

Validity Test of Lean Healthcare using Lawshe's Method

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Abstract- The objective of this paper is to measure the validity of lean healthcare in the healthcare sector specifically in the Malaysia's private hospitals. Validation of content is significantly important to ensure the development of questionnaires is an appropriate to measure the subject. Thus, content validity has been conducted to ensure the adapted instrument from the previous studies by using seven Subject Matter Expert (SME) to validate the instrument. Next, Lawshe's method was consumed for the purpose to scale or measure the content validity of each item. From the result, it indicates the result has fulfilled the minimum criteria of Lawshe's scale with more than half saying "essential", denotes as an E compared to U "useful but not essential" and N "not necessary". In conclusion, although it considered as classical measurement, but the Lawshe's method still significant as one of the statistical method in quantitative study to determine the validity of each item.

Keywords— Lean healthcare, content validity, Lawshe's method

1. Introduction

The prominence of research on lean healthcare has been the focus of various scholars, and to analyse it, they chose to use the qualitative approach. The choice of approach is made due to a high demand for research on lean healthcare, and is achieved by reviewing a number of established papers in online databases, such as Emerald Insight, ABI/Inform, Science Direct, Pub Med, Wiley, and Scopus, among others [1],[2],[3]. Moreover, several lean healthcare studies were conducted in the form of document analysis, interview, and case study [4],[5],[6]. Burgess and Radnor [5] noted that the reason qualitative method is used in exploring lean healthcare is because it requires a significant amount of time to study and a critical understanding of lean implementation in the healthcare sector.

Nevertheless, there are also several studies which took the quantitative approach; for instance, two researches which looked into the practices of lean healthcare which paid attention to healthcare performances in Scotland and in Malaysia, respectively [7],[8]. Due to limited studies in quantitative research, thus, it has resulted the difficulty

among researchers to find an accurate instrument of lean healthcare that has been validated conclusively. Specifically, it was found lack of studies concentrated on the validity of lean healthcare items. Thus, this study attempt to explain the content validity by introducing Lawshe's method to validate the lean healthcare instrument. According to Ayre and Scally [9], Lawshe's method has been extensively used among scholars to form content validity in various sectors including healthcare sector. Precisely, this study intend to validate the instrument of lean healthcare in the Malaysia's private hospitals by using Lawshe's method.

2. Literature Review

2.1 Definition of Lean

Definition of lean has been defined by a great number of scholars that brings a different perspective depending on the sectors involved [10]. Lean originates from the concept of *Muda* means waste in Japanese which not fully utilizing the resources that lead to no creations of value and people are not willing to pay for it [11],[12]. This evolved into the Toyota Production System (TPS's) seven wastes found in production; overproduction, inventory, waiting, transportation over processing, motion and correction as manifested in [13]. The terms world-class manufacturing, *kaizen*, TPS, lean manufacturing, and JIT all denote to the similar principles. However, since the publication of *Lean Thinking in 1996* by Womack and Jones, lean is the term most repeatedly used to describe these principles today [14].

2.2 Lean Healthcar

The original of lean has been developed from TPS in the automotive industry and now lean has progressed into different service sectors such as education, banks, airlines, hotels, restaurants and finally healthcare [15]. Womack and Jones [16] proposed, lean thinking can be experienced in medical services because the goal is to deliver valuable product to the customer and it has been stated, lean thinking or lean management considered as a latest tool of the current management system in the healthcare sector [17].

To date, many scholars have explicitly defined lean healthcare based on their research purposes. Leslie, Hagood, Royer, and Reece [18] defined lean healthcare is the best concept to require a high quality service and flexibility in the organization by concentrating on how to reduce waste of times and unnecessary travel. While Dahlgaard, Pettersen and Dahlgaard-park [19] defined lean healthcare is to participate everybody in the organization by forming a hospital culture in order to fulfill stakeholders desire, increase a number of patient and able to identify waste. Poksinska [20] states lean healthcare is a system designed that has been uniquely created to make continuous improvement of their work and bring some added value to the customer. Ballé and Régnier [21] advocates lean is a learning method, which not only focus on process improvement but is a system to ensure each employee in healthcare sector need to form a *kaizen* mentality.

Though lean has been positively accepted among scholars and practitioners [17], heavy pressures unremittingly appeared in implementing lean practices to increase hospital efficiency [22]. Moreover, triple pressures such as economic recession, ageing population and the cost of technological advances contributes much more burdens to the hospitals [23]. The implementation of lean in the healthcare sector is quite complicated and a better understanding is needed compared to manufacturing sector due to several challenges; how to reduce cost and reduce inefficiency in operational level which if the organization fail to curb the problem, waste will certainly emerge [24]. Waste in the healthcare sector has been explained and defined by numbers of scholars.

The original wastes were come from Taiichi Ohno where he had found seven types of wastes in the manufacturing sector. Presently wastes were also established in service sector which was difficult to shift these wastes from high number production into low number production [25]. Machado et al. [26] detected the causes of wastes were derived from failure in handling supplies and equipment and pay less attention in logistic planning in a healthcare sector. Nelson [27] in his book *Sustaining Lean in Healthcare* has called the eight deadly wastes which described in Table 1 had believed waste is happened across all industries. Armstrong [28] was also listed down the identification eight types of wastes in each process.

Table 1
Types of Deadly Wastes in Healthcare Sector

Types of wastes	Descriptions
Overproduction	Overproduction occurs when excessive material or service has been created and sooner it will be needed. Example: make an early preparation of immunizations before the patient needed.
Inventory	Placing unnecessary materials or stocks in disproportionate space

storage. Examples: unused files and equipment and obsolete charts.

Waiting	Waiting embraces waiting for anything contains people, communication, material and information. Example: waiting to start a meeting.
Transportation	The excessive movement of equipment, materials, communications and paper that does not contribute value added to the work. Example: moving patients in the surgery room before the staff is ready.
Overprocessing	Overprocessing happens when doing the process of work repetitively or put an effort that nobody requested for. Example: asking patients the same information for several times.
Unnecessary Motion	Unnecessary movement caused by poor ergonomic physical design, causing the staff and the patient doing more running, bending, walking and reaching. Example: spent too much time in searching patient files because failure to locate the file appropriately.
Errors	Errors will lead to destruction of works, goods or materials and the worst case is death. Example: failed to obtain accurate information causing the staff doing the repetitive test.
Waste of talent	Waste of talent occurs when the entire staff not fully utilized the talents and skills that will help to make continuous improvement.

Source: Nelson [27] and Armstrong [28]

2.3 A Review on Lawshe’s Method

Several studies have been conducted using Lawshe’s method especially in the area of psychology. Anderson and Gerbing [29] explains Lawshe’s method provided in measuring a measure’s substantive validity with larger values indicates better substantive validity of each item.

Research done by Lewis, Templeton and Byrd [30], had employed Lawshe’s method to perform item screening under the Stage II (instrumet construction). In conducting MIS research, 3 stages were identified to develop a construct for MIS research such as; Stage 1 for domain,

Stage 2 for instrument construction and Stage 3 is evaluation of measurement properties. By applying Lawshe, it has been suggested items that are statistically insignificant based on the CVR calculation, it should be released from the instrument.

Meanwhile, Ayre and Scally [9] had revisited Lawshe's method and it has claimed the calculation of original critical values were never testified. As such, it has recommended it is securely safe and appropriate to use value of CVR as proposed by Lawshe based on binomial calculations. Consistent with Gallin and Ognibene [31], significant results are more accurate if using binomial calculation.

Subsequently, Gilbert and Prion [32] has extended their understanding of CVR and Content Validity Index (CVI) in calculating validity of instrument that evaluated by an experts. The article addresses CVR and CVI were highlighted a quantitative measure of the validity of a simulation evaluation instrument for consumers and researchers.

In sum, this study elucidates the steps of using Lawshe's method in calculating the CVR value of lean healthcare instruments due to past studies of lean healthcare have shown different form in conducting content validity as presented in Table 3. Moreover, less studies have focused on the validity test of measuring lean healthcare in the healthcare sector using Lawshe's method.

Table 3
Past studies of lean healthcare in performing content validity.

Lean healthcare	Content Validity
Roszell [33]	Using an experts to perform content validity by obtaining an extensive and significant input to ensure the strength of the study.
Chakraborty [34]	Complying for stages to establish content validity. Stage 1: past literature were reviewed comprehensively to identify the main domain, Stage 2: adapted items were identified from the past literature, Stage 3: selected academicians reviewed research model and measures and Stage 4: conducting pilot study
Dobrzykowski, McFadden and Vonderembse [35]	An exhaustive literature review was done and Q-sort instrument development was produced to establish content validity.

3. Methodology

Validation of content is significantly important to ensure the development of questionnaires is an appropriate to measure the subject. Thus, content validity has been conducted to ensure the adapted instruments from the previous studies can be reliable which also has been used interchangeably among researchers [36]. Moreover, content validity can be done after gone through the process of pre-test and pilot test [37]

3.1 Content Validity

Content validity can be defined the level of which the instrument fully measures the construct of interest [37]. Thus, the researcher decided to appoint and select seven Subject Matter Experts (SMEs) in different categories. As proposed by Lynn [38] three experts are acceptable, indeed it is recommended to take 5-10 experts. However, it is not advisable to have more than 10 experts unnecessary. Gilbert and Prion [32] states, ideally, there should be a range of SMEs on this panel at various professional levels. SMEs were also selected to run the pre-test. Pre-test is an essential step before its completion [37] and it is essential for questionnaire to confirm that the questions is clear and the respondents could understand the questions the way they are planned and projected [39]. Two experts from academic institutions will be asked to check question wording for each item, the understanding of the questions, the sequence of the questions and the clear instructions to all the respondents [37]. While another five experts from private hospitals will be asked their wise opinion related to the selected variables and the appropriate content as well as to determine the acceptance or eliminations of the question. The experts will be asked to validate, examine, and feel free to make any suggestions of each question from the instruments and further, to enhance the understanding among the potential respondents.

3.2 Lawshe's Method

Lawshe's had created a Content Validity Ratio (CVR) for the purpose to scale or measure the content validity of each item which will be assessed by the expert or panel. There are three scales has been set up to see whether an each item in the category of "essential", "useful, but not essential" or "not necessary" [40].

Figure 1 shows the process of using Lawshe's method to determine whether each item on the instrument sufficiently represents the content domain of the construct. Each member of the panel is provided a number of items, where in this case about 36 items have been formed for the purpose to respond the question according to Lawshe's method. The SME's were invited to scale all the items based on the following question. As an example;

Implemented improvements enable employees to become more efficient measured by this item

- Essential
- Useful but not essential, or
- Not necessary

Responses from all panelists were pooled and the number indicating "essential" for each item is determined [40]. Consistent with Anderson and Gerbing [29] one of the assumption under Lawshe's method to ensure more than half the SME's agreed with the items must be essential. The more SMEs (beyond 50 percent), remarking an item as "essential", the greater the degree of substantive content validity [32],[29].

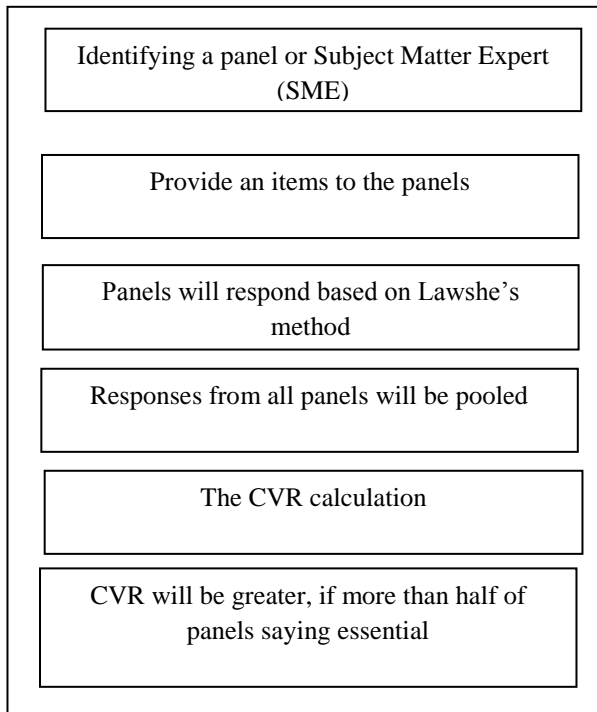


Figure 1
Flow chart of Lawshe's method

Next, the CVR was calculated to show the item is related or not to the content validity, which the range of CVR value is +1 to -1. In accordance with [40], there are four characteristics or indicator to determine the minimum value of CVR as presented in Table 4. Moreover, it will also help to fix which item is remained or rejected.

Table 4
The Characteristics Minimum Values of CVR

No	Characteristics	Results of CVR
1.	If fewer than half say essential	CVR is negative
2.	If half say essential and half do not	CVR is zero
3.	If all say essential	CVR is 1.00
4.	If more than half saying essential	CVR is in the middle of 0 and 0.99

Source: Lawshe [39]

Hence, if seven SMEs have been chosen as stated earlier to do the content validity, the minimum value of

CVR must be 0.62 based on Lawshe's method. The CVR has been formulated as follows:

$$CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}}$$

Notes:

n_e is the number of panelists identifying an item as "essential" and

N is the total number of panelists (N/2 is half the total number of panelists).

To interpret the result, the value of CVR can be measured between -1.0 and 1.0. The closer to 1.0 the CVR is, the more essential the object is measured to be. Contrariwise, the closer to -1.0 the CVR is, the more non-essential it is.

4.Measurement of Variables

Measurement is fundamental of business research and normally, measurement has been used into two basic processes; conceptualization and operationalization [37]. First, the variables defined by conceptual definitions (constructs) and second process, refers to operational definition that define on how variables will be measured [38]. Subsequently, the operationalization deals with two variables consist of two aspects in lean healthcare practices such as operational aspects ad sociotechnical aspects. All the items were adapted from the established sources before conducting a process of validity to suit the current trends in the organization.

4.1 Lean healthcare practices

There are two major groups have been recognized in lean healthcare practices which include operational aspects and sociotechnical aspects. Lean healthcare practices focuses on how to control the resources of healthcare organizations by considering high quality, best safety, less cost, high morale and short lead time which also in line with the Toyota Way Philosophy.

4.1.1 Operational Aspects

Operational aspects of lean do not intentionally focus on certain numbers of dimensions due to previous studies unable to set an accurate or consensus dimension of operational aspects. Besides, some of the operational aspects seem to be similar to one another. Thus, this research had considered several lean practices that have been validated by the experts in the context of operational aspect in the Malaysia's private hospital. Indeed, there are numbers of private hospital does not officially applying lean practices. However, it is believes there are some tools merely similar to lean practices of the operational aspects.

Operational aspects refers to the process improvement in reducing waste at the organizational level as a whole including *kaizen*, 5s visual management, VSM, waste elimination and *kanban*. Subsequently, to measure these practices, items were adapted from Aoun [41]; Gupta and

Jain [42]; Malmbrandt and Åhlström [43]; Balok [44]; and Woehl [45]. The items of this variable quite difficult to obtain because as stated by Aoun [41], numerous studies of lean healthcare practices were embarked in case studies compared to quantitative and certainly measurement tools was not used in qualitative study. Hence, the selected item has been adapted from the various past studies which include some of the lean have been practiced in other sector such as manufacturing and service. It was found about four practices of operational aspects has been adapted from manufacturing sector namely Gupta and Jain [42]; Balok [44]; and Woehl [45]. While the remaining practices were adapted from other sectors that constitutes service sector [43] and healthcare sector [41].

However, all the selected items or the survey instruments have genuinely validated in an iterative process to achieve high validity. As an example, the instrument of lean practices in manufacturing sector developed by Doolen and Hacker [46], is purposely to evaluate lean practices in a broad range. Indeed, this instrument should be integrated with the lean principles for the aim to construct a comprehensive lean assessment tool [44].

Besides, Malmbrandt and Åhlström [43] vetted the items through four steps which include the process of attending the workshop, conducted semi-interview, test the instrument's and finally made any changes of the item lean service to ensure the instrument can be measured appropriately. While the items adapted from Aoun [41] had done pre-test to ensure the items are valid and reliable. Consistent with Woehl [45] study, also had run pilot test after conducting content validity and construct validity for the items. Likewise, Gupta and Jain [42] used established instruments from manufacturing industry to measure the implementation of 5s.

4.1.2 Sociotechnical Aspects

Sociotechnical aspects of lean refer to the human factors and motivations aspect as to achieve humanization in the workplace without overdoing any repetitive works within the organization that could lead to waste. To measure this variable, items were adapted from Hadid et al. [47] and Hadid and Mansouri [48]. The question was measured using interval scale with 6-Likert scale.

5. Result

5.1 Result of CVR

The result of content validity established when the responses from all SMEs have been pooled to determine the amounts of essential for each item. From the result, it indicates the result has fulfilled the minimum criteria of Lawshe's scale with more than half saying "essential", denotes as an E compared to U "useful but not essential" and N "not necessary". The result also has been supported based on this following formula:

$$CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}} = 1$$

The result of CVR indicates most of the SMEs agreed with the items and it means the SMEs accepted with the item proposed after the validity of judgments has been made. However, certain items need to be removed due to SMEs have been found the item was not appropriate to ask the potential respondents. Finally, Table 5 and Table 6 demonstrated the result of CVR after some of the items were failed to meet the requirement.

Table 5

Measurement Items for Operational Aspects (24 items)

Adapted Items
1. The hospital practices continuous improvement.
2. Specialized teams gather and assess data to track work improvements.
3. Implementation of improvement plans enable employees to become more efficient.
4. Continuous improvement focuses on waste reduction and efficiency improvement.
5. The hospital provides clear written standards to dispose unused things.
6. There is no unused machine or equipment present.
7. Shelves are labeled with signboards for identification.
8. Storage areas are marked with indicator.
9. Separation lines are certain and clear.
10. The floor is free of wastewater and oil.
11. The air in the hospital is odorless and fresh.
12. All staff prevents dirtiness in the hospital compound.
13. The hospital is equipped with adequate lighting.
14. Activity boards up are up to date and regularly reviewed.
15. Visual stream mapping (VSM) is able to identify waste within the hospital.
16. VSM helps the flow of hospital operations to work smoothly and continuously.
17. Process maps of each department are updated more often than once per year.
18. The hospital trains the employees on methods to identify waste.
19. Employees are capable of using tools like Ishikawa (fish bone) diagrams, to identify sources of waste.
20. Visual sign are used to facilitate the work procedures.
21. Visual sign (e.g. colors) are used to distinguish similar items at the workplace.
22. Visual sign (e.g. arrows) are used to guide people reaching different departments.
23. Signboard system is used to control in-process inventories.
24. Materials, tools and equipment are stored in standard size containers.

Table 6

*Measurement Items for Sociotechnical Aspects (8 items)***Items**

1. The hospital has shown a good management support.
2. The hospital has provided a good reward system.
3. The hospital has provided a good communication system.
4. The hospital always provided training to the employees and top management.
5. The hospital has shown a good leadership practice.
6. The employees have shown a good involvement towards the hospital.
7. The employees have shown a good commitment towards the hospital.
8. The hospital permits the employees to make a decision.

To encapsulate, it has shown the selected items has undergone the process of validity using Lawshe's method which has been explained earlier and resulting 32 items which 24 items of operational aspects whereas 8 items of sociotechnical aspects as to suit the purpose of this study. Further, in measuring the item, the Likert scale has been adjusted to interval scale ranging from 1 (strongly disagree) to 6 (strongly agree).

6. Conclusion

This paper contains the explanation of lean healthcare and the validation process of lean healthcare instrument. The item has been validated by the SMEs through content validity using Lawshe's method. This is to ensure the item of each section is reliable and can be accepted where it has shown the result of CVR was 1. Although it considered as classical measurement, but the Lawshe's method still significant as one of the statistical method in quantitative study to determine the validity of each item.

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