

# Measure Phase Project: Optimizing Appointment Scheduling

## 1. Executive Summary

The Measure Phase of our Six Sigma Black Belt project was designed to quantify the current performance of the appointment scheduling process across five clinics. Using Six Sigma tools and statistical analysis, we aimed to identify patterns in unfilled appointment slots, assess process variability, and understand the causes of inefficiencies. The project seeks to improve slot utilization, thereby enhancing patient access and maximizing clinic revenue.

### Overarching Questions

**a) Precisely define what problems are occurring.**

Currently, clinics report a high volume of unfilled appointment slots—averaging 20% to 25% weekly. This results in approximately \$5,000 in weekly revenue losses and significantly affects patient access, as fewer appointments are available for scheduling.

**b) How did you prioritize and select critical input, process, and output measures?**

We reviewed VOC (Voice of Customer) feedback and CTQs (Critical to Quality metrics) to identify relevant factors. Input measures such as reminder compliance and scheduling method were considered. Process measures included lead time between scheduling and appointment date, while output measures involved the slot fill rate and patient satisfaction. A prioritization matrix helped narrow the focus to the most critical variables.

**c) What have you done to validate the measurement system?**

We conducted measurement system analysis on the data reporting from the EHR. Three schedulers performed manual audits of appointment logs from three separate weeks, cross-referencing with system reports. A Gage R&R analysis showed less than 5% variability between manual and system records, confirming measurement reliability. We also confirmed data extraction consistency across all five clinics.

**d) What patterns are exhibited in the data?**

- Afternoon and Friday slots have the highest rate of being unfilled.
- Patients receiving reminders less than 24 hours before their appointments were more likely to miss them.
- Self-scheduled appointments had a higher fill rate than those scheduled manually.
- Clinics with the lowest reminder compliance had the highest no-show rates.

These patterns indicate operational and behavioral factors influencing performance.

**e) Do you believe there was an appropriate use of tools?**

Yes, we used a variety of tools including process maps, Pareto charts, VOP matrices, and VOC summaries. These tools helped us dissect the appointment process, understand customer expectations, and assess how well the current system performs.

**f) What tools did you use beyond each required tool? Why?**

- **Time Series Plots:** Used to visualize weekly trends in unfilled slots.
- **Boxplots:** Used to identify variation in performance across different days and times.
- **Control Charts:** Helped evaluate process stability. These tools provided deeper insights into time-based and categorical variations.

**g) Is the project ready to move to the next phase? Why or why not?**

Yes. We have validated data, performed capability and stability analysis, and identified key areas of concern. This foundation supports transition to root cause analysis in the Analyze Phase.

**h) If not, what measures are needed to recover?**

If additional data quality issues are discovered, further audits and stakeholder interviews will be completed within 5 business days. Any gaps would be documented and resolved in the project log.

**i) Does the charter, problem, or scope need refining?**

The overall project scope remains appropriate. Based on VOC findings, CTQ definitions may need to more explicitly incorporate patient satisfaction with digital scheduling tools.

---

## **2. Process Maps**

### **High-Level Process: Appointment Scheduling**

1. Patient requests appointment
2. Scheduler checks availability
3. Slot assigned in EHR
4. Reminder sent (SMS/email)
5. Patient confirms or misses
6. Slot is either fulfilled or marked "unfilled"

Further breakdowns include subprocesses for reminder generation, cancellation workflows, and slot reallocation. A swimlane version is also available to show interactions between schedulers, patients, and automated systems.

---

## **3. Operational Definitions**

Term	Definition
<b>Unfilled Slot</b>	Appointment time not booked or cancelled <24 hrs before appointment.
<b>No-Show</b>	Patient scheduled for a visit who fails to appear without prior cancellation.
<b>Reminder Compliance</b>	Proportion of scheduled appointments for which timely reminders (at least 24 hours prior) were sent.
<b>Scheduling Lead Time</b>	Time in days between the appointment booking and the appointment date.
<b>Slot Fill Rate</b>	Percentage of total available appointment slots filled within a defined period.

---

#### 4. Data Collection Plan

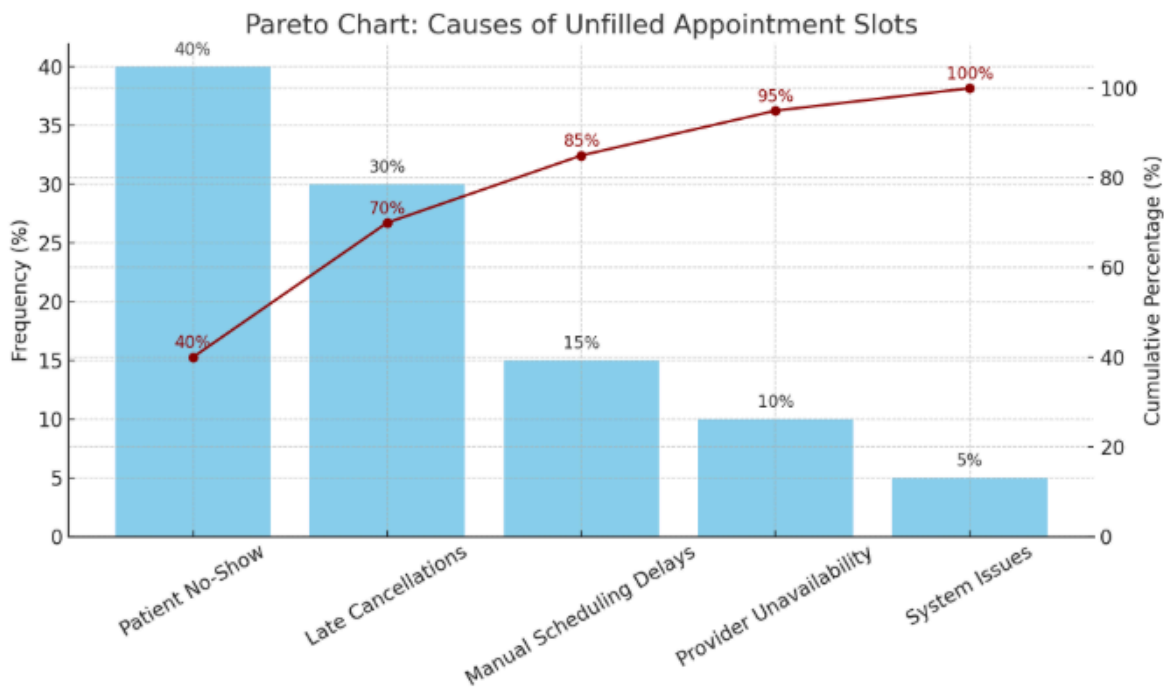
Metric	Source	Frequency	Method
Unfilled Slots	EHR Reports	Weekly	System-generated
No-show Rate	EHR	Weekly	Report queries and visual dashboards

Reminder Compliance	EHR + SMS Logs	Weekly	Combined extraction from communication logs and scheduling systems
Patient Satisfaction	Surveys	Monthly	Post-visit feedback forms and net promoter score
Scheduling Lead Time	EHR	Weekly	Calculated from appointment booking timestamps

We used random sampling over 12 weeks to ensure data reliability and representativeness.

5. Pareto Charts

Pareto Analysis of Causes for Unfilled Slots:



---

## 6. VOP Matrix (Voice of the Process)

Metric	Baseline Value	Target	Performance Gap
Slot Fill Rate	75–80%	90%	10–15%
Reminder Compliance	70%	95%	25%
Avg. Scheduling Lead Time	3.5 days	≤2 days	1.5 days
No-Show Rate	18%	≤10%	8%

---

## 7. VOC Results

### Sources:

- Post-visit patient surveys
- Direct patient interviews
- Feedback from front desk staff

### Themes Identified:

- Frustration with scheduling bottlenecks and long waits
  - Limited visibility into appointment availability
  - Positive feedback on SMS reminders
  - Interest in expanding evening/weekend appointment slots
- 

## 8. VOP Baseline Results

Clinic	Slot Fill Rate	Reminder Compliance	No-Show Rate
Clinic A	79%	65%	20%
Clinic B	76%	72%	18%
Clinic C	81%	68%	22%
Clinic D	74%	70%	19%
Clinic E	78%	67%	17%

This data forms the baseline for evaluating improvements in later phases.

---

## 9. Basic Statistics

### Unfilled Slot Rates (12-week period):

- Data: [19%, 22%, 21%, 23%, 20%, 17%, 25%, 18%, 28%, 14%, 21%, 24%]
- Mean ( $\mu$ ) =  $(\sum x) / n = (272\%) / 12 = 22.67\%$
- Median = 21.0%
- Variance ( $\sigma^2$ ) =  $\sum (x_i - \mu)^2 / n = 17.8$
- Standard Deviation ( $\sigma$ ) =  $\sqrt{17.8} \approx 4.22\%$
- Range = Max - Min = 28% - 14% = 14%

**Interpretation:** The data shows moderate variability. The standard deviation indicates that most values fall within  $\pm 4.22\%$  of the mean. The highest unfilled rate was 28%, and the lowest was 14%.

### No-Show Rate Summary (12-week period):

- Data: [18%, 20%, 19%, 17%, 21%, 16%, 22%, 19%, 20%, 17%, 18%, 19%]
- Mean ( $\mu$ ) =  $(\sum x) / n = (224\%) / 12 = 18.67\%$

- Mode = 19%
- Variance ( $\sigma^2$ ) =  $\sum(x_i - \mu)^2 / n \approx 2.06$
- Standard Deviation ( $\sigma$ ) =  $\sqrt{2.06} \approx 1.43\%$
- Range = Max - Min = 22% - 16% = 6%

**Interpretation:** The no-show rates are relatively stable with lower variation. The standard deviation of 1.43% suggests tight clustering around the mean of 18.67%.

Additional descriptive statistics were calculated by clinic, time of day, and appointment type.

---

## 10. Gage R&R (if applicable)

**Scenario:** Manual classification of slot statuses by different schedulers.

- Operators: 3 schedulers
- Parts: 10 randomly selected days with slot records
- Result: <5% variability between operators → Acceptable system accuracy

We validated that the EHR definitions and outputs are reliable enough for process evaluation.

---

## 11. Process Capability Analysis

**Metric: Slot Fill Rate**

- Lower Spec Limit (LSL): 90%
- Current Mean: 78%
- Cp = 0.67 → Below minimum acceptable capability
- Cpk = 0.58 → Indicates left skewness, with greater frequency of underperformance

Process improvements are clearly needed to raise performance closer to specifications.

---

## 12. Summary of Next Steps

1. Move forward into the Analyze Phase to explore root causes of unfilled appointment slots.
2. Use tools like Fishbone Diagrams and 5 Whys to identify key contributing factors.
3. Conduct statistical analysis to validate the influence of lead time, reminder timing, and scheduling method.

4. Assess non-value-added steps in the current workflow.
  5. Begin scoping pilot improvement strategies based on key findings.
-