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Araştırma / Research Article

Yedi temel kalite aracının kullanımı ile ilgili performans değerlendirme ve iyileştirmesi için bir model: sağlık performansı için bir yol haritası

A model for performance measurement and improvement related to the usage of seven basic quality tools: a roadmap for healthcare performance

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ÖZET

Kalite uzmanları kalite iyileştirme araçları uygun şekilde kullanıldığında sürekli kalite iyileştirmeyi sürdürülebilir hale getirebilirler. Pek çok kalite problemi 7 temel kalite aracı ile çözülebilir. Bu çalışmanın amacı kalite araçlarını kullanarak bir performans değerlendirme ve iyileştirme modeli oluşturmaktır. Bizim modelimiz yönetim araçlarından çok istatistiki yöntemlerin kullanımına odaklıdır. Bu makalede hasta düşmeleri uygun kalite araçları kullanılarak analiz edilmiş ve zaman içerisinde belirli bir oranın altına düşürülmüştür. Yedi kalite iyileştirme aracının etkin kullanımı ile müdahele öncesi hasta düşme hızı 1000 hasta gününde 7.83, müdahele sonrası düşme hızı ise 1000 hasta gününde 0.86 olarak saptanmıştır. (% 89.02'lik bir düşüş). Sonuç olarak, bu çalışma ile uygun kalite iyileştirme araçlarını uygun zamanda kullanarak performans değerlendirme söz konusudur ve iyileştirme sağlanmaktadır. Bu model aynı zamanda idari personelinde iyileştirmeye karşın etkin ve effektif çalışmasına olanak sağlamaktadır.

ABSTRACT

Quality improvement personnel are best served when they use appropriate quality tools for sustaining continuous quality improvements. Most of the quality problems can be solved by seven basic quality tools. The purpose of this study is to build a model for performance measurement and improvement with regard to the appropriate utility of quality tools. Our model was developed using statistical approach, rather than from the management point of view. In this paper, incidence of patient falls were analyzed and reduced using appropriate quality tools. Pre intervention fall rate was reported as 7.83 per 1,000 patient days, whereas post intervention fall rate was measured as 0.86 per 1,000 patient days (89.02% reduction) after implementation of the seven basic quality tools. In conclusion, this study demonstrates a model for performance measurement and results in improvement when appropriate quality tools are used at the proper time. This model also assists the quality management personnel to work efficiently and effectively toward improvement.

INTRODUCTION

Continuous quality improvement requires standards as well as more appropriate quality tools for the analysis of data. Proper usage of data analysis leads to better quality improvement. While reviewing the literature, many studies cited seven basic quality tools [1-9]. However, the exact road map for performance measurement and improvement is very limited and currently there are no studies that utilize an innovative statistical approach. Statistical thinking and approach is more important for the analysis of quality measurements. Mirko Sokovic[10] et al and Dusko Pavletic[11] et al has developed a road map for continuous improvement, but these studies are combined with quality measurement and improvement. In addition, the quality tools are not placed appropriately. In another study, the application of quality tools for continuous improvement is discussed and quality tools are placed for only quality improvement but such tools are not used in a statistical approach. [12] The usage of quality tools in the right place is critical for improving the quality of the process. Today, there are more than a hundred different tools available. Many scientists have tried to define them and

differentiate among them on various bases. [13]

Several studies have explained the quality improvement tools (Barker[14]; Dale et al[15]; Mizuno[16]). The most common quality improvement tools are the seven quality control (QC) tools, which includes; Control Chart, Flow Chart, Check Sheet, Pareto Diagram, Scatter Diagram, Cause and Effect Diagram and Histogram.

In the field of business as well as in the healthcare sector, quality improvement is associated with several problems. The complexity of problem solving requires the use of quality tools and techniques in an appropriate way because it will identify the problems. Ahmed and Hassan[17] argued that quality management (QM) cannot be ensured without the application of the appropriate tools and techniques. These authors further asserted that better implementation of such tools and techniques can improve business results. Seven basic quality tools are the well-known methodology, described by numerous authors in previous studies. According to McQuater et al. (1995)[18], tools and techniques are practical methods that can be applied to particular tasks and also used to facilitate positive changes and improvements. Dale (2003)[19] stated that no one technique is more important than any other, but that seven basic quality tools are all different and applicable in different situations. Each technique has unique effectiveness and can emphasize the same data in different ways. Among seven basic quality tools, a problem solver should understand every tool and how and when it is to be used (Hagemeyer et al., 2006).[20]

In relevance to quality improvement methodology, a lot of approaches have been developed including PDCA[21], DFSS, and Six Sigma 'DMAIC'[22,23]. Ahmed Al Kuwaiti et al[24] recently developed a methodology for key performance analysis, and is described as 'DMCIB'. This approach is based on quality tools. These authors concluded that quality tools are key for performance improvements.

Most of the studies related to seven basic quality tools focused on management view not on a statistical approach or thinking. Bennis (1969)[25], French and Bell (1978)[26] and Box (1988)[27] emphasized that achieving total quality requires knowledge of statistical thinking, engineering, management, psychology, sociology, and anthropology. After taking into consideration of the previous studies and exploring the existing models, this study focused on developing a new model by utilizing the statistical approach.

There are two important phases or stages for quality improvement, i.e., the first one is performance measurement and the second is performance improvement. In performance measurement, it is mandatory to collect data over a period of time and the data sets must be diagnosed for process stability. The process stability analysis is the primary step of process performance measurement. If the process is not stable, one needs to first stabilize the process before subjecting it to further analysis by suitable quality tools. Therefore, the presences of seven quality tools are starting from performance measurement, not only for performance improvement. Most of the studies addressing the quality tools for process improvement. This is a contradicting statement for quality improvement. When utilizing the statistical approach for quality improvement, it is important to start by checking the performance whether it is stable or unstable by using Control Chart, if not, improve the process by using the rest of the quality tools.

Proposed model for the integration of seven quality tools

In this study, a new model is proposed for the process of performance measurement and improvement, which consists of two phases and four steps, which include, Step 1: Stability analysis, Step 2: Significant factor for a special cause of variation, Step 3: Root cause analysis and Step 4: Process Capability analysis. This model is based on statistical approach, and it includes step by step flow for process improvement. Many researchers explained the structured approaches to problem solving but almost all are in management approach (Tennant, 2001[28]; Straker, 1995[29], Dale and McQuater, 1998[30]).

METHODS

Study Setting

A prospective study design was adopted to reduce the risk of incidence of patient falls. To execute this study, seven quality tools were used more appropriately in various stages of quality improvement. This study was conducted during the year 2013 to 2015 and all inpatient falls were included.

Quality Tools

The seven basic tools and techniques of quality is a designation given to a fixed set of graphical technique identified as being most helpful in troubleshooting issues related to quality [31]. These tools and techniques that are called basic because they are suitable for users with little formal training in statistics and can be used to solve the vast majority of quality–related issues[32]. The basic tools include quality improvement and monitoring activities, and giving feedback to quality improvement team easier [33].

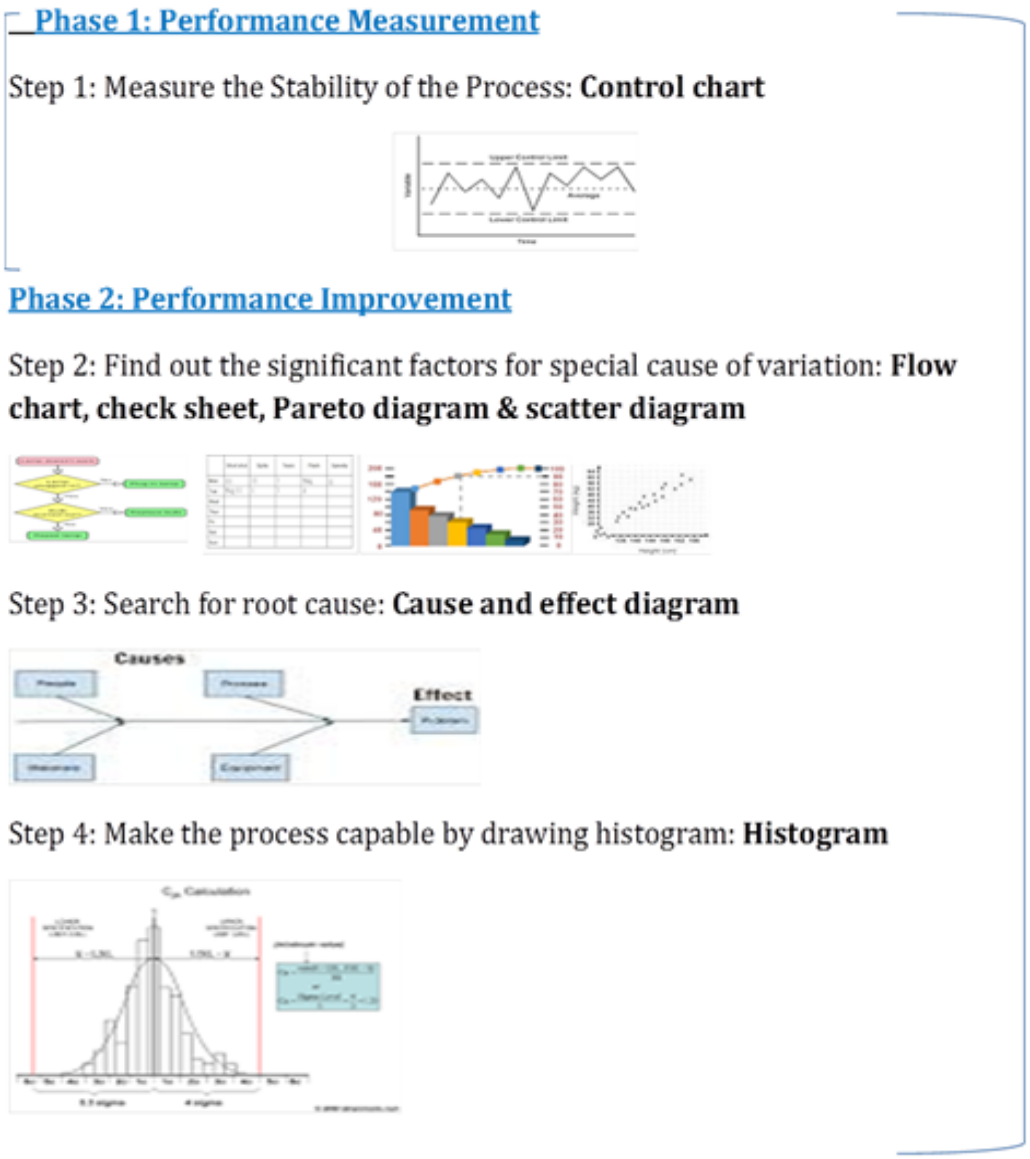

Figure 1. Model for Performance Measurement and Improvement.
In this study, the developed model for performance measurement and improvement was applied in a real healthcare performance

Control chart was used to measure the stability of incidence of patient falls. In this study, incidence of patient falls is attribute (defects) data with unequal sample size. Therefore, U chart is used for measurement of this performance. Control limits of the U chart as follows

$UCL = \overline{U} + 3\sqrt{\frac{\overline{U}}{n}}$

$CL = \overline{U}$

$LCL = \overline{U} - 3\sqrt{\frac{\overline{U}}{n}}$

Where $\overline{U}$ = Average falls rate and n = sample size.

Flow chart is used to represent the process flow in a diagrammatic approach. It helps to visualize what is going on and will be processed, and users will better understand the process.

A check sheet is used to track data for process improvement in which the data are classified by different categories. Pareto analysis is based on Pareto's "80-20" rule [34, 35] stated that 20 percent of causes accounts for 80 percent of failures. Scatter diagram is used to test the relationship between the outcomes. In this study, causes of falls were recorded by Check sheet and was further analyzed by Pareto diagram to determine the most important cause for falls. The cause and effect diagram is used to gather all possible causes for the

effect. Based on the findings of the cause and effect diagram, the investigator located eight potential causes for the occurrence of falls. In addition, Histogram is used to represent the distribution of the data and it will provide the process capability.

RESULTS

Performance Measurement

Inpatient falls during the year 2013 were measured and tested for stability of the process.

Step 1: Inpatient falls incidence (2013).

Control chart

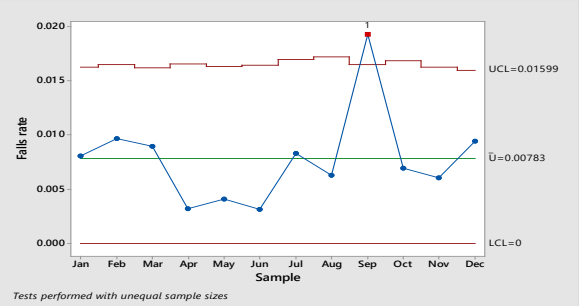

Figure 2. Control chart showing the process variability of fall rate during the year 2013.

The figure shows the control charts demonstrating the incidence of falls at KFHU during the year 2013. It is observed that in the month of September, the incidence of falls is increases dramatically and it is above the upper control limit. This might suggest some special causes of variation. This needs to be addressed to improve the process further.

Performance Improvement

In this stage, the factor for special cause of variation and its root causes are to be explored by each step.

Step 2: To find the significant factor for a special cause of variation.

As per the stability analysis, the quality members decided to reduce the fall rate by implementing Six-sigma 'DMAIC' approach. In order to execute this study, a multidisciplinary team covering all the relevant stakeholders was formed and it was carried out through five stages of 'DMAIC".

Flow chart

During the define phase, the problem was defined based on stability analysis, which was reported as 7.18 with a special cause of variation in the year 2013. Nursing personnel prepared a process flow chart related to nursing patient care and it was explained to all team members to understand the entire process.

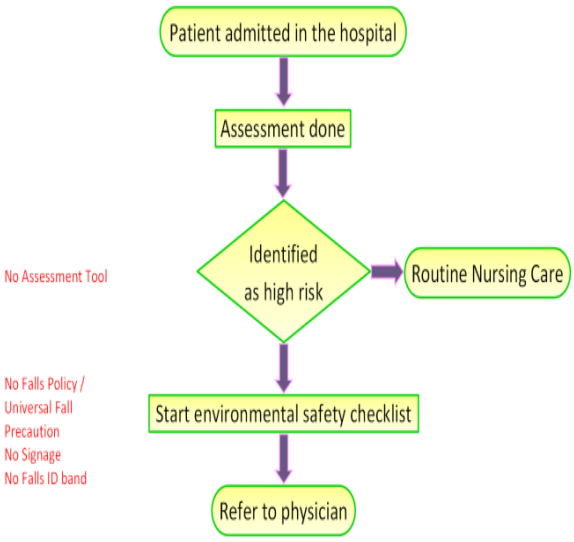

Figure 3. Process Map.

Check sheet

The causes of falls were recorded during the year 2014, and the causes for each fall was analyzed using check sheet to determine its frequency. Various causes contributing to falls are depicted in Table 1.

Table 1: Causes of falls.

6zs	Tally marks	Frequency
Wet floor		10
loss Balance		27
Dizzy		12
Unattended		5
Unsteady gait		4
Gen.Condition		18
Multiple meds		5

Pareto diagram

In this step, the causes for each fall which was documented using check sheet is subjected to further analysis using Pareto chart with an aim to find out the vital few factors contributing to falls (Figure 4).

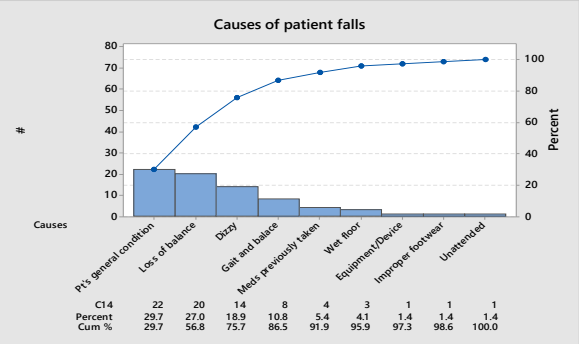

Figure 4. Pareto chart of patient falls stratified by different causes.

From the Pareto analysis, it is observed that most important factor for falls were patient general condition, loss of balance and dizziness.

Step 3: Root Cause Analysis

As a next step, the quality team identified the reasons for the occurrence of each fall using Root Cause Analysis.

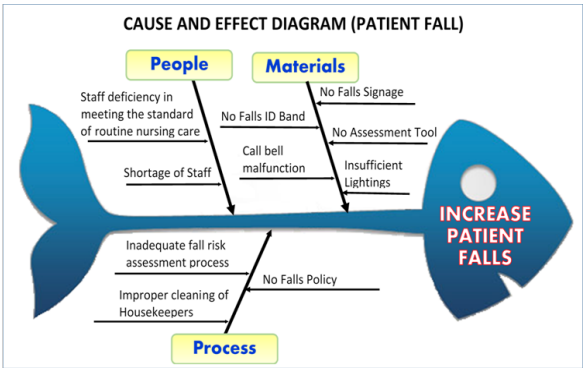

Figure 5. Cause and Effect diagram used to assist in identifying possible causes of patient falls.

Based on the findings of the cause and effect diagram, the investigator located nine potential causes for the occurrence of falls and is given below

1. Fall risk was not communicated when patients were handed off between care givers.
2. Falls risk sign not used
3. Staff unaware of what to do for a fall –risk patient
4. Power chart doesn't display high risk for falls in detail
5. Fall risk assessment not completed
6. Rounding does not happen every 2 hours
7. Medication events trigger falls because medications given do not drive treatment of the patient (rounding, toileting, etc.)
8. Inappropriate or inadequate use of the bed alarms/ tab alarms.
9. Patient goes to bathroom unassisted

All the potential causes identified during the analysis phase were taken into consideration and appropriate strategies were developed through various brainstorming session held with the relevant stakeholders of the hospital. The following strategies were adopted to reduce incidence of patient falls:

- Periodic review of falls policy and procedure every three years.
- Continue education of Nursing Staff on fall prevention.
- Continuous monitoring of patient falls by the Nursing Quality Staff.
- Falls data should be discussed frequently during the Unit Staff Meeting, Nursing Administration Meeting and performance improvement opportunities be explored and shared through the nursing units.
- There should be a Fall Prevention Program and Committee to meet biweekly and reviews all incidents of falling, looking for trends and opportunities for improvement.
- Falls Data Analysis is presented monthly to the Nursing Staff and recommendations to the nursing units that have an upward trend in fall data.

Step 4: Process Capability Analysis (PCA)

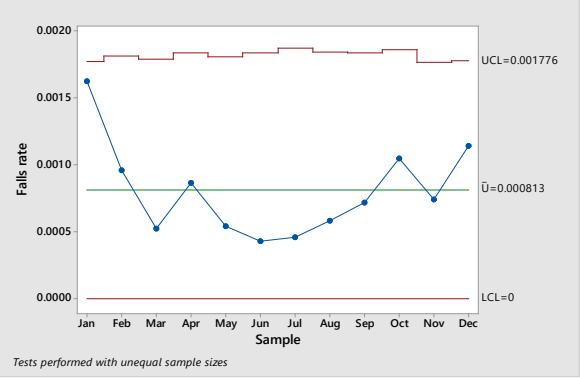

Figure 6. Control chart showing the process variability of fall rate during the year 2014.

After the processes were stabilized and staff within the targeted areas of the hospital was familiar with the

changes, the research team began the Control phase to sustain the improvement obtained. A control plan was created to statistically monitor the process, such as fall rates and how regularly staff used the Fall Debriefing tool. Control phase was initiated during the month of January to March of 2014, after implementing all strategies the fall rate per 1,000 patient days was reduced to 0.813.

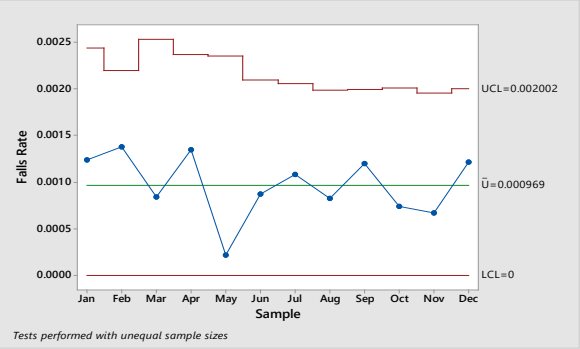

Figure 7. Control chart showing the process variability of fall rate during the year 2015.

Fall rate per 1,000 patient days during the year 2015 was 0.969. No points beyond the lower control and upper control limit. Therefore, we conclude that the process is more stable.

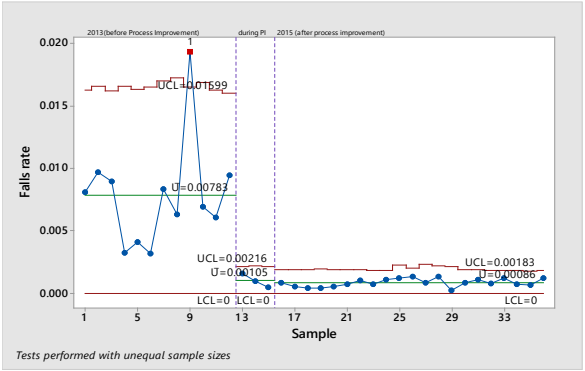

Figure 8. Control chart showing the process variability of fall rate during the period before and after process improvement.

Figure 8 shows the effect of implementing Six-sigma 'DMAIC' approach in reducing patient falls. During the define phase fall rate was 7.83 per 1,000 patient days, after implementation of all strategies the fall rate per 1,000 patient days was reduced from 7.83 to 0.86 at the end of December 2015.

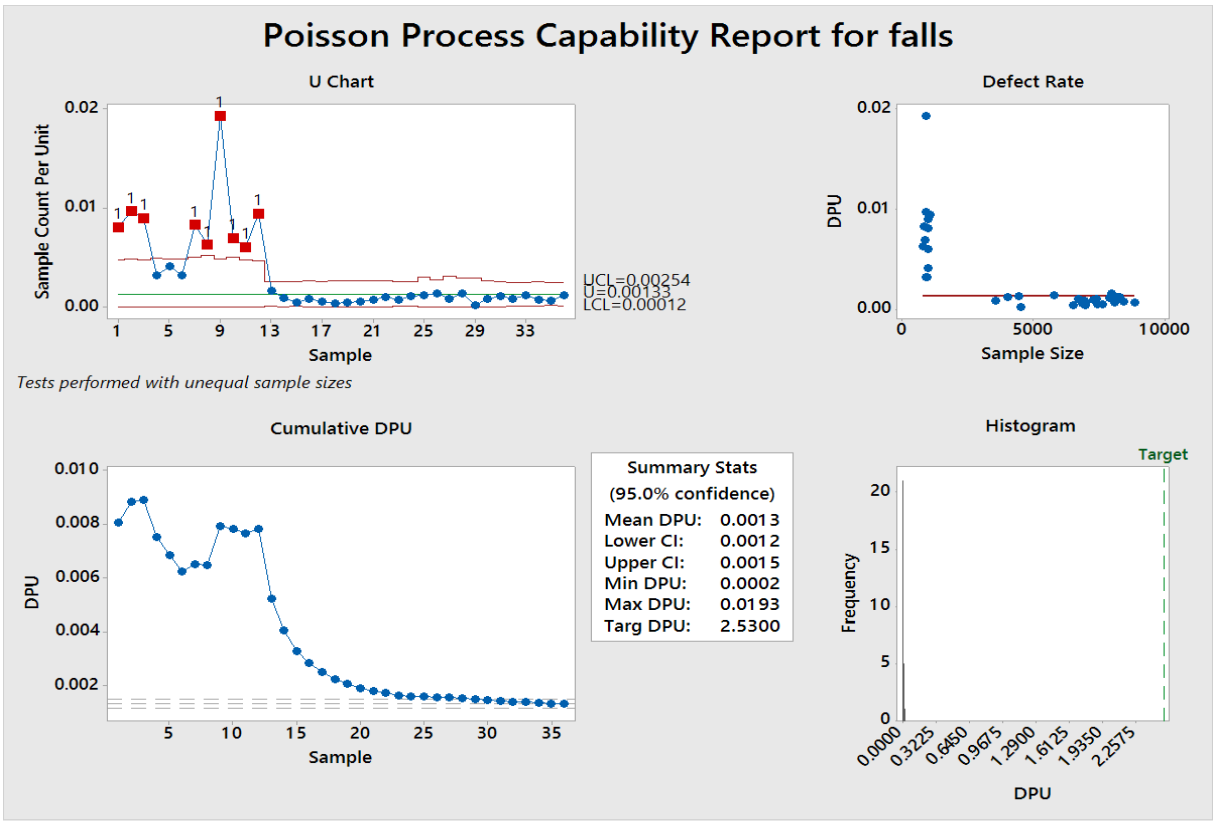

Figure 9. Process Capability of fall rate during the period before and after process improvement.

Figure 8 shows the effect of implementing Six-sigma 'DMAIC' approach in reducing patient falls. During the define phase fall rate was 7.83 per 1,000 patient days, after implementation of all strategies the fall rate per 1,000 patient days was reduced from 7.83 to 0.86 at the end of December 2015.

DISCUSSION

Process stability analysis is the primary objective of all performance analysis, and it is related with performance measurement. Stability analysis is the leading principle of statistical process control (SPC). The joint commission international (JCI) stated that SPC is 'an understanding of statistical quality control, including SPC, and variation is essential for an effective assessment process. Statistical tools such as run chart, control charts, and histogram are especially helpful in comparing performance with historical patterns and assessing variation and stability[36]. Most of the recent studies discussing the theory of the 7 basic quality tools have also developed a road map but it seems not in the statistical approach. Arash Shahin et al [37] has developed a road map related to quality tools, but the road map started from Pareto chart. This is not a statistical approach to do the analysis of quality improvement. The statistical approach is more important for quality improvement especially for data analysis because it involves a lot of statistical terminology. Quality improvement personnel both in business and healthcare sector should use statistical process control terminology. The statistical approach related with selection of quality tools is very simple. Primary and first thing is to measure the process consistency or stability by suitable control chart. If the process is not consistent, improve the process with the help of quality improvement techniques by using Flow chart, Check sheet, Pareto diagram, Cause and Effect diagram and Histogram. Many studies discussed about the application of seven quality tools. Lam (1996)[38] found that quality tool usage is confined to relatively simple tools. The QC7 are popular, but most of the sophisticated quality techniques such as Quality Function Development (QFD) and Desion of Experiment(DOE) QFD and DOE are used by fewer than 10 percent of the responding companies. Curry and Kadasah (2002)[39] observed that the most often used quality tools are the simple ones such as check sheet, flow chart and brainstorming. While the more sophisticated tools are not used. In another study by Grigg and Walls (2007)[40] discussed the importance of control chart for process improvement and revealed that statistical tools such as control charts can provide an advantage to organizations for creating process improvement and organizational learning and providing the charts utilized to actively convert the data they contain into information and knowledge about the process.

In this case study, Six sigma 'DMAIC' approach was implemented to reduce the patient falls incidence. In order to execute 'DMAIC 'approach, 7 quality tools were used to improve the process. After using all 7 quality tools, the fall rate per 1,000 patient days has been reduced from 7.83 to 0.86 at the end of 2015. Therefore, the implemented strategy has led to 89.02% of reduction of falls rate at the end of December 2015.

CONCLUSION

Usage and selection of quality tools play an important role in quality improvement. Quality improvement tools like Pareto diagram, Scatter, Flow chart, Check sheet, Histogram, and Cause & effect diagram are not suitable for all quality measurements. Before using quality improvement tools statistically, each quality measurement data should be tested for process stability by using control chart. Control chart is the primary tool for measuring the performance. Therefore, the proposed model for performance measurement and improvement allows the user to identify the appropriate tool at the right time; this may assist the quality team members to work efficiently and effectively toward improvement.

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