

Malay Language Translation of an Instrument to Assess Perception of Lean Adoption in Healthcare Service

AZIZUL RAHMAN MJ, MOHD RIZAL AM, SHARIFA EZAT WP,
KIRAN GB

Department of Public Health Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia, Jalan Yaacob Latiff, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia

Received: 15 October 2023 / Accepted: 31 October 2023

ABSTRAK

Berdasarkan carian literatur yang menyeluruh, "Lean in Healthcare Questionnaire" (LiHcQ) belum disahkan dalam Bahasa Melayu, jadi matlamat kajian ini ialah untuk mencipta versi Bahasa Melayu yang telah disahkan bagi tujuan menilai persepsi penerimaan "Lean" di kalangan pekerja penjagaan kesihatan. LiHcQ yang diterjemahkan boleh menggalakkan lebih banyak kajian untuk mengkaji persepsi penerimaan "Lean" di Malaysia. Terjemahan menggunakan kaedah ke hadapan dan ke belakang dijalankan mengikut garis panduan tersedia yang melibatkan pelbagai ahli jawatankuasa. Sepuluh responden terlibat dalam penilaian kesahan muka dengan indeks kesahan muka universal adalah 0.91. Penilaian kesahan konstruk dilakukan menggunakan 251 kakitangan Jabatan Kecemasan yang terdiri daripada doktor, jururawat dan penolong pegawai perubatan. Nilai indeks kesepadanan untuk empat faktor dalam LiHcQ-M adalah baik. Kebolehpercayaan komposit bagi empat domain adalah antara 0.784 hingga 0.902 dan ekstrak varians purata (AVE) berjulat dari 0.547 hingga 0.653. Konsistensi dalaman berkisar antara 0.750 hingga 0.905 dan kebolehpercayaan kestabilan boleh diterima. LiHcQ-M adalah instrumen yang sesuai untuk mengukur persepsi penerimaan lean di kalangan kakitangan kesihatan berdasarkan hasil penilaian kesahan dan kebolehpercayaan tersebut. Ia adalah disyorkan supaya lebih banyak kajian dijalankan bagi mengesahkan kesesuaian LiHcQ-M.

Kata kunci: Pengurusan "lean"; perkhidmatan penjagaan kesihatan; terjemahan

Address for correspondence and reprint requests: Mohd Rizal Abdul Manaf. Department of Public Health Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia, Jalan Yaacob Latiff, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia. Tel: +6019-3208925 Email: mrizal@ppukm.ukm.edu.my

ABSTRACT

Based on thorough literature search, Lean in Healthcare Questionnaire (LiHcQ) has not yet been validated in Malay, so the purpose of this study was to create a validated Malay version of LiHcQ for the purpose of assessing perceptions of lean adoption among healthcare workers. The translated LiHcQ could encourage more studies to examine the perception of lean adoption in Malaysia. The translation using forward-backward method was carried according to the established guideline available involving multiple committee members. Ten respondents involved in face validity assessment with universal face validity index was 0.91. Assessment of construct validity was done using 251 Emergency Department personnel which included doctors, nurses and medical assistants. The goodness of fit indices for the four LiHcQ-M factors were good. The composite reliability of the four domains ranged from 0.784 to 0.902 and average variance extracted (AVE) ranged from 0.547 to 0.653. The internal consistency ranged from 0.750 to 0.905 and stability reliability was acceptable. LiHcQ-M is a suitable instrument for measuring the perception of lean adoption among medical staff based on the results of its validity and reliability assessments. It is highly recommended for additional validity study to be carried out in order to validate LiHcQ-M's credentials.

Keywords: Healthcare service; lean management; translation

INTRODUCTION

The ever-increasing prices of medical care, as well as other factors, such as an increase in the prevalence of noncommunicable diseases, and rising patient expectations, are compelling healthcare providers to adopt new approaches in an effort to improve their effectiveness. Lean management is one of the best approach in catering this issue in healthcare service (Martínez et al. 2021; Muka et al. 2015; Shortell et al. 2021). "Lean thinking" was first proposed by Womack and Jones (1996), and it refers to a collection of lean practices that are combined into a single concept. Since the start of the lean concept until the present

day, the lean way of thinking has seen phenomenal growth in terms of its popularity. What distinguishes lean management from other techniques is its strong emphasis on continuous improvement to enhance the work process. Lean has been described as management practice based on the philosophy of continuously improving processes by either reducing waste (*muda*), reducing imbalance (*mura*), and preventing overburden of staff (*muri*) (Burgess & Radnor 2013). Implementing lean into an organisation is a process, not a single event. The concept of lean has traditionally been regarded as a systematic approach to continuous improvement. Lean is a perpetual and ongoing process of

improvement or a protracted process of transformation (Byrne & Womack 2012; Camacho-Minano et al. 2013).

The healthcare system is currently confronted with challenges arising from a significant surge in demand and escalating expectations with respect to quality of care (Shazali et al. 2013). Numerous healthcare organisations adopt Toyota Production System practices to improve performance and efficiency. These practices are commonly referred to as the Lean Healthcare management system. The lean initiative is not focused on large-scale investments, but it provides healthcare organisations with an alternative method for achieving improvement with investment on a smaller scale (Bahensky et al. 2005). The application of lean principles in healthcare aims to effectively minimise waste, decrease wait times, and eliminate unnecessary movement, as well as enhance the organisation's capacity for quality and efficiency. In the field of healthcare, Lean methodology is frequently employed and evaluated through the utilisation of value stream and process mapping, improvement events, and standardisation (Henrique et al. 2021; Marsilio et al. 2022; Mazzocato et al. 2010)

The majority of lean assessment instruments place a strong emphasis on evaluating operational performance and efficiency. Since the middle of the 1990s, researchers have proposed instruments for measuring the adoption of lean (Boyer 1996; Karlsson & Åhlström 1996; Malmbrandt & Åhlström 2013). Most of the time,

it seeks to understand how lean is evolving in the manufacturing sector. Recently, more assessment tools were created with the goal of assisting managers in making decisions that will influence the lean implementation in the service sector. It evaluates lean implementation using a variety of method. The questionnaires featured questions about lean philosophy, tools, and techniques and it attempts to evaluate the maturity of lean adoption in the organisation. Lean service assessment instruments have the potential to serve as a valuable addition to traditional financial measures. These instruments can also function as an alert system, providing indications of whether the implementation of Lean service is progressing according to the intended plan or not (Bayou & De Korvin 2008). The Lean in Healthcare Questionnaire (LiHcQ) was developed with the specific purpose of evaluating lean adoption in the healthcare services. It was produced based on two instruments from industries other than manufacturing that were deemed relevant for further development in the healthcare base measurement tool of lean adoption (Malmbrandt & Åhlström 2013; Roszell & Lynn 2016). The instrument developed by Malmbrandt and Åhlström (2013) was implemented in European service sector companies that exhibit similarities to the healthcare industry, particularly in their emphasis on direct interaction with customers. The most important detail during the development of this instrument lies in its capacity to incorporate the fundamental principle of healthcare service, namely the

cultivation of respect for individuals and collaborative partnerships (Kaltenbrunner et al. 2017). Person-centered care, which entails the treatment of patients as individuals or equal partners, is a crucial component in the delivery of healthcare services.

The development and evaluation of LiHcQ followed a cross-sectional design with a mixed-method approach. This approach involved a theoretical step followed by two empirical steps based on data analysis. During the process of theoretical development, the items in the questionnaire were grouped into four factors which are Philosophy, People and Partner, Process and Problem Solving (Liker 2004). This was followed by a subsequent forward and backward translation process. The second step involved the utilisation of a qualitative approach, specifically employing the think aloud process on two separate occasions to assess the face validity of the questionnaire. Subsequently, the third phase of the study involved a quantitative assessment of the construct validity, internal consistency, and stability of the questionnaire. The current study aimed to validate a Malay language version of LiHcQ among emergency department personnel in the public hospital in Selangor, Malaysia. This study was designed to ensure the items of LiHcQ-M will be easily understood by the healthcare worker in Malaysia while achieving a good level of validity and reliability. Permission to adopt LiHcQ instrument for the current research was obtained from the authors.

MATERIALS AND METHODS

Instrument Translation

The initial questionnaire was translated from English to Malay in order to create a version that closely resembled the original questionnaire in terms of semantics and concepts. The process of forward translation was carried out by a pair of translators, both of whom possess bilingual proficiency. The translators possess extensive expertise in both Malay and English languages, specifically in the field of medicine, as they are qualified medical doctors. They have acquired substantial experience in writing and editing within these languages. A forward translation of the LiHcQ into the target language was done independently. Two initial versions of LiHcQ-M were subjected to a thorough analysis by the researchers. Reverse translation from Malay to English was carried out by another translator who is a healthcare administration expert and has experience in lean management in the healthcare setup. Inconsistencies were resolved in a consensus meeting between the translators, researcher and supervisor. The response process of the LiHcQ-M was evaluated by measuring its clarity and comprehensibility through the participation of ten respondents from the same setting. The respondents exhibited the same characteristic as the target population of the main study and did not involve in the construct validity process. The researcher then engaged in a discussion with the respondents regarding to the comments, and further

improvement to the questionnaire were implemented after consultations with team members.

The primary investigation employed a cross-sectional design which was carried out within the emergency department of three hospitals located in Selangor, the most densely populated state in Malaysia. The emergency department was chosen because it is the busiest department in the hospital and has a gatekeeping function in a hospital (Cowling et al. 2014). A target sample size of 160 respondents (ten respondents per item) was determined to be appropriate for ensuring sufficient precision in a reliability and validity study (Hair et al. 2010). Respondents were randomly selected from three categories of staff, namely doctors, nurses, and medical assistants from these hospitals. They constitute the department's primary workforce. The confirmatory factor analysis (CFA) of the LiHcQ-M was done using a sample of 251 individuals working in emergency department settings. To be included in the study, the staff had to (i) have worked in the department for more than six months and (ii) be able to communicate in the Malay language. Staff who were not permanent staff of the department (such as on attachment program) were excluded from the study. Administration of the translated sixteen-items of LiHcQ-M and collection of socio-demographic data was done from October 2019 to January 2020. Later, 27 respondents from Department of Public Health Medicine, Universiti Kebangsaan Malaysia were selected and agreed for a two-week reliability test-retest

analysis. They are medical professional who has experience in healthcare administration. The individuals who met the criteria for participation in each phase were given an information document that included pertinent information about the research, and their consent was obtained. Subsequently, the demographic information of the participants was documented. The data were collected through the distribution of hardcopy questionnaire forms to the respondents.

Ethical Approval

Ethical approval was obtained from the Medical Research and Ethics Committee, Ministry of Health Malaysia (NMRR-19-1019-47197) and UKM Research Ethics Committee (UKM PPI/111/JEP-2019-263)

Psychometric Properties

Clarity and comprehension, two face validity indices (FVI), were evaluated using 4-Likerts scale responses to LiHcQ-M items. Participants were asked to rate clarity on a scale from 1 (not clear at all) to 4 (very clear), and comprehension on a scale from 1 (unable to understand at all) to 4 (easily understood). For calculation of face validity index, these responses were then categorised as 0 (scale 1 or 2) or 1 (scale 3 or 4). By taking the average of the index values for comprehension and clarity, the universal FVI was determined. The value of FVI of 0.8 and above was considered as a satisfactory (Yusoff 2019). Internal consistency was determined using

based on the correlations between different items on the same factor. Cronbach's alpha coefficient was the measured parameter to determine internal consistency. Cronbach's alpha values above 0.7 were considered as satisfactory (Bolarinwa 2015). Confirmatory factor analysis was utilised to assess the construct validity, discriminant validity, convergent validity and composite reliability of the factors of lean adoption. Average Variance Extracted (AVE) determined the convergent validity should be above 0.5 and composite reliability (CR) determined the composite reliability should be above 0.6. All factor loading for items should be greater than 0.60. Construct validity was assessed through fitness indexes

and discriminant validity (Fronell-Larckerr Criterion) was measured (Awang 2015). Intraclass correlation coefficient above 0.75 was considered good for this study (Koo & Li 2016). Data analysis was performed by Microsoft Excel, SPSS Version 22 and AMOS software.

RESULTS AND DISCUSSION

Face Validity

Both clarity and comprehension had face validity indices of 0.92 and 0.89. The face validity index for the universal measure was determined to be 0.91, which suggested a good level of face validity. The information pertaining to item-level indices was briefly presented

TABLE 1: Face validity index

Item	Face validity index			
	Label	Clarity	Comprehension	Universal
1. Employees participation in Lean	kom1	1.00	0.90	0.95
2. Clinical manager participation in Lean	kom2	0.90	0.80	0.85
3. Allocated time for continuous improvements	m3	1.00	1.00	1.00
4. Lean champion in the organisation	s4	1.00	0.80	0.90
5. Quality of given care to patient	k5	0.90	0.90	0.90
6. Employee collaboration with partners and suppliers	p16	0.90	0.80	0.85
7. Value stream mapping usage	v6	0.80	1.00	0.90
8. Employee involvement in standardisation	s7	0.80	0.80	0.80
9. Planning according to patient's need	p8	1.00	1.00	1.00
10. Automatically quality controls	s9	0.80	0.90	0.85
11. Patient's need control the work flow	n10	0.90	1.00	0.95
12. Visual improvements to guide the employees	v11	1.00	0.80	0.90
13. Staff's involvement in product evaluation	t15	1.00	0.90	0.95
14. Evaluate each work task	v12	0.90	0.80	0.85
15. Develop process to solve problem	e13	1.00	1.00	1.00
16. Participation of employee in decision making	i14	0.80	0.90	0.85
Overall		0.92	0.89	0.91

in Table 1. The findings of this study provided evidence of a satisfactory level of face validity.

Confirmatory Factor Analysis

The study was conducted among Emergency Department Personnel of three public hospitals in Selangor. Respondents were given a week to complete the questionnaire. After one week, 251 respondents returned the forms. The demographic of respondents were as in Table 2.

The CFA was utilised to assess the construct validity, convergent validity, and discriminant validity of the factors in the questionnaire. The measurement model in Figure 1 had achieved the required fitness indexes satisfactorily (RMSEA = 0.07, CFI = 0.94, TLI = 0.92, NFI= 0.90, ChiSq/df = 2.32) and all factor loading for the items were greater than 0.60.

Through the CFA procedure, the

TABLE 2: Demographic of respondents

Characteristic	Frequency (n)	Percentage (%)
Gender		
Male	96	38.2
Female	155	61.8
Age		
Mean (SD)	31.80 (5.48)	
Median (Q1-Q3)	30.00 (27-33)	
Ethnic		
Malay	200	79.7
Indian	27	10.8
Chinese	5	2.0
Others	19	7.5

study validated the constructs for convergent validity and composite reliability by computing AVE and CR. Internal reliability was validated using Cronbach's Alpha. The results in Table 3 indicated the factors of Lean adoption namely Philosophy, People and Partner, Process and Problem Solving. The acceptable level for AVE was above 0.5 and CR was above 0.6 while Cronbach's alpha was above 0.7.

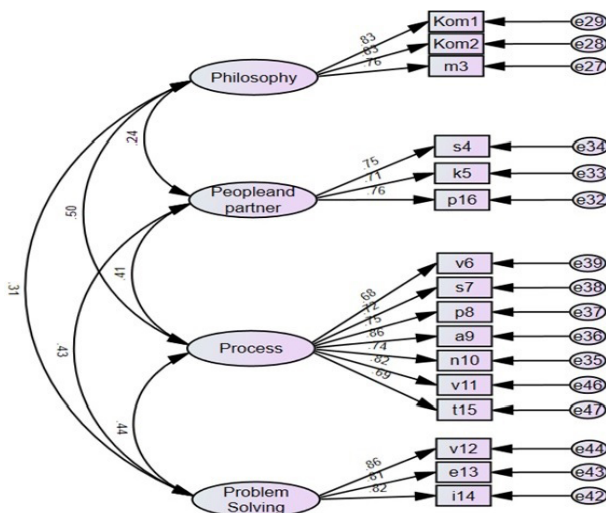


FIGURE 1: Measurement model: standardised regression weight

TABLE 3: CFA results for the measurement model

Construct	Items	Cronbach's alpha	CR	AVE
Philosophy	3	0.835	0.850	0.653
People and partner	3	0.750	0.784	0.547
Process	7	0.905	0.902	0.570
Problem solving	3	0.846	0.838	0.635

Discriminant Validity

Discriminant validity of the respective factors was measured by using the square root of its AVE. If it exceeded its correlation value with others domain in the model, it was considered acceptable. Furthermore, the correlation between factors should be less than 0.85 (Awang 2015). This meant that the discriminant validity was attained if the diagonal values in the discriminant validity index table were higher than any other values in both its row and column. The results obtained were as depicted in Table 4.

Stability Reliability

A pilot study was conducted twice to the same respondents with two weeks interval apart. Results of test-retest reliability was analysed. Intraclass correlation (ICC) was done between total score of each factor. All domains showed good score with p value <0.05. The result of ICC were shown

in Table 5.

DISCUSSION

The study of lean adoption has been conducted in numerous countries. Numerous instruments have been developed specifically for the manufacturing sector (Malmbrandt & Åhlström 2013; Wickramasinghe & Wickramasinghe 2017). But few were created for the service sector, which includes healthcare services and development of the assessment tool is still needed (Muhammad & Karningsih 2020). The primary aim of the research was to present an assessment of the translated version of the LiHcQ-M in terms of its reliability and validity when administered to healthcare personnel employed in Malaysia. This study represented the initial effort to thoroughly translate and validate the sixteen items in a systematic manner. This study examined the conceptual equivalence and semantic equivalence to ensure that the translated version

TABLE 4: Discriminant validity index

Construct	Philosophy	People and Partner	Process	Problem Solving
Philosophy	0.808			
People and partner	0.240	0.740		
Process	0.504	0.413	0.755	
Problem solving	0.309	0.430	0.440	0.797

TABLE 5: Intraclass correlation

Construct	N of Items	ICC	P
Philosophy	3	0.90	<0.001
Processes	7	0.89	<0.001
People and partner	3	0.81	<0.001
Problem solving	3	0.93	<0.001

maintained the quality and consistency of meaning as found in the original version. In order to ascertain the suitability of an instrument for use in a different setting, it is necessary to subject the translated instruments to evaluations of content, context, conceptual, semantic, and technical equivalence. Neglecting to evaluate these elements will result in substantial problems pertaining to contextual and conceptual parity (Squires et al. 2013).

The response process results in this study showed that the translation process was executed proficiently using clear and comprehensible sentences. All indices of the face validity exceeded the requirement which was 0.8 (Mohamad Marzuki et al. 2018; Yusoff 2019). This result could not be compared with the original development of the questionnaire where qualitative method was used for face validation during development of instrument from English to Swedish. The results of CFA showed good factor loading between the items and the domains. Goodness of fit indices were acceptable. These results were similar to the CFA that was done in the original questionnaire. Similar to previous study, modification index was high between item 15 and 16. However, the correlation was not done between the items as the fit index already achieved

satisfactory level. The correlation can be seen as both items discuss about staff participation in decision-making. However, item 15 focuses on improving processes, while Item 16 focuses on staff respecting partners and suppliers to help all parties grow (Kaltenbrunner et al. 2017).

The validation procedures employed to establish construct validity involve the assessment of both convergent validity and discriminant validity of the measurement instrument. Convergent validity refers to the degree of correlation observed among multiple items designed to assess a common construct (Saunders et al. 2009). The results of the convergent validity analysis demonstrated strong findings, as all of the factors exhibited average variance extracted (AVE) values exceeding 0.5. Discriminant validity is the extent to which a construct is truly different from other constructs, in terms of its correlation, as well as how the items exclusively represent a construct (Hair et al. 2010). It is imperative that one factor does not possess overlapping meaning with another dimension, and also it does not have identical items with another factor. The findings of the present study indicated that there were no discriminant validity concerns pertaining to the factor.

The internal consistency showed

acceptable value for all factors in this study. It is comparable to the original study where Cronbach's alpha was 0.6 for people and partner and the other factors were more than 0.7. ICC showed an acceptable stability for all factors. This showed that the current study had good stability reliability. The ICCs finding were similar with the original study where it ranged from 0.77 to 0.88. The successful outcome of this study can be attributed to the comprehensive translation process, which adhered to established standards guidelines, as well as the active participation of experts in both content and language during the translation process (Hall et al. 2018; Pan & de la Puente 2005). Furthermore, researchers, content experts, and language experts convened board meetings to facilitate the finalisation of the translation product. These steps had produced a good face validity, internal consistency, construct validity and stability reliability.

Several limitations of research should be taken into account. The scope of this study was limited to a group of healthcare professionals, specifically doctors, nurses, and medical assistants, employed in public hospitals in Malaysia. In order to ensure the validity of LiHcQ-M psychometric evaluation, it is recommended that future studies incorporate professionals from various disciplines including pharmacists, therapists, radiographers, and administrators. Additionally, this study was conducted within the emergency departments of three hospitals. The inclusion of additional departments and hospitals has the

potential to yield improved outcomes in psychometric evaluation. Further investigation is required to support the validity of LiHcQ-M through comparative analysis with other established instrument pertaining to the perception of lean adoption in healthcare service.

CONCLUSION

This study demonstrates that the LiHcQ-M is a reliable and valid instrument for assessing the perception of lean adoption within a healthcare environment. It is strongly recommended that future studies conducted in Malaysia regarding to the perception of lean adoption should employ the use of the LiHcQ-M.

ACKNOWLEDGEMENT

The author would like to express sincere appreciation and gratitude to his supervisor, the invaluable guidance, support, and mentorship throughout the entire research process. Additionally, the author extends heartfelt thanks to the owner of the questionnaire used in this study for generously granting permission to utilise the questionnaire for our research.

REFERENCES

- Awang, Z. 2015. *SEM made simple: A gentle approach to learning structural equation modelling*. Bandar Baru Bangi: MPWS Rich Resources.
- Bahensky, J.A., Roe, J., Bolton, R. 2005. Lean sigma - Will it work for healthcare? *J Healthc Inf Manag* 19(1): 39-44.
- Bayou, M.E., De Korvin, A. 2008. Measuring the leanness of manufacturing systems-a case study of Ford Motor Company and General Motors. *J Eng Technol Manag* 25(4): 287-304.

- Bolarinwa, O. 2015. Principles and methods of validity and reliability testing of questionnaires used in social and health science researches. *Niger Postgrad Med J* 22(4): 195-201.
- Boyer, K.K. 1996. An assessment of managerial commitment to lean production. *Int J Oper Prod Manag* 16(9): 48-59.
- Burgess, N., Radnor, Z. 2013. Evaluating Lean in healthcare. *Int J Health Care Quali Assur* 26(3): 220-35.
- Byrne, A., Womack, J.P. 2012. *The lean turnaround: how business leaders use lean principles to create value and transform their company: How business leaders use lean principles to create value and transform their company*. New York: McGraw Hill Professional.
- Camacho-Minano, M.D.M., Moyano-Fuentes, J., Sacristán-Díaz, M. 2013. What can we learn from the evolution of research on lean management assessment? *Int J Prod Res* 51(4): 1098-116.
- Cowling, T.E., Soljak, M.A., Bell, D., Majeed, A. 2014. Emergency hospital admissions via accident and emergency departments in England: Time trend, conceptual framework and policy implications. *J Royal Soc Med* 107(11): 432-8.
- Hair, J., Black, W., Babin, B., Anderson, R. 2010. *Multivariate data analysis: A global perspective*. Upper Saddle River: Pearson
- Hall, D.A., Zaragoza Domingo, S., Hamdache, L.Z., Manchaiah, V., Thammaiiah, S., Evans, C., Wong, L.L.N. 2018. A good practice guide for translating and adapting hearing-related questionnaires for different languages and cultures. *Int J Audiology* 57(3): 161-75.
- Henrique, D.B., Filho, M.G., Marodin, G., Jabbour, A.B.L. de S., Chiappetta Jabbour, C.J. 2021. A framework to assess sustaining continuous improvement in lean healthcare. *Int J Prod Res* 59(10): 2885-904.
- Kaltenbrunner, M., Bengtsson, L., Mathiassen, S.E., Engström, M. 2017. A questionnaire measuring staff perceptions of Lean adoption in healthcare: Development and psychometric testing. *BMC Health Serv Res* 17(1): 235.
- Karlsson, C., Åhlström, P. 1996. Assessing changes towards lean production. *Int J Oper Prod Manag* 16(2): 24-41.
- Koo, T.K., Li, M.Y. 2016. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *J Chiropractic Med* 15(2): 155-63.
- Liker, J.K. 2004. *The toyota way*. New York: McGraw-Hill.
- Malmbrandt, M., Åhlström, P. 2013. An instrument for assessing lean service adoption. *Int J Oper Prod Manag* 33(9): 1131-65.
- Marsilio, M., Pissarra, M., Rubio, K., Shortell, S. 2022. Lean adoption, implementation, and outcomes in public hospitals: benchmarking the US and Italy health systems. *BMC Health Serv Res* 22(1): 1-10.
- Martínez, M.D.C.V., Ramírez-Orellana, A., Grasso, M.S. 2021. Health investment management and healthcare quality in the public system: A gender perspective. *Int J Env Res Public Health* 18(5): 1-25.
- Mazzocato, P., Savage, C., Brommels, M., Aronsson, H., Thor, J. 2010. Lean thinking in healthcare: A realist review of the literature. *Qual Saf Health Care* 19(5): 376-82.
- Mohamad Marzuki, M.F., Yaacob, N.A., Yaacob, N.M. 2018. Translation, cross-cultural adaptation, and validation of the Malay version of the system usability scale questionnaire for the assessment of mobile apps. *JMIR Hum Factors* 5(2): e10308.
- Muhammad, D.N., Karningsih, P.D. 2020. Development of lean assessment tool for healthcare industry. *International Conference on Business and Engineering Management: 1st Feb 2020; Indonesia*.
- Muka, T., Imo, D., Jaspers, L., Colpani, V., Chaker, L., van der Lee, S.J., Mendis, S., Chowdhury, R., Bramer, W.M., Falla, A., Pazoki, R., Franco, O.H. 2015. The global impact of non-communicable diseases on healthcare spending and national income : A systematic review. *Eur J Epidemiol* 30(4): 251-77.
- Pan, Y., de la Puente, M. 2005. Census Bureau guideline for the translation of data collection instruments and supporting materials: Documentation on how the guideline was developed. *Survey Methodology* 6: 1-38.
- Roszell, S.S., Lynn, M.R. 2016. A measure of lean quality improvement for hospital staff nurses. *J Nurs Care Qual* 31(4): 373-9.
- Saunders, M., Lewis, P., Thornhill, A. 2009. *Research methods for business students*. Harlow: Pearson Education.
- Shazali, N.A., Habidin, N.F., Ali, N., Khaidir, N.A., Jamaludin, H. 2013. Lean healthcare practice and healthcare performance. *Int J Sci Res Publ* 3(1): 1-5.
- Shortell, S.M., Blodgett, J.C., Rundall, T.G., Henke, R.M., Reponen, E. 2021. Lean management and hospital performance: Adoption vs. implementation. *It Comm J Qual Patient Saf* 47(5): 296-305.
- Squires, A., Aiken, L.H., van den Heede, K., Sermeus, W., Bruyneel, L., Lindqvist, R., Schoonhoven, L., Stromseng, I., Busse, R., Brzostek, T., Ensio, A., Moreno-Casbas, M., Rafferty, A.M., Schubert, M., Zikos, D., Matthews, A. 2013. A systematic survey instrument translation process for multi-country, comparative health workforce studies. *Int J Nurs Stud* 50(2): 264-73.
- Wickramasinghe, G.L.D., Wickramasinghe, V. 2017. Implementation of lean production practices

- and manufacturing performance: The role of lean duration. *J Manuf Technol Manag* 28(4): 531-50.
- Womack, J.P., Jones, D.T. 1996. *Lean thinking-banish waste and create wealth in your corporation*. New York: Free Press.
- Yusoff, M.S.B. 2019. ABC of response process validation and face validity index calculation. *Educ Med J* 11(3): 55-61.