

# Lean Six Sigma in Health Care: Improving Utilization and Reducing Waste

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**Abstract.** Healthcare costs have been increasing worldwide mainly due to over utilization of resources. The savings potentially achievable from systematic, comprehensive, and cooperative reduction in waste are far higher than from more direct and blunter cuts in care and coverage. At King Faisal Specialist Hospital and Research Center inappropriate and over utilization of the glucose test strips used for whole blood glucose determination using glucometers was observed. The hospital implemented a project to improve its utilization. Using the Six Sigma DMAIC approach (Define, Measure, Analyze, Improve and Control), an efficient practice was put in place including updating the related internal policies and procedures and the proper implementation of an effective users' training and competency check off program. That resulted in decreasing the unnecessary Quality Control (QC) runs from 13% to 4%, decreasing the failed QC runs from 14% to 7%, lowering the QC to patient testing ratio from 24/76 to 19/81.

**Keywords.** Improving Utilization, Reducing Waste, Healthcare, Hospitals.

## Introduction

The burden of health care expenditure on national budgets has increased dramatically worldwide over the past two decades [1]. Like other service operations, healthcare requires systematic innovation efforts to remain competitive, cost efficient, and up-to-date. The cost of medical care is increasing at an alarming and unsustainable rate. A significant source of increasing healthcare costs is attributed to the unnecessary operational inefficiency [2]. Laboratory testing, and other healthcare resources, has been over utilized with a huge number of unnecessary tests being done routinely in different healthcare settings. The elimination of unnecessary laboratory testing is becoming essential in the control and management of healthcare costs [3]. The savings potentially achievable from systematic, comprehensive, and cooperative reduction in waste are far higher than from more direct and blunter cuts in care and coverage [4]. Many international healthcare systems have applied a number of quality improvement approaches from manufacturing; most notably Six Sigma and, more recently, Lean [5]. Lean Six Sigma is a methodology that relies on a collaborative team effort to improve performance by systematically removing waste and achieving the fastest rate of improvement in customer satisfaction, cost, quality, process speed, and invested capital [6]. Many studies prove that quality improvement tools such as Six Sigma and Lean can provide healthcare managers the opportunity to improve quality on the basis of sound methodology and data [7]. Point of Care Testing (POCT) is defined as medical

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diagnostic testing performed outside the clinical laboratory in close proximity to where the patient is receiving care typically by non-laboratory personnel using devices that are often hand held [8]. POCT is generally more expensive than in lab testing but is appropriate and cost effective in some clinical settings because results are promptly available to caregivers [9]. At King Faisal Specialist Hospital and Research Center, inappropriate and over utilization of the glucose test strips used for whole blood glucose determination using glucometers was observed, which resulted in increased costs. The hospital implemented a project to improve its utilization.

## **1. Methods**

A cross-functional problem solving team was formed from the Department of Pathology and Laboratory Medicine, led by POCT coordinator, Nursing Department, Biomedical Engineering, Medical Informatics, and Training and Education. Team members were trained by the POCT coordinator regarding the proper process as per the related Internal Policies and Procedures. The team used Six Sigma DMAIC problem solving approach as an improvement tool. Six Sigma DMAIC is an organized and systematic method for strategic process improvement that relies on statistical and scientific methods to make dramatic reductions in customer defined defect rates. This improvement procedure is generally known under the acronym DMAIC, standing for Define, Measure, Analyze, Improve and Control [10]. Data on glucometers' strips utilization by the hospital units for both patient testing and quality control was collected from the POCT data management system, validated by comparing the number of strips utilized by each unit to the number of strips that were issued to that unit and verified with the overall test strips' inventory in the unit and in the stock room. Four months data was collected and analyzed in the measure and analyze phases of the DMAIC approach. Root Cause Analysis (RCA) was performed to identify the main causes of the overutilization, as a root cause analysis is a method of problem solving used for identifying the root causes of faults or problems [11]. Recommended interventions were implemented and four months data, after the implementation, was collected and analyzed in the improve phase of the DMAIC approach. Pre and post data were analyzed and compared to determine the percentage of improvement and help the team decide on the control measures that should be put in place to hold the gains.

## **2. Results**

There were 57 glucometers distributed in 33 hospital units. Analysis of the pre data; 4 months prior to the improvement, revealed that 13% of the total Quality Control (QC) runs were unnecessary, 14% of the QC runs were outside the tolerance limits that were defined by the laboratory, i.e. failed QC runs with which no patient testing would be possible, as per the internal policy and procedure of the hospital. It has been also observed that QC to patient testing ratio was 24/76. It was found that the main cause of these issues was either misunderstanding of the related internal policies and procedures or lack of staff training and competency check off. Therefore; the related internal policies and procedures were updated in a way to be easily understood and not confusing, in-service training was conducted to all users, proper competency check off program was implemented using a written test, hands-on and direct observation to

ensure users' competency, the POCT information system was programmed not to allow any user who didn't pass the competency check off, or his competency check off is expired, to access or operate the glucometers, monthly reports were generated from the information system and shared with the concerned staff and the unit head nurses for proper action and follow up, and finally glucometers were removed from low utilization areas as low utilization may compromise staff competency. Analysis of the post data; 4 months after the implementation of these interventions, revealed that 53 glucometers were distributed in 28 hospital units. The unnecessary total QC runs were decreased to 4%, failed QC runs were decreased to 7% and the QC to patient testing ratio was lowered to 19/81. Comparing the pre and post data; the total number of strips utilized in QC runs was decreased by 18.6% while the total number of strips utilized in patient testing was increased by 10.4%.

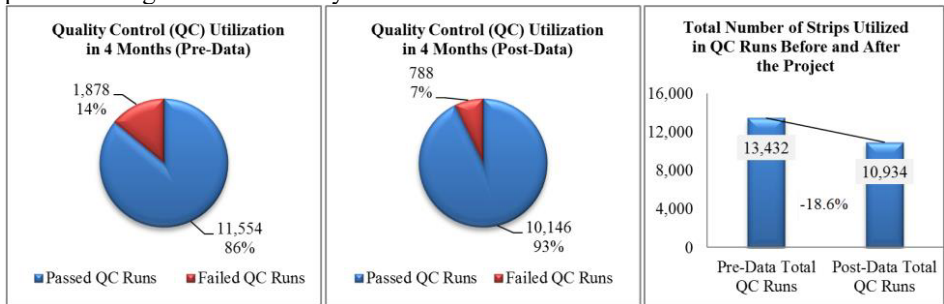


Figure 1. Quality control utilization pre & post data with improvement percentage.

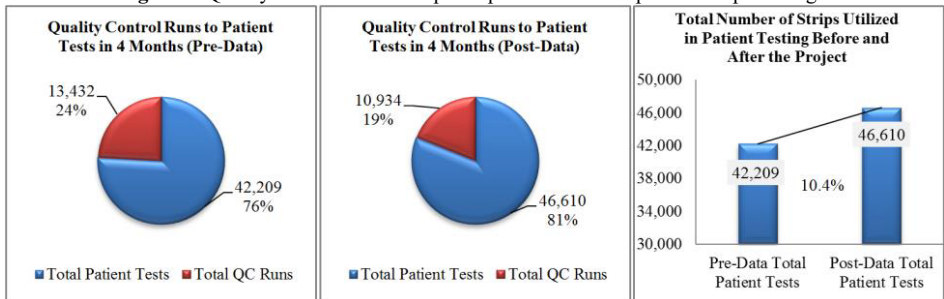


Figure 2. Quality control runs to patient tests pre & post data with improvement percentage.

### 3. Discussion

Although POCT is generally more expensive than in lab testing, the main advantages include the decreased turnaround time and consequently improved clinical outcomes in some settings, such as the significant influence on reducing patients' length of stay in emergency department and the potential to improve the management of infectious diseases, especially in resource limited settings where health care infrastructure is weak, and access to quality and timely medical care is a challenge [12, 13]. POCT offer rapid results, allowing for timely initiation of appropriate therapy, and facilitation of linkages to care and referral. Most importantly, POCT can be simple enough to be used at the primary care level and in remote settings with no laboratory infrastructure. As POCT is defined as medical diagnostic testing performed outside the clinical laboratory and in close proximity to patient by non-laboratory personnel, users' training and competency

check off program should be properly implemented and closely monitored. Many studies actually discuss that training can improve users' competence, and many methods are available, including seven main aspects; introduction of concept and technology, use of the device and reagents, use of the quality control sample, sample collection, evaluation of patient result, recording patient and control sample results, and maintenance and waste disposal [14].

#### 4. Conclusion and Recommendations

Based on the findings of the study and to build a well-established POCT in any healthcare setting; we need to ensure proper implementation of well understood and updated policies and procedures, develop a solid users' training and competency check off program, improve the utilization of the POCT information system to monitor and control staff access and activities, develop an effective feedback tool of automated reporting to help identifying gaps and actions needed, and to effectively distribute POCT devices according to the number of patients in units and the clinical need. By following these recommendations the overutilization of POCT can be significantly decreased resulting in increased efficiency and cost savings.

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