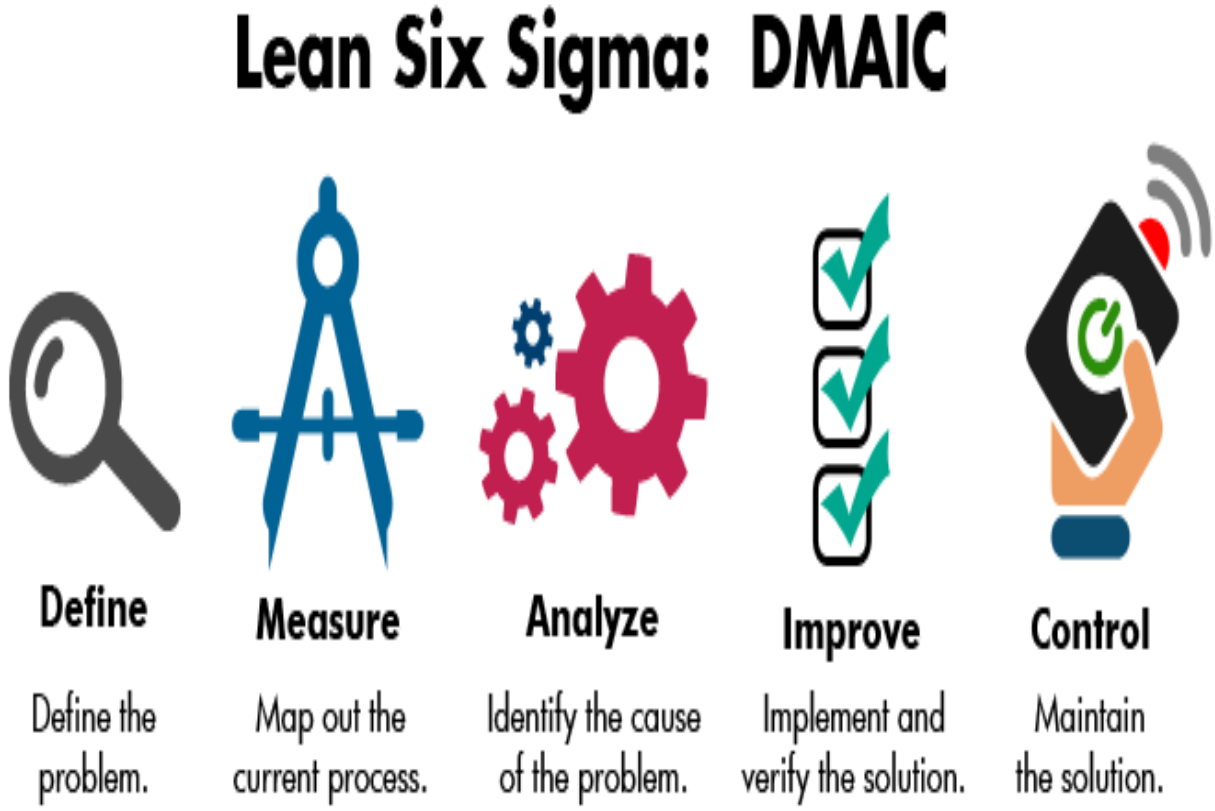
In scope: Defining the problem of inefficient scheduling of appointments at ABC Hospital in California, USA, leading to excessive patient wait times, surpassing the industry benchmark, unlike competitors who maintain an average wait time of 30 minutes.		
Out of scope: Other processes, detailed study on resources, and vendors		
Milestones	**Start date**	**End Date**
Define phase	14 Feb'25	31st Feb'25
Measure phase	1st Mar'25	15th Mar'25
Analyze phase	16th Mar'25	15th Apr'25
Improve phase	16th Apr'25	15th May'25
Control phase	16th May'25	31st May'25



- Map the voice of the business (VOB) and the voice of the customer (VOC)

Voice of the Business (VOB)

Management – ABC Hospital in California, USA

Voice of Management	**Management Issues**	**Critical Management Requirement**
Low patient satisfaction Score	A low satisfaction score reduces the patient outflow	To improve the patient satisfaction score related to wait time, surpassing the industry benchmark with competitors who maintain an average wait time of 30 minutes
		PROJECT GOAL →

	← **PROJECT GOAL**		
Critical to Quality	**Critical Patient Requirement**	**Patient Issues**	**Voice of Patient**
To reduce the OPD wait time to 30 minutes	Reduce wait time before consultation	Too much wait time before consultation	Reduce OPD wait time
Output Indicators			
*Critical to Process			
To reduce the OPD wait time to 30 minutes	**Voice of the Customer (VOC) ABC Hospital in California, USA**		

Voice of the customer (VOC) Customer	**Comments**	**Critical to Quality (CTQ)**
John Doe: ABC Hospital in California, USA	The client expressed dissatisfaction because the hospital failed to meet the industry benchmark - SLA (service level agreement) targets, unlike competitors.	The current Hospital Wait Time is more than 30 minutes.
End customers - General	The agents struggled to understand customer problems, resulting in longer response and resolution times.	The company needs to meet the desired AHT target, which is 30 minutes per patient.
Process owner	The BCS team has been unable to meet the SLA target for AHT	The AHT target is set at 30 minutes per patient.

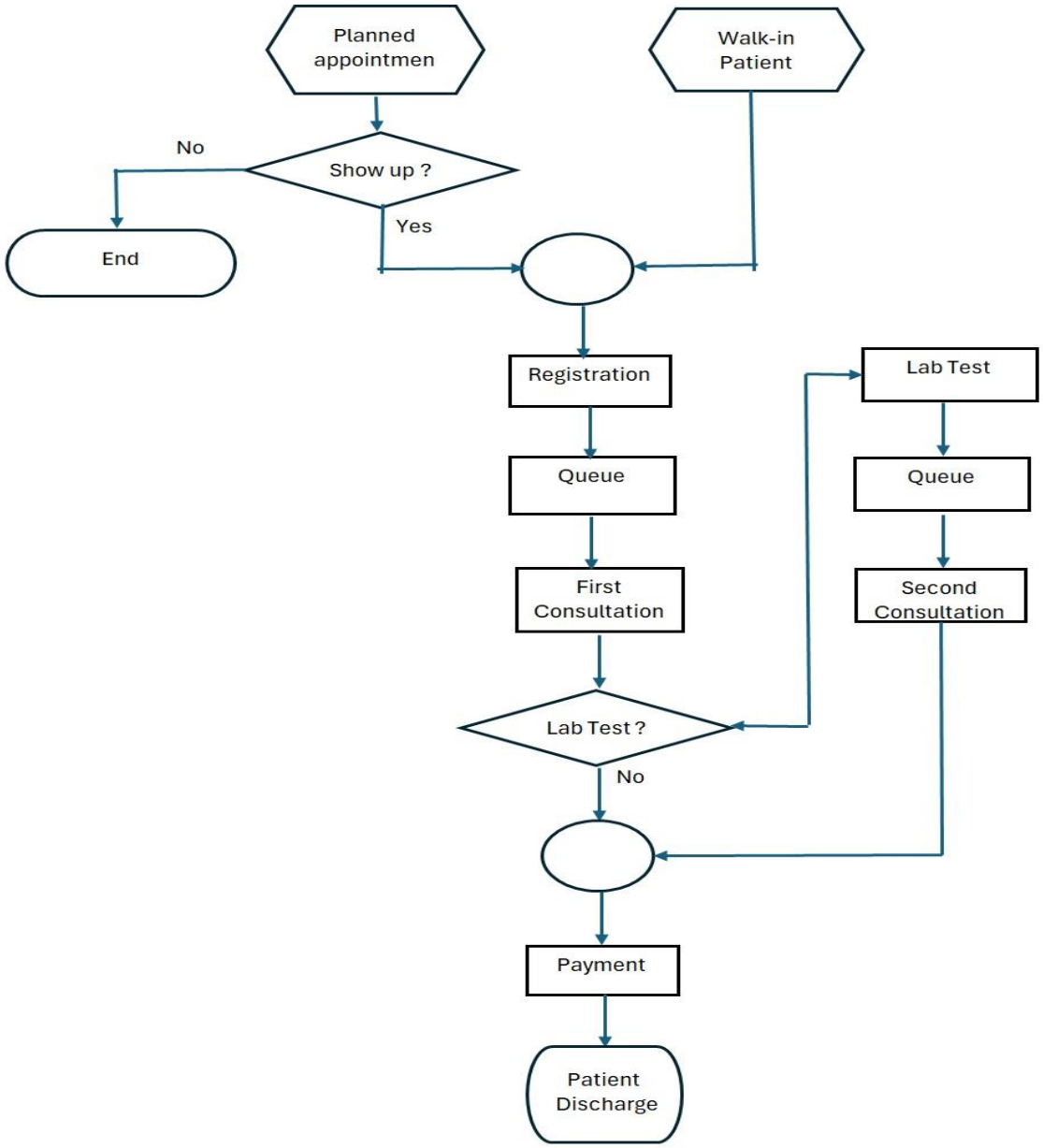
- Create the SIPOC diagram for the hospital process

SIPOC diagram

Supplier	Input	Process	Output	Customer
Avi Software and Networking	Avi software and call master	Receiving the customer's call	Answer the call with a greeting and the agent's introduction	Credit account holder
Avi Software and Networking	Call master	Listening to the customer's query	Provide the necessary information as per the customer's requirement	Credit account holder
Human resource	Agent and call script	Probing in case of any doubt	Help the customer with the necessary information	Credit account holder
SOP (standard operating procedure) and process flow	Information or documents	Resolving the customer's query with the necessary information	Satisfied and happy customer	Credit account holder
Caller & Co.	Query concerns and updates (for example, GUI updates) received from the customer	Documenting the conversation	Update and save the conversation summary, and provide the ticket number if any	Credit account holder
Calling software	Incoming calls	Ending the call with proper verbatim	Customer's satisfaction with needed information	Credit account holder

Process Mapping

- Once stakeholders are identified, the process can be broken down by each stakeholder's perspective to get a comprehensive view.
- Process map helps pinpoint areas that may be causing waiting time.
- Each clinic or hospital has its unique process map, but they all tend to share a basic process map.



- Create the RACI (Responsible, Accountable, Consulted, and Informed) matrix

RACI (responsible, accountable, consulted, and informed) matrix and communication plan:

Key stakeholders	RACI				
	Define	**Measure**	**Analyze**	**Improve**	**Control**
Sponsor: Mr. Jon Doe	**I**	**I**	**I**	**I**	**I**
Champion: Mr. Sameer Yadav	**I and A**	**I and A**	**I and A**	**I and A**	**I and A**
Process Manager: Xyz	**I and R**	**I and R**	**I and R**	**I and R**	**I and R**
Green Belt: Raghu	**C and R**	**C and R**	**C and R**	**C and R**	**C and R**
Team member: Minakshi, Aditi, Nidhi, Ilyas	**R**	**R**	**R**	**R**	**R**

R: A member of the team whose expertise will be needed on a regular basis
A: Approver of team decisions, including the sponsor, business leader, and Master Black Belt
C: Contributor to the team, whose expertise and skills may be needed on an ad hoc basis
I: Interested party, who will need to be kept informed of the direction and findings

- Create a project communication plan

Communication plan				
Information or activity	**Target audience**	**Information channel**	**Who?**	**When?**
Project status	Leadership	Emails	Joe Doe and Sameer Yadav	Biweekly
Tollgate review	Master Black Belt, Green Belt, and champion	Emails or meetings	Raghu and Sameer Yadav	Per the project Plan
Project deliverables or activities	Members	Emails or meetings	Raghu, Minakshi, Aditi, Nidhi, Ilyas	Weekly

High-Level Process Map - COPIS					
C Customer(s)	O Output(s)	P Process(s)	I Input(s)	S Supplier(s)	
Patients	Prescription by Doctor	↓	Patient's vital – BP, Weight, Age, illness history	Patients Nurse	

Patient in *Walk-in *Online appointments ► Registration & Payment Enter in OPD ► Enter in OPD ► Doctor Consultation ► Prescription by Doctor ► Feedback Collected

- Analyze the data and calculate the measures of central tendency and the measures of dispersion

- **Data Collection Plan**

Measure Name	Wait time	Patient Satisfaction	Doctor Un-availability	Support Staff	Less Counters for Registration	Morning / Afternoon	Day of the week	Week of the Month
Measure Type (Y or X)	Y	X	X	X	X	X	X	X
Data Type (Continuous or Discrete)	Cont	Cont	Dis	Dis	Dis	Dis	Dis	Dis
Who	Operations Manager	Black Belt	Operations Manager	Operations Manager	Operations Manager	Operations Manager	Operations Manager	Operations Manager
Sample size	300 Patients							

Month	Patient Name	Wait Time (Minutes)	Rating (out of 5)	Spciality visited
January	John Smith	45	4	General Physician
January	Jane Doe	30	2	Surgery
January	Alex Miller	60	1	Surgery
February	Sarah Jones	50	3	General Physician
February	David Lee	45	4	General Physician
February	Emily Brown	45	3	General Physician
March	Michael Garcia	30	5	
March	Amanda Johnson	45	3	General Physician
March	Christopher Davis	45	4	Surgery
April	Daniel Hernandez	30	4	
April	Elizabeth Wilson	60	2	General Physician
April	Matthew Rodriguez	45	3	Surgery
May	William Miller	30	5	
May	Jennifer Garcia	30	4	
May	Christopher Clark	60	1	General Physician
June	Olivia Davis	30	4	
June	Andrew Lopez	45	3	General Physician
June	Sophia Hernandez	45	4	General Physician
July	Daniel Johnson	45	3	General Physician
July	Emily Perez	45	2	General Physician

July	Michael Jackson	30	5	
August	Olivia Brown	45	4	Surgery
August	Sophia Hernandez	45	3	General Physician
August	Christopher Miller	60	1	Surgery
September	Sarah Lee	45	3	Surgery

Month	Patient Name	Wait Time (Minutes)	Rating (out of 5)
May	Sarah Lee	33	4
May	David Wilson	29	3
May	Elizabeth Garcia	34	5
May	Olivia Brown	30	3
May	Sophia Hernandez	28	4
May	William Miller	32	5
May	Sarah Wilson	31	4
May	David Lee	27	5
May	Amanda Johnson	30	4
May	Daniel Johnson	29	4
June	Emily Perez	32	5
June	Christopher Clark	34	3
June	Olivia Davis	35	5
June	Andrew Lopez	33	4
June	Sophia Hernandez	26	3
June	Daniel Lopez	30	4
June	Emily Brown	28	3
June	Michael Jackson	31	5
June	David Jones	34	4
June	Elizabeth Garcia	29	4
June	Matthew Miller	32	4
June	Sarah Wilson	30	3
June	David Lee	26	5
June	Amanda Johnson	33	4
June	Olivia Hernandez	28	5
June	Sophia Miller	32	4
June	Christopher Garcia	30	4

Central Tendency		
Factor	Before Six Sigma	After Six Sigma Implimentation
Mean	43.40	30.59
Median	45	30
Mode	45	30
Measures of Dispersion		
Range	30	9
Variance	101.5	6.33
St. Deviation	10.1	2.52

- Calculate the DPMO for the wait time.

Before implementing the Six Sigma Methodology

Consultation Time	Wait Time (Minutes)	Rating (out of 5)	Specialty visited
9:45 AM	45	4	General Physician
10:30 AM	30	2	Surgery
12:00 PM	60	1	Surgery
9:20 AM	50	3	General Physician
10:15 AM	45	4	General Physician
10:45 AM	45	3	General Physician
10:30 AM	45	3	General Physician
11:00 AM	45	4	Surgery
10:30 AM	60	2	General Physician
10:45 AM	45	3	Surgery
11:00 AM	60	1	General Physician
10:15 AM	45	3	General Physician
10:45 AM	45	4	General Physician
9:30 AM	45	3	General Physician
10:00 AM	45	2	General Physician
9:45 AM	45	4	Surgery
10:30 AM	45	3	General Physician
11:00 AM	60	1	Surgery
9:15 AM	45	3	Surgery

Before Six Sigma Methodology		
Step	**Equation**	**Result**
Determine number of defecet opportunities per unit	O=	1
Determine number of units processed	N=	19
Determine total number of defects made	D=	18
Calculate defects per opportunity	DPO = D / (N X O)=	0.947368
Calculate yield	Yield = (1-DPO)*100	5.26
Sigma Level from Sigma conversion table	process sigma =	-0.120

A sigma level of 0 means that a process has extremely high variability and is producing a very large number of defects, indicating a completely unacceptable level of quality; essentially, it signifies that the process is completely out of control and is producing nearly all defective outputs within the specified limits.

Key points about sigma levels:

- **Higher sigma level = better quality:**

A higher sigma level indicates a process with less variation and fewer defects, while a lower sigma level means more variation and more defects.

- **Interpretation of sigma levels:**

A sigma level of 0 is considered extremely poor, while a level of 6 is considered near perfect.

- **Six Sigma methodology:**

The concept of sigma levels is primarily used in the Six Sigma quality improvement methodology, where the goal is to achieve a very high sigma level by minimizing process variation.

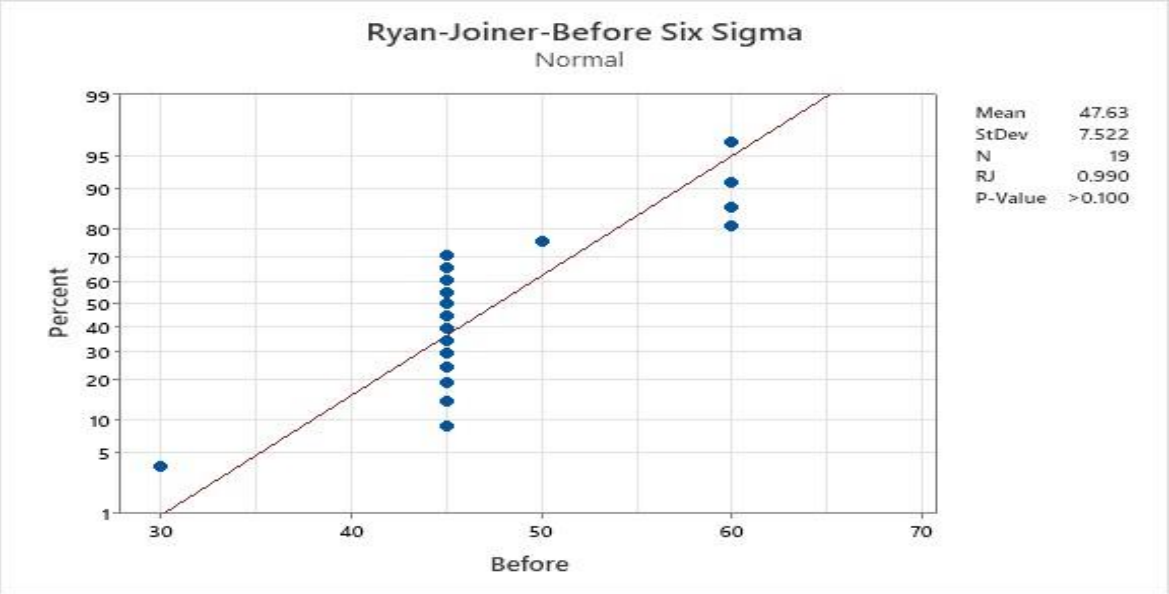
After implementing the Six Sigma Methodology

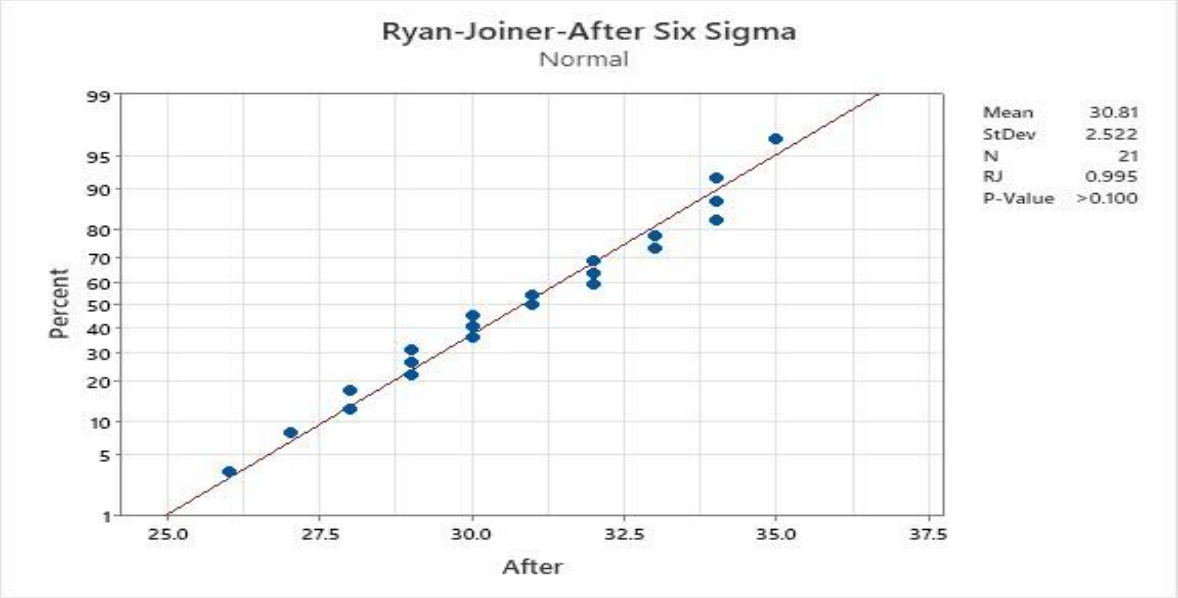
Month	Patient	Consultation	Wait	Rating
May	Sarah Lee	9:15 AM	33	4
May	David	9:30 AM	29	3
May	Elizabeth	10:15 AM	34	5
May	Olivia	9:00 AM	30	3
May	Sophia	9:30 AM	28	4
May	William	10:15 AM	32	5
May	David Lee	9:30 AM	27	5
May	Amanda	10:15 AM	30	4
June	Emily	9:30 AM	32	5
June	Christopher	10:15 AM	34	3
June	Sophia	10:15 AM	26	3
June	Emily	9:30 AM	28	3
June	Michael	10:15 AM	31	5
June	David	9:00 AM	34	4
June	Elizabeth	9:30 AM	29	4
June	Sarah	9:15 AM	30	3
June	David Lee	9:30 AM	26	5
June	Amanda	10:15 AM	33	4
June	Olivia	9:00 AM	28	5
June	Sophia	9:30 AM	32	4
June	Christopher	10:15 AM	30	4

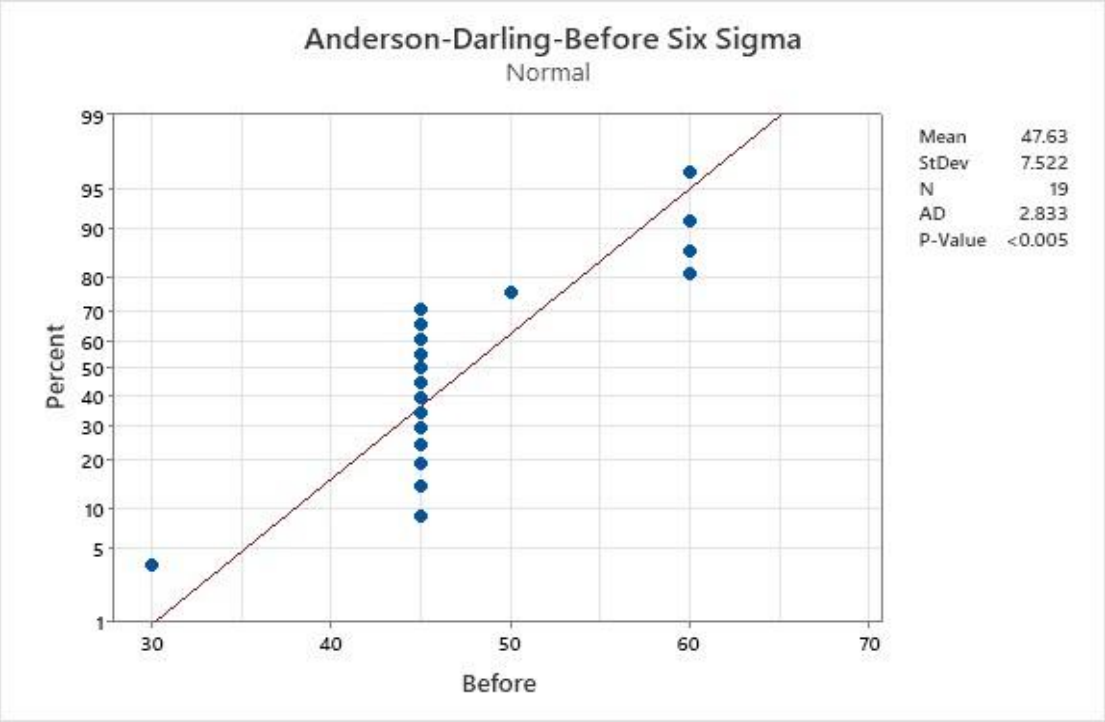
Data after Six Sigma Methodology		
Step	**Equation**	**Result**

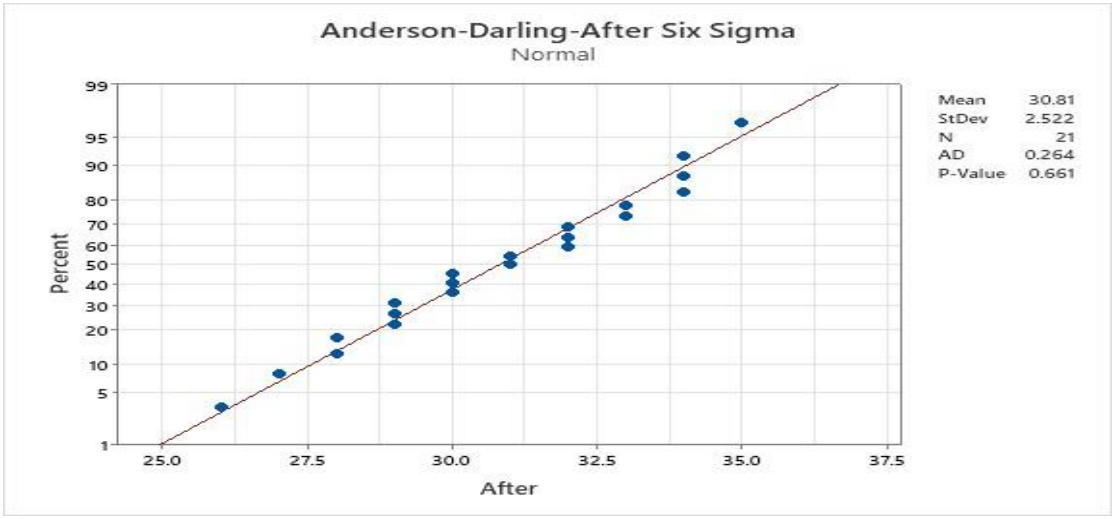
Determine number of defecet opportunities per unit	O=	1
Determine number of units processed	N=	21
Determine total number of defects made	D=	9
Calculate defects per opportunity	DPO = D / (N X O)=	0.428571
Calculate yield	Yield = (1-DPO)*100	57.14
Sigma Level from Sigma conversion table	process sigma =	1.680

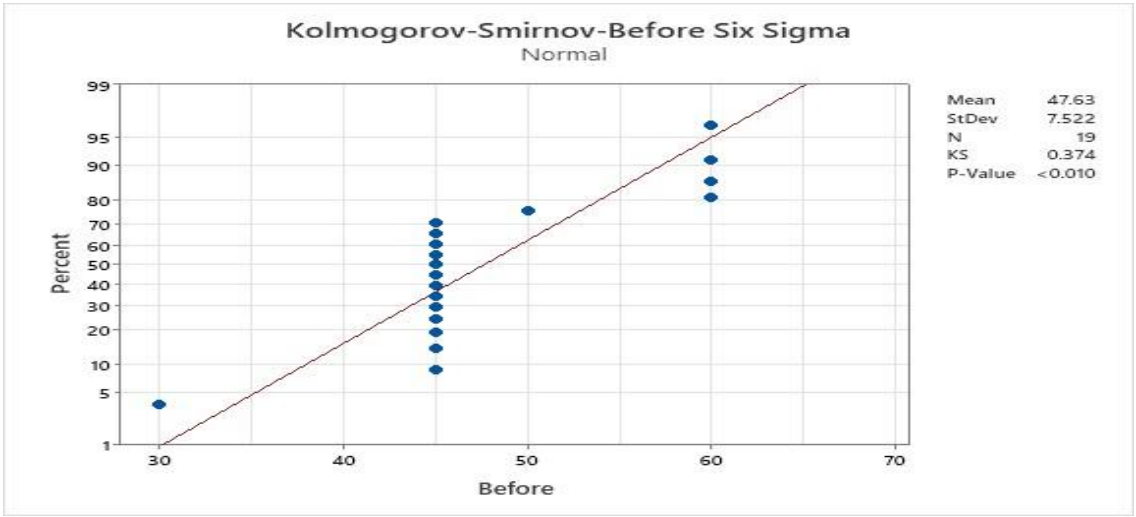
- Perform process capability and stability checks.

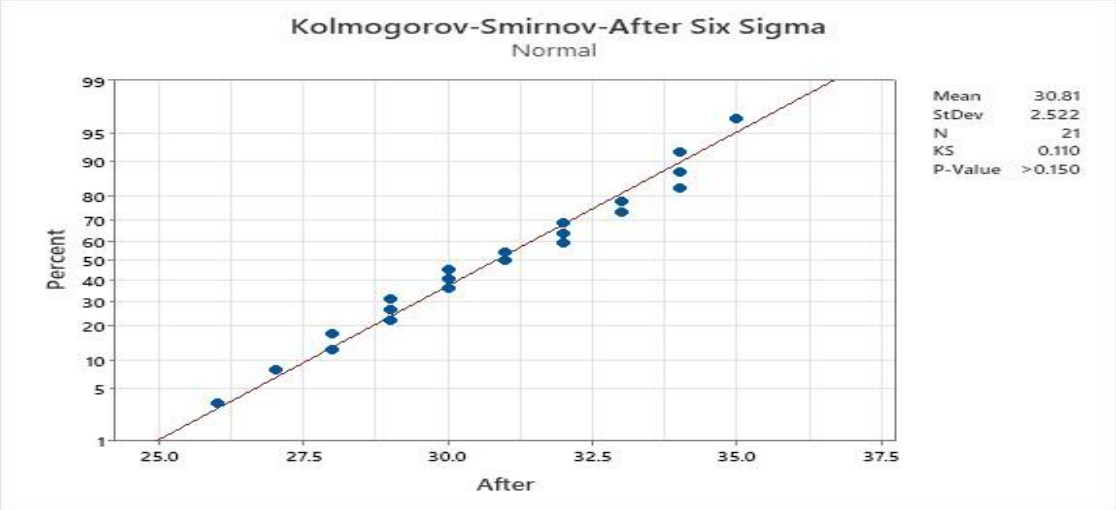



Ryan-Joiner-After Six Sigma
Normal
Percent
After
Mean 30.81
StDev 2.522
N 21
RJ 0.995
P-Value >0.100


Anderson-Darling-Before Six Sigma
Normal
Percent
Before
Mean 47.63
StDev 7.522
N 19
AD 2.833
P-Value <0.005


Anderson-Darling-After Six Sigma
Normal
Percent
After
Mean 30.81
StDev 2.522
N 21
AD 0.264
P-Value 0.661


Kolmogorov-Smirnov-Before Six Sigma
Normal
Percent
Before
Mean 47.63
StDev 7.522
N 19
KS 0.374
P-Value <0.010



- Identify possible causes of a delayed appointment.

Factors Causing Patient Wait Time

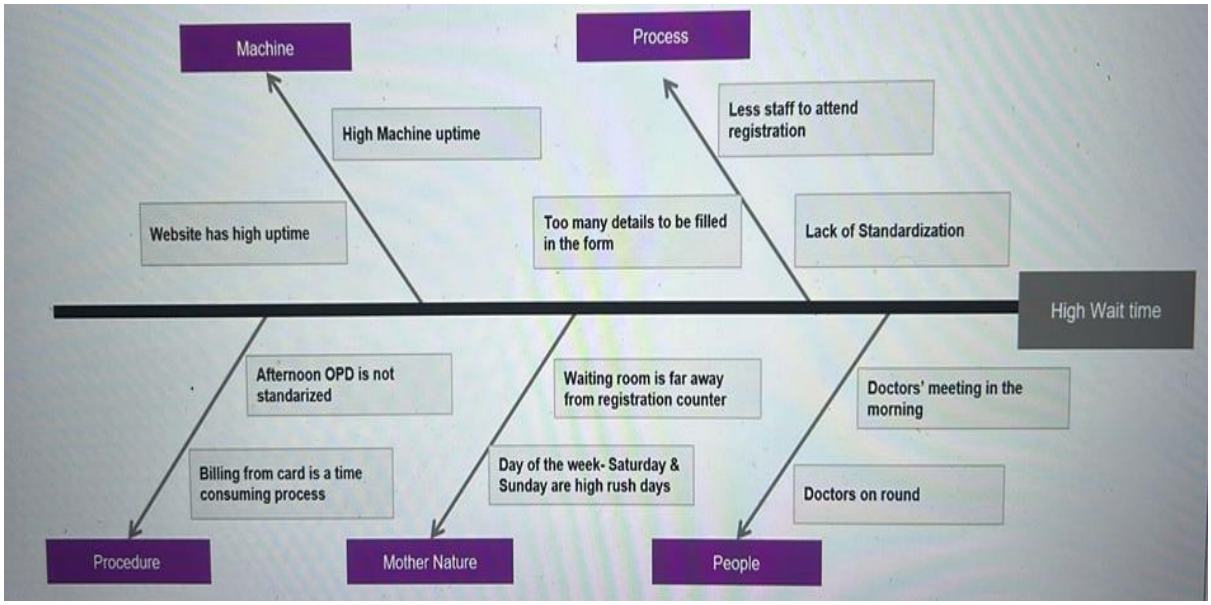
General Factors causing long wait time for Patients are:

- The Staff's weekly work schedule is not aligned to accommodate patients during peak times.
- Not enough doctors to meet patient demand.
- Patient appointment scheduling.
- Irregular calling sequence.
- Registration and Checking in.
- Unused session time (i.e. not having materials in the consultation room).

- Create a fishbone diagram.

Cause & Effect Diagram

Identify Potential X's



- Conduct hypothesis testing.

A hypothesis test for patient waiting time would typically aim to assess whether the average waiting time in a clinic or healthcare setting is significantly different from a predetermined standard or benchmark, often focusing on the null hypothesis that the average waiting time is equal to the standard, while the alternative hypothesis would be that it is either longer or shorter depending on the research question, and could be tested using a t-test with patient waiting times as the data points.

Key elements of a patient waiting time hypothesis test:

- **Null Hypothesis (Ho):**

The average patient waiting time is equal to a specified standard (e.g., "The average waiting time is 30 minutes").

- **Alternative Hypothesis (Ha):**

The average waiting time is significantly different from the standard (e.g., "The average waiting time is not equal to 30 minutes" or "The average waiting time is greater than 30 minutes").

Steps to perform the hypothesis test:

1. **Gather data:** Collect a sample of patient waiting times from the clinic or system you are studying.
2. **Calculate descriptive statistics:** Find the sample mean and standard deviation of the waiting times.
3. **Choose a significance level (α):** This is the threshold for determining statistical significance, often set at 0.05.

4. **Perform the t-test:**
    - Calculate the test statistic (t-score) using the formula:

Code

t = (sample mean - hypothesized mean) / (standard deviation / sqrt(sample size))

- Determine the critical value for your chosen significance level and degrees of freedom (n-1).

1. **Make a decision:**
    - If the calculated t-score falls within the critical region (outside the confidence interval), reject the null hypothesis.
    - If the t-score falls within the non-critical region, fail to reject the null hypothesis.

Important considerations:

- **Sample size:** A sufficiently large sample size is crucial for reliable results.
- **Data distribution:** Check if the waiting time data is normally distributed to appropriately apply the t-test. If not, consider non-parametric tests like the Mann-Whitney U test.
- **Factors affecting waiting time:** When interpreting results, consider potential confounding variables like day of the week, appointment type, or provider availability that might influence waiting times.

Example research questions:

- "Does implementing a new appointment scheduling system significantly reduce patient waiting times?"
- "Is there a difference in average waiting times between the morning and afternoon clinic sessions?"
- "Do patients with urgent appointments experience significantly shorter waiting times compared to non-urgent appointments?"

F-Test Two-Sample for Variances

	Before	*After*
Mean	47.63157895	30.80952381
Variance	56.57894737	6.361904762
Observations	19	21
df	18	20

F	8.893397416
P(F<=f) one-tail	5.34819E-06
F Critical one-tail	2.151124427

z-Test: Two Sample for Means

	Before	*After*
Mean	47.63157895	30.80952381
Known Variance	56.57894737	6.361904762
Observations	19	21
Hypothesized Mean Difference	0	
z	9.287311719	
P(Z<=z) one-tail	0	
z Critical one-tail	1.644853627	
P(Z<=z) two-tail	0	
z Critical two-tail	1.959963985	

t-Test: Two-Sample Assuming Unequal Variances

	Before	*After*
Mean	47.63157895	30.80952381
Variance	56.57894737	6.361904762
Observations	19	21
Hypothesized Mean Difference	0	
df	22	
t Stat	9.287311719	
P(T<=t) one-tail	2.27692E-09	
t Critical one-tail	1.717144374	
P(T<=t) two-tail	4.55384E-09	
t Critical two-tail	2.073873068	

Ho: The patient experience before and after the implementation of Six Sigma is similar
Ha: The patient experience before and after the implementation of Six Sigma is not similar

- Brainstorm solutions to reduce patient wait time at the hospital.

How Six Sigma can fix this?

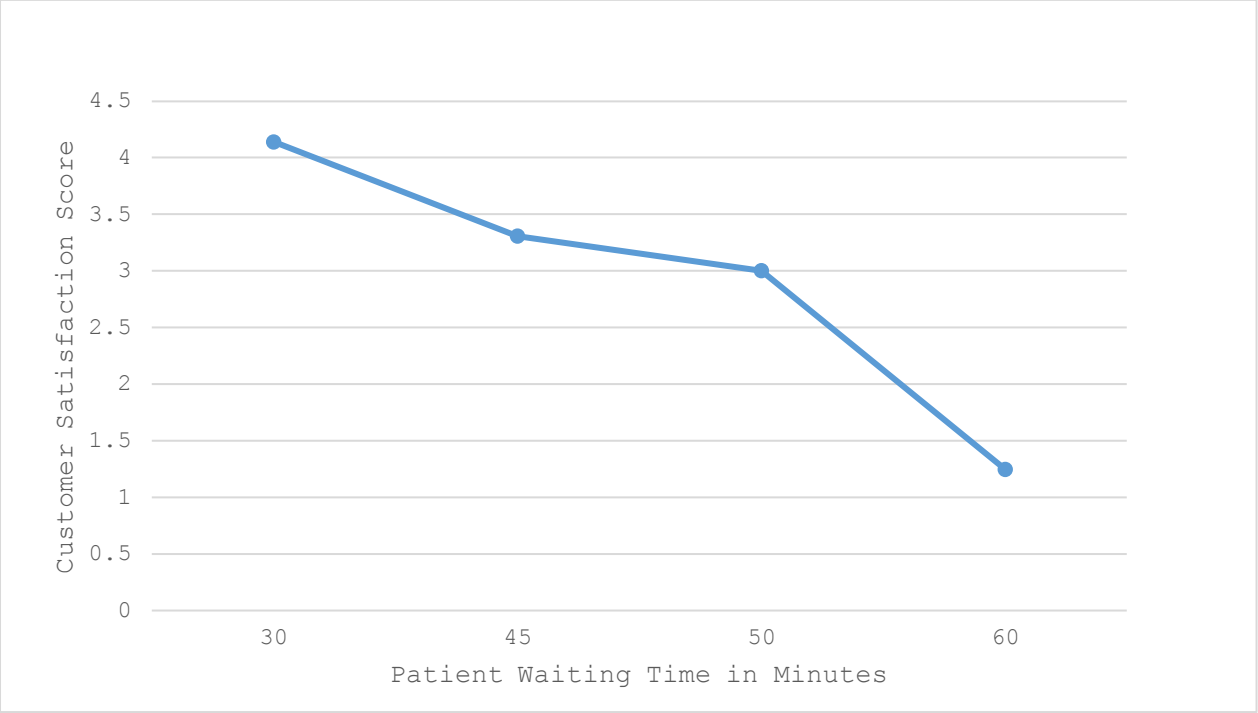
- Six Sigma is successful in process-oriented applications. Patient wait time can be broken down into a process and data can be collected such as wait time.
- First phase of DMAIC, Define, analyses the entire process
- Break down process, by identifying potential stakeholders
- Stakeholders
  - Patients
  - Doctors
  - Nurses
  - Other Staff

- Execute the pilot run and compare the new and old results.

Before the implementation of Six Sigma

Month	Patient Name	In Time	Consultation Time	Wait Time (Minutes)	Rating (out of 5)	Specialty visited
January	John Smith	9:00 AM	9:45 AM	45	4	General Physician
January	Jane Doe	10:00 AM	10:30 AM	30	2	Surgery
January	Alex Miller	11:00 AM	12:00 PM	60	1	Surgery
February	Sarah Jones	8:30 AM	9:20 AM	50	3	General Physician
February	David Lee	9:30 AM	10:15 AM	45	4	General Physician
February	Emily Brown	10:00 AM	10:45 AM	45	3	General Physician
March	Amanda Johnson	9:45 AM	10:30 AM	45	3	General Physician
March	Christopher Davis	10:15 AM	11:00 AM	45	4	Surgery
April	Elizabeth Wilson	9:30 AM	10:30 AM	60	2	General Physician
April	Matthew Rodriguez	10:00 AM	10:45 AM	45	3	Surgery
May	Christopher Clark	10:00 AM	11:00 AM	60	1	General Physician
June	Andrew Lopez	9:30 AM	10:15 AM	45	3	General Physician
June	Sophia Hernandez	10:00 AM	10:45 AM	45	4	General Physician
July	Daniel Johnson	8:45 AM	9:30 AM	45	3	General Physician
July	Emily Perez	9:15 AM	10:00 AM	45	2	General Physician
August	Olivia Brown	9:00 AM	9:45 AM	45	4	Surgery

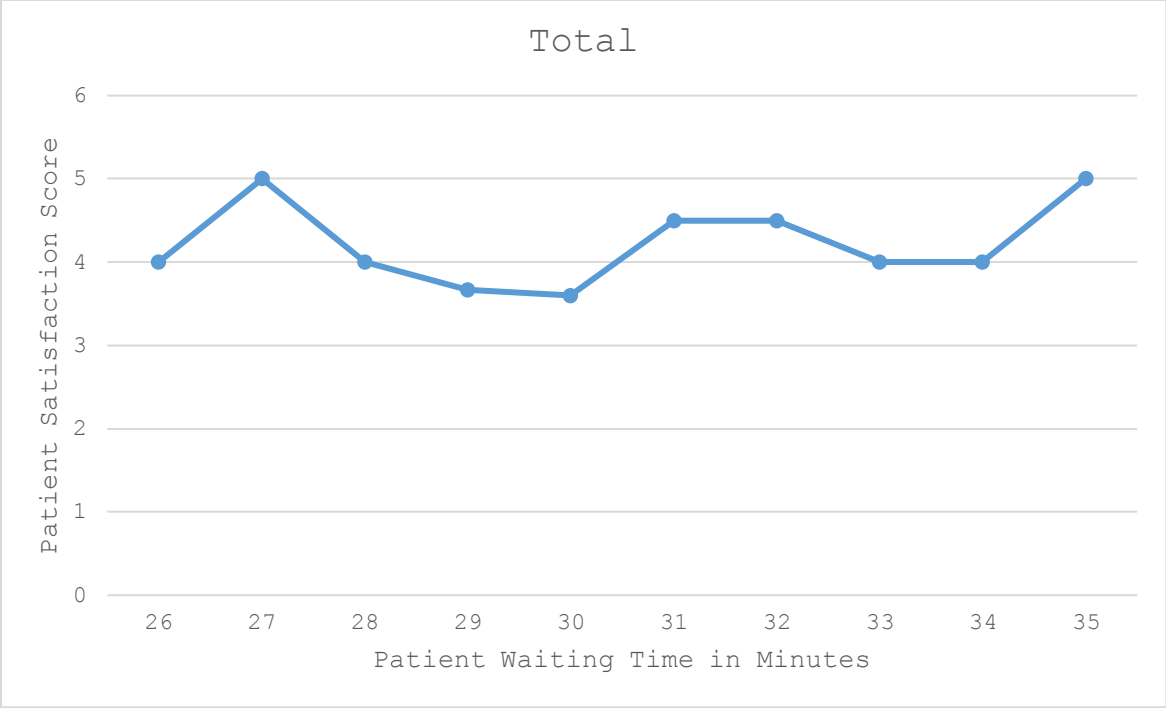
August	Sophia Hernandez	9:45 AM	10:30 AM	45	3	General Physician
August	Christopher Miller	10:00 AM	11:00 AM	60	1	Surgery
September	Sarah Lee	8:30 AM	9:15 AM	45	3	Surgery

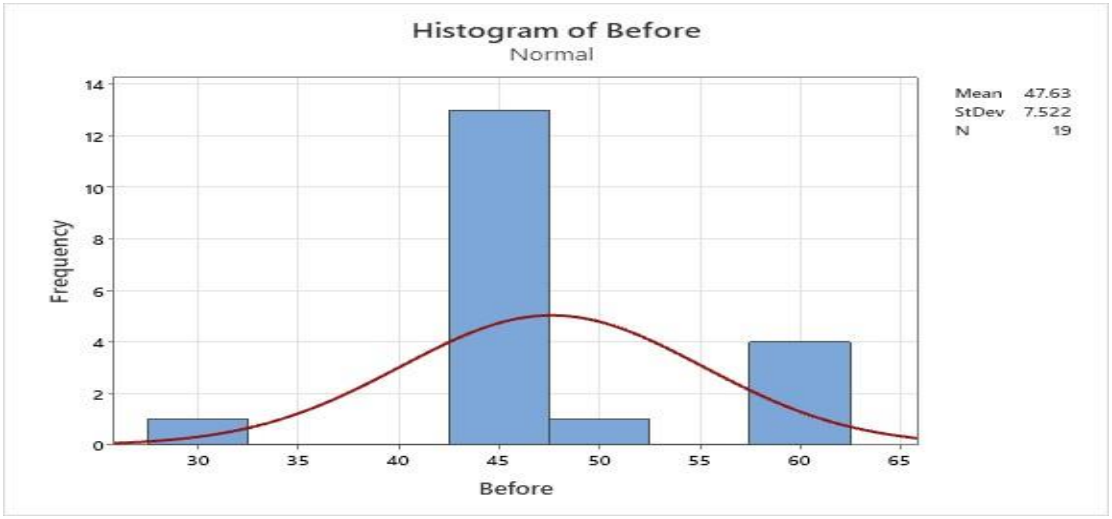


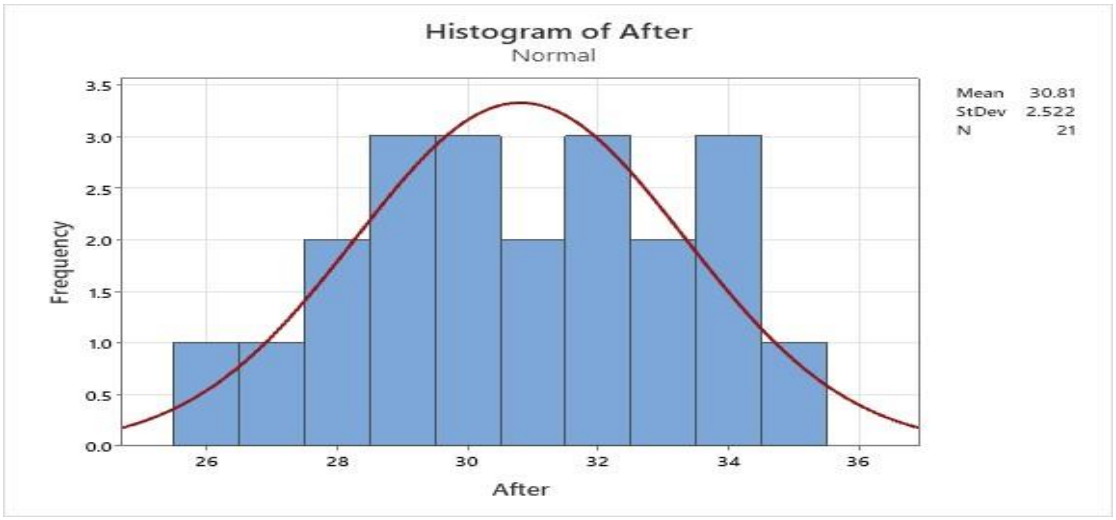
- Patient wait time is a direct factor that affects patient satisfaction and an indicator of the quality of care received.
- As the waiting time increases, patient satisfaction reduces significantly.
- It is acceptable for patients to wait up to 30 minutes to see a doctor in a clinic. Anything after that drastically reduces patient satisfaction.
- As satisfaction decreases, patients will not recommend coming back to the hospital.

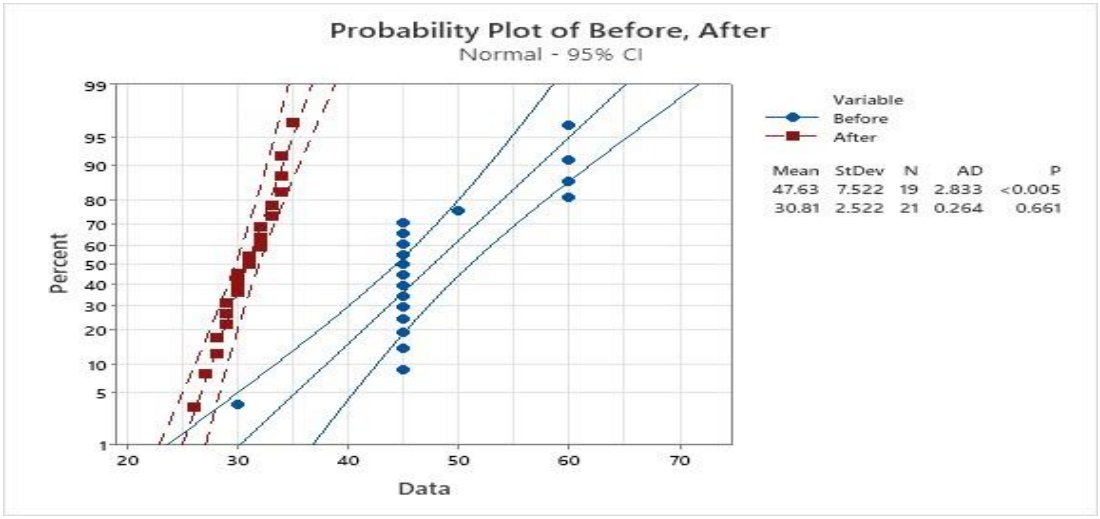
After the Implementation of Six Sigma

Month	Patient Name	Consultation Time	Wait Time (Minutes)	Rating (out of 5)
May	Sarah Lee	9:15 AM	33	4
May	David Wilson	9:30 AM	29	3
May	Elizabeth Garcia	10:15 AM	34	5
May	Olivia Brown	9:00 AM	30	3
May	Sophia Hernandez	9:30 AM	28	4
May	William Miller	10:15 AM	32	5
May	David Lee	9:30 AM	27	5
May	Amanda Johnson	10:15 AM	30	4
June	Emily Perez	9:30 AM	32	5
June	Christopher Clark	10:15 AM	34	3
June	Sophia Hernandez	10:15 AM	26	3
June	Emily Brown	9:30 AM	28	3
June	Michael Jackson	10:15 AM	31	5
June	David Jones	9:00 AM	34	4
June	Elizabeth Garcia	9:30 AM	29	4
June	Sarah Wilson	9:15 AM	30	3
June	David Lee	9:30 AM	26	5
June	Amanda Johnson	10:15 AM	33	4
June	Olivia Hernandez	9:00 AM	28	5
June	Sophia Miller	9:30 AM	32	4
June	Christopher Garcia	10:15 AM	30	4




Histogram of Before
Normal
Mean 47.63
StDev 7.522
N 19
Frequency
Before


Histogram of After
Normal
Mean 30.81
StDev 2.522
N 21
Frequency
After


Probability Plot of Before, After
Normal - 95% CI
Variable
Before
After
Mean StDev N AD P
47.63 7.522 19 2.833 <0.005
30.81 2.522 21 0.264 0.661
Percent
Data

Six Sigma Success

- In both case studies, the average wait time was reduced and processes were more efficient resulting in better patient satisfaction.

- Success was achieved with the available resources and no extra investment.

- The biggest challenge was to train medical staff in Six Sigma methodology and have them accept it.

- However, once staff accepted it, they were given more responsibility and were more involved with the process improvement initiatives.

- Prepare a control plan.

Recommendations

My recommendations for the problems that can be reasonably solved for the factors.

- Create a website or app to make the appointment and registration process more efficient.
- Display patient orders on the screen in the waiting room to avoid irregular calling sequences and book newer patients with a longer session time.
- Add a feature to the app/website that allows patients to write symptoms they are suffering from and allows staff to send them to the right doctor.
- Digitalize medical records to save doctors time from having to ask patients.
- More productive ways to entertain patients in the waiting room such as health education.

Conclusion

- Waiting time is a big factor in patient satisfaction, which is an indicator of the level of quality the patient is receiving.
- Long waiting time implies inefficient processes to handle patient demand.
- Six Sigma can improve processes and reduce patient wait times.
- Both case studies achieved great results by using Six Sigma.

- Six Sigma helps reduce stress on staff during peak times reducing the chances of misdiagnosing the patient.