Effect of Lean Six Sigma on quality performance in Malaysian hospitals

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Abstract

Purpose – The purpose of this paper is to investigate the effects of Lean Six Sigma (LSS) and workforce management on the quality performance of Malaysian hospitals. This paper also investigates the direct and indirect relationships between top management commitment and quality performance of the healthcare organisations in Malaysia.

Design/methodology/approach – This study applied stratified random sampling to collect data from 15 different hospitals in Peninsular Malaysia. The self-administered survey questionnaires were distributed among 673 hospital staff (i.e. doctors, nurses, pharmacists, and medical laboratory technologists) to obtain 335 useful responses with a 49.47 per cent valid response rate. The research data were analysed based on confirmatory factor analysis and structural equation modelling by using AMOS version 23 software.

Findings – The research findings indicated that LSS and workforce management have a significant impact on quality performance of the Malaysian hospitals, whereas senior management commitment was found to have an insignificant relationship with quality performance. The research findings indicate that senior management commitment has no direct significant relationship with quality performance, but it has an indirect significant relationship with quality performance through the mediating effects of LSS and workforce management.

Research limitations/implications – This research focussed solely on healthcare organisations in Malaysia and thus the results might not be applicable for other countries as well as other service organisations.

Originality/value – This research provides theoretical, methodological, and practical contributions for the LSS approach and the research findings are expected to provide guidelines to enhance the level of quality performance in healthcare organisations in Malaysia as well as other countries.

Keywords Hospitals, Lean Six Sigma, Quality performance, Top management commitment, Workforce management

Paper type Research paper

1. Introduction

Healthcare is a service industry with unique characteristics. In healthcare, customers are the immediate patients followed by their families and friends, as the outcome of the healthcare service potentially affects all their lives. Error or mistake in this field can be devastating to individuals and groups alike as lives and quality of life are at risk. In 1999, the Institute of Medicine published a report "To err is human: building a safer health system" which estimated that up to 98,000 people die annually in the USA due to medical errors (Hunt, 2002). However, a new report published in the *Journal of Patient Safety* reveals that each year 210,000–400,000 patients die because of preventable adverse events in US hospitals (Allen, 2013). Those figures would make such medical errors the third leading cause of death in America behind heart disease, which is the first and cancer, which is the second according to the Centre for Disease Control and Prevention (Allen, 2013).

According to Gurses and Carayon (2007), healthcare has serious patient safety and quality problems and is in need of fundamental change. Healthcare processes are poorly designed and characterised by unnecessary duplication of services and long waiting times

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and delays for the patients (Rashid, 2007). Costs are rising sharply and waste increases expenditures in healthcare services. Due to these problems, healthcare organisations are facing difficulties meeting their patients' desire for quality services. To overcome medical patient safety and quality problems, healthcare organisations can implement the Lean Six Sigma (LSS) approach to improve quality performance (Heuvel *et al.*, 2006). The LSS approach helps healthcare organisations eliminate waste, variation, and work imbalance in the service processes (Dahlgaard *et al.*, 2011). This approach also eliminates the unnecessary long cycles or waiting times between value-added activities to improve the quality performance of the hospitals (Poksinska *et al.*, 2016).

In Malaysia, healthcare systems are regulated by the Ministry of Health. The public health sector plays a more important role in providing healthcare services than the private health sector. However, it was observed that the private healthcare sector has been rapidly growing over the last few decades and it is playing an important role in the healthcare industry to provide better medical services to patients such as the development of specialist hospitals for serious illnesses, continuous improvement in healthcare information technology, and private medical insurance for local patients (Teo, 2013; Ministry of Health, 2012). Although the private health sector provides a reasonable level of healthcare service, it needs to ensure the quality of its services is at par with international standards (Ministry of Health, 2012).

Currently, Malaysian public hospitals are overworked and face difficulty ensuring appropriate appointments between patients and doctors (Ren, 2007). Butt and de Run (2010) conducted an empirical study on service quality of Malaysian private hospitals and found that hospital service quality has a negative influence on reliability and responsiveness due to delayed response to the patients and the attitude problem of hospital staff. They suggested that the private healthcare sector should emphasise workforce management and provide training to staff to improve their skills to reduce response times while dealing with patients. A similar study conducted by Pillay *et al.* (2011) on patient satisfaction with waiting times of the public hospitals in Malaysia found that, on average, patients wait more than 2 h to meet with medical personnel for only 15 min due to employee attitudes and delayed work processes, heavy workload, management and supervision problems, and inadequate facilities. In addition, recent studies show that Malaysian private healthcare sector is accused by many patients for being overly concerned with making profit rather than providing quality medical services at reasonable costs (*The Star Online*, 2010, 2012).

To minimise these medical problems, many Malaysian hospitals have started to implement a LSS approach to improve their quality performance. Under the LSS methodology, the hospitals are applying many quality tools and techniques such as control chart, histogram, Pareto chart, scatter diagram, plan-do-check-act (PDCA), root cause analysis (RCA), balanced scorecard, benchmarking, 5 S, and five whys (Ministry of Health, 2007, 2012). Thus, this study investigates whether the implementation of the LSS methodology has a significant influence on the quality performance of Malaysian hospitals.

2. Literature review

2.1 Lean Six Sigma

The Lean approach is a process of streamlining that increases business revenue, reduces costs, and improves customer satisfaction by eliminating unnecessary activities that are considered wasteful. The Lean process is faster, efficient, economic, and delivers satisfactory quality to customers (Jimmerson *et al.*, 2005; Antony *et al.*, 2007). This approach focusses on maximising process speed of service, provides a means for quantifying and eliminating the cost of complexity, provides tools for analysing process flow and delay times at each activity in a process, and creates process speed by reducing costs and cycle time with efficiency (Hina-Syeda *et al.*, 2013).

To reduce costs and improve customer satisfaction, service organisations should implement Lean and Six Sigma approaches together because speed and quality cannot be separated when improving processes. Both methods are necessary when working to improve customer satisfaction by eliminating unnecessary costs and waste. The Six Sigma application focusses more on the reduction of variation, whereas the Lean method focusses on the removal of waste by reducing cycle time (Nave, 2002; Laureani and Antony, 2012). The question is why Lean and Six Sigma are required to improve business processes? According to George (2003), the collective use of Lean and Six Sigma is required to improve business processes because Six Sigma does not directly address speed or reduce invested capital, while Lean increases productivity but does not provide any tool to fix seen or unseen quality issue, and both enable the reduction of the cost of complexity. Moreover, the organisations need to consider some critical success factors of LSS deployment towards quality performance such as the involvement of senior management, leadership, financial support (funding), build a good work culture, develop best strategy, competency, and performance-based projects (Arcidiacono *et al.*, 2016).

2.2 Determinants of Lean Six Sigma in healthcare services

The application of LSS can be described by many factors to evaluate the quality performance of the healthcare organisation. This study defined the LSS methodology by six components, namely, continuous quality improvement, Six Sigma initiatives, Lean initiatives, patient safety, value-added activity and team. These six components describe how continuous quality improvement influence on process improvement of healthcare organisation, how Six Sigma initiatives measure the quality improvement process of the healthcare organisation, how Lean initiative focus on patient needs by reducing costs with value chain service, how patient safety ensure high environmental health and safety where patient will not face any adverse situation, how value-added activities create a new value which fulfil the requirement of the patient's need and how teamwork collaborate with functions, employees, and managers to solve healthcare problems towards quality performance.

2.2.1 Continuous quality improvement. Continuous quality improvement is an incremental approach towards process improvement and takes an organisation-wide systems perspective, which is tied to the strategic goals and aligned with a culture of quality (Sollecito and Johnson, 2011). This approach includes the plan, do, check/study, and act (PDCA/PDSA) method to establish a culture for continuous quality improvement and measure patient satisfaction by conducting survey and focus group studies (Evans and Lindsay, 2011). It integrates continuous quality improvement activities by using interdisciplinary teams at all levels in the healthcare organisation and offers reward/recognition for employees who contribute in the quality improvement process (McFadden *et al.*, 2015).

2.2.2 Six Sigma initiatives. "Six Sigma is a radical breakthrough approach that is heavily focussed on bottom-line results, specifically for process improvement projects" (Gowen *et al.*, 2012, p. 135). This approach includes process improvement tools to measure the quality improvement process of the healthcare organisation such as statistical process control chart, check sheet, histogram, Pareto chart, and RCA. This approach also includes process improvement methods such as define, measure, analyse, improve, and control (DMAIC), design for Six Sigma (DFSS) processes to focus on continuous improvement project of the healthcare organisation (Coronado and Antony, 2002; Furterer, 2011).

2.2.3 Lean initiatives. The Lean initiatives emphasise patient needs by reducing costs and increasing efficiency of the delivery speed of the medical services (Hagan, 2011). Normally, Lean initiatives include "5 S" practices, process mapping, value stream mapping (VSM), Kaizen methods, and just-in-time (JIT) approach for continuous improvement in the quality performance of the healthcare organisation (Protzman *et al.*, 2010). Process mapping

eliminates non-essential elements in the work processes by using flow charts and process map to better understand quality improvement processes of the healthcare organisation. VSM is applied in healthcare organisation to distinguish between value-added and non-value-added activities in the quality improvement processes, identifies problems and opportunities for improving workflow, and shows how the future workflow would look. The Kaizen method defines the problem of the workflows, analysing workflows, determine the cycle times of the work processes, testing improvement alternatives, and select the best alternative to solve the problem in the quality improvement work processes. Finally, JIT approach eliminates waste and reduces waiting time in work process, employee movement, and transportation (Burgess and Radnor, 2013; D'Andreamatteo *et al.*, 2015; Williams, 2017).

2.2.4 Patient safety. Patient safety can be described as the avoidance, prevention, and amelioration of adverse outcomes or injuries that stem from the process of healthcare (Burström *et al.*, 2014). It is a fundamental principle that policymakers, healthcare providers, and managers would prevent adverse events to treat patients without errors. In the healthcare organisation, patient safety depends on a strong and positive patient safety culture such as awareness of the patient safety, teamwork, communication, and work climate (El-Jardali *et al.*, 2014).

2.2.5 Value-added activities. The main concept behind LSS is creating "value" for the customers. Value-added activity can be defined as how the service providers deliver exactly the (customised) product or service a customer wants with minimal time between the moment the customer asks for that product or service and the actual delivery at an appropriate price (Womack and Jones, 2003). By defining "what customers want," the delivery of the service processes can be categorised into two activities, namely, value-added time and non-value-added time (Joosten *et al.*, 2009). Value-added time can be described as a reduction of the customer waiting time for the product or service and how service providers manage time during the delivery service to their customers. On the other hand, non-value-added time can be defined as a waste that reduces customer satisfaction and loyalty.

2.2.6 Teamwork. Teamwork can be described as collaboration between functions, between employees, between employees and managers, between employees and suppliers, and between managers and non-managers (Sabry, 2014). According to Leong and Teh (2013), teamwork should have value added, and mutual trust and respect to one another to solve any organisational problem together as a team. For effective teamwork in the healthcare organisation, there should be cooperation among the hospital units to provide the best care for patients (El-Jardali *et al.*, 2014).

2.3 Conceptual framework and hypotheses development

The present research developed a conceptual framework and hypotheses based on a review of literature (i.e. Lee and Choi, 2006; Zu *et al.*, 2008; Kathan, 2008; Kennedy and Daim, 2010; Shafer and Moeller, 2012; D'Andreamatteo *et al.*, 2015). Figure 1 maps the research conceptual framework with six hypotheses. The subsequent sections explain the six hypotheses with the relationships among the research variables.

2.3.1 Relationships of top management commitment with Lean Six Sigma and workforce management. Top management commitment is crucial in LSS implementation, as demonstrated by Chief Executives such as JackWelch of GE, Bob Galvin of Motorola, and Lawrence Bossidy of AlliedSignal, each of whom led the LSS implementation in their firm. Top management makes the strategic decisions required for LSS adoption (Lee *et al.*, 2014). The LSS approach can only be established if top management uses its authority and power to integrate the LSS black belt (usually serve as advisers to the project leaders) and green belt (who is well trained for quality problem solving) systems into the organisation's human infrastructure. Top management commitment not only positively influences

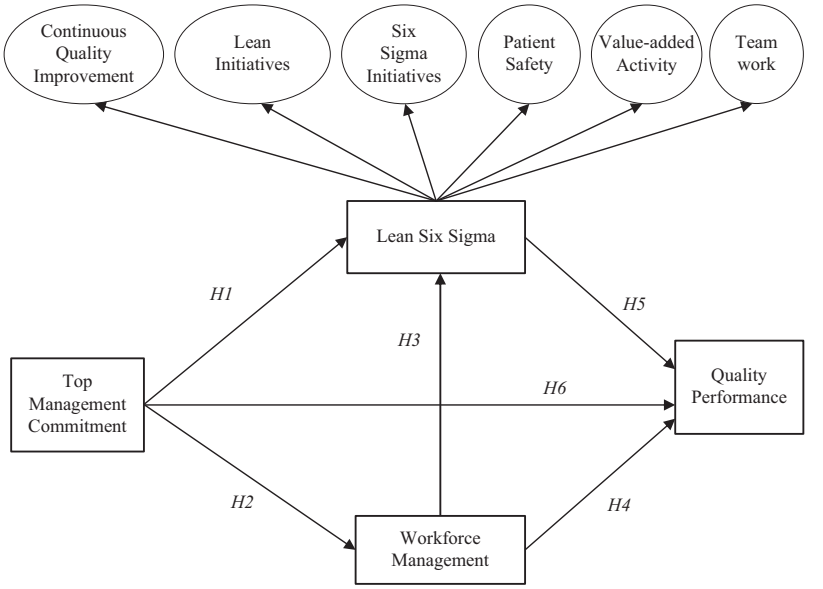

Figure 1.
Conceptual framework and hypotheses of the Lean Six Sigma approach

LSS but also influences the healthcare workforce management to improve quality performance (Shafer and Moeller, 2012). Within the context of this study, it is believed that top management commitment influences LSS and workforce management towards quality performance of the hospital. Thus, the first and second hypotheses are:

H1. Top management commitment has a positive impact on LSS.

H2. Top management commitment has a positive influence on workforce management.

2.3.2 Relationship between workforce management and Lean Six Sigma. The workforce management supports LSS approach to improve the quality performance of the organisation by providing employee commitment and teamwork (Guesalaga, 2014). It encourages employee involvement in quality management performance, offers recognition of their good performance, and considers their interests and satisfaction. Workforce management offers promotion and reward/recognition for employees to increase their involvement and achievement in the LSS projects (Dhar, 2015), which peaks employee interest in quality improvement and increases their commitment to the organisation's goal of high quality (D'Andreamatteo *et al.*, 2015). Within the context of this study, it is believed that workforce management influences LSS approach towards quality performance. Therefore, the third hypothesis is:

H3. Workforce management has a positive impact on LSS.

2.3.3 Relationship between workforce management and quality performance. Workforce management plays a significant role in improving quality performance in the healthcare organisation. To achieve high quality performance, the healthcare organisation must reform their human resources planning to increase equity and fairness in the healthcare workforce management (Ehrhardt *et al.*, 2011). According to Kennedy and Daim (2010), health workforce requires improvements in skills at all levels of hospital service such as nurses care, physicians care, patient satisfaction, and patient registration accuracy among others. They also mentioned that effective workforce management helps healthcare organisations

increase employee retention within the workplace and prevents early retirement of hospital specialists. However, a healthcare workforce management system could be affected due to a number of specific problems such as duplication services by hospital staff, lack of continuity between the various service providers, relatively poor salaries for hospital staff, excessive working hours, the undersupply of nursing staff, and shortage of doctors in the emergency room and surgical operation areas, and doctors move overseas for higher specialty training (Rechel *et al.*, 2006). Within the context of this study, it is believed that workforce management has a positive influence on quality performance of the hospital. Therefore, the fourth hypothesis is:

H4. Workforce management has a positive influence on quality performance.

2.3.4 Relationship between Lean Six Sigma and quality performance. The LSS approach is applied in healthcare organisations to increase value-added activities which are required by the patients. It not only increases the value-added activities but also reduces non-value-added activities (i.e. waste and unnecessary services) for the continuous improvement in healthcare quality performance (Abdallah, 2014). The LSS approach depends on RCA to investigate waste and errors within organisational processes, and it improves quality performance by eliminating waste and errors (Khanchanapong *et al.*, 2014). Besides eliminating waste and errors, the LSS methodology could help healthcare organisations to improve service quality performance such as nurse care, physician care, hospital environment, patient safety, hospital stay, and waiting time in the hospital. These factors ensure the level of performance of the healthcare service quality towards patient loyalty (Chiarini and Bracci, 2013). Within the context of this study, it is believed that the LSS methodology has a positive influence on healthcare quality performance. Therefore, the fifth hypothesis is:

H5. LSS has a positive influence on quality performance

2.3.5 Relationship between top management commitment and quality performance. Top management commitment provides positive direction and resources to the healthcare organisation to improve quality performance. It also provides a cooperative and learning working environment which helps healthcare organisations implement the quality management system for greater customer satisfaction (Yeung *et al.*, 2005; Harmancioglu *et al.*, 2010). To implement the quality management system in the healthcare organisation, senior management makes a strategic decision to adopt the LSS approach to improve their quality performance (Zeng *et al.*, 2015). According to Kathan (2008), top management commitment helps healthcare organisations build organisational awareness and increase employees' commitment by implementing the LSS approach to achieve superior quality goals. Within the context of this study, it is believed that top management commitment has a positive influence on healthcare quality performance. Hence, the sixth hypothesis is:

H6. Top management commitment has a positive influence on quality performance.

3. Methodology

The present study used stratified random sampling to collect data from 15 selected hospitals in Peninsular Malaysia. The research questionnaire measured LSS, top management commitment, workforce management, and quality performance of the hospital based on 36 items. Out of these 36 items, five items measured the top management commitment of the hospitals which adopted from Harmancioglu *et al.* (2010) and Guesalaga (2014), six items measured the workforce management which adopted from Kennedy and Daim (2010) and Zeng *et al.* (2015), seven items measured the quality

performance which adopted from Gowen *et al.* (2012) and Antony and Kumar (2012), and 18 items measured the six sub-variables of LSS, namely continuous quality improvement, Six Sigma initiatives, Lean initiatives, patient safety, value-added activity, and teamwork. These sub-variables items were adopted from previous studies (e.g. Gowen *et al.*, 2012; Antony and Kumar, 2012; El-Jardali *et al.*, 2014). The respondents of the study included only doctors, nurses, pharmacists, and medical laboratory technologists. The research data were collected from four different regions in Peninsular Malaysia, namely, Central region (Kuala Lumpur, Selangor), Northern region (Penang, Kedah, and Perak), Southern region (Johor Baru and Melaka), and Eastern region (Pahang). In this study, 673 self-administered questionnaires were distributed randomly to the respondents to obtain 335 useful responses which gave a 49.47 per cent response rate. Outliers, normality, confirmatory factory analysis (CFA) and structural equation modelling (SEM) were undertaken using SPSS version 23 and AMOS version 22.

4. Data analysis

4.1 Outliers and normality

According to Hair *et al.* (2010), multivariate outliers can be detected by computing squared Mahalanobis distance (D^2) for each case in the data set. There are several reasons behind the occurrences of outliers in the database, such as data entry errors, observation errors, unclear instructions or inappropriate layout in the survey questionnaire, erroneous responses from the respondents and collected data from inappropriate respondents who are not representatives of the target population of the study. In this study, univariate and multivariate outliers were tested by using SPSS and AMOS software programmes, respectively. Based on univariate and multivariate outliers tests, it was observed that there was no standardised value (*z*-scores) more than ±4 in the data set and no serious multivariate outliers observed in the results of Mahalanobis distance (D^2). Thus, all 335 cases were retained in the statistical analysis. Moreover, the data set was tested for all items of the research variables to determine the normal distribution of the sample by using SPSS and AMOS. The results of the normality test indicated that the maximum index of skewness and kurtosis were −1.166 and 1.517, respectively. These values were well below their respective cut-offs of ±1.96 as suggested by Hair *et al.* (2010) meaning that all items are normally distributed.

4.2 Tests for measurement model

Confirmatory factor analysis (CFA) is a member of the factor analysis family with the objective of determining unidimensionality and constructs validity of the variables. In this study, CFA was carried out to measure the construct validity of the research variables. CFA needs to be carried out for item purification first before processing to test the measurement model. Items purification is based on maximum likelihood estimation whereby unsuitable items were dropped and retested until salient few items remain for the variables (Hair *et al.*, 2010). CFA also needs to be applied before examining the full structural model, after which mediating and moderating effects are explored.

The present study estimated the measurement model together with the four research variables, namely top management commitment, workforce management, LSS, and quality performance. A number of fit indices can be applied to examine the fitness of the measurement model but not all fit indices are required in the data analysis due to redundancy (Hair *et al.*, 2010). Thus, this study only focussed on four fit indices to determine the model, namely, relative χ^2/df or normed χ^2 (χ^2/df), comparative fit index (CFI), normed fit index (NFI), and root mean square approximation (RMSEA). The general guidelines are given by several authors (Hair *et al.*, 2010; Kline, 2011) to determine

the fit indices of the model, such as value of normed χ^2 should be less than 5, CFI and NFI values should be above 0.9 and RMSEA value should be less than 0.088. Based on results it was observed that the value of normed χ^2 (χ^2/df) is 1.673, which is less than maximum point of 5.0, CFI = 0.957 and NFI = 0.912 which are more than the 0.90 cut-off point, and RMSEA value of 0.045 which is less than maximum cut-of value 0.088, indicates an acceptable fit of the measurement model. The results also indicate that standardised loadings for all remaining constructs were greater than 0.5. Moreover, the present study calculated the composite reliability (CR) for all variables to establish the reliability of those constructs. The results revealed a CR value ranging from 0.82 to 0.93, indicating strong evidence of reliability (see Table I).

Apart from the CR, this study also calculated average variance extracted (AVE), maximum shared variance (MSV), and average shared squared variance (ASV) to establish convergent validity and discriminant validity. For convergent validity, CR value should be greater than 0.70, AVE value should be greater than 0.50, and CR value must be greater than AVE (Hair *et al.*, 2010). For discriminant validity, the values of MSV and ASV should be less than AVE. Table I illustrates that the present study not only met the criteria for reliability but also met the criteria for convergent validity and discriminant analysis.

4.3 Tests for structural model

The hypothesised model in Figure 2 was examined by using AMOS software version 23. The model was evaluated based on the χ^2 test, the comparative fit index (CFI), normed fit index (NFI), and root mean square error of approximation (RMSEA), as per the suggestions of many scholars (Hair *et al.*, 2010; Kline, 2011). In addition, the coefficients were measured for statistical significance at 5 per cent level ($p < 0.5$). In this study, a full baseline structural model shows satisfactory goodness-of-fit with relative χ^2 value (χ^2/df) of 1.967, which is within the maximum point of 5.0; CFI of 0.940, more than 0.90; NFI of 0.902, which is greater than 0.90; RMSEA of 0.053 less than minimum requirement value 0.088; and PNFI of 0.762, less than 0.90 (see Figure 2). The full structural model summary indicates an acceptable fit with satisfactory goodness-of-fit except parsimony fit. Nevertheless, the standardised loadings for most of the constructs were greater than 0.5.

Figure 2 contains the diagram and Table II presents the output for the full model including the standardised estimates (coefficients), and *p*-values. Based on Table II, it is observed that five hypotheses (e.g. *H1–H5*) have significant relationships in the structural model such as relationship between top management commit and LSS ($\beta = 0.437$, *p*-value = 0.001), relationship between top management commit and workforce management ($\beta = 0.807$, *p*-value = 0.001), relationship between workforce management and LSS relationship ($\beta = 0.474$, *p*-value = 0.001), relationship between workforce management and quality performance ($\beta = 0.170$, *p*-value = 0.015), and relationship of LSS and quality performance ($\beta = 0.818$, *p*-value = 0.001). The results also indicate that there is no direct significant relationship between top management commitment and quality performance since ($\beta = -0.041$ and *p*-value = 0.530), thus, *H6* was not supported in the structural mode. However, top management commitment has an indirect significant relationship with quality performance through the mediating effects of LSS and workforce management. According to Hair *et al.* (2010), when the coefficient of indirect paths are multiplied and the outcome of this multiplication is greater than 0.08, evidence of mediation is confirmed. In this study, the multiplication of coefficient of indirect paths between top management commitment and quality performance through the mediating effect of LSS was 0.357 (0.437×0.818) and workforce management was 0.137 (0.807×0.170) which are greater than 0.08.

In addition, the R^2 for quality performance was 86.4 per cent indicating that all the independent variables (i.e. top management commitment, LSS, and workforce management) contributed to approximately 86 per cent of the variance explained in quality performance

Variable items		Std. loading	CR	AVE	MSV	ASV
Top management commitment			0.88	0.60	0.43	0.36
TM1	Our hospital's department head provides supportive leadership for quality improvement	0.74				
TM2	Our hospital's department heads within our hospital participate in the quality improvement processes	0.81				
TM3	Our hospital's top management appreciates individual staff contribution to improve healthcare service	0.78				
TM4	The top management works closely with employees to improve quality performance of our hospital	0.85				
TM5	Our hospital's top management decides what to do when patient complains about service received	0.74				
Workforce management			0.88	0.56	0.39	0.28
WM1	Our hospital gives feedback to employees to improve hospital services	0.79				
WM2	Our hospital employees are recognised for superior quality performance	0.74				
WM3	Our hospital regularly provides quality-related training to improve our skills	0.75				
WM4	Our hospital puts a high value on employee job satisfaction	0.78				
WM5	I am committed to participate on quality improvement processes in our hospital	0.70				
WM6	I clearly understand the ultimate objectives of my hospital	0.68				
Quality performance			0.93	0.65	0.52	0.37
QP1	Our hospital's quality management process has been improved over the past years	0.66				
QP2	The severity errors of medical services have been reduced over the past years	0.59				
QP3	The patient waiting time (meet with medical personnel) has been reduced over the past years	0.71				
QP4	In our hospital, waste in processes have been reduced over the past years	0.62				
QP5	Number of patient complaints has been decreased over the past years	0.75				
QP6	The employee job satisfaction of our hospital has been increased over the past years	0.86				
QP7	Patient satisfaction with the quality of our hospital services has been increased over the past years	0.91				
Lean Six Sigma			0.90	0.60	0.46	0.36
Continuous quality improvement			0.84	0.63	0.56	0.43
CQ1	In our hospital, teams of employees are very active for quality/process improvement	0.82				
CQ2	Our hospital offers reward/recognition for employees who contributed in the quality improvement process	0.75				
CQ3	Our hospital establishes a culture for continuous quality improvement	0.81				
Lean initiatives			0.82	0.61	0.35	0.28
LM1	Our hospital implements value stream mapping (VSM) to identify waste and error which are non-value-added processes	0.81				
LM2	Our hospital implements kaizen methods to continuous improvement in processes	0.81				
LM3	Our hospital implements just-in-time (JIT) to improve work process management	0.72				

(*continued*)

Table I.
Construct validity of the measurement model

Variable items		Std. loading	CR	AVE	MSV	ASV
Six Sigma initiatives			0.82	0.60	0.51	0.41
SS1	Our hospital implements process improvement tools to measure quality improvement process	0.78				
SS2	Our hospital implements process improvement method such as DMAIC to focus on continuous improvement project	0.76				
SS3	Our hospital offers training in process improvement tools for employees to improve their skills	0.77				
Patient safety			0.85	0.66	0.51	0.37
PS1	Our hospital increases awareness of errors among employees to ensure patient safety	0.83				
PS2	Our hospital reduced the impact of errors in the medical services	0.81				
PS3	The actions of our hospital show that patient safety is a top priority	0.79				
Value-added activity			0.85	0.65	0.51	0.43
VA1	Our hospital practices lower process time to reduce patient waiting time in the delivery services	0.76				
VA2	Our hospital uses advanced equipment to reduce the lead/cycle time in the delivering service	0.82				
VA3	Our hospital practices lower process time to reduce the operating time in the work processes	0.84				
Teamwork			0.87	0.70	0.56	0.41
TW1	In our hospital, people treat each other with respect	0.84				
TW2	When members of our unit get really busy, other members of the same unit help out	0.84				
TW3	Our hospital units work well together to provide the best care for patients	0.83				

Table I.

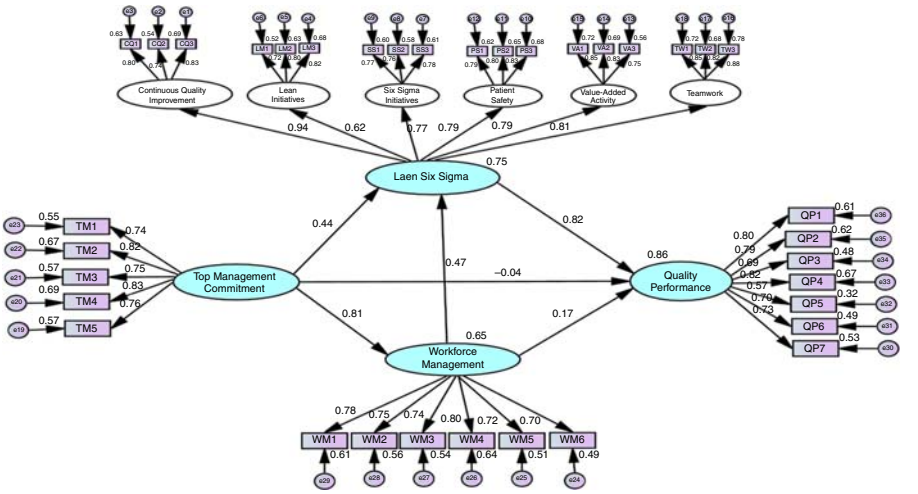

Figure 2.
Full baseline structural model

Notes: χ^2=1,046.464, df=543, p=0.000, normed χ^2=1.927, CFI=0.940, RMSEA=0.053

of the healthcare services. Next, R^2 value for LSS was 75.0 per cent indicating that all the variables (i.e. top management commitment and workforce management) contributed to 75 per cent of the variance explained in LSS applications in the healthcare sector. Last but not least, R^2 value for workforce management was 65.1 per cent indicating that the variable (i.e. top management commitment) contributed approximately 65 per cent of the variance explained in workforce management of the healthcare services.

5. Discussion and conclusions

The present research outcomes indicated that the LSS approach and workforce management have direct and significant influence on quality performance of the Malaysian hospitals. The findings also indicated that there is no significant relationship between top management commitment and quality performance in the Malaysian healthcare organisations. Though research findings indicated that top management commitment has no direct significant impact on quality performance, it has an indirect significant impact on quality performance through the mediating effects of the LSS approach and workforce management. Thus, top management commitment alone cannot influence on quality performance of the healthcare organisation without the mediating effects of LSS applications and workforce management.

For the effective relationship between top management commitment and quality performance, the healthcare organisation requires proper planning, prioritisation, resource allocation, budgeting, training, and proper review and reward mechanisms through LSS process assessment (Hayes, 2010). Moreover, the healthcare organisation needs to apply the informal strategies to enhance the relationship between top management commitment and quality performance such as supportive management, conducting periodic employee reviews, offering employee suggestion programmes, soliciting employee feedback, and managing employee relations and engagement (Griffith, 2009). The hospital also can identify relevant information to meet the hospital's performance objectives, manage organisational knowledge from various sources to create value, set targets for employees that are linked to strategies and goals, evaluate and improve hospital strategic planning processes, and improve key processes for higher productivity and quality of services for the patient satisfaction.

Apart from these recommendations, the practitioners and policy makers need to consider five essential aspects to improve the overall performance of the healthcare organisation such as developing and clarifying an understanding of the healthcare problems, fostering and sustaining a culture of change and patient safety, continuous monitoring of performance and reporting of findings to sustain the change, testing change strategies for better performance, and involving key stakeholders of the healthcare organisation (Bergman *et al.*, 2015). They also need to follow some useful guidelines to improve the quality performance of the hospitals such as selecting quality projects which are strategically significant for the hospital, providing training to the doctors and nurses about the quality tools and applications of the healthcare systems, developing the skills to design

Table II. Hypothesised path coefficients

Hypothesised path coefficient relationships	Coefficient (β)	p-value (sig)	Remarks
H1. Top management commitment → Lean Six Sigma	0.437	0.001	Supported
H2. Top management commitment → Workforce management	0.807	0.001	Supported
H3. Workforce management → Lean Six Sigma	0.474	0.001	Supported
H4. Workforce management → Quality performance	0.170	0.015	Supported
H5. Lean Six Sigma → Quality performance	0.818	0.001	Supported
H6. Top management commitment → Quality performance	−0.041	0.530	Not supported

and use measures of quality to identify the key performance indicators of the healthcare services, not neglecting those services which are doing little to address quality problems, and ensuring quality projects working on complex subjects by following the steps of a structured team-working process (Williams, 2017; Burgess and Radnor, 2013). Once quality performance has improved, the healthcare organisation will be able to better fulfil patient needs through enhanced quality services.

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