

Lean Six Sigma DMAIC Project (*Example*)

GREEN BELT

**Project Objective:
To Reduce Clinic Cycle Time**
Last Updated: 04/01/2019

Team: *The Speeders*

Tom Jones (Team Leader)

Linda Hill (Sponsor)

**Steve Martin
Amy Kidd**

**Art Franklin
Bob Villa**

**Mary Jefferson
Jimmy Smits**

Background

- The Community Health Organization (CHO) Leadership Team determined that Clinic Cycle Time (patient flow from check-in through check-out) needed improvement.
- This objective was driven by patient satisfaction survey results from throughout the service area.
- The Executive Director assigned Tom Jones as the Team Leader, and requested Mr. Jones to assemble a cross-functional company-wide team to develop a Project Charter and confirm the need for improvement.
- The team decided to use the DMAIC methodology and Lean Six Sigma tools to address this issue.

Background

Project Name: Reduce Clinic Cycle Time (Check-in through Check-out)

Situation:

11 Clinics in Service Area

Average Cycle time = 70 minutes

Industry Best = 30 minutes

Customer Satisfaction = 68%

Customer Complaints = 3.7/100 encounters

Strategic Issue related to patient satisfaction, revenue, and Federal funding

20% of patients leave without being seen (LWOBS)



Theme Selection Matrix

The team evaluated cycle time in the context of the 5 greatest issues identified in the strategic planning SWOT process.

Theme Selection Matrix

Date: June, 2018

Potential Themes	Importance	Need to Improve	Overall Score
Facility Cleanliness	3	4	12
Employee Lost Time Incidents	5	3	15
Employee Turnover	3	3	9
Clinic Cycle Time (Check-in to Check-out)	5	5	25
Customer Service Responsiveness	5	2	10
Scale: 1 = Negligible 2 = Somewhat 3 = Moderate 4 = Very 5 = Extreme			

The team selected “Reduce Clinic Cycle Time” as its theme because cycle time was a driver of patient satisfaction, retention, and referral. Cycle Time was also a strategic objective and Key Performance Indicator on the Senior Leadership Scorecard.



Stakeholders and Needs

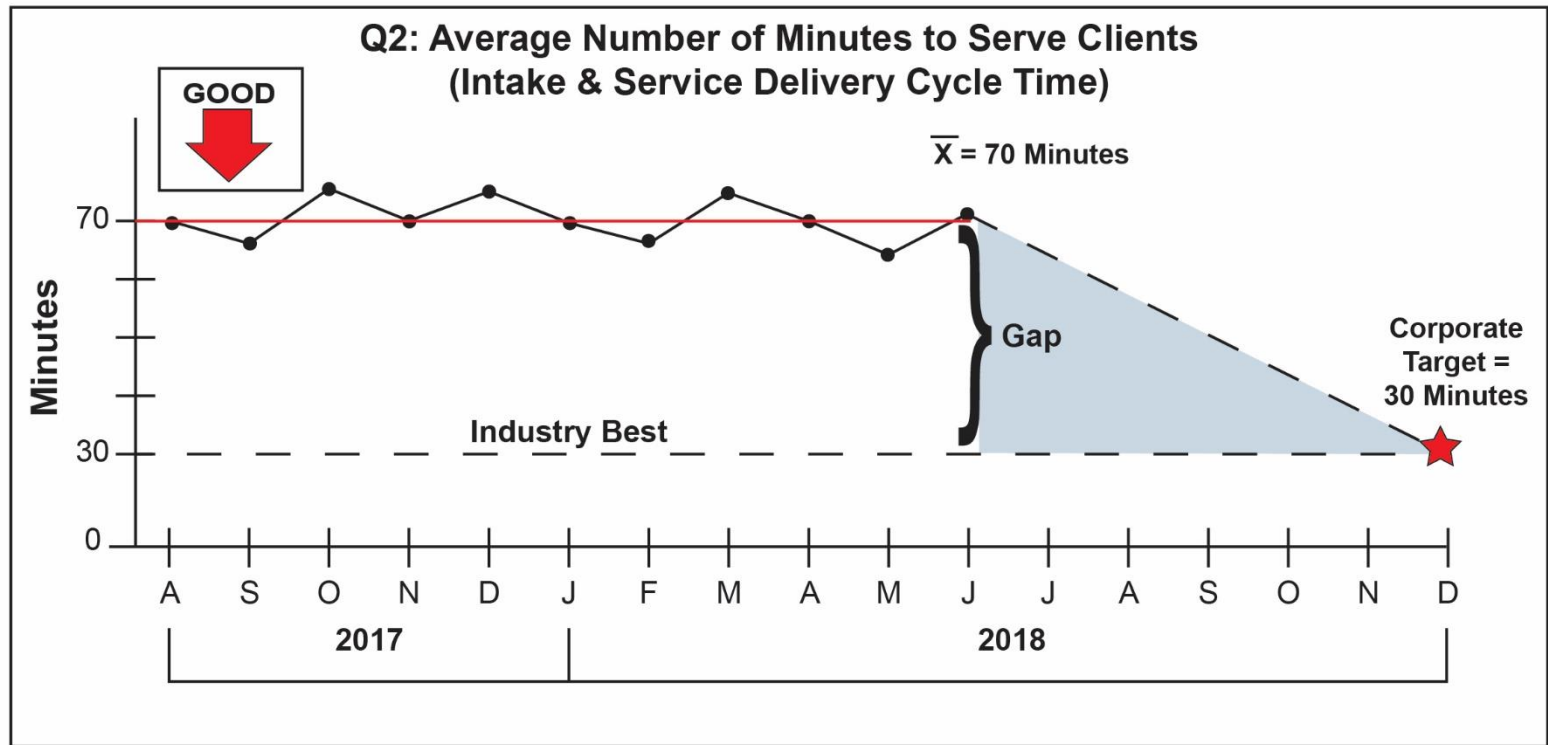
Stakeholders and Needs Analysis

1. 

Stakeholders	Needs
Customer / Patient	Quality Medical Services
	Responsive Medical Services
	Being Seen at Scheduled Appointment Time
Company / Senior Leadership Team	Retain Existing Patients (Maximize Revenue)
	Add New Patients (Revenue Growth)
	Maximize Funding Potential (No Penalties)
Employees	Meaningful Work
	Positive Work Environment
	Fair Pay and Benefits
	Recognition



Line Graph



2.

Theme: Reduce Clinic Cycle Time from 70 to 30 minutes by 12/31/18.

3.

The team collected a random sample of 300 patients from August 2017 through May 2018.



Cost of Poor Quality

Stakeholder	Pain	Annualized "Costs"
Customer / Patient	Low Satisfaction	68% Satisfaction
	Complaints	3.7/100 Encounters
	Leaves Without Being Seen (LWOBS)	20% LWOBS
Company / Senior Leadership	Lost Patients	\$1.5 Million Revenue
	Financial Penalties from Funders	\$900,000 in Penalties
Employees	Rework	10% Rework = \$2.5 Million per Year in Wasted Labor and Inventory Expense
3. <input checked="" type="checkbox"/>	Total Annualized COPQ	\$4,900,000



Project Charter

Note: In some cases the team's sponsor may require a project charter.

GREEN BELT TEAM PROJECT CHARTER		
Business Case	Project Name (Theme):	To Reduce Clinic Cycle Time (Current Actual = 70 Minutes)
	Problem / Impact:	Clients expect to be treated within a reasonable time. Longer than necessary Length of Stays (LOSs) cause Client dissatisfaction and loss of trust in the clinic's ability to meet their health care needs.
	Expected Benefits:	Reduce Arrival to Checkout (Intake & Service Delivery) Times; Reduced # of Client Complaints; Increase Client Satisfaction
Objectives	Outcome Indicators:	Q2 - Average # of Minutes to Serve Clients (from Arrival to Checkout)
	Proposed Target(s):	Target = 30 minutes
	Timeframe:	June 2018 through December 2018
	Strategic Alignment:	Supports CHO Strategic Plan
Scope	In Scope:	Clients within CHO Area
	Authorized By:	Linda Hill
Team	Sponsor(s):	Linda Hill
	Team Leader:	Tom Jones
	Team Members:	Steve Martin, Art Franklin, Mary Jefferson, Amy Kidd, Jimmy Smits
	Process Owner(s):	Linda Hill
	Mgmt. Review Team:	Dr. Kildare and Linda Hill
Schedule	Completion Date:	December 31, 2018
	Review Dates:	Monthly and Final Review in December 2018
	Key Milestone Dates:	See Action Plan



Project Planning Worksheet

Note: In some cases a team may choose to use a separate Project Planning Worksheet with DMAIC schedule as follows.

Project Planning Worksheet – Page 1 of 2																	
Theme		Reduce Clinic Cycle Time from 70 to 30 minutes by 12/31/18.															
Problem Statement (Summarize)		73.6% of Clients served that were taking longer than 30 minutes required CBC Lab Work															
Team Work Location		Miami, FL															
Team Name		The Speeders															
Duration		6/1/18 (mm/yy) through			12/31/18 (mm/yy)			Sponsor: Linda Hill									
Team Members	Team Leader		Tom Jones												Team Information Subject matter experts from various disciplines invited throughout meeting schedule.		
	2 nd Team Leader		N/A														
	Team Member 1		Amy Kidd														
	Team Member 2		Steve Martin														
	Team Member 3		Art Franklin														
	Team Member 4		Bob Villa														
	Team Member 5		Mary Jefferson														
	Team Member 6		Jimmy Smits														
Team Member 7																	
Meetings	#	Date	Time	Att.	#	Date	Time	Att.	#	Date	Time	Att.	#	Date	Time	Att.	
	1	6/3	9:00a	7	9	7/30	6:00p	4	17	10/12	2:00p	7	25				
	2	6/10	10:00a	7	10	8/10	4:00p	4	18	10/31	9:00a	7	26				
	3	6/17	3:00p	5	11	8/17	3:00p	5	19	11/15	9:00a	4	27				
	4	6/24	2:00p	6	12	8/24	7:00a	3	20	12/3	10:00a	5	28				
	5	7/2	1:00p	5	13	8/31	8:00a	7	21	12/19	4:00p	7	29				
	6	7/9	9:00a	7	14	9/4	9:00a	7	22				30				
	7	7/16	11:00a	7	15	9/11	4:00p	6	23				31				
	8	7/23	Noon	6	16	9/18	5:00p	5	24				32				



Project Planning Worksheet

Note: In some cases a team may choose to use a Project Charter and a separate Project Planning Worksheet with DMAIC schedule as follows.

Project Planning Worksheet DMAIC Schedule – Page 2 of 2															
STEP	<div style="display: flex; align-items: center; gap: 10px;"> <div style="border: 1px solid black; width: 20px; height: 10px; background-color: white;"></div> = Proposed <div style="border: 1px solid black; width: 20px; height: 10px; background-color: black;"></div> = Actual </div>														Comments / Exceptions
	2018												2019		
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	
Outline of Activities	Define														
	Measure														
	Analyze														
	Improve														
	Control														

4.

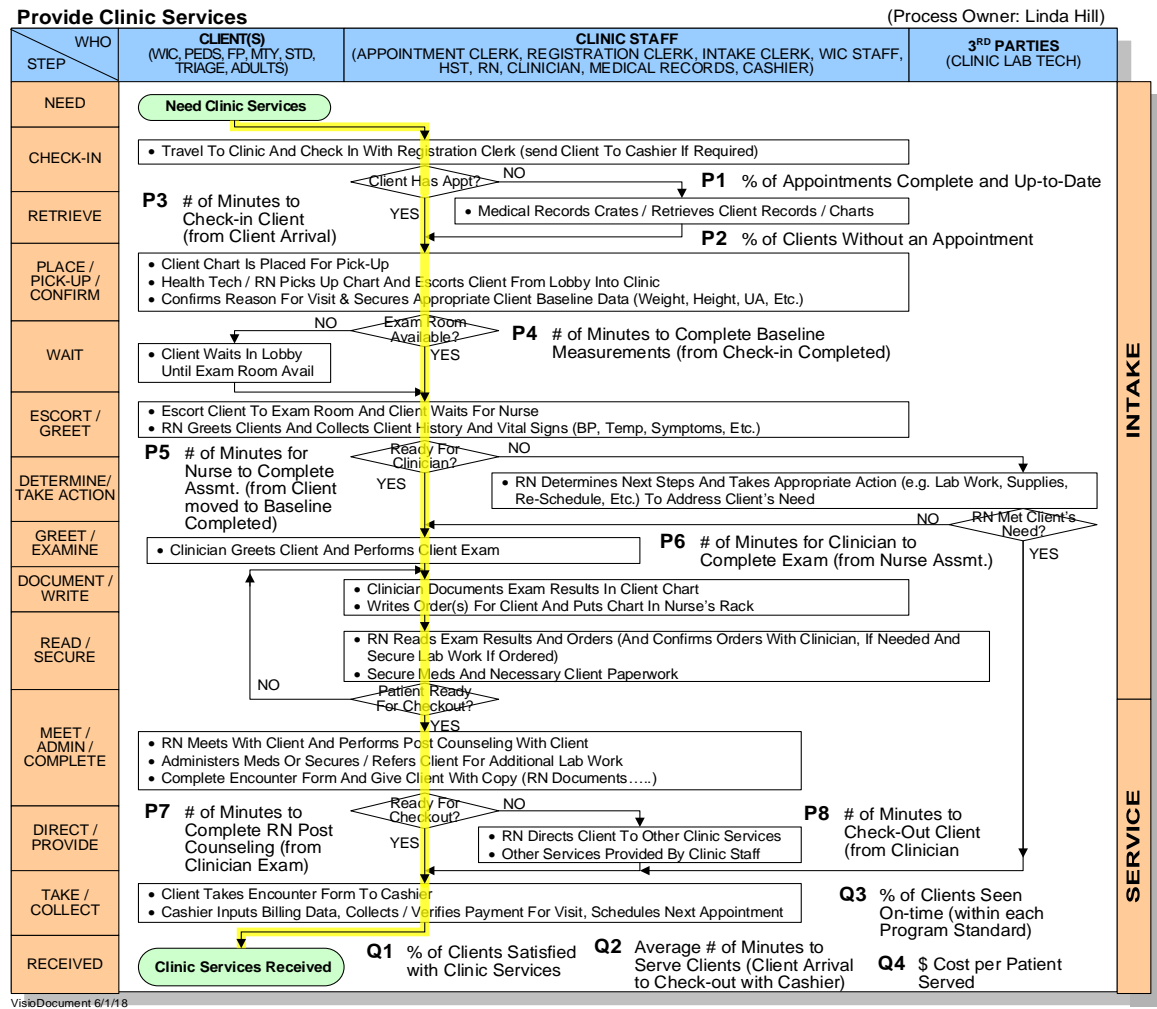
The sponsor signed off on the project's purpose, scope and significance.

5.



Flow Chart

- The team developed a flow chart to better understand the process driving the Theme Indicator (Q2) and the 70 minutes average cycle time.




Define Measure Analyze Improve Control

8 Wastes

8 Wastes	Potential Causes of Waste
1. Defects & Rework	<ul style="list-style-type: none"> • Patients show up late for appointments. • Walk-ins are accepted and worked into the patient flow. • Must call-back patients many times to reach them.
2. Over-production	Requiring patients to change gown when not necessary.
3. Waiting	<ul style="list-style-type: none"> • Patient waits for blood draw and lab work. • Patients without appointments are mixed with those that have appointments. • Exam rooms are not available. • Patient must wait for nurse. • Clinician not informed immediately when nurse completes exam. • Patient must wait to be checked out. • Patients must wait in line at cashier.
4. Non-Utilized Talent & Wasted Knowledge	<ul style="list-style-type: none"> • Only clinicians are allowed to order lab work. • Physicians required to complete routine paperwork.
5. Transporting	Must move equipment between exam rooms.
6. Inventory	Supplies and equipment are ordered based on the calendar rather than demand.
7. Motion	Desk top computers not positioned in exam rooms to provide convenient access by physician or nurse.
8. Excess Processing	Unnecessary tests may be performed on the patient.



Checksheets (Used to collect & analyze data)

Using insights gained from the flow chart and 8 Wastes analysis, a checksheet 6.  was developed to collect data on patient flow through the clinic for 300 patients.


Clinic Services Summary

DEMOGRAPHICS													Milestone Dates / Times											
Client Information											Clinic													
Line #	B	C	D	E	G	H	I	I	I	I	I	J	K	L	M	N	O	P	Q	R	S	T	U	X
	Program Type	Client Had Appmt? Y/N	Client Gender	Client Eligibility Status	Client Age at Arrival Date	Client Speaks English?	Visit Type	Chief Complaint	Acuity	Primary Diagnosis	Lab Test	# of People Under staffed during Visit Day	Clinic Locn	Sched'd Appmt Time	Arrival Date / Time			Check In Compl (ready for Pickup)	Baseline Measures Compl'd	Moved to Exam Room	RN Completes Vitals / Asmt	Clinician Completes Client Exam	RN Completes Post Counseling	Checkout Compl'd by Cashier
	% Y	% F			Avg	% Y																		
	40.0	66.7			41.8	40.0																		
1	Matern	Y	Fem	Medicaid	82	Y	Check	Dizziness	Urgent	Dizziness	Culture/GN	-2	Mirama	1:30 PM	07/05/06	We	1:30 PM	1:41 PM	1:56 PM	2:15 PM	2:34 PM	2:52 PM	3:15 PM	3:24 PM
2	STD	N	Male	Self-Pay	20	N	Suppl	- Possible	Less-Ur	Finger Abs	UA (w/o Mi	0	Coral G	9:00 AM	07/06/06	Th	9:00 AM	9:13 AM	9:20 AM	9:35 AM	9:45 AM	9:56 AM	10:12 AM	10:23 AM
3	Adults	Y	Fem	Medicaid	19	Y	Proble	Other;Urin	Less-Ur	Bladder Inf	No Labor	-1	Miami	NA	07/05/06	We	1:30 PM	1:41 PM	1:56 PM	2:15 PM	2:34 PM	2:52 PM	3:15 PM	3:24 PM
Duration (Minutes)																AK								
Y= P-O	Z= Q-P	AA= R-Q	AB= S-R	AC= T-S	AD= U-T	AE= X-U	AF= X-O	AG= W-V	AH	AI	AJ=Y if AF <=Std	AK												
Arrival to Chk In Compl	Ck In Compl to Basline Compl	Baseline Compl to Exam Room	Exam Room to RN Asmt	RN Asmt to Clinician Exam	Clinician Exam to Post Counseling	Post Counseling to Cashier CkOut	Arrival to Cashier CkOut	Lab Work Start to Lab Compl'n	Appmt Info Complete and Up-to-Date Y/N?	Client Visited without an Appmt? Y/N	Client Seen On Time? Y/N	Comments (Variations from normal process)												
Average # of Minutes											%Y													
12.0	11.0	17.0	14.5	14.5	19.5	10.0	98.5	2.0	50.0	50.0	0.0													
P3	P4	P5	P6	P7	P8	P9	Q2		P1	P2	Q3													
11	15	19	19	18	23	9	20	2	Y	Y	N	System down;												
13	7	15	10	11	16	11	78		N	N	N													
11	15	19	19	18	23	9	24	2	Y	Y	N													

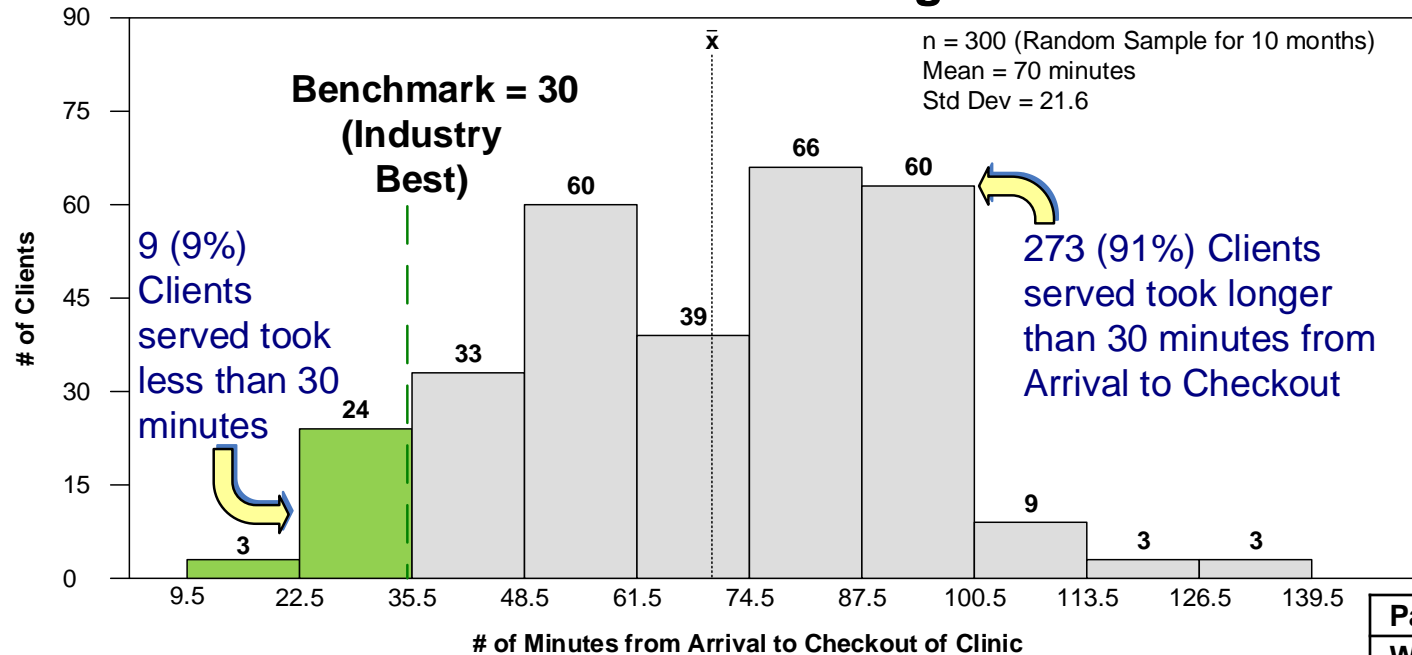
Note: The team considered who, what, when, and where in the checksheet's design.



Histogram - Stratification

The team collected a random sample of 300 clinic clients served during 7.  August 2017 through May 2018. Because the Theme Indicator represented continuous data, the team developed a histogram of randomly sampled patients.

Clinic Clients Served During 8/17 – 5/18



The team looked closer at these 273 clients served.

Patient Flow Report
When: May 2018
Where: Miami, FL
Who: J. Smits x 313

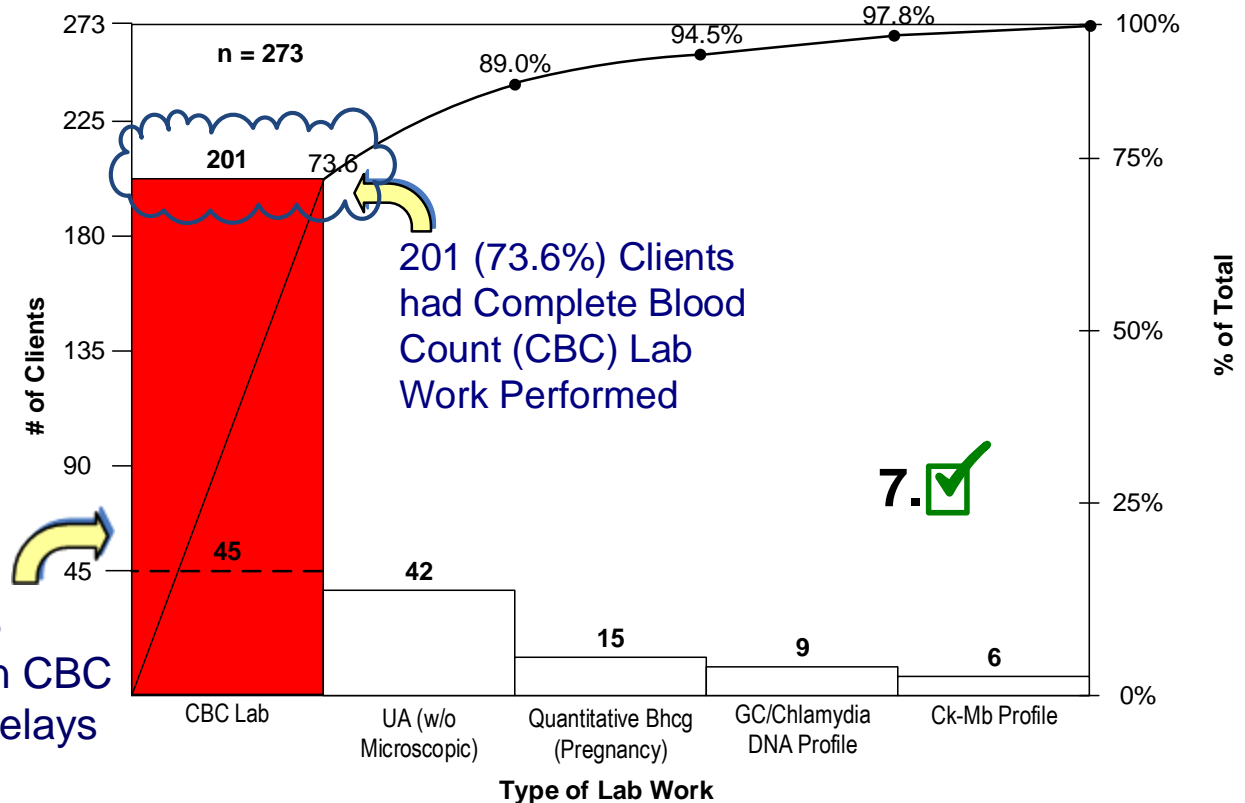


Pareto Chart – Stratification Continues

The team stratified the 273 clients which took longer than 30 minutes from 4 perspectives - what, when, where and who, and found...

Clinic Clients Served During 8/17 – 5/18 taking longer than 30 minutes from Check-in to Check-out and involving Lab Work.

Target: 78% Reduction in CBC Lab Work Delays



The team set a target to reduce the number of CBC Lab clients taking longer than 30 minutes from check-in to check-out by 78%.



Problem Statement and Target

- If the target is achieved, the team determined that it could reduce the Average Cycle Time on the Theme Indicator in the Define step by 40 minutes and achieve the corporate target of 30 minutes. (Calculations are shown in the Appendix).
- **Problem Statement:** Reduce the number of CBC Lab clients taking longer than 30 minutes from Check-in to Check-out by 78% (from 201 to 45) by 12/31/18.
- The team met with the sponsor to discuss what could be achieved vs. the organizational target of 30 minutes. The sponsor signed off on the project's focus and target.

9.

10.

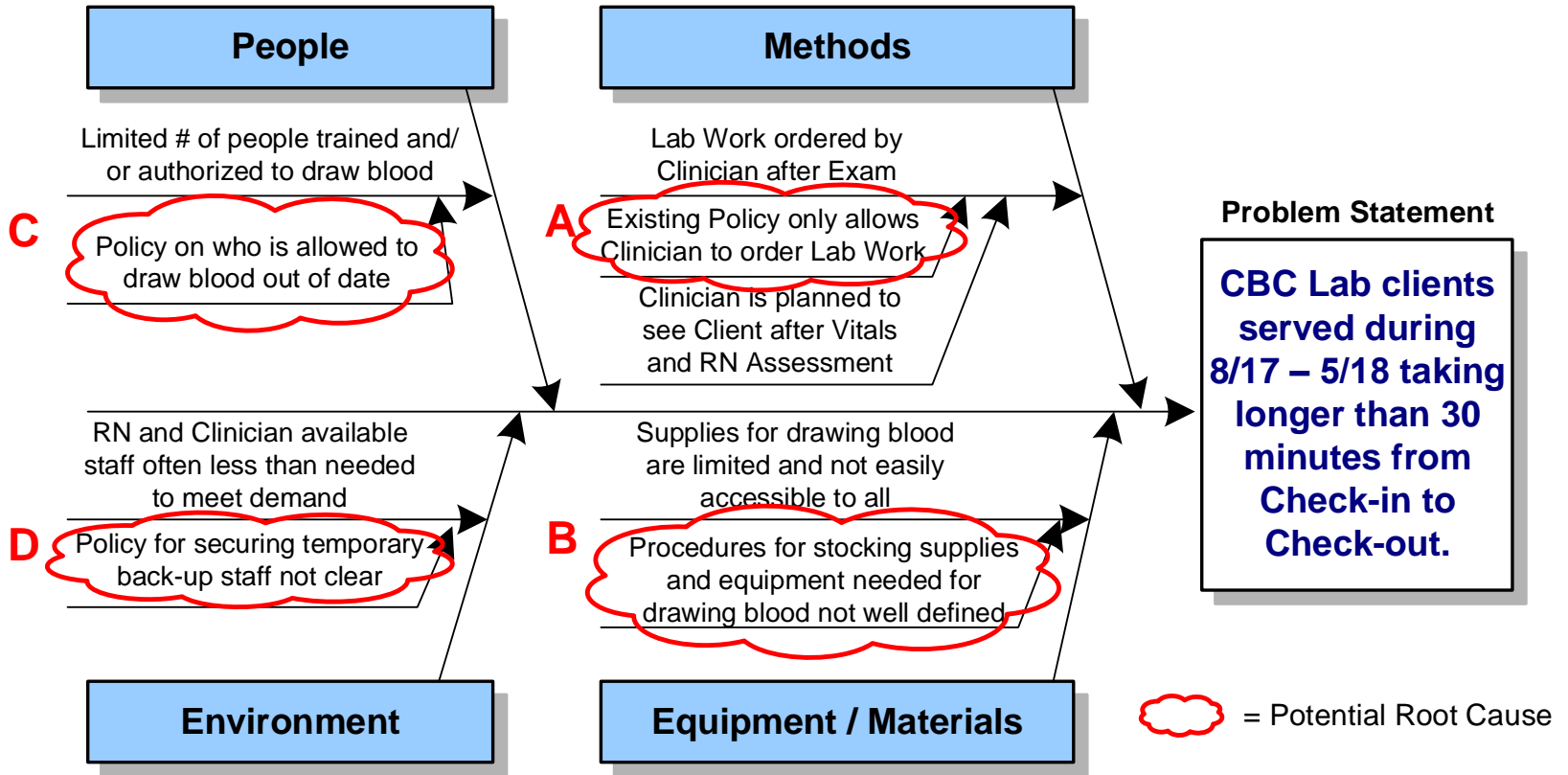
11.



Cause and Effect (Fishbone) Diagram

The team completed Cause and Effect Analysis and found...

12. ✓



The team selected 4 potential causes for verification.

13. ✓

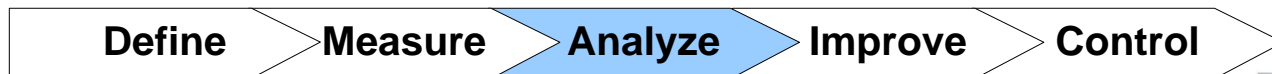


Probable Cause Verification Matrix


The team collected data to verify causes and summarized its findings on a Verification Matrix.

14. 

Potential Root Cause	How is it Verified?	Root Cause or Symptom	
A. Existing Policy only allows Clinician to order Lab Work	Team reviewed current Policy and guidelines and verified Policy only allows Clinician to order Lab Work.	Root Cause	A
B. Procedures for stocking supplies and equipment needed for drawing blood not well defined	Team reviewed current guidelines and verified that no clear Policy exists.	Root Cause	B
C. Policy on who is allowed to draw blood out of date	Team reviewed current guidelines and found Policy is current and matches company standards	Symptom	C
D. Policy for securing temporary back-up staff not clear	Team reviewed current guidelines and found there is no written Policy on when to secure back-up staff to meet staffing needs.	Root Cause	D




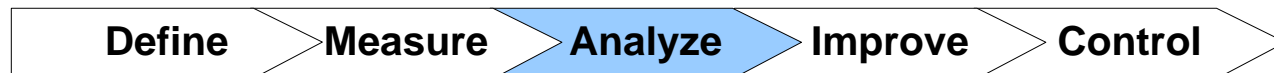
Probable Cause Verification Matrix

- The 201 late CBC patients from the sample were further analyzed to determine the frequency of occurrence of each selected cause. The Chi-square test was conducted for each cause. This enabled the team to verify the root causes and estimate the impact of each root cause on the gap. Three (3) primary causes were verified by the team. 14. 

- Root Cause A = present 35% of the time = 69 patients;
- Root Cause B = present 22% of the time = 45 patients;
- Root Cause D = present 19% of the time = 39 patients;
- Total** = 153 patients

Estimate: $153 \div 201 = 76\%$ which approximates the target in the Measure step of a 78% reduction.

- The sponsor signed off on the verified root causes and impact on the gap. 16. 



Countermeasures Matrix

The team developed three countermeasures and evaluated seven practical methods for effectiveness and feasibility.

17.

18.

Rating Legend: 1 = None 2 = Some 3 = Substantial 4 = High 5 = Extreme				Ratings				
Problem Statement	Verified Root Causes	Counter-measures	Practical Methods	Effectiveness	Feasibility	Overall	Take Action? Yes/No	
Clinic Clients served during July 2013 taking greater than 30 minutes from Arrival to Checkout and involved CBC Lab Work	A. Existing Policy only allows Clinician to order Lab Work	Revise the policy	A1- Develop protocols approved by Clinicians to order Lab Work under certain conditions found by the RN	4	4	16	Y	1
			A2- Have Clinician see the Client first	4	2	8	N	
	B. Procedures for stocking supplies and equipment needed for drawing blood not well defined	Develop properly defined procedures	B1- Develop procedures for keeping supplies stocked	5	5	25	Y	2
			B2- Use "Kanban" cards to notify staff when supplies down to reorder levels	5	5	25	Y	3
	D. Policy for securing temporary back-up staff not clear	Develop standardized staffing procedures	D1- Develop procedures for when to call in back-up staff	4	5	20	Y	4
			D2- Cross-train staff to be able to back-up certain positions when vacancies arise	4	4	16	Y	5
D3- Identify paid temporary or volunteer persons willing to come in and help when vacancies arise			4	3	12	Y	6	

The team next looked closer at implementing the 6 practical methods chosen.



Barriers and Aids Analysis

- The team developed a Work Breakdown Structure on each practical method.
- Next, the team performed Barriers and Aids (B&A) Analysis on each of the 6 Practical Methods (PM) selected. (**Note:** Only B&A for practical method A1 is shown. Others are shown in the Appendix).

19. 

Countermeasure: Practical Method A1		
Barriers		Aids
Impact (H,M,L)	Forces Against Implementation	Forces For Implementation
M	1) Lack of buy-in by Clinic staff (supported by Aid: 1,2,3,4).	1) Management very supportive of efforts due to expected gains in efficiency and patient satisfaction.
M	2) Possible temporary workload issue for staff (supported by Aid: 1,2,3).	2) Beneficial impact on timeliness of Clinics.
H	3) Resources are limited (supported by Aid: 1,2,3).	3) Reduced costs and workload will result.
H	4) Budget is limited (supported by Aid: 1,2,3).	4) Other Clinics already have implemented some of the countermeasures.

The team incorporated the 4 Aids into the action plan for PM A1.


















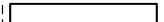





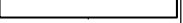

Action Plan

The team developed an action plan to implement the countermeasures / practical methods (CM / PM). **Note:** Only Action Plan A1 is shown. Other action plans are shown in the Appendix.

20. 

WHAT: Implement PM A1 to Improve Clinic Cycle Time

Legend:  = Actual
 = Proposed

ELEMENTS (HOW)	WHO	SCHEDULE (WHEN)						Cost
		2018						
		Jul	Aug	Sep	Oct	Nov	Dec	
1. Develop protocols approved by Clinicians to order Lab Work under certain conditions found by the RN.	Jimmy		  Completed 8/30/18					\$53,000
2. Develop training materials.	Tom		  Completed 8/31/18					
3. Select training facilities.	Dr. House		  Completed 8/28/18					
4. Schedule Clinicians for training.	Steve		  Completed 8/30/18					
5. Address the 4 Aids.	Ben		  Completed 8/30/18					
6. Secure Management approval of training plan. (Share clinic and staff benefits and cost savings).	Tom		  Completed 8/30/18					
7. Communicate / train regional staff in CM / PM and related policies / procedures. (Share clinic and staff benefits and cost savings).	Jimmy		  Completed 9/30/18				--	
8. Implement pilot for countermeasures.	Steve			  Completed 9/30/18			\$1,000	
9. Evaluate pilot and determine benefits and adjust as necessary and present results to management. Document lessons learned and calculate ROI.	Ben			  Completed 10/11/18			\$500	
	Tom			  Completed 10/16/18			\$500	
10. Establish ongoing responsibilities and standardize countermeasures into operations	Dr. House					  Ongoing	\$500	
		Total Cost						\$55,500

- The team implemented the pilot and then finalized the action plan.

21. 



Lessons Learned

The team documented lessons learned.

22. 

From Pilot

- No shows to training impacted project costs.
- Must have better controls on vendor costs and schedules.
- Training schedule must have built-in flexibility due to summer vacation schedules.
- Better Barriers and Aids analysis would have predicted union-related issues.

From Overall Project

- COPQ only applies to the gap.
- The histogram helps stratify the data from a time perspective.
- It is important to ensure the root causes addressed will be sufficient to achieve the target.
- The Work Breakdown Structure helped with action planning, accountability, and cost estimates.



Step 4: Improve

The team determined the project's **expected** Return on Investment.

22. 

RETURN ON INVESTMENT (ROI) WORKSHEET			
Itemized Costs		Itemized Benefits	
Descriptions	\$ Value (Annualized)	Descriptions	\$ Value (Annualized)
A1 Protocols	\$55,500	Reduced LWOBS	\$1,200,000
B1 Procedures	\$5,000	Reduced penalties	\$900,000
B2 Kanban Cards	\$8,000	Reduced inventories	\$800,000
D1 Procedures	\$3,000	Reduced rework	\$400,000
D2 Cross-train	\$25,000	Reduced rework	\$525,000
D3 Temps & Volunteers	\$15,000	Reduced complaints	\$75,000
Total Annualized Costs	\$ 116,500	Total Expected Annualized Benefits	\$ 4,900,000
(Expected) ROI Ratio = $\frac{\text{Benefits} - \text{Costs}}{\text{Costs}} = \frac{\$4,900,000 - \$116,500}{\$116,500} = 41.1:1$			
Note: Costs are summarized by Practical Method.			

The sponsor signed off on the action plans and expected ROI.

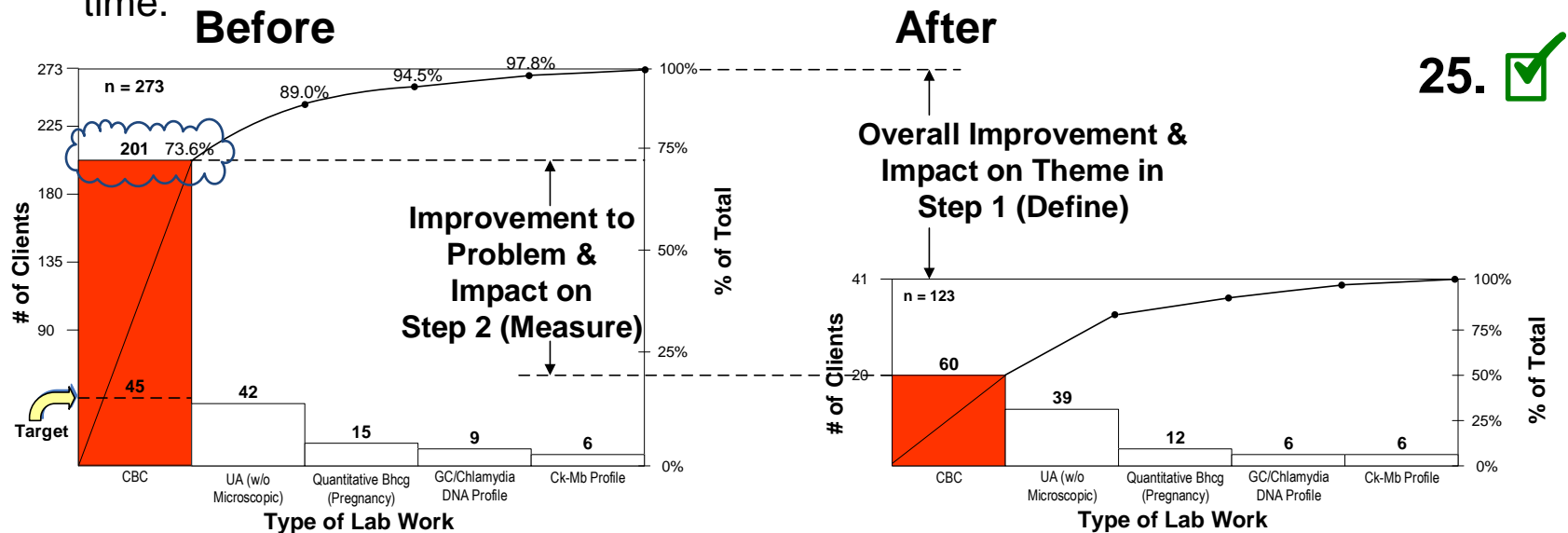
23. 

Step 5: Control

Results

24.

- First, the team confirmed that each root cause identified in the Analyze step was eliminated by the countermeasures.
- Next, the team evaluated the impact of countermeasures on the problem shown in the Measure step by doing another sample of 300 patients and developing “Before” and “After” Pareto charts of clients who exceeded the 30 minute cycle time.



25.

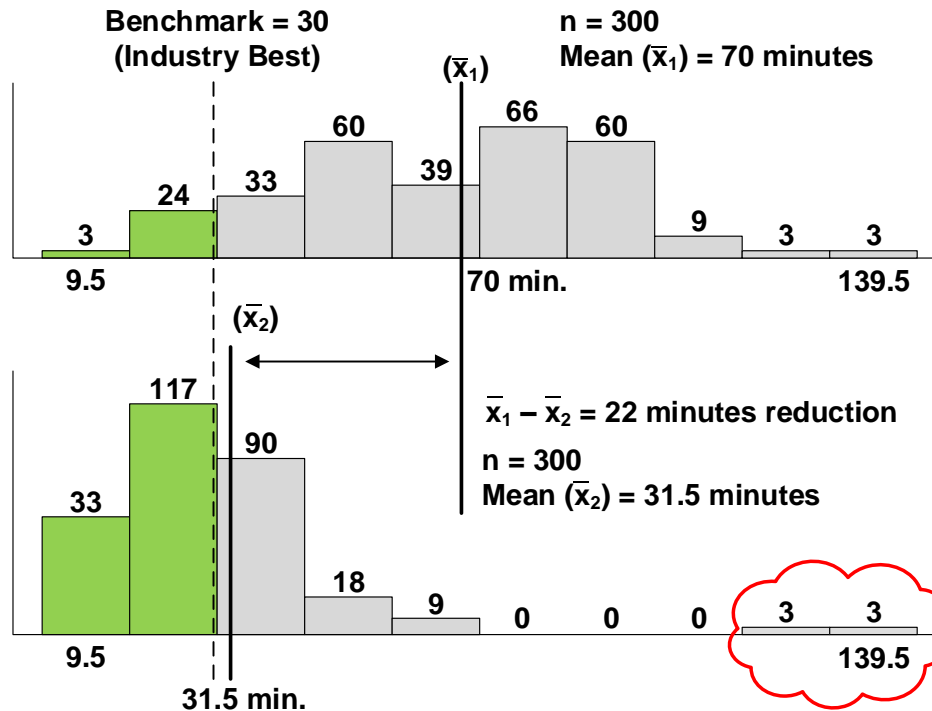
- Reduction of 141 CBC Lab patients = 70.2% reduction.
- Target was 201 x 78% = 157 CBC Lab patient reduction.

The team **almost** achieved its target for CBC reduction, but 3 other problems showed minor improvements.

Step 5: Control

Then, the team developed “Before” and “After” Histograms using the same sample data used for the Pareto analysis.

25. 



(Before Countermeasures)

(After Countermeasures)

- Average Overall Cycle Time was reduced from 70 to 31.5 minutes. (55% improvement).
- The 6 outliers were attributed to unscheduled walk-ins.
- **Conclusion:** The team determined that missed training deadlines on practical method D3 were responsible for falling short of the target and adding to the costs of the countermeasures.

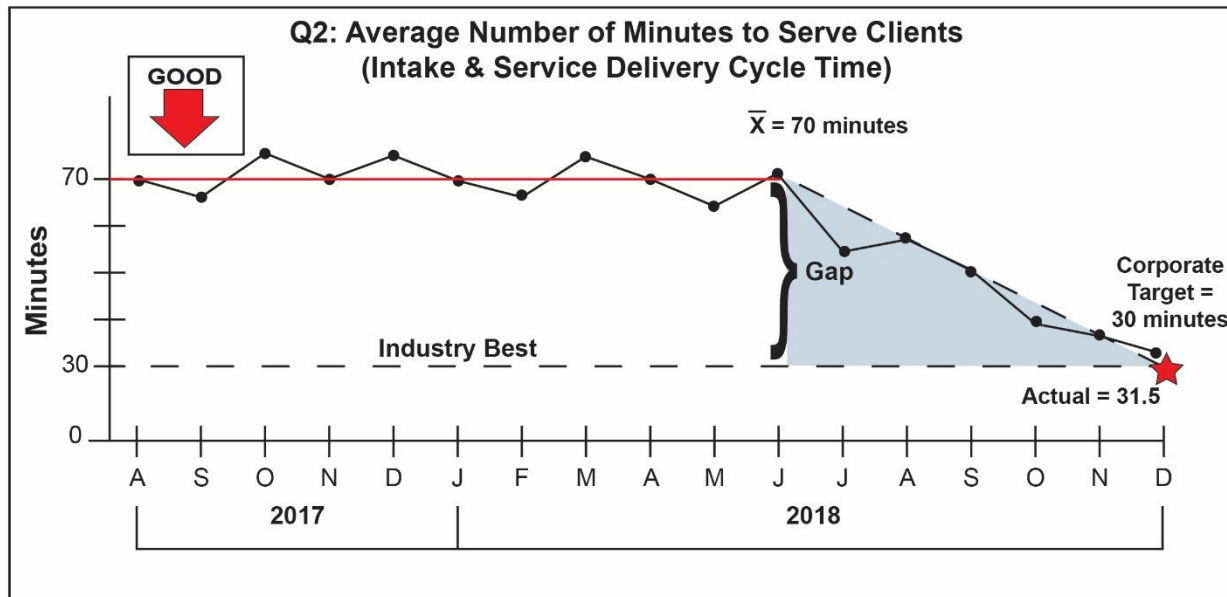
26. 



Step 5: Control

- Finally, the team evaluated the impact of countermeasures on the Theme Indicator represented by the line graph in the Define step and calculated the **actual** project's Return on Investment Ratio as **38.3:1** (Annualized Financial Benefits = \$4,716,250 and Costs = \$120,000).

27. ✓



Standardization

- New procedures were put in place.
- Employees were trained on the new procedures and monitored monthly by QA and supervisors to ensure compliance.
- Improvements were replicated at all other clinics.

28. ✓

29. ✓

30. ✓

Step 5: Control

Lessons Learned & Future Plans

- 1) The team recommended that CBC Lab patient delays continue to be addressed and that UA Lab delays also be addressed to minimize impact on scheduled patient flow and clinic cycle time. 31.
- 2) Lean Six Sigma offers a different way to review problems, 90% of which can be solved using basic analytical tools. 32.
- 3) The flow chart helped a diverse group of team members to see the process clearly and examine it for waste.
- 4) Identifying cause(s) using the tools and techniques is better than guessing at what you **think** are the causes, or focusing on low impact causes.
- 5) Even though the team focused on CBC Lab Work, other problem areas improved because of the increased awareness of wasted time and better use of standard procedures.



Step 5: Control

Lessons Learned & Future Plans

- 6) The DMAIC framework provided a basis for logical analysis and for communicating the improvements to others.
- 7) Subsequent to this successful project and results, management replicated the new system to the other 10 clinics.
- 8) Management identified other areas from the Theme Selection Matrix to target the application of Lean Six Sigma tools.

The sponsor signed off on the results and next steps. 33.

The Leadership team recognized the team for its accomplishments and encouraged it to compete in the statewide competition next June.



DMAIC Summary

Key Learning Points



- The DMAIC Story should flow and be logical.
- Show the linkage of the measure used in the Define step to the organization's Key Performance Indicators (KPIs) and/or Strategic Plan.
- Use the “Before and After” technique in the Control (Results phase) step to reinforce the value of analysis and impact.
- Let the data tell the story with minimal supporting text.
- The DMAIC Story should stand on its own without a narrator.

Summary

- Lean tools can engage the entire workforce in the continuous improvement mindset.
- Six Sigma tools are important for the ongoing management and improvement of processes.
- DMAIC is a logical way of thinking, problem solving, and communicating.
- Basic tools can solve most business issues.
- Solving problems without considering the process that created them yields minimal impact, and any benefits achieved will not be sustainable.

Contact Information

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