Developing Predictive Quality Scorecards – A Futuristic Approach to Quality Management

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Abstract:*This research was based on a unique approach to managing medical operational systems by implementing balanced scorecards based predictive indicators of performance. Traditionally, medical systems manage their performance based on lagging indicators of performance which is an "after-the-fact" approach focusing on past performance. It helps medical systems by studying and scrutinizing what had already taken place and if accidents did happen, the damage has already been inflicted to their reputation, credibility and goodwill. Unlike performance lagging indicators, predictive indicators consistently monitor the reliability and capability of medical systems to perform effectively in future. This research was based on applied projects for the development and implementation of "Performance Leading Indicator Scorecards" by the presenters in hospitals. Healthcare is a highly regulated industry with a strong focus on safety and reliability; medical systems needed a control mechanism that could effectively predict and control quality of services with ever improving reliability. The presenters were tasked with conceptualizing and developing a set of PQIs which could be good predictors of safe and reliable performance in future. A set of PQIs were selected representing quality of human resources, training, patient perception, product & process integrity, daily accountability, auditing and corrective actions. The study showed promising results and significant improvement in lagging indicators consequently.*

Key Words: Predictive Balanced Score Cards (PBSC), *Kiken Yochi* Training (KYT), Total Patient Experience (TPE), Medical Services Value Streams (MSVS), Neuro Linguistic Programming (NLP)

1.0 Introduction

The services and products have been become more expensive gradually in recent years. In United States of America, it has been estimated that the federal government will spend around US$4.0 trillion or 20% of the national budget on healthcare by year 2017. It has also been estimated that most of the medical services and products prescribed by doctors directly cure the symptoms or the presentation conditions by 35% ~ 65% only and sometimes patients have to be treated subsequently or develop

adverse side effects which require another set of treatments, similarly there have been an estimated one million cases of medical errors committed every year(Albanese, 2014).Further, approximately US$450 ~ US$650 billion was spent on “unwarranted” medical treatments. These numbers suggest a compelling case for performance improvement in medical operational systems and their support services. Additionally, several researches conducted in the field of medical operations management, many opportunities for improvement have been identified. With so many system and operational losses, there have been massive improvement opportunities in core healthcare delivery processes which were the focus of this research to identify areas that can be improved with simple tools and techniques instead of complex modeling (Spathe, 2013).

Historically, the medical sciences have been treated as a specialized field of study where doctors and medical professionals spent many years in training and acquiring knowledge relevant skills to pertinent medical profession and patients relied on their expertise exclusively but with the recent advances in information technologies, including the Internet, access to analytics, social and conventional media; patients have become far more informed about diseases, their treatments and cures, risks associated with different delivery methods, costs associated with different treatment choices and the value proposition of medical services (Arthur, 2010). With these evolutionary changes, patients wish to be “co-innovators” and to actively participate in designing and developing future medical services which are more efficient and cost effective (Arthur, 2011). Consequently, these trends have also been opening healthcare institutions to external the environment and scrutiny by non-medical stakeholders. Faced with new business realities, many medical businesses have approached other industries that have demonstrated tremendous improvements in safety, quality, cost and operational efficiency. Hospitals and supporting medical organizations have been learning many useful tools and techniques from automotive industry and more specifically from Toyota Motor Company’s coveted Toyota Production System (TPS) as popularly known in the West (Asefeso, 2014).

It’s TPS’s approach of seeking commonsense and simple solutions to complex problems has a tremendous appeal to the healthcare industry because approaches like process simplification, standardized work protocols, workplace organization (5S), visual controls, error proofing (*Poke Yoke*), effective hazard planning (*Kiken Yochi*), a good understanding of past problems (*Kako Tora*) and managing for daily improvement (*Kaizen*), have helped many hospitals in US improve their performance and attain higher levels of patient satisfaction (Asefeso, 2012).

The purpose of this research was not to propose complex *Predictive Analytics* and *Forecasting Models* housed and retrieved from large data warehouses. Predictive Analytics have been become very popular recently and play significant role in overall policy formulation and long term planning but have not yet shown any promise for day-to-day medical operations. The reasons cited for limited effectiveness of Predictive Analytics include; having too much information that has to be processed before medical staff can reach a decision, it is not good for daily business. Before medical businesses can make use of unlimited potential of analytics, they would need to understand how they work, technically and programmatically. In the absence of protocols and patient-specific outcomes data, predictive analytics are largely academic exercises rather than practical tools. Lastly, gaps in healthcare industry data limit the effectiveness of Neuro Linguistic Programming (NLP). In simple words, it means all complex information has been stored in higher level codes and transferring it to daily routine work is not simple and requires expert help (Bisognano 2012).

Research was conducted to discover a set of PQIs which when properly identified and managed, can significantly improve operational efficiency of a health system. A literature survey was conducted, case studies from automotive, aerospace, airlines, hospitality, pharmaceutical, education, recreational and sports sectors,were reviewed and benchmarked. It was observed that all efficient organizations had some common characteristics irrespective of industry, size or geographic location. They shared the same drivers of success or less than perfect performance. Further, they had the same operational and leadership philosophies. Their daily operations were managed by empowered and knowledgeable employees and had

a built-in capability to identify and correct abnormal situations (Dean, 2013). After completion of the literature survey and global benchmarking of most efficiently managed organizations, assumptions were drawn for an effective set of PQIs metrics. Many studies have demonstrated that for operational systems to have an enduring effectiveness they must have four basic characteristics because systems cannot stay healthy for long by constant top down intervention of senior leadership. Only if people at the lowest level understand the concept, get indoctrinated into the concept and internalize the new system, long term effectiveness is ensured.

2.0 Assumptions and Metrics Model Design

The four fundamental characteristics of an efficient operational system were identified as being transparent, simple, self-correcting and appealing (Dean, 2011):

2.1 Transparent

Transparency means the ability of the people to assess system capability and health by direct observation. If people cannot determine what could go wrong by direct observation and have to rely heavily on massive data and numbers crunching, there would be a probability that it would not happen frequently and they would only realize the existence of abnormality when it would be too late and or costly to correct.

Figure – 1: Ability to see number and what is behind numbers

2.2 Simple

Generally, people have the tendency to avoid complex work and have been prone to making more mistakes when they were presented with complex tasks. That is why some industrial psychologists have recommended considering a simplicity index to be one of the metrics when designing a new or redesigning an existing job. Further, research studies have shown that work and process simplification, shortened learning period, improved skill levels, reduced or eliminated errors and raised interest in work making it more interesting and appealing to people.

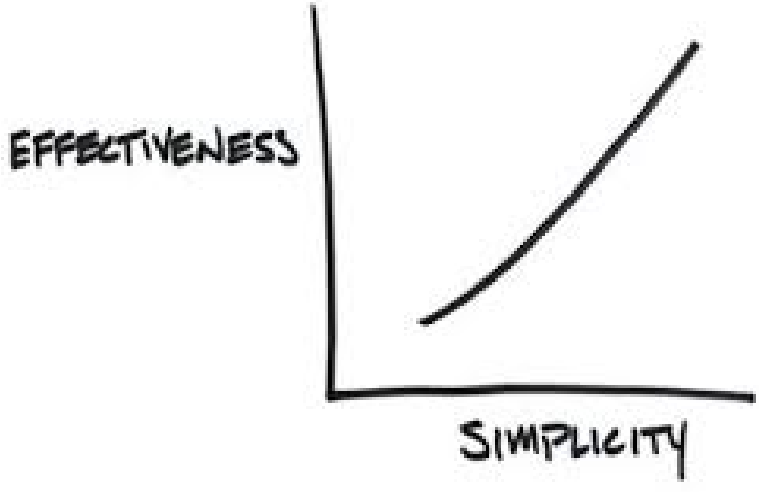

Figure 2: Simplicity has shown a strong correlation to effectiveness in several researches

2.3 Self-Correcting

An added advantage of managing by PQIs is that such systems have the ability to self-correct themselves. Since people would be proactively involved and would have the ability to observe and correct abnormal trends before they become major issues, they would get resolved and the system would be restored back to normal operating conditions.

Figure – 3:In a transparent and simple system, all critical facts were on finger tips and self-correction was easier.

2.4 Appealing

Literature reviews also revealed that the healthcare operational systems that are transparent, simple and self-correcting had inherent appeal. The most appealing attribute of any future state system design was attributed to process simplification, and when unnecessary complexities were removed from the process, it improved their motivation and they subsequently expressed higher levels of interest in work.

Figure – 4: Effective systems have shown spontaneous appeal to people using them.

This research had two underlying assumptions; first, it was based on exhaustive medical analytic data but it did not recommend using it on a daily basis by frontline staff, rather they were encouraged to deploy standard protocols based on data analysis because the primary objective of the study was to help understand their core capabilities and build on them. Second, the selection of PQIs was an evolutionary and dynamic process; no simple metric was effective over long periods. It was critical to periodically review inclusion and exclusion of individual PQIs inperformance scorecard. Sometimes individual PQIs, which were being monitored, either matured so much that they were not left with any opportunity for improvement without dramatic process re-engineering or became irrelevant due to changes in other processes. In the course of research which spanned a period of twenty months, the PQI scorecard was revisited and adjusted four times. It was observed that some PQIs where critical and held their values as good predictors of performance while some were critical in the beginning and lost their usefulness over time; these were either replaced or consolidated with other PQIs.

3.0 PQI Predictive Model – Equation 1

$$\begin{aligned} \textit{Future Performance (Y)} = {} & \{\textit{Human (H)} + \textit{Skills } (S_1) + \textit{Perception (P)} \\ & + \textit{Improvements (I)} + \textit{Responsiveness(R)} \\ & + \textit{Standardization } (S_2) + \textit{Billing (B)} + \textit{Complaints (C)} \\ & + \textit{Maintenance (M)} + H*S_1 + H*P + H*I + H*R + H*S_2 \ldots\} \; 1 \end{aligned}$$

4.0 Performance Leading Indicators

As can be observed from the model in the previous section, that the PQI metric was a simple regression equation as shown in Equation – 1 with nine variables accounting for improved future performance which included human resources, training, patient perception, a disciplined of accountability, quick response system, standardized processes, on-time and accurate billing, number of complaints closed effectively and in a timely manner and the number of improvement suggestions received and implemented in a given period (Graban, 2010). Explanations about each PQI have been provided below.

4.1 Resources (People)

The most critical indicators of success in any organization are people. People are unique because they influenced all other indicators and had a strong correlation in the regression analysis. It was not the intension of this research to explore and explain every aspect of human capabilities, which would require complete analysis by itself. For this research, two aspects of human nature were studied and the results were analyzed including the level of performance and probability of making mistakes. Professional capability of human beings at work is derived by three traits, i.e. knowledge, skills and abilities formally known as K-S-A. According to the principles of cognitive psychology, knowledge is what people accumulate over time by formal and informal education, skills are the ability to do work in a prescribed way with an expected level of efficiency and abilities are considered natural aptitude and personality traits of people to undertake kind of work they wish to do (Graban, 2012).

For a medical facility to be competitive like any other business, it was concluded through data that if they hired, developed and retained the best industry talent using the 20/80 rule of performance, a hospital can attain best in class performance levels (Jackson, 2013). 20/80 rule simply meant that using any industry specific performance standards, 80% of the workforce of a hospital would perform equivalent to top 20% of the industry workforce, which means that the majority of the workforce were top performer as compared to the competition (Figure – 5).

When it was determined that most of the performers in the hospital met the best industry standards, the second critical performance aspect was to study probability of making mistakes. An exhaustive review of research literature revealed that medical errors had been the biggest cause of concern both to patients as well as medical staff. Further, the rate of errors had no correlation with the knowledge, experience or skills of any provider.The rates of making mistakes were uniformly scattered over the whole medical staff evenly, which led to conclude that human beings have the same tendency of being wrong irrespective of their background or professional experience. There had been a heightened awareness in the medical profession about errors and have devised different ways to eliminate but the medical industry had been heavily relying on the principles of cognitive psychology to deal with the issue, for example, improving focus and attention, removing distractors, holding meditation sessions etc. For reduction of errors, medical industry can learned a lot from the Japanese manufacturing industry which proposes completely error proofing (*Poke Yoke*) critical processes. Poke Yoke is essentially based on the principle, “The only way to do a job is the right way” and it designed out the possibility making a mistake. Poke Yoke strategy has gained prominence in medical industry and has been widely applied in many core processes (Jackson, 2009).

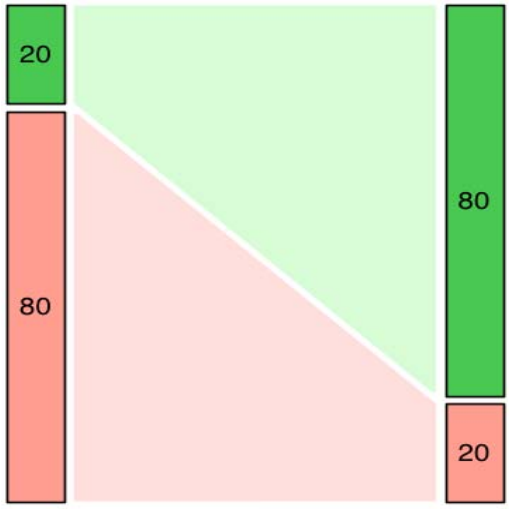

Figure – 5: 20/80 rule for organizational performance levels

4.2 Training

Review of historical records showed that in spite of acquiring great talent initially, many medical systems did not develop good training and skill development programs, which led to less than full potential utilization of talent. In some cases, it caused frustration in highly motivated people. This research proposed that a training program and its effectiveness must be used as a key PQI. It was proposed that consistent training, re-training, certifications and re-certifications were the best way to keep people up-to-date about professional knowledge and advances in medical sciences.

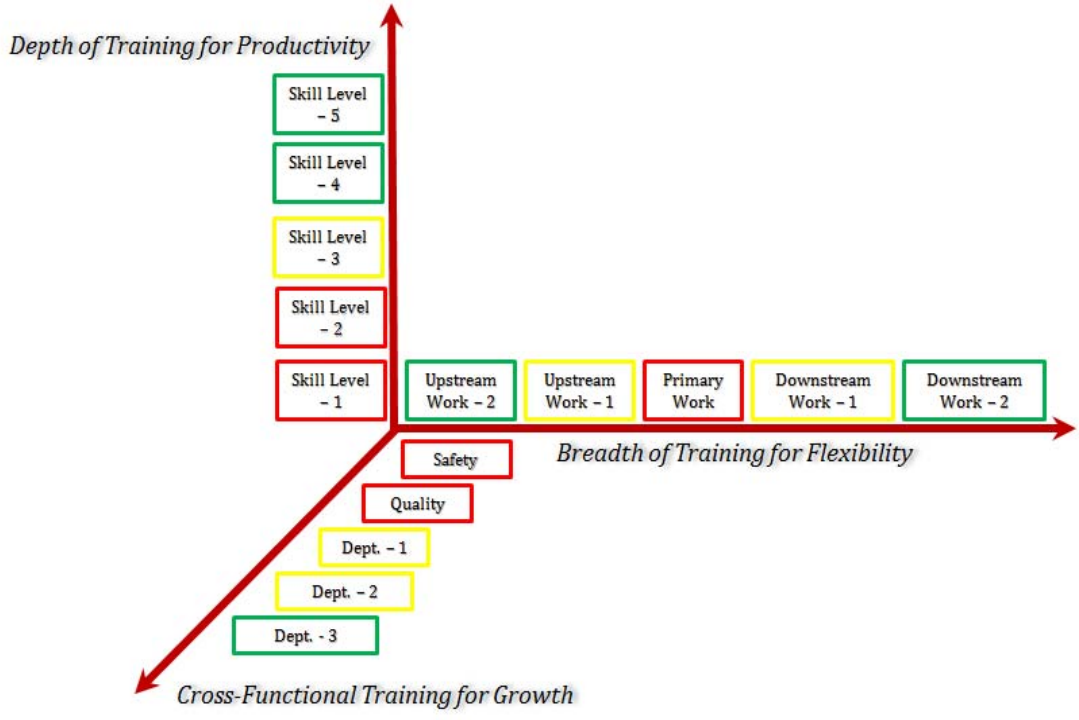

Figure – 6: Three Dimensions of training

For an effective training program, three dimensions of training were proposed; first training to build higher skill levels in the basic job function of a person; second, training in technical skill set in downward and upward delivery processes to make the workforce more flexible and deal with service demand fluctuations; and finally, training people outside of their core functions to develop a sense of big picture operations when these workers become more resourceful in dealing issues that required understanding of cross functional operations. It was also proposed to raise recognition and pride associated with successful completion of training so that people feel motivated to acquire more training and certifications (Jackson, 2009).

4.3 Patient Perception

Perception has been defined as a very subjective measure of performance but recently many statistical models have been generated to estimate the cost-benefit of human perception (Jackson, 1996). In general, all service industries and specifically in medical business, patient perception plays a critical role in success or failure of a hospital. In spite of the difficulty of estimation, patient perception had been a keyPQI in the research. Also, it was challenging to improve perception in the short time period and required tremendous effort but perception could become negative quickly. In this study, poor perception about the timeliness of the service provided in an Emergency Room (ER) of a chain of hospitals was considered for analysis. This chain of hospitals promised their patients that they would be seen by an ER doctor in 30 minutes or less. A review of 512 records showed that their actual wait time was around 29

minutes and they were well below their goal, yet the patients felt that the wait time was too long. A Level I, II and III analysis of the wait time has been provided in Figure – 7 below.

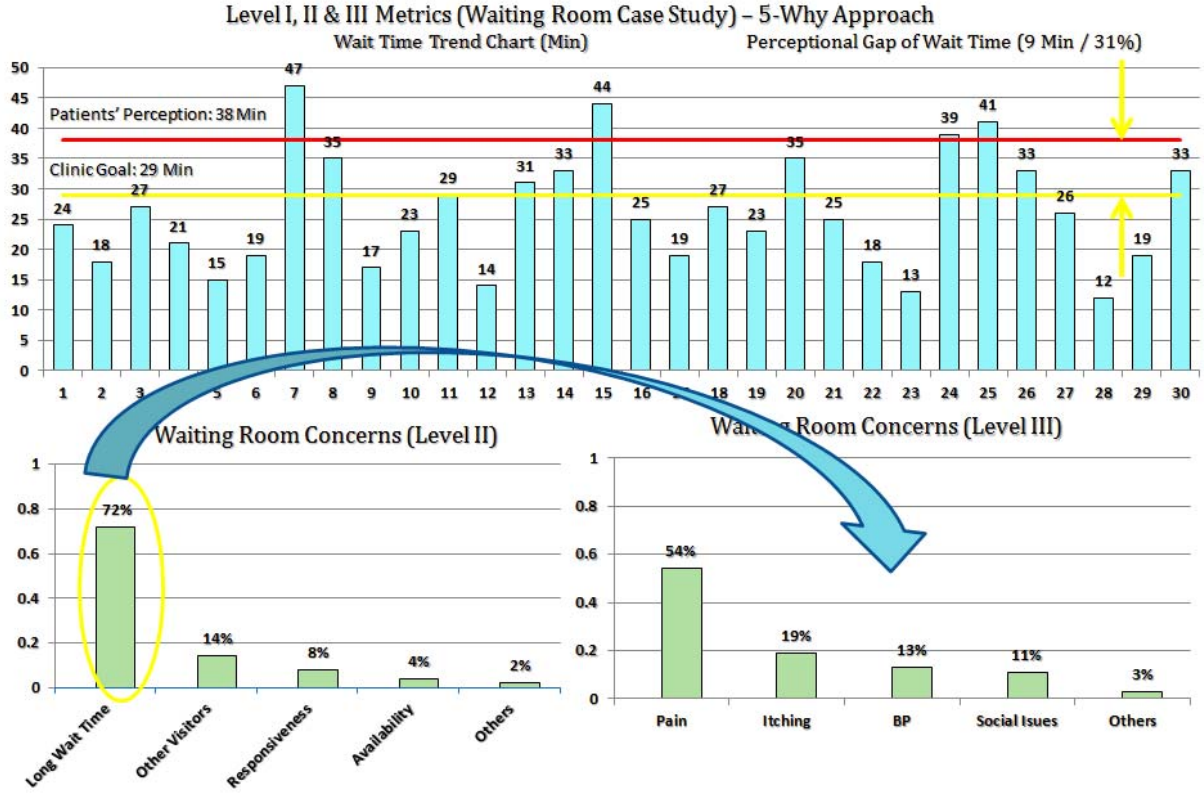

Figure – 7: Wait time in a hospital ER for Actual vs. Perceived

Wait time data was collected from two different sources; one from the hospital IT system as it was entered by triage staff and the other by asking the patients verbatim without checking their watches in a focused *Gemba* exercise. When the averages of timesverbally reported by same population of patients were calculated, overall average wait time reported was 38 minutes –a gap of 9 minutes or 31% longer than hospital's official numbers. Further investigation was conducted to reach the true root cause for the difference between actual and perceived wait times reported in Level II Pareto chart. It can be observed that 72% of the people complained about wait times to be long were the source of dissatisfaction in ERs and the people who felt that the time was too long, their condition was analyzed in Level III Pareto, where it was found that 54% of them had some kind of pain, 19% had itching or a similar discomfort, 13% had high blood pressure and 11% had social matters of equal importance. These observations validated results of several reported studies conducted in the field of perception management where it was reported that when human beings have feelings of discomfort, time tends to prolong before the symptoms of discomfort were treated. Two strategies were recommended to improve perceived length of time in ERs. First, the internal goal of seeing a patient by a triage staff was reduced to 22 minutes. Second, a supplemental fast track treatment system stream was created for patients with relatively severe symptoms. When these two proposals were implemented, perception improved significantly in around 3 ~ 4 months' time by a magnitude of 37%.

4.4 Managing for Daily Improvements (MDI)

This PQI was selected based on the spirit of *Kaizen*; several research studies have demonstrated that better run organizations do not wait for a long time to get feedback about poor performance and act when it is too late. Rather, they look for small opportunities on the daily basis and implement incremental

changes in small chunks so that they do not disrupt current state and permit people to carry out their routine work while improvements were being tested and implemented.

The success of Managing for Daily Improvements as a PQI metric depended on a hospital's culture to actively look for doing minor things in more efficient way. When people were used to doing their work in a specific way, it was difficult for them to see things in different ways but once they were apprised about the new way, they showed strong interest in making daily improvements. The metric was designed to consider the total number of tasks completed vs tasks identified on a daily basis. When fully indoctrinated into the concept, the completion rate reached 100%.

4.5 Quick Response System

Although all medical facilities have different kinds and versions of quick response systems, in some areas, the discipline of execution of a responsive system was less than perfect. In the interest of time and other priorities, some standardized protocols for fast response were either omitted or were completed partially, as a result of this the outcomes were not uniform and the quality of service had large variations. As a part of this research, a fast response station was created, where all necessary information and tools were provided to deal with the abnormal conditions; responsiveness metrics was created to ensure timeliness and effectiveness of response and roles and responsibilities were assigned for a clear understanding of tasks to be accomplished. It was observed that when people had clarity about their work and how to react to emergency situations, performance improved to a significantly higher level.

4.6 Standardized Processes

Several studies have successfully implemented standardized processes and protocols for routine repetitive work especially in the area of industrial engineering. Work processes basically had two distinct advantages; first variation in quality of service improved and second, it helped in predicting and enhancing productivity. Yet, it was important to consider that it was not possible to completely standardize protocols in a medical setting. Furthermore, it cannot be accomplished in a single iteration. Process standardization was achieved using many iterations for transformation using P-D-S-A cycles and current processes were gradually changed. For example, a metric was created where target was set to improve a minimum number of processes and then a target was set to establish what percentage of protocol would be standardized, usually in the range of 10% ~ 20% in every iteration. So, any current protocol which had around 30% content standardized would attain 80%+ standardization in 3 ~ 4 iterations. Finally, time and motion studies were conducted to validate standardization using cycle time or Length of Stay (LOS) being the basis of comparison. Generally, LOS variation could be reduced for the same presenting conditions but not for all presenting conditions. LOS also varied across providers due to difference in their education levels, training, years of experience and schedule of work. Several common and special causes for variations in LOS were studied and eliminated.

It is important to note that standardization in service industries has been traditionally far more challenging to accomplish as compared to product industries because in latter's output is tangible and can be ascertained using objective standards where in service industries, decision making depends heavily on subjective standards and people have to make several assumptions. Specifically in medical systems, patient's presenting conditions are the basis of judgment and different people describe their conditions for the same symptoms differently and medical staff has to consider several options and diagnostic procedures before they can confirm the symptoms (Jackson, 2011).

4.7 On-Time and Accurate Billing

Billing might not be a problem in countries outside United States where medical treatment and supporting services have either been subsidized by governments or have been free. In the United States, the majority of people have to manage their insurance by personal means or via their employers. At times, medical billing gets difficult to manage. Rather in this study, accuracy and timeliness of billing were the

major source of patient dissatisfaction after the delivery of medical services. The most commonly cited problems were inaccuracy, mistakes and timeliness. Several lean tools including Medical Services Value Stream, error proofing and visual controls were proposed and implemented to improve billing processes. It helped in reducing the errors and many hours of work attending to follow up calls by patients to adjust the bills. Since billing accuracy was a critical part of the medical process, a metric was created to monitor it on regular basis.

4.8 Number of Improvement Suggestions Received and Implemented

This metric was proposed and implemented to ensure active contribution of all hospital employees on a regular basis and was monitored with two sets of numbers because one number did not provide a complete picture of employee involvement in improvements. In one set of numbers, suggestions submitted a given time period were counted, for example number of suggestion every month increased after people understood the concept but it did not consider the quality of suggestions. If the number of suggestions submitted increased but they did not have a notable impact on performance improvement, they were ignored and did not add any value. So, the second set of numbers reported the percentage implemented as a fraction of total suggestions submitted. When both the set of numbers were reviewed, it helped in estimating the effectiveness of sustaining efforts.

4.9 Predictive Maintenance

Hospitals have many pieces of capital equipment that are complex and require a high degree of maintenance to keep them operational. Historical data from research sites indicated that there have been instances of unplanned downtime due to breakdown of MRI scanners, which caused bottlenecks in patient diagnostics and a lot of capital to get them either fixed or replaced. Several equipment uptime and maintenance procedures were recommended and implemented including Total Predictive maintenance (TPM). A fixed interval maintenance schedule was created where irrespective of the use of capital equipment, maintenance was done at a fixed time each month, and medical staff were informed in advance for the scheduled downtime and were expected not to schedule any patients during that time, usually at non-peak times. Initially, it increased the planned down time but slowly dropped unplanned down time due to sudden breakdown and operational errors. Numerically, the number of completed maintenance work orders as a ratio of total work orders was monitored with an assumption that the total number of work orders would include all kinds of equipment that needed periodic maintenance.

5.0 Conclusions

Managing by Performance Leading Indicators (PQIs) has been a great way of managing the system proactively and predicting problems before they become full blown crisis and cause many problems for the organizations. Medical services systems in particular cannot succeed by managing through lagging indicators of performance like the number of people who lose their lives or the number of people who were readmitted for not having the correct diagnosis in the first place or were not properly treated, or the number of people who interacted infections etc. Whenever an organization is presented with the idea of managing by PQIs, there are always some reservations and reluctance shown by stakeholders because it is completely new way of looking at their work, yet when that phases passes and people understand the true philosophy and spirit of managing by PQIs, it becomes easier to transform the system. It is important to note that implementation of PQIs metrics is a constantly evolving and self-correcting process and should be carried out in many iterations.

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