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Perception of Lean Adoption among Emergency Department Personnel in Public Hospitals in Selangor, Malaysia

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Abstract

Background: This research aims to assess the perceptions of the staff working in emergency departments in Selangor, Malaysia, regarding the adoption of lean management and identify the factors that affect their perceptions.

Methods: A cross-sectional study using the Lean in Healthcare Questionnaire was conducted with 251 respondents, which consisted of doctors, nurses and medical assistants employed in three selected hospitals.

Results: One-way analysis of variance (ANOVA) showed a significant difference in every domain score in accordance with the occupation category. For the domain process, a significant negative correlation was found between age and domain score ($r = -0.195$, $p = 0.002$). In particular, nurses had better perceptions of lean adoption compared with others (odds ratio [OR] = 2.44, $p < 0.004$). The odds of having a better perception decreased by 6.3% as the age increased ($p < 0.008$).

Conclusions: The findings revealed that age and occupation appeared to be determinants of lean adoption perceptions among emergency department personnel. Specifically, older employees tend to have negative perceptions, while nurses have more positive perceptions. However, further research is needed to understand perceptions of lean adoption better and develop guidelines for implementing lean principles in healthcare settings.

Keywords: emergency care, health services, hospital, Malaysia

INTRODUCTION

In the late 1950s, Toyota Motor Company began to implement a radical change in its production system, which was the opposite of the traditional mass production concept.¹ Taiichi Ohno, a Japanese industrial engineer, is recognized as the founder of the Toyota Production System, which is designed to produce cars based on specific customers' requirements, thus reducing the number of cars in inventories.² This system eventually came to be known as lean manufacturing—a system that focuses on identifying waste sources and then applying methods, tools and techniques to eliminate them.³ Womack and Jones introduced lean to the rest of the world in the 1990s, by defining the concept of Lean Thinking.⁴

A variety of benefits can be obtained with the implementation of lean methodology in hospitals, including improved service quality and patient care processes.⁵ By reducing waste, increasing value-added activities, and meeting patient expectations, lean management effectively improves hospital service

quality.⁶ In the United States, lean adoption in hospitals also has a positive financial impact, wherein such a practice is significantly associated with lower health insurance spending per beneficiary.⁷ Thus, we can conclude that the implementation of lean practices in healthcare organizations has led to enhanced financial performance, improved efficiency, and elevated patient care.⁸ A more systemic approach to lean implementation in hospitals may assist in spreading improvement and supporting sustainable reform.⁹ The introduction of lean management has generated conflicts between healthcare practitioners and hospital administrators regarding the sociocultural aspects of healthcare labor. Some clinicians have argued that an excessive emphasis is placed on organizational efficiency and productivity at the expense of patient experience and quality of care.^{10,11} Meanwhile, some clinicians have also voiced their view that this initiative is targeted to optimize operational costs instead of enhancing the satisfaction of patients and staff.¹² Lean managers also face challenges in materializing lean thinking and redesigning the health care system. It requires patience to endure resistance and skepticism, high-quality leadership, and professionals who are dedicated to the cause.¹³

Meanwhile, the emergency department (ED) has a gatekeeping function in a hospital.¹⁴ Most hospital EDs face issues of delayed service and overcrowding, which are worsened by the continuously increasing cost of care.^{15,16} In terms of advocating for the implementation of

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lean principles in healthcare, specifically in the ED, the notable achievements of lean methodologies within health services have generated significant momentum.¹⁷ In particular, the EDs that have implemented lean methodologies generally attained positive outcomes, including reduced length of hospital stay, procedure duration, and waiting time, as well as improved patient flow.¹⁵ Nevertheless, there is a pattern of biased reporting in which only positive results are published, and hospitals that failed to achieve the desired behavioral changes refuse to examine the causes of their failure publicly.¹¹

Most of the studies involving lean healthcare discuss the process of care and the outcome of the provision of care.¹¹ In comparison, limited research has been conducted to investigate the perceptions of healthcare professionals regarding lean implementation, along with their overall well-being and working conditions. A Swedish study found a correlation between positive worker perceptions of lean and positive employee outcomes, including worker well-being.¹⁸ Hence, achieving positive perceptions among the workers during the implementation process is crucial. Factors like age, gender, occupational status, and training, can affect how people perceive lean management adoption.^{19–21} Thus, the current study aims to assess the perceptions of personnel employed at EDs in Selangor, Malaysia, regarding the implementation of lean management and to determine the factors influencing their perceptions. Hence, the following hypothesis is proposed: Perceptions of lean adoption are affected by the demographic factors of employees, such as gender, age, occupation, attended training in the last two years, and duration of service.

METHODS

We conducted this cross-sectional study at the EDs of three public hospitals in Selangor, Malaysia. The study was conducted within six months, from October 2019 to January 2020. We chose the hospitals based on their agreement to participate in the study. These hospitals were grouped administratively as cluster hospitals and were specifically selected because they had adopted lean initiatives in their respective EDs. A questionnaire was used to assess healthcare workers' perceptions of lean management adoption in healthcare. The target population of this survey were healthcare staff working at the EDs, including doctors, nurses, and medical assistants. The inclusion criterion was working in the EDs for six months or more (duration of working should exclude long leave taken in between working period), while the exclusion criterion was staff involvement with attachment programs, regardless of the duration.

The study employed the total sampling method, in which 350 questionnaires were distributed to the participants. The hospitals requested that we deliver the questionnaire to subjects in hard copy form to boost the response rate

among respondents. The participants were allotted one week to fill out the questionnaire. Taking into consideration their demanding schedules in the EDs, they had the option to complete the questionnaire outside of their working hours. Data collection was conducted in accordance with the ethics approval of the protocol. Ethical approval was obtained from the Medical Research and Ethics Committee, Ministry of Health Malaysia (NMRR-19-1019-47197).

In the present study, we used a validated questionnaire, the Lean in Healthcare Questionnaire (LiHcQ), upon obtaining permission from the author of the questionnaire. LiHcQ was developed to evaluate lean adoption in healthcare services based on instruments from other industries and was originally implemented in European service sector companies. The instrument incorporated the principles of collaborative partnerships and respect for individuals, focusing on person-centered care in which patients are treated as equal partners. The questionnaire consists of questions measuring staff perceptions of lean adoption in healthcare.²² Items are categorized according to Liker's 14 principles describing lean within four domains: philosophy, processes, people and partners, and problem-solving.²³ There are 16 questions, with each domain having 3 questions, except for the processes domain, which had 7 questions. Upon testing the validity and reliability of the original LiHcQ, confirmatory factor analysis revealed a satisfactory correlation with Liker's definition of lean ($\chi^2 = 221625$, d.f. = 95, $p < 0.001$, relative χ^2 : 2.33, root mean square error of approximation (RMSEA) = 0.07, standardized root mean square residual (SRMR) = 0.048 and comparative fit index (CFI) = 0.93) and Cronbach's alpha values ranging from 0.60 to 0.86. The test-retest reliability, as determined by the intra-class correlation coefficient, varied from 0.77 to 0.88.²² Prior to the distribution of the questionnaire, we conducted a translation process to Malay and a pilot study. The results of the pilot study revealed face validity index of 0.91, intra-class correlation coefficient ranging between 0.81 and 0.93, and good Cronbach's alpha (0.75 to 0.90).²⁴

In the current study, each question had five statements, representing increasing levels of maturity (levels 1–5), and the respondents should choose the statement that best described their organization. The relationships between demographic factors (independent variable: gender, age, occupation, attended training in the last two years, and duration of service) and domain score (dependent variable: philosophy, people and partner, processes, and problem-solving) in the questionnaire were examined. Bivariate analysis was conducted using one-way ANOVA and Pearson correlation. The correlation between each demographic characteristic and the total score of LiHcQ (i.e., the sum of all domains), was initially determined using simple logistic regression analysis, followed by multivariate logistic regression. To classify the total score of LiHcQ as dichotomous, scores exceeding and falling

below the mean were categorized as high and low, respectively. The total score of LiHcQ represents the staff's general perceptions of lean adoption. Statistical Package for the Social Sciences software version 20 was used for data analysis in the current study, wherein a *p*-value less than 0.05 was considered statistically significant. In this case, the null hypothesis would be rejected, and the alternative hypothesis would be accepted.

RESULTS

After one week, 251 respondents returned the forms (response rate: 71.7%). Table 1 describes the demographic status of the respondents. In this study, the majority of the participants were female (61.8%), and the mean age was 31.8 (±5.48). The respondents were well distributed among three categories of staff: nurses (36.7%), medical assistants (29.5%), and doctors (33.9%). In this study, the duration of service was described as the number of months in service with the mean of 83.50 (±60.80). The percentage of staff who attended training in the last two years was 36.4%. Table 2 describes the descriptive data of the study. As can be seen, the highest mean was 3.80 (Item 7: standardization: process), and the lowest mean was 3.22 (Item 16: partner and supplier respect). All items had 4 as the median, except for items 4 (agent of change: people and partner), 8 (patient centered care: processes), and 13 (problem-solving: problem-solving). The percentage of respondents with a score of 5 was highest at 28.3% (item 7: standardization: process), followed by 27.5% (item 10: sign and signal based on

patient value). Problem-solving had the lowest domain score compared with the other domains.

The relationship between the demographic factors and each domain score of LiHcQ was tested using one-way ANOVA test and Pearson correlation for the categorical and continuous variables, respectively (Table 3). No significant difference was observed between genders in all domain scores. There was a significant difference of *p* < 0.05 in the occupation category for each domain. In particular, nurses had the highest mean, followed by medical assistants and doctors. Furthermore, age and duration of service had weak negative correlations with all domain scores. However, the correlation was only significant for age in the domain process (*r* = -0.195, *p* = 0.002). Generally, those who attended training within the last 2 years of the study had a higher mean score in all domains, but it was only significant for the domain process.

TABLE 1. The sociodemographic status of respondents

Characteristic	N	%
Gender		
Male	96	38.2
Female	155	61.8
Occupation		
Nurses	92	36.7
Medical assistants	74	29.5
Doctors	85	33.9
Attended training in the last 2 years		
Yes	99	36.4
No	152	60.6

TABLE 2. Descriptive data for each item and domain scores of LiHcQ

Item	Question	Mean ± SD	Median	N (%)				
				1	2	3	4	5
Philosophy								
1	Employee commitment	3.62 ± 1.04	4	4 (1.6)	34 (13.5)	62 (24.7)	94 (37.5)	57 (22.7)
2	First line manager's commitment	3.68 ± 1.00	4	4 (1.6)	29 (11.6)	55 (21.9)	94 (43.4)	57 (21.5)
3	Time for improvement work	3.42 ± 1.14	4	11 (4.4)	45 (17.9)	64 (25.5)	81 (32.3)	50 (19.9)
People and Partner								
4	Agent of change	3.31 ± 1.05	3	2 (0.8)	52 (20.7)	85 (33.9)	66 (26.3)	46 (18.3)
5	customer value identification	3.63 ± 1.07	4	5 (2.0)	36 (14.3)	42 (16.7)	115 (45.8)	53 (21.1)
16	Partner and supplier respect	3.22 ± 1.29	3	28 (11.2)	45 (17.9)	51 (20.3)	76 (30.3)	51 (20.3)
Process								
6	Value stream mapping	3.44 ± 0.96	4	7 (2.8)	38 (15.1)	73 (29.1)	106 (42.2)	27 (10.8)
7	Standardization	3.80 ± 1.01	4	1 (0.4)	35 (13.9)	52 (20.7)	92 (36.7)	71 (28.3)
8	Patient centered care	3.33 ± 0.93	3	8 (3.2)	40 (15.9)	85 (33.9)	100 (39.8)	18 (7.2)
9	Technology for quality control	3.60 ± 1.06	4	8 (3.2)	34 (13.5)	63 (25.1)	92 (36.7)	54 (21.5)
10	Sign and signal based on patient value	3.68 ± 1.10	4	6 (2.4)	37 (14.7)	58 (23.1)	81 (32.3)	69 (27.5)
11	Visualizing improvement	3.57 ± 0.99	4	2 (.8)	43 (17.1)	59 (23.5)	104 (41.4)	43 (17.1)
15	Proactive planning	3.40 ± 1.30	4	29 (11.6)	31 (12.4)	62 (24.7)	67 (26.7)	62 (24.7)
Problem-solving								
12	Self-evaluation	3.39 ± 1.19	4	10 (4.0)	39 (15.5)	48 (19.1)	96 (38.2)	58 (23.1)
13	Problem-solving	3.29 ± 1.22	3	11 (4.4)	49 (19.5)	2 (20.7)	83 (33.1)	56 (22.3)
14	Staff contribution to decision-making	3.41 ± 1.21	4	7 (2.8)	47 (18.7)	47 (18.7)	92 (36.7)	58 (23.1)
Total Score		55.77 ± 10.84	55					

TABLE 3. Bivariate analysis of between demographic factors and domain scores

Group	Mean Philosophy	Mean People and partner	Mean Process	Mean Problem-solving	Total Score
Gender					
Male	10.76	9.83	24.58	9.64	
Female	10.68	10.34	24.95	10.38	
<i>p</i>	0.833	0.171	0.625	0.076	
Occupation					
Nurse	11.14	10.97	26.15	11.03	59.29
Medical assistant	10.99	9.81	25.12	10.15	56.07
Doctor	10.01	9.55	23.09	9.04	51.69
<i>p</i>	0.016	0.002	0.002	0.001	0.001
Attended training					
Yes	11.13	10.47	26.60	10.38	
No	10.44	9.93	23.65	9.91	
<i>p</i>	0.056	0.143	0.002	0.256	
Age*					
<i>r</i>	-0.1	-0.013	-0.195	-0.067	
<i>p</i>	0.115	0.843	0.002	0.289	
Duration of service*					
<i>r</i>	-0.047	-0.006	-0.107	-0.051	
<i>p</i>	0.459	0.923	0.091	0.422	

*used Pearson Correlation

TABLE 4. Post hoc test between occupation category and total score of LiHcQ

Job		Mean Difference	Standard Error	<i>p</i>	95% CI	
					Lower Bound	Upper Bound
Nurse	Medical assistant	3.226	1.624	0.118	-0.60	7.05
	Doctor	7.599*	1.565	0.001	3.91	11.29
Medical assistant	Nurse	-3.226	1.624	0.118	-7.05	0.60
	Doctor	4.373*	1.653	0.074	0.47	8.27
Doctor	Nurse	-7.599*	1.565	0.001	-11.29	-3.91
	Medical assistant	-4.373*	1.653	0.074	-8.27	-0.47

*The mean difference is significant at the 0.05 level

TABLE 5. Simple logistic regression and multivariate logistic regression

Characteristic	Simple			Multivariate		
	UOR	<i>p</i>	95% CI	AOR	<i>p</i>	95% CI
Age	0.937	0.008	0.894 – 0.983	0.927	0.004	0.881 – 0.976
Duration of Service	0.995	0.022	0.991 – 0.999	Exclude		
Gender						
Male	1			Exclude		
Female	1.236	0.419	0.739 – 2.065			
Occupation						
Doctor	1	0.016		1	0.058	
Nurse	2.444	0.004	1.325 – 4.508	2.229	0.020	1.137 – 4.372
Medical Assistant	1.398	0.294	0.748 – 2.613	1.004	0.991	0.472 – 2.137
Attended training						
No	1			1		
Yes	1.534	0.106	0.913 – 2.577	1.646	0.078	0.945 – 2.866

UOR: Unadjusted odds ratio; AOR: Adjusted odds ratio; CI: Confidence interval

The relationship between the total score of LiHcQ and the occupation category was examined using one-way ANOVA, followed by post hoc test. Tukey's post hoc test results (Table 4) revealed that nurses had a significantly higher total LiHcQ score (mean = 59.29) compared to doctors (mean = 51.69), *p* = 0.001. However, no significant

difference was observed between medical assistants and the other staff members.

First, simple logistic regression was done to determine the association of each demographic factor with the total score of LiHcQ, (Table 4). The total score was made

dichotomous, with scores above the mean defined as high. From simple logistic regression, the odds of having higher perceptions decrease by 6.3% ($p = 0.008$) for each increase in age. A significant finding was also found for the duration of service, where the OR = 0.995 ($p = 0.022$). Therefore, for each increase in duration of service, the odds of having better perceptions decrease by 0.5%. In the occupation category, nurses had 2.444 odds of better perceptions compared to the others ($p = 0.004$). The finding for the OR compared with those who attended training and those who did not attend training was insignificant. Multivariate logistic regression was done using the included factor (Table 5). Two factors were removed: gender and duration of service. Here, duration of service was removed due to its correlation with age, and gender was also removed due to the insignificant finding with a high p -value. The finding for age was significant, where the odds decreased by 7.3% per increase in age. In particular, nurses had a lower adjusted OR than their unadjusted OR, which was 2.229 compared with 2.444. The results of the multivariate logistic regression on the training category were not significant.

DISCUSSION

The ways in which healthcare staff view the adoption of lean practices differ based on various demographic factors. A questionnaire that aligned with Liker's principles of lean could effectively gauge staff perspectives on lean implementation in the healthcare setting.²² The present study supported the hypotheses that the perception of lean adoption can be affected by the demographic factors of the staff employed in hospital EDs. Furthermore, lean adoption might be affected differently based on different categories of occupation. A previous study revealed that nurses hold more positive views about lean adoption than physicians do.¹⁸ As frontline healthcare professionals, nurses may view lean methodologies as mechanisms that amplify their capacity to effectively and efficiently deliver care, thereby boosting job satisfaction and morale.¹⁰ This study also found that a less favorable perception of lean adoption is associated with increasing age. This finding is in accordance with another study, which found that a negative correlation between lean adoption in manufacturing and leaders' age, where task-orientation style outperformed relation-orientation style.²⁵ In addition, a study on lean manufacturing in India showed that, on the one hand, older employees tend to be negative towards change but are rich in experience. Younger employees, on the other hand, tend to be more receptive towards change.²⁶

The question pertaining to standardization had the highest proportion of respondents who rated it at the highest level. This result aligned with the findings of a previous study among Swedish primary care units.²⁷ One possible reason for this in the present study could be attributed to the nature of the question, which focuses on

developing and following routines. This aspect is important in EDs given that a standard protocol has been developed to help staff conduct tasks, especially during a disaster. In particular, EDs typically have developed protocols for responding to mass casualty incidents that often draw out more resources such as additional personnel to work in such situations.^{28,29} However, a study conducted using LiHcQ in a hospital in Indonesia had the lowest standardization acceptance level. Poor documentation and updates of value stream mapping on several services contributed to this problem.³⁰

In the current study, those who attended training in the last two years had a higher mean total score. The training includes comprehensive awareness on lean principles, Kaizen workshop, and value stream mapping exercise. However, the finding was not significant. Training is an important factor for consideration as it is one of the main strategies in an organization. An organization must implement a strategic training program to implement lean principles. Continuous training and awareness are very important to ensure sustained lean adoption in an organization.^{31,32} Therefore, it is important for staff to have refreshment courses over a period of time, such as every two years. The implementation of lean management can have both positive and negative impacts on employees. Some staff members are willing to adopt the change, while others resist it due to fear of the unknown, uncertainty about the measurement system and conflicting values.³³ A study conducted in Finland revealed that staff members exhibited resistance towards lean practices due to their preference for maintaining established work methods, insufficient access to information, and weariness stemming from project development efforts.³⁴ Furthermore, implementers must address this issue by providing clear guidance, raising awareness, and guiding staff through the process.

One significant strength of the study is its comprehensive approach to assessing the perceptions of a diverse group of emergency ED personnel, including doctors, nurses and medical assistants. This inclusivity ensures that the findings reflect a wide range of perspectives, which is crucial for understanding the overall sentiment towards lean adoption in a multifaceted healthcare setting. However, this study's findings may not be directly applicable to other healthcare settings or regions and caution should be exercised when applying the results to different contexts. In addition, the study mainly depended on quantitative data and including qualitative data or interviews with employees could have provided more meaningful insights into the reasons behind their perceptions.

CONCLUSIONS

The study's findings suggest that occupation plays a significant role in the perception of lean adoption among

ED personnel, with nurses generally having more positive perceptions. In particular, age also appears to influence perception, specifically the processes domain, where older employees tend to have less favorable perceptions. Further research should be conducted to investigate the perceptions of lean adoption to assist implementers in developing a comprehensive framework and a set of guidelines for the implementation of lean principles in healthcare settings.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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