

Reduction in Average Length-of-Stay in Emergency Department of a Low-Income Country's Cancer Hospital

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Abstract

Introduction: Prolonged length of stay (LOS) in emergency departments (ED) is a widespread problem in every hospital around the globe. Multiple factors cause it and can have a negative impact on the quality of care provided to the patients and the patient satisfaction rates. This project aimed to ensure that the average LOS of patients in a tertiary care cancer hospital stays below 3 hours. **Materials and Methods:** The Six Sigma DMAIC (Define, Measure, Analyze, Improve, Control) approach was followed. **Results:** The average LOS was 166 minutes before implementing interventions. The two primary reasons for the increased length of stay were delays secondary to physician assessment and diagnostic lab reports. Strategies were defined to control these factors, which helped reduce the average length of stay to 142 minutes, a 30% reduction. **Conclusion:** A process improvement model similar to this project is recommended to enhance the quality of hospital services. It will provide valuable insights into the process flow and assist in gathering precise data on the various steps involved. The data collected can then be analyzed to identify potential causes and make informed decisions that can significantly improve hospital processes.

Keywords: Cancer hospital; emergency room; length of stay; Six Sigma

Introduction

The length of stay (LOS) of patients in the emergency department (ED) is the time between the patient's arrival and the time the patient physically departs the ED. Prolonged LOS in the ED is a widespread problem in many hospitals worldwide.^[1] Multiple factors cause it and can negatively impact the quality of care provided to patients and patient satisfaction rates. Hence, it is very important to implement strategies that can help reduce LOS.

This quality improvement (QI) project was implemented in one of the largest cancer hospitals in Pakistan, which offers a wide range of health-care services free of cost to nearly 75% of the registered cancer patients. With the expansion of clinical services, patient flow through emergencies increased, which resulted in an increased LOS beyond 3 h [Figure 1]. Patient surveys during this time showed increased patient dissatisfaction with ED services, primarily related to prolonged LOS.

The emergency services are open around the clock. It currently has one triage area, two isolation rooms, and six patient beds, with a nurse-to-bed ratio of 1:4. On average, 40-50 patients visit the ED daily. This QI project was implemented to reduce the LOS and increase patient satisfaction without compromising the quality of care.

Six Sigma is a well-organized, data-driven approach that helps reduce process variability.^[2] Therefore, this approach was adapted for the project following the guidelines from the National Health System

(NHS) of the United Kingdom.^[3] Previous studies support the implementation of the Six Sigma methodology as an effective way to reduce patient LOS in the ED.^[4-6] This QI project aimed to ensure the average LOS remains 10-15% below the target for the patients discharged from the ED with the help of Six Sigma methodology.

Materials and Methods

The hospital institutional review board (IRB) exempted this project from review. The baseline data of patients' visits were included from August 2021 until May 2022 [Figure 1].

Define, Measure, Analyze, Improve, and Control (DMAIC), a Six Sigma approach was followed. In the define phase, the main problem identified was increased patient LOS. A project charter was developed, which had all the key elements of team formation, goals, project planning, and constraints.^[3] Other tools used in this phase were supplier, inputs, processes, outputs, and customers (SIPOC) and the voice of the customer (VOC), through which patient satisfaction rates were measured.^[3]

A task force of three physicians, one clinical nurse manager, and two quality department members was developed to oversee the project. In the *measurement phase*, a detailed flowchart of the patient flow in the ED was created. Based on this, a data collection plan was made [Table 1], and data were collected accordingly. Run charts and histograms were used to represent the data.^[3]

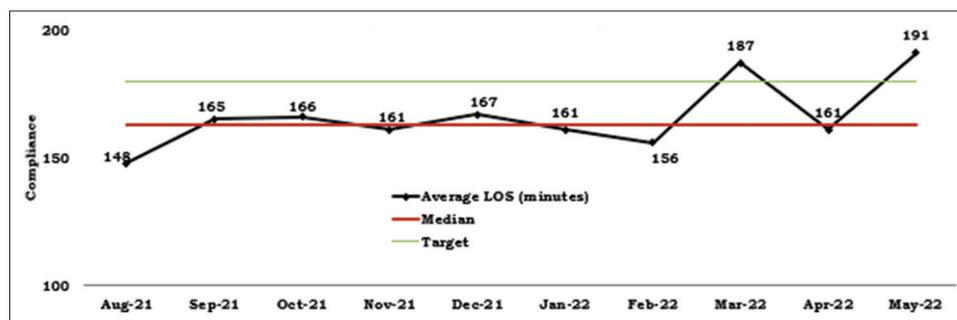


Figure 1: A run chart showing increase in the average length of stay data before implementation of interventions

Table 1: Initial data collection plan before interventions

Who	What				When	How	Others
Responsible	Operational Definition	Data Type	Sample size	Frequency	Date	Recording Method	Collection Method
EAR	Average length of stay	Time	All patients	Monthly	1 st week of every month	The data is recorded online from the electronic Hospital Information System (HIS)	Report retrieval from HIS
	Triage Time	Time					
	ESI/PEWS	Time					
	Junior doctor assessment (notes)	Time					
	Consultant assessment (notes)	Time					
	Labs/Tests Turn-around time	Time					
	Patient left without being seen (Absconded/LAMA)	Numbers					

Multiple analysis tools were used in the *Analyze Phase*, starting with the fishbone diagram [Figure 2] to identify all the potential causes of delays during the stay in ED through brainstorming with the team.^[3]

Patient medical records were reviewed to determine the exact contributing delay factors. A Pareto analysis [Figure 3] was done on the information extracted from patient medical records to identify the top two out of seven causes contributing to about 80% of delays.^[3] The two main issues highlighted were delays in physician assessments and diagnostic laboratory reports.

Further, a why-why analysis [Figure 4] was done to establish the root cause of these issues.^[3]

After another brainstorming session, an action plan [Table 2] was made and implemented in the *Improve Phase*. Re-analyses were done, and significant improvements were observed after implementing the plan. A control chart in the *control phase* was used to show the results [Figure 5]. A control plan was also made to ensure the continuity of implemented changes and sustainability.^[3]

The process performance index (P_{pk}) was calculated to measure the efficiency of the ED process flow. If P_{pk} is 1.0, the system produces 99.73% of its output within specifications. The larger the P_{pk} , the less variation there is between process output and specifications.^[7]

Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) software (version 22.0; SPSS, Chicago, IL). Descriptive statistics were computed for each variable. The distribution of data was assessed using the Shapiro-Wilk test. If the data was non-parametric, the Mann-Whitney U test was applied. $P < 0.05$ was considered to be statistically significant.

Results

The average LOS was 166 min before the implementation of interventions. Using the Six Sigma DMAIC methodology, the whole ED process was studied, and areas of improvement were identified with the help of appropriate analysis tools. The Pareto analysis conducted on a sample of 128 patients in the ED highlighted two primary concerns. First, there were delays in physician assessments, and secondly, patients experienced



Figure 2: Fish bone diagram for potential causes of delays contributing towards increased length of stay

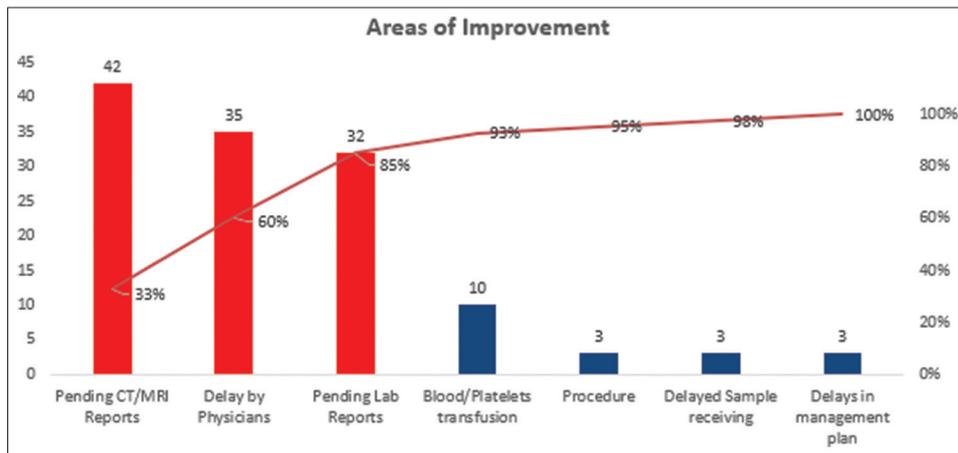


Figure 3: Pareto analysis highlighting major contributing factors of increased length of stay using 80/20 rule

Table 2: Action plan for improvement which was implemented to bring improvements

Action Plan
Responsible Team: Emergency Physicians
Action/Tasks
1. Emergency patients to be seen by a consultant physician within half an hour after initial assessment by the junior doctor.
2. Ensure adequate staffing level at daytime, evening and on weekends.
3. The consultant physician will be informed by the junior doctor if there is a failure to establish contact with diagnostic services for performing and reporting of diagnostic tests ordered from ED.
4. On call roster will be developed, updated on regular basis, and shared with the ED staff.
5. Planned periodic emergency department meetings with the team to analyze the impact of above-mentioned points.

long wait times for diagnostic lab reports. These issues require attention to optimize patient care and improve efficiency within the department.

Previously, doctors would take approximately 1 h to assess patients taken on the bed. However, after implementing new strategies, this time was cut

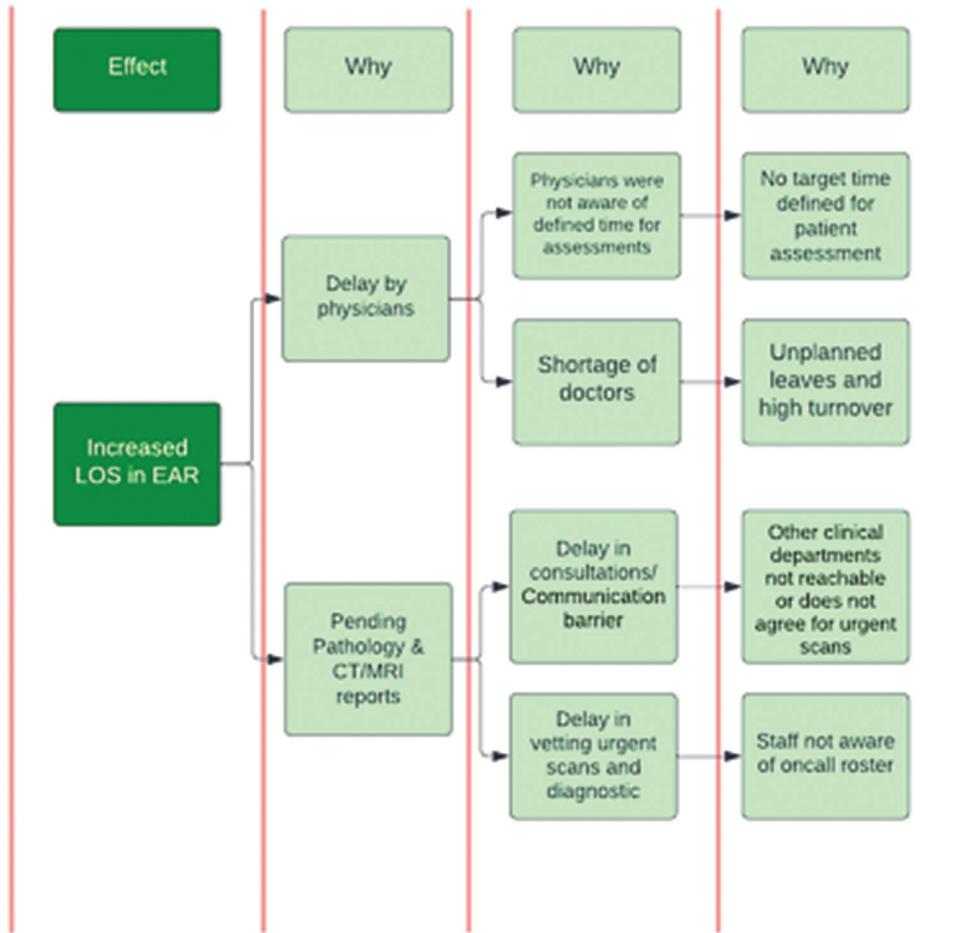


Figure 4: A Why-Why analysis of the contributing factors highlighted in the pareto analysis

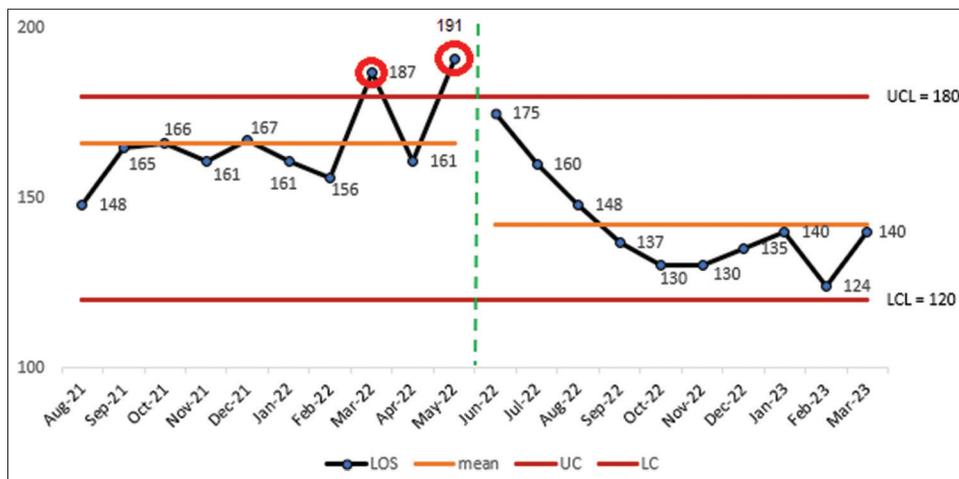


Figure 5: Control chart showing comparison of pre and post-intervention average length of stay data. Lower control limit is 120 min and upper control limit is 180 min which are the normal control limits. Data exceeding these limits is highlighted in red

in half to just 30 min. Communication difficulties previously caused delays in receiving lab reports, but these were resolved by setting up a better system for contacting diagnostic services. As a result of these changes, the average time spent in the ED decreased from 166 min to 142 min, a reduction of almost 30%.

To confirm the enhancements, the P_{pk} was computed using the initial data to determine whether the ED process flow was meeting its time requirements. The P_{pk} value, estimated at 0.37, indicated that improvements were necessary. Following the implementation, P_{pk} was recalculated and showed an improvement to 0.51. Higher P_{pk} values suggest that the patients' average LOS has reduced.

Discussion

Timely assessment and treatment of patients attending the ED is paramount to ensuring safe clinical practice. This project aimed to elaborate on using process improvement methods such as Six Sigma DMAIC to reduce the LOS in ED. This method helped identify and solve underlying issues in the ED contributing to increased LOS, which, in turn, helped reduce the average LOS by almost 30%.

Using the Six Sigma DMAIC methodology, various improvement steps were taken in this project to address the issues related to prolonged LOS. When this project was started, it was learned there was no target time defined for senior (fellow or consultant) physicians to assess the emergency patients. Once a target of 30 min was set, junior doctors ensured that the senior physician reviewed the patient within that period after completing their initial assessment of the patients in the ED.

Staffing levels were analyzed against peak rush hours within the ED. As a result, adequate medical and nursing staff during rush hours were deputed to ensure safe and timely assessments and treatment.

The most crucial step in this activity was improving communication between different teams. One

major factor in the delayed disposition from the emergency was waiting for the laboratory and radiology test reports, which were required to complete the patient workup and formulate a management plan. This issue of untimely laboratory reports as a contributing factor in increased LOS was also observed in previous studies.^[4,8-11] To reduce this delay in reporting, effective and timely communication between ED clinicians and the diagnostic services and clinicians was recommended and established, which also helped reduce LOS in this project. Regular multidisciplinary meetings with relevant teams to review the performance of ED helped in keeping track of performance and in resolving the identified issues.

In this project, process mapping was observed to be the key factor in identifying and tracking process-related issues. The literature also found that focusing on process problems is an important step for reducing the average LOS and, in turn, improving the flow of patients in the ED.^[4,8-11]

This project has not only helped in reducing the average LOS but also reduced patients' dissatisfaction. In the pre-implementation phase, 7 out of 30 patients in the annual patient satisfaction and experience survey complained about delays, whereas in the post-implementation phase, which is the 2023 patient survey, there were no complaints received.

There were a couple of limitations to the present study. This investigation was conducted at a single cancer center serving a low-income country. Therefore, the results may not apply to other hospitals serving different socioeconomic setups or dissimilar patient populations. Furthermore, the investigation did not account for patients' medical conditions or performance status. However, there were no known reasons or events that could have affected the patient population during the study. In the next phase, the project will be expanded to include patients waiting for admission to the inpatient department and those who are being transferred from the ED. This will broaden the

project's scope and benefit various types of patients by reducing their LOS at the ED.

By implementing process improvement models such as Six Sigma DMAIC, the LOS in the ED was reduced. To improve problem areas in the hospital, it is recommended to use this process improvement model to gain a better understanding of the process flow. This will result in collecting accurate data on the various steps involved, enabling analysis of potential causes and fact-based decisions to improve processes. Furthermore, monitoring the change will help keep the improvements observed in this project.

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Author Contributions

Conceived and designed the analysis: QS, HH, KS, AS. Collected the data: HS. Contributed data or analysis tools: QS, HH, KS, AS, HS, ZSK. Performed the analysis: QS, ZA, ZSK. Wrote the paper: QS, HH, KS, AS, ZA, ZSK.