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Selim Ahmed, Noor Hazilah Abd Manaf, Rafikul Islam,

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Selim Ahmed
World School of Business, World University of Bangladesh, Dhaka, Bangladesh, and

Noor Hazilah Abd Manaf and Rafikul Islam
Department of Business Administration, International Islamic University Malaysia, Kuala Lumpur, Malaysia

Abstract

Purpose – This study aims to investigate applications of Six Sigma methodology in Malaysian private hospitals. It measures Six Sigma initiatives of the private hospitals based on demographics such as gender, position and working experience.

Design/methodology/approach – The present study measures Six Sigma initiatives of private hospitals and used stratified random sampling to collect data from eight selected hospitals in Peninsular Malaysia. The respondents of the study include doctors, nurses, pharmacists and medical laboratory technologists. In this study, 520 questionnaires were distributed to respondents who are working in Malaysian private hospitals. In total, 251 responses were received (48.27 per cent response rate). The descriptive analysis, independent samples *t*-test and one-way ANOVA were undertaken using SPSS version 23.

Findings – The findings of this study indicate that male respondents have better perception on four aspects of Six Sigma applications such as process improvement tools, process improvement methods, manage quality improvement activities and formal planning process compared to female respondents. The research findings also indicate that doctors have better perception regarding process improvement tools to measure quality improvement process, leadership to continuous improvement processes, training in process improvement tools for employees' skill improvement compared to nurses, pharmacists, medical laboratory technologists.

Research limitations/implications – The present research focussed solely on the Malaysian private hospitals, and thus the results might not be applicable to other countries. This study focussed on Six Sigma initiatives of private hospitals in Malaysia, while the future research may consider investigating the difference or conformance between private and public hospitals on Six Sigma initiatives and its relationship with quality performance. In addition, present study findings are expected to provide guidelines to enhance the applications of Six Sigma methodology in private hospitals in Malaysia as well as other countries.

Originality/value – This research provides theoretical and practical contributions for the Six Sigma initiatives in private hospitals. Most of the past studies of Six Sigma initiatives are centred on manufacturing sector, but few empirical studies have been conducted on the health-care organisation. Thus, findings of the present study on the health-care sector contribute to the on-going pursuit of knowledge in the area of Six Sigma by using the strength of related theories and parent disciplines.

Keywords Six sigma, Quality improvement, Malaysia, Private hospital

Paper type Research paper

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1. Introduction

Healthcare is a unique service industry which provides better medical care for a better life. In healthcare, errors or mistakes 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 because of medical errors (Donaldson *et al.*, 2000). 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 (PAEs) in USA hospitals (James, 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 (Makary and Daniel, 2016).

In Malaysia, the healthcare industry has become a powerful enabler of economic growth because of demographic shifts, greater affluence and demand from patients for better health-care services, in addition to medical tourism (ETP Annual Report, 2012). There are three key sub-sectors of the Malaysian health-care eco-system, namely, pharmaceuticals and biotechnology, medical technology and health services. These sub-sectors have contributed towards achieving Malaysia's goal to become a developed nation by 2020 (ETP Annual Report, 2012). To be a developed nation, the Malaysian National Key Economic Area (NKEA) is focussing on forging collaboration between public and private health-care sectors to contribute to the gross national income (GNI). NKEA seeks to identify the private sector initiatives and opportunities to develop the healthcare industry in a more organised and coherent manner (ETP Annual Report, 2012). Meanwhile, it is expected that the Healthcare NKEA projects will generate RM35.3bn GNI and 181,000 new jobs by 2020 (ETP Annual Report, 2012). NKEA not only generates revenue and new jobs but also ensures continuous improvement in the health-care services (ETP Annual Report, 2012; MOH, 2012). To ensure continuous improvement in the health-care services, some Malaysian private hospitals (i.e. KPJ hospitals, Sunway Medical Centre, Gleneagles Medical Centre, Prince Court Medical Centre, Sime Darby Medical Centre and Mahkota Medical Centre) have been implementing Six Sigma methodology (Annual Report MOH, 2007; Shazali *et al.*, 2013).

The Six Sigma philosophy was first introduced by Motorola in 1987. It has been extensively used within companies such as General Electric (GE), Allied Signal (former Honeywell), ABB, TX Instruments, Caterpillar, Sony, Toshiba, City Bank, Bank of America and JP Morgan among others (Koning *et al.*, 2006). The health-care organisations embraced the Six Sigma concept after it was fully developed, tested and adopted in the manufacturing sector by companies such as Motorola, Allied Signal and General Electric (Ganti and Ganti, 2004). Since 1998, the Six Sigma method has been used by many health-care organisations including the Commonwealth Healthcare Corporation, Decatur Memorial Hospital, Charleston Area Medical Centre and Baptist Medical Centre (Salah *et al.*, 2010; Evans and Lindsay, 2014). By implementing Six Sigma approach, these medical institutions have managed to reduce their waste and costs towards quality performance in the health-care services. This approach benefits health-care organisations in terms of better operational efficiency, cost-effectiveness and higher process quality. It has a positive impact in clinical areas such as infection control and medication delivery (Taner *et al.*, 2007). Therefore, this study measures Six Sigma initiatives of the private hospitals based on demographics such as gender, position and working experience. The present study contributes on-going pursuit of knowledge in the area of healthcare by using the Six Sigma application in hospital and other service organisations.

2. Literature review

2.1 The concept of Six Sigma

Sigma is a Greek letter of the alphabet used to describe variability or in mathematical terms, standard deviation of a random variable. It is a statistical unit of measure that reflects the likelihood that an error will occur. Six Sigma relies on rigorous statistical methods and implements control mechanisms to tie together quality, cost, process, people and accountability (Evans and Lindsay, 2014). Six Sigma was originally a concept for company-wide quality improvement first introduced and implemented by Motorola in 1987. It has been used by many other companies to improve the quality performance of the organisation (Psomas, 2016). The higher level of sigma means the higher level of performance in the organisational system. For instance, a three-sigma process has a defect rate of 6.7 per cent, whereas a Six Sigma process has less than four defects (i.e. 3.4 defects) per million opportunities. Defects in processes cause increase in costs because of scrap, rework, repair, retest and so on (Evans and Lindsay, 2014).

Six Sigma projects can be led by Black or Green Belt ninjas (experts) who are well trained for quality related problem solving. Master Black Belt ninjas usually serve as advisers to the project leaders while local champions promote Six Sigma in their organisations (Kalra and Kopargaonkar, 2016). There are two basic methodologies of Six Sigma. These are as follows:

- Define, measure, analyse, improve and control (DMAIC) for existing processes; and
- Design for Six Sigma (DFSS) for designing new products/processes. (Prashar, 2014; Smith, 2016).

DMAIC is a five step improvement cycle with the aim to continuously reduce errors through defining the project by identifying problems, clarifying scope and defining goals (Taner *et al.*, 2007). Each step has three sub-steps. On the other hand, DFSS implements the Six Sigma quality into product or processes from the design stage (Prashar, 2014). The Six Sigma methodology is a well disciplined and structured approach for enhancing the performance process to achieve the highest level of quality and the lowest level of variability. To achieve the highest level of quality performance, the Six Sigma methodology can be applied with the lean methodology (Salah *et al.*, 2010; Huang and Klassen, 2016).

2.2 Benefits of Six Sigma methodology

There are many benefits for using the Six Sigma methodology in terms of organisational performance. It reduces project costs, project duration and improves organisational performance. It may enhance product development cycles and process design and reduce product lead times by reducing the cycle time of the overall manufacturing or service process. It can be used to find and eliminate the root causes of the problem, thereby reducing the variability in the process to prevent defects (Liberatore, 2013).

The Six Sigma approach provides guidelines that help workers understand how to carry out their job to solve the potential problems. It also improves the efficiency of the production line and production capacity, including minimising the organisational waste such as removing useless components and excessive movements and decreasing the cycle time for repair (Tjahjono *et al.*, 2010). The Six Sigma approach also helps the organisation to select the best project to achieve the organisational goals. According to Sharma and Chetiya (2010), Six Sigma can ensure organisational success by identifying the project selection

criteria. Based on their research, it was observed that 17 factors have a positive impact on the success of the Six Sigma project. These 17 factors are:

(1) waste reduction potential;
(2) increasing customer-centricity;
(3) improvement in work flows;
(4) user complaint reduction potential;
(5) scope for cycle time reduction;
(6) scope for method simplification;
(7) scope for process reengineering;
(8) process mapping;
(9) asset availability;
(10) transparency of information;
(11) availability of a good measurement system;
(12) clearly defined deliverables;
(13) availability of innovative and qualified people;
(14) deployment of adequate financial resources;
(15) clear identification of critical-to-quality characteristics;
(16) presence of top management commitment; and
(17) presence of a good communication system.

These 17 factors help determine whether the Six Sigma programme has a high probability of success or failure by selecting the best project processes. Moreover, it helps improve the relationship within and outside the organisation. The factors also foster customer satisfaction and loyalty by meeting their needs and expectations (Stanton *et al.*, 2014). The Six Sigma application is among the important methods which continuously improve quality performance to achieve organisational goals. As a result, many service organisations such as hospitals, educational institutes and other service organisations have been applying Six Sigma methodology to improve quality performance towards greater customer satisfaction (Fortenot *et al.*, 1994; Antony, 2006, 2015).

2.3 Six sigma in health-care organisation

In 1998, the first Six Sigma hospital was initiated by the Commonwealth Health Corporation (CHC) in the USA. After several years, it was observed that applications of Six Sigma were slowly but successfully implemented by health-care organisations across the nation in terms of reducing ER cycle time, unnecessary cost on medical services, medical errors and increasing timely completion of medical records (Plonien, 2013). In Netherlands, the Red Cross Hospital successfully implemented Six Sigma methodology and saved €1.2m from 44 Six Sigma projects (DelliFraine *et al.*, 2013). The Six Sigma programme not only improved quality performance, but also reduced the cost substantially to resolve the current financial problems in the health-care services (Ibliwi *et al.*, 2014). The Six Sigma method also increased patient satisfaction with excellent quality service at minimal cost, effective and efficient utilisation of existing resources and driving out non-value added activities (Plonien, 2013). These methodologies can be applied in health-care processes such as:

Increasing capacity in X-ray rooms	Reducing turnaround time in preparing medical reports
Increasing surgical capacity	Reducing bottlenecks in emergency departments
Increasing productivity of healthcare personnel	Reducing avoidable emergency admissions
Increasing accuracy of laboratory results	Reducing cycle time in various inpatient and outpatient diagnostic centres
Increasing accuracy of billing processes and thereby reducing the number of billing errors	Reducing number of medical errors and hence enhancing patient safety
	Reducing patient falls
Improving bed availability across various departments in hospitals	Reducing errors from high-risk medication
Improving MRI exam scheduling	Reducing medication ordering and administration errors
Improving day care performance	Reducing lost MRI films
Improving accuracy of clinical coding	Reducing length of stay in ER
Improving patient registration accuracy	Reducing ER diversions
Improving patient satisfaction at emergency room	Reducing inventory levels
Improving turnaround time for pharmacy orders	Reducing the number of post-operative wound infections and related wound problems
Improving nurse or pharmacy technician recruitment	

Source: Antony *et al.* (2007); Taner *et al.* (2007); Jhon and Ram (2008); Yao *et al.* (2017)

Moreover, Taner *et al.* (2007) mentioned that the application of Six Sigma methodology clearly benefits health-care organisations in terms of better operational efficiency, cost-effectiveness and higher process quality. They mentioned that Six Sigma method has a positive impact in clinical areas such as infection control and medication delivery. However, they also mentioned lack of financial resources, human resources, time, leadership, poor training, poor project selection and internal resistance as possible reasons behind failure of Six Sigma applications.

3. Methodology

The present study used stratified random sampling to collect data from 8 selected private hospitals in Peninsular Malaysia. The sampling frame of the study was developed based on the proportion of the medical staffs.

> This study targeted only doctors, nurses, pharmacists and medical laboratory technologists of the private hospitals because they are key personnel to improve the quality performance of the hospital .The Currently, approximately 52300 medical staffs (i.e., doctors, nurses, pharmacists, and medical laboratory technologists) are serving in private hospitals in Peninsular Malaysia (MOH, 2014). In this study, five hundred and twenty survey questionnaires (one percent of the population) mailed to eight hospitals and two hundred and fifty one completed questionnaires were returned. This represented 48.27 per cent response rate which was regarded as satisfactory (Saunders *et al.*, 2010).

The current study used self-administered survey questionnaire to measured Six Sigma initiatives in Malaysian private hospitals based on ten items. These ten items were adapted from previous studies (i.e. Zu *et al.*, 2008; Shafer and Moeller, 2012; Antony and Kumar (2012) and measured by five-point Likert scales. 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).

Before collect data, the researchers contacted with all selected hospitals' director/chief executive officer through email and phone call to get approval to conduct survey in their hospital. After got the approval, the hardcopy survey questionnaires were mailed to the hospital along with covering letter and information sheet. The distributions of the survey questionnaire and data collection were carried out by an official who was assigned by the hospital's authority. Although the survey questionnaires were distributed from the Director/CEO office of the hospital, the element of bias was controlled since the respondents were selected from the sampling frame by the researchers.

After collection of the data, the present study revealed that the majority of the respondents (81.3 per cent) were female, whereas male respondents were only 47 (18.7 per cent). Concerning the position of the respondents, half of the survey respondents were nurses (54.2 per cent), whereas 25.9 per cent, 10 per cent, and 10 per cent respondents were doctors, pharmacists and medical laboratory technologists, respectively. Regarding the working experience of the respondents, 32 (12.7 per cent), 78 (31.1 per cent), 50 (19.9 per cent) and 91 (36.3) respondents were working in the current hospital one-two years, three-five years, six-10 years and above 10 years, respectively (see Table I). To analyse the data, this study applied independent samples *t*-test and one-way ANOVA using SPSS version 23.

4. Findings

4.1 Perception on Six Sigma approach in hospital

This section presents the preliminary analysis of the collected data. The analysis covers calculating the mean and standard deviation scores (based on a five-point Likert scale: 1 = strongly disagree; 3 = neutral; 5 = strongly agree) for all the items of Six Sigma instrument. Table II provides mean and standard deviation values for ten items of Six Sigma methodology. Based on the descriptive analysis, it was observed that the highest mean was 4.103 (item 7), whereas the lowest mean was 3.908 (item 2). On the other hand, the lowest standard deviation was 0.6106 (item 3), whereas the highest standard deviation was 0.7268 (item 4).

The results of the descriptive analysis indicate that the majority of the items of the Six Sigma initiatives mean values were more than the midpoint of the scale (mean = 3.995, standard deviation = 0.506). This suggests that the majority of the respondents agreed with the positive statement of the Six Sigma initiatives of the Malaysian private

Description	Frequency	(%)
Gender		
Male	47	18.7
Female	204	81.3
Position		
Doctor	65	25.9
Nurse	136	54.2
Pharmacist	25	10.0
Medical laboratory technologist	25	10.0
Working experience		
1-2 years	32	12.7
3-5 years	78	31.1
6-10 years	50	19.9
Above 10 years	91	36.3

Table I.
Demographic profile of the respondents

No.	Variable item	Mean	Stand. Deviation
SS1	Hospital implements process improvement tools (e.g. statistical process control chart, check sheet, histogram and Pareto chart) to measure quality improvement process	4.0876	0.7044
SS2	Hospital implements process improvement method such as DMAIC to focus on continuous improvement project	3.9084	0.7235
SS3	In the hospital, continuous improvement projects are conducted by PDCA/PDSA quality improvement method	4.0558	0.6106
SS4	In the hospital, teams of employees are very active for quality/process improvement	3.9124	0.7268
SS5	The hospital integrates continuous quality improvement activities interdisciplinary teams at all levels	4.0000	0.6261
SS6	Hospital has strong leadership to continuous improvement processes demonstrated by managers at all levels	3.9602	0.6621
SS7	Hospital offers training in process improvement tools for employees to improve their skills	4.1036	0.6302
SS8	Hospital uses a structured approach to manage quality improvement activities	3.9920	0.6752
SS9	Hospital has a formal planning process to decide the major quality improvement projects	3.9442	0.7244
SS10	Hospital, all improvement projects are reviewed regularly during the process	3.9880	0.6601

Table II.
Descriptive statistics for Six Sigma approach in hospitals

hospitals. This is because hospitals staff believed that their hospital applies process improvement tools (e.g. statistical process control chart, check sheet, histogram and Pareto chart) to improve quality (mean = 4.087). The hospital also applies process improvement methods such as DMAIC to focus on continuous improvement of the system (mean = 3.908). It was also noted that continuous improvement projects are executed by employing plan, do, check/study, act (PDCA/PDSA) cycle (mean = 4.055). Further, hospital integrates continuous quality improvement activities by using interdisciplinary teams at all levels (mean = 4.000). The respondents (hospital staff) also believed that their hospital offers training in process improvement tools to employees to improve their skills (mean = 4.103) and hospital also uses a structured approach to manage quality improvement activities (mean = 3.992).

4.2 Six Sigma initiatives in hospital

This study analysed Six Sigma initiatives in Malaysian private hospitals based on independent samples *t*-test and one-way ANOVA (see Tables III, IV and V). The present study used independent samples *t*-tests to identify the differences or conformance among hospital staff's perceptions of Six Sigma methodology based on gender (Tables III). The results of the independent sample *t*-tests indicate that there are significant differences between male and female respondents. Male respondents have better perception on process improvement tools ($\mu = 4.319$, *t*-values = 2.526, $p = 0.012$) and process improvement method to focus on continuous improvement ($\mu = 4.127$, *t*-values = 2.325, $p = 0.021$) compared female respondents. They also have better perception on structured approach to manage quality improvement activities in hospital ($\mu = 4.148$, *t*-values = 2.019, $p = 0.045$) and formal planning process to decide the major quality improvement projects ($\mu = 4.127$, *t*-values = 2.165, $p = 0.031$) compared to female respondents.

No.	Variable items	Gender	*N*	Mean	*t*-value	Sig.
SS1	Hospital implements process improvement tools (e.g. statistical process control chart, check sheet, histogram and Pareto chart) to measure quality improvement process	Male Female	47 204	4.3191 4.0343	2.526	0.012
SS2	Hospital implements process improvement method such as DMAIC to focus on continuous improvement project	Male Female	47 204	4.1277 3.8578	2.325	0.021
SS3	In the hospital, continuous improvement projects are conducted by PDCA/PDSA quality improvement method	Male Female	47 204	4.1915 4.0245	1.696	0.091
SS4	In the hospital, teams of employees are very active for quality/process improvement	Male Female	47 204	3.9787 3.8971	0.694	0.489
SS5	The hospital integrates continuous quality improvement activities interdisciplinary teams at all levels	Male Female	47 204	3.8936 4.0245	−1.294	0.197
SS6	Hospital has strong leadership to continuous improvement processes demonstrated by managers at all levels	Male Female	47 204	4.0213 3.9461	0.701	0.484
SS7	Hospital offers training in process improvement tools for employees to improve their skills	Male Female	47 204	4.2340 4.0735	1.579	0.116
SS8	Hospital uses a structured approach to manage quality improvement activities	Male Female	47 204	4.1702 3.9510	2.019	0.045
SS9	Hospital has a formal planning process to decide the major quality improvement projects	Male Female	47 204	4.1489 3.8971	2.165	0.031
SS10	In the hospital, all improvement projects are reviewed regularly during the process	Male Female	47 204	4.1489 3.9510	1.862	0.064

Table III.
Independent samples *t*-test on gender

After analysing the independent sample *t*-tests, this study used one-way ANOVA to investigate the significant differences among the hospital staff based on job position such as a doctor, nurse, pharmacist and medical laboratory technologist (MLT). According to the results of ANOVA tests, it was observed that there are significant differences among the different job positions on process improvement tools to measure quality improvement process ($F = 2.489$, $p = 0.044$) leadership to continuous improvement processes ($F = 2.459$, $p = 0.046$) and training in process improvement tools for employees to improve their skills ($F = 3.436$, $p = 0.009$). The results indicate that doctors have better perception on process improvement tools ($\mu = 4.246$) and leadership for continuous improvement processes ($\mu = 4.092$) compared to nurses, pharmacists and medical laboratory technologists. They also have a better perception of the training in process improvement tools for employees' skill improvement ($\mu = 4.292$) compared to other staff (Table IV). The present study also used one-way ANOVA to investigate the significant differences among the hospital staff based on job experience. However, the results show that there is no significant difference among the hospital staff according their job experience (see Table V).

5. Discussion

The objective of the present study is to measure Six Sigma initiatives in Malaysian private hospitals based on demographics such as gender, position and working experience.

The findings of the present study show that there are significant differences between male and female respondents on Six Sigma initiatives in Malaysian private hospitals. The research results indicate that male hospital staff have better perception on process improvement tools,

No.	Variable Items	Groups	*N*	Mean	*F*-value	Sig.
SS1	Hospital implements process improvement tools (e.g. statistical process control chart, check sheet, histogram and Pareto chart) to measure quality improvement process	Doctor	65	4.2462	2.489	0.044
		Nurse	136	4.0074		
		Pharmacist	25	3.9600		
		MLT	25	4.1453		
SS2	Hospital implements process improvement method such as DMAIC to focus on continuous improvement project SS2	Doctor	65	4.0462	1.348	0.253
		Nurse	136	3.8824		
		Pharmacist	25	3.6800		
		MLT	25	3.9333		
SS3	In the hospital, continuous improvement projects are conducted by PDCA/PDSA quality improvement method	Doctor	65	4.1538	1.668	0.158
		Nurse	136	4.0147		
		Pharmacist	25	3.8800		
		MLT	25	4.1833		
SS4	In the hospital, teams of employees are very active for quality/process improvement	Doctor	65	4.0769	2.193	0.070
		Nurse	136	3.8603		
		Pharmacist	25	3.8800		
		MLT	25	3.7000		
SS5	The hospital integrates continuous quality improvement activities interdisciplinary teams at all levels	Doctor	65	4.0000	1.408	0.232
		Nurse	136	3.9926		
		Pharmacist	25	4.0800		
		MLT	25	3.8667		
SS6	Hospital has strong leadership to continuous improvement processes demonstrated by managers at all levels	Doctor	65	4.0923	2.459	0.046
		Nurse	136	3.9044		
		Pharmacist	25	3.9600		
		MLT	25	3.8833		
SS7	Hospital offers training in process improvement tools for employees to improve their skills	Doctor	65	4.2923	3.436	0.009
		Nurse	136	4.0588		
		Pharmacist	25	3.8800		
		MLT	25	4.1333		
SS8	Hospital uses a structured approach to manage quality improvement activities	Doctor	65	4.0923	0.850	0.495
		Nurse	136	3.9559		
		Pharmacist	25	3.8800		
		MLT	25	4.0167		
SS9	Hospital has a formal planning process to decide the major quality improvement projects	Doctor	65	4.1077	2.090	0.083
		Nurse	136	3.8456		
		Pharmacist	25	4.0400		
		MLT	25	3.9500		
SS10	In the hospital, all improvement projects are reviewed regularly during the process	Doctor	65	4.0000	0.858	0.490
		Nurse	136	3.9559		
		Pharmacist	25	3.9600		
		MLT	25	4.1467		

Table IV.
One-way ANOVA tests on position

process improvement method such as DMAIC to focus on continuous improvement, structural approach to manage quality improvement activities and formal planning process to decide the major quality improvement projects compared to female staff.

> "It's understandable, men first introduced the Six Sigma methodology for Motorola Company in 1980s and they also refined the system for many other companies such as Xerox Company, Sony, Boeing, Toyota and Texas Instruments and, Apple Computers and Citigroup that remains admired to this day (Six Sigma Daily, 12 April, 2018). However, gender plays no role for implementing the Six Sigma methodology in service industry. Nowadays, women have been excelling at applying Six Sigma to make operations more efficient and effective in all service areas. In healthcare industry, the hospital need to find the employees who are dedicated and motivated to improve the quality performance of hospital.

No.	Variable Items	Groups	*N*	Mean	*F*-value	Sig.
SS1	Hospital implements process improvement tools (e.g. statistical process control chart, check sheet, histogram and Pareto chart) to measure quality improvement process	1-2 years	32	4.2188	2.316	0.076
		3-5 years	78	4.0385		
		6-10 years	50	3.9000		
		Above 10 years	91	4.1868		
SS2	Hospital implements process improvement method such DMAIC to focus on continuous improvement project SS2	1-2 years	32	3.9375	0.498	0.684
		3-5 years	78	3.9744		
		6-10 years	50	3.8200		
		Above 10 years	91	3.8901		
SS3	In the hospital, continuous improvement projects are conducted by PDCA/PDSA quality improvement method	1-2 years	32	4.0625	1.396	0.244
		3-5 years	78	4.1026		
		6-10 years	50	3.9000		
		Above 10 years	91	4.0989		
SS4	In the hospital, teams of employees are very active for quality/process improvement	1-2 years	32	3.9688	1.516	0.211
		3-5 years	78	3.9359		
		6-10 years	50	3.7200		
		Above 10 years	91	3.9780		
SS5	The hospital integrates continuous quality improvement activities interdisciplinary teams at all levels	1-2 years	32	4.0313	1.043	0.374
		3-5 years	78	4.0385		
		6-10 years	50	3.8600		
		Above 10 years	91	4.0330		
SS6	Hospital has strong leadership to continuous improvement processes demonstrated by managers at all levels	1-2 years	32	3.8438	1.055	0.369
		3-5 years	78	4.0128		
		6-10 years	50	3.8600		
		Above 10 years	91	4.0110		
SS7	Hospital offers training in process improvement tools for employees to improve their skills	1-2 years	32	4.0313	0.410	0.746
		3-5 years	78	4.1026		
		6-10 years	50	4.0600		
		Above 10 years	91	4.1538		
SS8	Hospital uses a structured approach to manage quality improvement activities	1-2 years	32	4.0625	1.380	0.249
		3-5 years	78	4.0256		
		6-10 years	50	3.8200		
		Above 10 years	91	4.0330		
SS9	Hospital has a formal planning process to decide the major quality improvement projects	1-2 years	32	3.8125	1.008	0.390
		3-5 years	78	4.0513		
		6-10 years	50	3.9000		
		Above 10 years	91	3.9231		
SS10	In the hospital, all improvement projects are reviewed regularly during the process	1-2 years	32	4.0625	0.731	0.534
		3-5 years	78	3.9744		
		6-10 years	50	3.8800		
		Above 10 years	91	4.0330		

Table V.
One-way ANOVA tests on job experience

The research results also indicate that doctors have better perception regarding process improvement tools to measure quality improvement process, leadership to continuous improvement processes, training in process improvement tools for employees' skill improvement compared to nurses, pharmacists, medical laboratory technologists. To improve the perception of nurses, pharmacists, medical laboratory technologists on Six Sigma initiatives, the private hospitals must focus on process improvement tools, leadership and training. This is because Six Sigma methodology can ensure the success of the health-care organisation and it helps the organisation develop a continuous improvement processing system which ensures accurate results in a timely fashion (Jhon and Ram, 2008). It also provides accurate results to the health-care service

providers enable them to diagnose and treat patients with a higher quality of care. According to Taner *et al.* (2007), the Six Sigma initiatives can contribute to business strategy to deliver a truly high-class service to their patients. They believed that Six Sigma initiatives will continue to develop in the health-care sector for the next five years or more.

6. Practical implications

The key implication derived from this study is the effect of Six Sigma initiatives in Malaysian private hospitals. This not only provides insights to practitioners about the blueprint of Six Sigma methodology for continuous improvement of private hospitals' quality performance, but also creates a unique competency that may be difficult for competitors to duplicate. As such, any organisation can invest its money, time, and effort to continuously improve quality and business performance through Six Sigma initiatives.

The present study revealed that male hospital staffs have better perception on Six Sigma initiatives in Malaysian private hospitals compared to female staffs. Similarly, the research findings also indicate that doctors have better perception on Six Sigma initiatives compared to nurses, pharmacists, medical laboratory technologists. To improve the perception of female staff as well as nurses, pharmacists, medical laboratory technologists in private hospital, the practitioners need to understand the concept of Six Sigma initiatives is not static but dynamic in nature. There are several strategies that can improve the perception of female staff in private hospital such as identifying employee needs and measuring employee satisfaction through engagement surveys, offering training programmes, providing continuing education, providing leadership development programmes, enabling job enrichment, conducting periodic employee reviews, offering employee suggestion programmes, soliciting employee feedback and other methods of managing employee relations and engagement. (Griffith *et al.*, 2009).

From a strategic point of view, this study reveals that the Six Sigma methodology not only binds all operational activities together, it also links between the strategic level and the operational level in private hospital. It is imperative that the management of the private hospital should spend time to understand the Six Sigma initiatives and incorporate this approach into management oversight and strategic planning for the continuous improvement of quality performance. When this is done properly, the Six Sigma methodology can maximise value to the private hospitals by improving quality and its business performance.

7. Limitations and future research

The present study has some limitations that should be considered when interpreting its findings. First, this study only focussed on Six Sigma initiatives of private hospitals in Malaysia, while the future research may consider investigating the difference or conformance between private and public hospitals on Six Sigma initiatives and its relationship with quality performance. Second, it focussed solely on the Malaysian private hospitals and thus the results might not be applicable to other countries. Third, the findings of this study were obtained using a cross-sectional study that reduces the ability to reflect the temporal changes in the research constructs. As a result, longitudinal studies are needed to clarify the effects of temporal changes on Six Sigma initiatives. Replicating the study across different countries would provide evidence about the generalizability of the Six Sigma initiatives and the robustness of its relationships with quality performance in hospital.

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About the authors

Selim Ahmed is the Head of World School of Business, World University of Bangladesh. Previously, he worked at the International University of Agadir (Universiapolis), Morocco, as an Assistant Professor. He received his PhD in Business Administration from the International Islamic University Malaysia (IIUM) in 2016. His PhD thesis title was "Lean Six Sigma and its Effect on Quality Performance in Malaysian Hospitals". He has published more than 20 articles in the international journals such as *International Journal of Quality and Service Sciences; Reviews on Environmental Health; Humanomics; International Journal of Health Care Quality Assurance; International Journal of Business and Systems Research*; *International Journal of Medical Engineering and Informatics;*

Malaysian Management Review and others. He is also an editorial board member for the journals, such as *Malaysian Management Review; International Journal of Entrepreneurship and Development Studies; and International Journal of Economics Management and Social Science*, and reviewer for many top international journals, namely, *Total Quality Management and Business Excellence; International Journal of Lean Six Sigma; International Journal of Healthcare Quality Assurance; International Journal of Healthcare Management; International Journal of Quality and Service Sciences; International Journal of Bank Marketing; Journal of Global Entrepreneurship Research; Internet Research; International Journal of Islamic and Middle Eastern Finance and Management; International Journal of Business and Systems Research; Environmental Monitoring and Assessment* and others. His research areas include operation management, business management, quality management, health-care management, and service marketing. Selim Ahmed is the corresponding author and can be contacted at: selim.research@gmail.com

Noor Hazilah Abd Manaf is an Associate Professor at the Department of Business Administration at the International Islamic University Malaysia. She has published articles in *Total Quality Management* and *Business Excellence; Leadership in Health Services; International Journal of Quality and Service Sciences*; *Asian Journal on Quality*; *International Journal of Public Sector Management; Reviews on Environmental Health*, etc. *Her* research areas include public healthcare, patient safety and quality management.

Rafikul Islam received his MSc in Applied Mathematics from the University of Calcutta in 1988. Subsequently, he obtained his PhD in Operations Research from Indian Institute of Technology, Kharagpur in 1996. Currently, he is working as a Professor at the Department of Business Administration at the International Islamic University Malaysia. His articles have appeared in *European Journal of Operational Research; IIUM Journal of Economics and Management; International Transactions in Operational Research; International Journal of Commerce and Management; International Journal of Business Information Systems; International Journal of Business and Systems Research; Socio-Economic Planning Sciences*, etc. His research areas include multiple-criteria decision-making, operations and quality management.