Healthcare Service Quality Improvement Migration Strategy: A Lean Six Sigma Based Approach

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Abstract

Access to affordable healthcare is critical to the quality of life of SA citizens. It may be argued that the service quality in SA public healthcare institutions is not comparable to private healthcare and/or international best practice. The need for a systematic quality improvement migration strategy arises. Universally effective quality improvement strategies across different industries, cultural and geographic settings are difficult to find. Quality healthcare is a moral and ethical imperative within the healthcare profession. Lean six sigma is acknowledged as a systematic and widely effective quality improvement methodology. We apply the hybrid methodology to suggest an effective service quality improvement migration strategy for public healthcare institutions in South Africa. Healthcare service sigma levels currently range between 0.98 and 2.3 for the service quality elements evaluated. The proposed migration framework is expected to raise sigma level to above 3 for all quality elements

Keywords
Lean, Six Sigma, Lean Six Sigma, Service Quality and Healthcare

1. Introduction

Public healthcare is critical to the health and wellbeing of SA citizenry as well as sustainable economic development (Young, 2016). Monitoring, evaluation, and continuous improvement of healthcare delivery is important. It may be argued that public healthcare delivery in SA is deteriorating. The public has lost trust in the health delivery system in SA (Maphumolo & Bhengu, 2019). The need arises to mitigate the decline and improve healthcare service delivery. Effective service quality improvement methodologies are required. Service quality may be defined as the difference between the service a customer is expecting and the service the customer is receives.

Service quality constitutes a key metric to evaluate the excellence or lack thereof of service delivery. Service quality potentially plays an important role in the healthcare service delivery quality improvement effort (Rehaman & Husnain, 2018). Service quality improvement has been implemented through various quality improvement methodologies. Lean six sigma has proven generally effective for this purpose. In this research we determine the current service quality six sigma levels for different quality dimensions of a selected healthcare centre and identify wastes in the healthcare process. We develop and suggest a quality improvement migration strategy applicable to the public healthcare facility. We apply the lean six sigma methodology to design the service quality improvement framework. This paper is outlined as follow: literature review, research methodology, findings and results discussion, proposed framework and the concluding remarks.

1.1 Objectives

The main objectives of this research are to determine the current healthcare service quality six sigma performance level, to identify service delivery wastes in the patient treatment process and finally to develop a service quality improvement framework for a health delivery centre.

2. Literature Review

Service quality is the difference between what the customer is expecting, and service received. Service quality constitutes a key metric to measure the excellence of service provided by the organization. Healthcare service quality may be defined as the provision of care that exceeds patient expectations and achieves the highest possible care outcomes with available resources (Ovretveit, 1992).

Many organisations use service quality as a methodology to shape customer satisfaction positively. The improvement in service quality results and a high probability of customer satisfaction (Rehaman & Husnain, 2018). The concept of service quality is widely adopted in healthcare. Service quality has a positive impact on the bottom-line of companies (Henderson, 2013). Patient satisfaction is an important indicator of how well the quality of the health care is delivered. Hospitals are seeking effective methodologies to improve patient care (Al-Damen, 2017).

Lean six sigma is a methodology that relies on team effort to eliminating waste, reduce errors, and ensure that the process performance is predictable. The most common implementation tools for lean six sigma are the Seven Tools of Quality (Ellis, 2016). The application of lean six sigma improves customer satisfaction hence service quality (Dumitrescu and Dumitrche, 2011). Six sigma has been successfully applied in healthcare service to improve service quality (Mousa, 2013)

The Healthcare industry presents unique challenges to process improvement methodologies. The primary challenge in the deployment of Lean six-sigma approach in healthcare revolves around effectively leveraging Lean six sigma to drive human behavioural change. Patient care involves human elements whose variability is wide but difficult to quantify (Fursule, et al., 2012).

3. Methods

We applied quantitative research, specifically statistical methods to determine the sigma level of current healthcare service quality in a selected healthcare facility. Primary data is used, collated through direct onsite random sample patient treatment observations. Metrics such as processing time and administration errors were used. Lean tools were applied to identify the service quality gaps (waste). The six sigma methodology, process capability and control charts/equations were applied.

$$Z = \frac{\mathrm{USL} - \bar{X}}{S} + 1.5\ sigma\ shift$$

Where, Z = Process-Sigma-Level

Key lean tools applied to identify service delivery wastes included (i) Cross-functional process flow, (ii) Value stream mapping, where-in high level process steps were considered.

4. Data Collection

A. Administrative errors (Defects) healthcare service quality element
The data was collected through the observation of a random sample of 108 patients through the end-to-end healthcare process. Administration errors were captured at various steps of the process.

B. Patient care & availability of equipment an infrastructure healthcare service quality elements
Surveys were conducted wherein patients were requested to rate the service quality. 'Not-satisfied' feedback was recorded as a defect for calculation purposes.

C. Process throughput service quality element

Observations to determine actual throughput time on sample patients were conducted. Throughput time in excess of targets as per service charter were classified as defectives for sigma level determination purposes.

5. Results and Discussion

5.1. Numerical Results

The respective variables were used to calculate the defect per million opportunities applying the following classical equation:

$$DPMO = \frac{Total\ number\ of\ defects\ found\ in\ a\ sample}{(Number\ of\ samples\ X\ number\ of\ defect\ opportunities\ per\ unit\ in\ sample\ )}\ X\ 1000\ 000$$

Where:

N = *number of patients observed during the study*

D = *Total number errors relative administrative occurred during the in the observation*

O =*The number of errors opportunities per patient in a sample. The administrative errors that could occur are incorrect patient information and misplacement of patient file*.

A. With respect to throughput administration error,

$$DPMO = 231482$$

The corresponding sigma level from the conversion table, see appendix 3, is 2.3. The probability of error free administration service is 76.85%.

B. Patient care:

$$DPMO = 564815$$

The corresponding sigma level is 1.33. The probability of an error free patient care is 43.52%.

C. Equipment's and Infrastructure.

$$DPMO = 805\ 556$$

The corresponding sigma level is 0.63. The probability for functional equipment is 19.44%.

5.2 Control charts

A. Determining Sigma level: Process through put

Figure 1, illustrate that the mean is not cantered, and the distribution is skewed to the right and the process mean is higher than the upper specification limit of 4 hours. This indicates that the process is out of control and not stable. Most data points are outside the target throughput time of 4 hours.

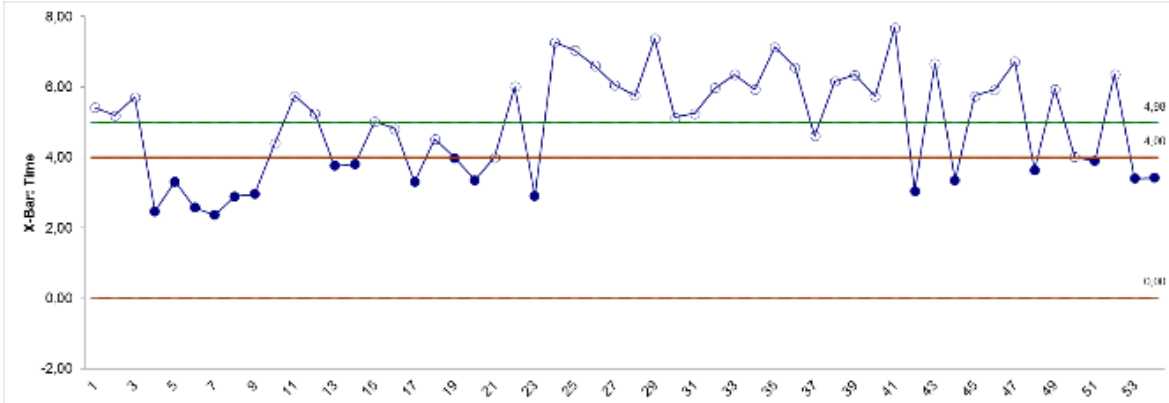

Figure 1: X-bar chart-Patient time

Patient treatment time:

$$X\ (Mean) = \frac{537.87}{108}$$
$$= \mathbf{4.98\ Hours}$$

The results confirms patients spent on average 4.98 hours in the value chain, Figure 2, illustrates that the process performance is not predictable, process variation is out of control.

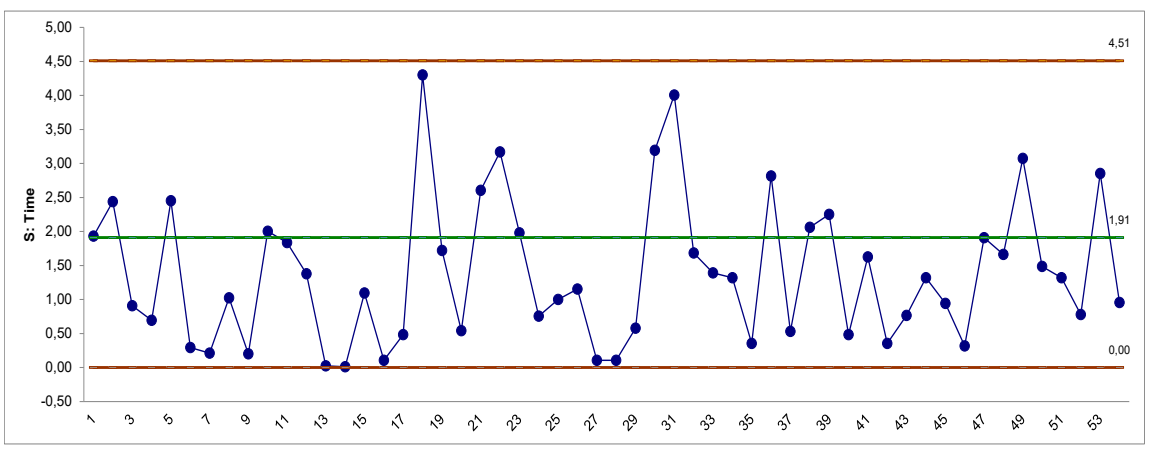

Figure 2: S-chart patient time

The resultant patient treatment process throughput time standard deviation:

$$Sd = \mathbf{1.910}$$

Corresponding sigma level,

$$Z = \frac{4-4.98}{1.910} + 1.5\ sigma\ shift$$
$$= 0.98$$

sigma level = **0.98**

B. Process flow analysis

The process walk audit was performed with aim of identifying the process inefficiencies. During the process walk audit the following process Inefficiencies or non-value adding activities discovered: (a). Manual capturing of triage forms (b) Over-processing on measuring patient blood pressure, (c)Manual capturing of the registration form, (d) Duplication of patient registration activity, (e) Manual allocation of the patient to the doctor's consultation room, (f) No signal to notify the next patient that the doctor is available and (g) Manual referral of patients to other hospital departments.

C. Value stream mapping analysis

The values stream mapping analysis was conducted for both patients with existing hospital records and also patients without. Opportunities for improvement include:

- Manual completion of triage forms (no system integration between the departments)
- Waiting for files to be collected from file record departments.
- Duplication of patient registration steps
- Manual allocation of the patient to doctors for consultation (visual pull system).
- There are no visual controls that provide the status of the patients moving through the process.

5.3 Proposed Improvements

The Lean six sigma tools assisted identification and control of waste. Cause and effect analysis facilitated determination and isolation of root causes. High level remedial strategies assisted framework development. The framework is defined as a tool that provides comprehensive solutions to problems related to operational elements (Lethbridge & Laganiere, 2005). The service quality improvement framework in figure 3, can be described as an approach to provide guidelines to improve the service quality through the application of lean six sigma. The process of developing the service quality improvement framework encompass the combination of the key service quality improvement recommendation. Furthermore, the service quality improvement framework includes the lean six sigma methodologies to ensure that the recommended service quality improvements are continually monitored and sustained across the value chain.

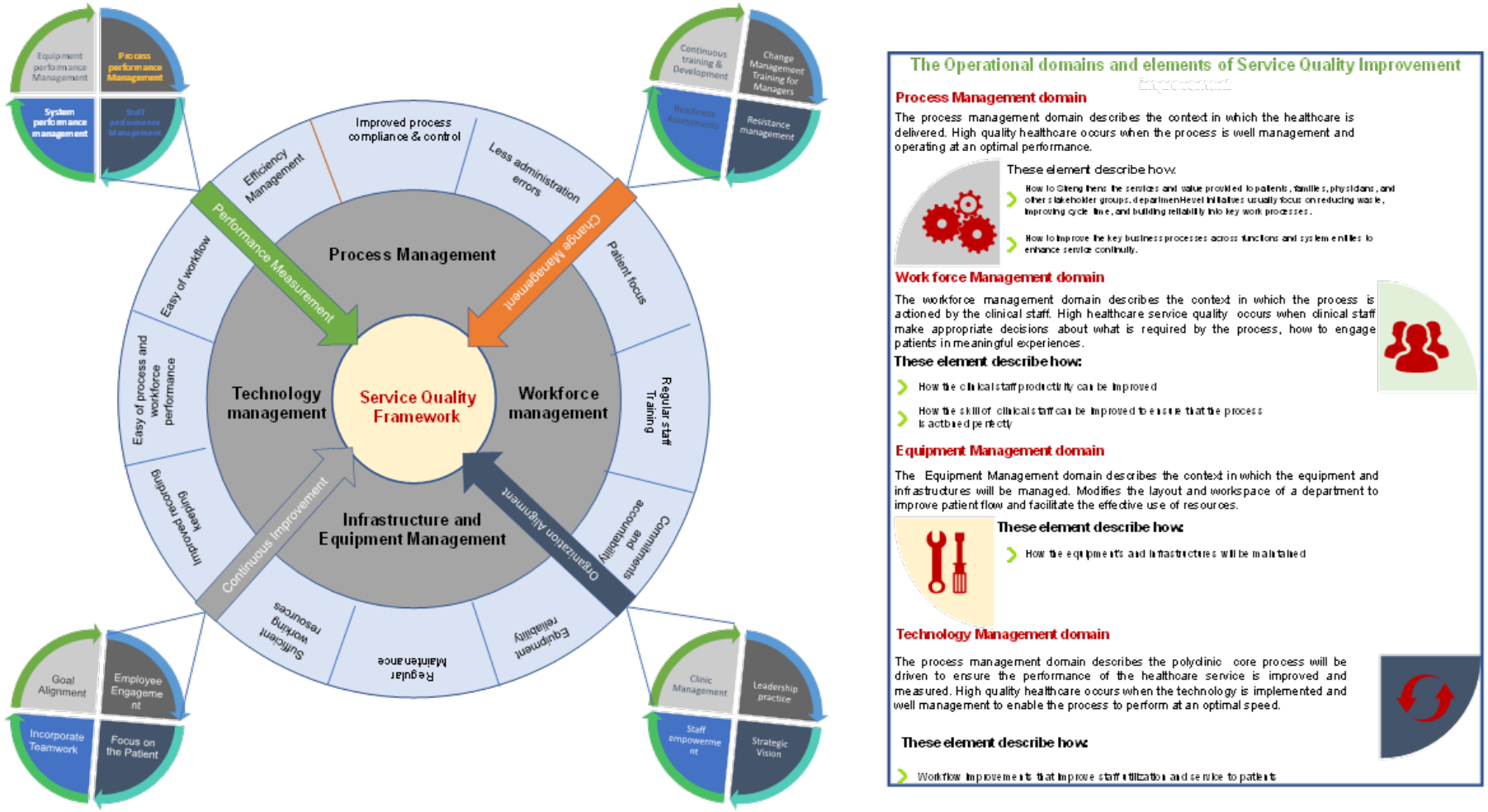

Figure 3: Service Quality improvement framework

6. Conclusion

The proposed service quality improvement framework shows the improvement by reducing the lengthy time in the process. The implementation of the service quality improvement framework is anticipated to assist improve the process sigma level significantly.

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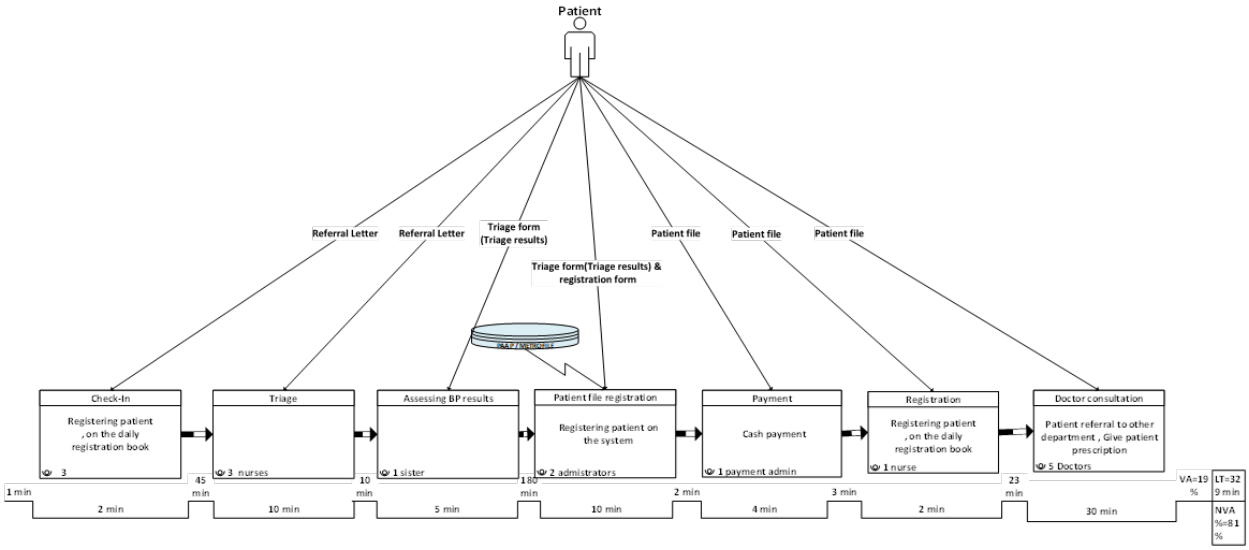
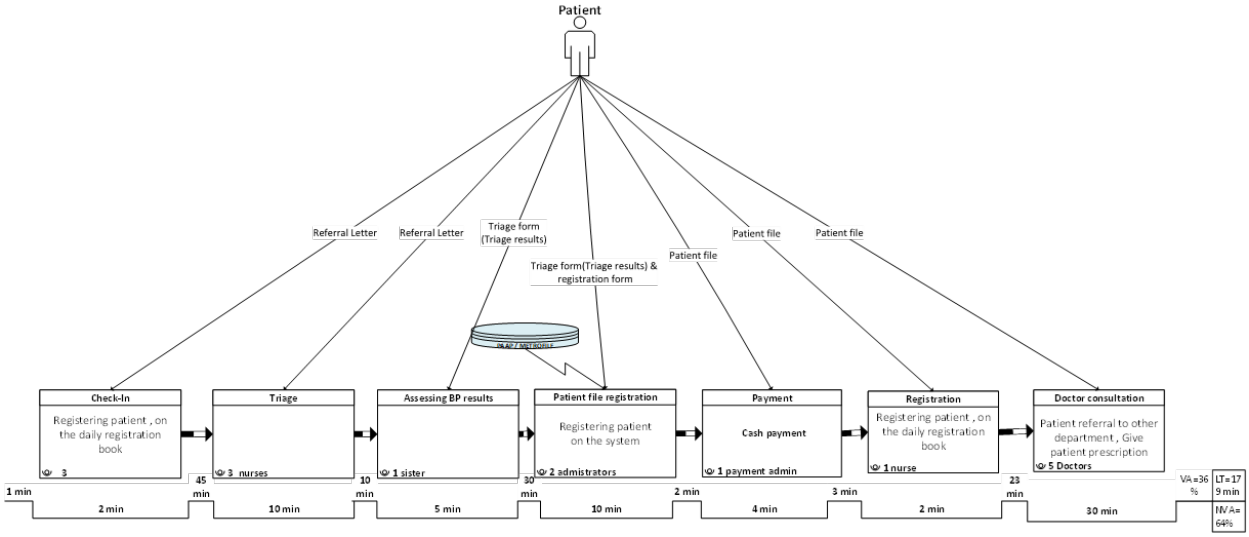
Appendixes



Appendix 1: Value Stream Map for the patients with existing hospital record



Appendix 2: Value stream map for the patients without existing hospital record

Yield	DPMO	Sigma	Yield	DPMO	Sigma	Yield	DPMO	Sigma
6.6%	**934,000**	**0**	**69.2%**	**308,000**	**2**	**99.4%**	**6,210**	**4**
8.0%	920,000	0.1	72.6%	274,000	2.1	99.5%	4,660	4.1
10.0%	900,000	0.2	75.8%	242,000	2.2	99.7%	3,460	4.2
12.0%	880,000	0.3	78.8%	212,000	2.3	99.75%	2,550	4.3
14.0%	860,000	0.4	81.6%	184,000	2.4	99.81%	1,860	4.4
16.0%	840,000	0.5	84.2%	158,000	2.5	99.87%	1,350	4.5
19.0%	810,000	0.6	86.5%	135,000	2.6	99.90%	960	4.6
22.0%	780,000	0.7	88.5%	115,000	2.7	99.93%	680	4.7
25.0%	750,000	0.8	90.3%	96,800	2.8	99.95%	480	4.8
28.0%	720,000	0.9	91.9%	80,800	2.9	99.97%	330	4.9
31.0%	**690,000**	**1**	**93.3%**	**66,800**	**3**	**99.977%**	**230**	**5**
35.0%	650,000	1.1	94.5%	54,800	3.1	99.985%	150	5.1
39.0%	610,000	1.2	95.5%	44,600	3.2	99.990%	100	5.2
43.0%	570,000	1.3	96.4%	35,900	3.3	99.993%	70	5.3
46.0%	540,000	1.4	97.1%	28,700	3.4	99.996%	40	5.4
50.0%	500,000	1.5	97.7%	22,700	3.5	99.997%	30	5.5
54.0%	460,000	1.6	98.2%	17,800	3.6	99.9980%	20	5.6
58.0%	420,000	1.7	98.6%	13,900	3.7	99.9990%	10	5.7
61.8%	382,000	1.8	98.9%	10,700	3.8	99.9992%	8	5.8
65.6%	344,000	1.9	99.2%	8,190	3.9	99.9995%	5	5.9
						99.99966%	**3.4**	**6**

Appendix 3: Six Sigma Conversion Table

Biography

Mayver Ramogayane is an experienced Process Engineer, and a Certified Lean Six Sigma Green Belt professional focusing on process improvement and optimization. He is au fait with process optimization in various industries (manufacturing, banking, finance and insurance) and was part of the team responsible for the process improvement projects for reputable insurance and Banking companies in South Africa. He enjoys working on complex data based projects involving problem solving, analysis, continuous improvement and innovation. His skillset allows him to be at ease in busy environments, producing a high standard of work, whether it is team related or in individual capacity.