ICASH
Research for Better Society

Proceedings of International Conference on Applied Science and Health
(No. 3, 2018)
Addressing Global Health Challenges: Policy, Research and Practices

ICASH-A28

THE IMPLEMENTATION OF LEAN STRATEGY TO ALLEVIATE OVERCROWDING IN EMERGENCY ROOM: NARRATIVE REVIEW

Yani Oryza [1,*], Jaslis Ilyas [2]

[1] *Hospital Administration Department, Faculty of Public Health, University of Indonesia*
[2] *Department of Health Policy and Administration, Faculty of Public Health, University of Indonesia*

*Corresponding authors' e-mail: iyani0183@gmail.com

ABSTRACT

***Background**: Emergency Room (ER) of hospital worldwide undergoes significantly challenging problems; overcrowding patient leads to block the access, causes discomfort and increases demands to be served by medical personnel immediately. To overcome these problems, the ER needs to implement lean strategies. This study presents a narrative review aimed to identify whether there is a positive impact of the lean implementations in overcoming the overcrowded ER or not.*
***Methods**: This narrative review explores the current literature from an online database and highlights the lean strategies adopted by several ER to reduce overcrowding and delaying and to streamline patient flow. Literatures without data ~~on~~ waiting time, length of stay (LOS), and untreated patients leaving the ER, will be excluded from this review. The types of intervention were grouped into team triage, streaming, fast track, point-of-care test (POCT), and nurse-requested x-ray.*
***Results**: The evidence of lean intervention is beneficial in reducing patients' waiting time and length of stay (LOS). Fast track reduces the length of waiting time, LOS, and the number of untreated patients by physician. Team triage consisting of appointed doctors and nurses also has a positive impact on shortening the waiting time. There is not enough evidence to suggest that streaming, POCT early in arrival, and x-rays by nurses can reduce waiting times and LOS.*
***Conclusions**: The implementations of lean strategy have a positive impact in shortening the waiting time and LOS, and help speed up the patients' flow and access to other supporting units.*

***Keywords**: Emergency Room, overcrowding, implementation of lean strategy*

BACKGROUND

A hospital plays a vital role in healthcare as an institution which provides curative, rehabilitative and palliative health services for outpatient, inpatient, and emergency situations. Emergency room (ER) acts as a crucial part of a hospital that undergo various problems in delivering the patient healthcare [1,2]. Such problems include patients overcrowding which could cause patients flow slow down and access blocked which may result in discomfort to the patient [3,4]. This discomfort ultimately enhances the patient's desire to be immediately served by medical personnel [3,4,5]. Until recently, patients overcrowding has tended to take place in hospitals and become a significant challenge for hospital management. Many studies suggest that patients overcrowding cause a negative impact on quality service, treatment by the doctors, and waiting times, which may increase mortality [1,2,3-5].

Patients overcrowding in the ER occurs when the demand for health care is higher than the capacity that can be serve at the same time [1,2,3-7]. ER crowding is described as having more patients-staff ratio than staff could ideally care for, or more patient to ER area or bed shortage [8]. The ER performance is

determined by a health worker, facility, and equipment. Less proficient worker, limited facility, or bed shortage could cause poor performance of an ER. The greater number of the patient, the more prolonged the waiting time of patients being ~~a~~ treated. Lean management strategy could minimize those problems; *i.e.,* reduce the waiting time, shortening the length of stay (LOS). The short waiting duration to get treatment may increase a patient's satisfaction level [1,2,3-11].

Lean thinking designed by Toyota Motor Corporation is a method, concept, and philosophy focused on minimizing waste and losses from a production process [6,7]. This efficient lean concept is referred as *Jidoka* which means the machine automatically stops safely when the process is complete; and just-in-time production which means only produce 'what is needed, when it is needed, and the correct amount' [9]. This concept has been adapted to construct an ER strategy. Several fundamental principles in this strategy include eliminating useless process, maximizing the product value to the consumer, producing goods seamlessly with minimal delay (*heijunka*); delivering good products, and reducing large quantities inventory; involving workers and empowering them to inspect and improve their own work; implementing autonomation, detecting a production defect immediately (*jidoku*); Immediately solving the problem at the source of the root; make continuous improvement and innovation to achieve perfection [10].

The lean strategy at ER can be conducted by looking for the cause of patient overcrowding [1,2], where the long duration of waiting time at ER may be considered as waste [10,11-13]. Many hospitals already applied lean strategy to solve these problems, resulting in the elimination of all the 'waste' such as reducing access block and speeding up the patient's flow. This effort is a proven strategy to serve an effective, efficient and good quality service [1,2,11,12-14]. According to a review conduct by Oredssen et al. (2010), there are several components of lean strategies including streaming, team triage, the point of care test (POCT) and nurse requested x-ray [1,2].

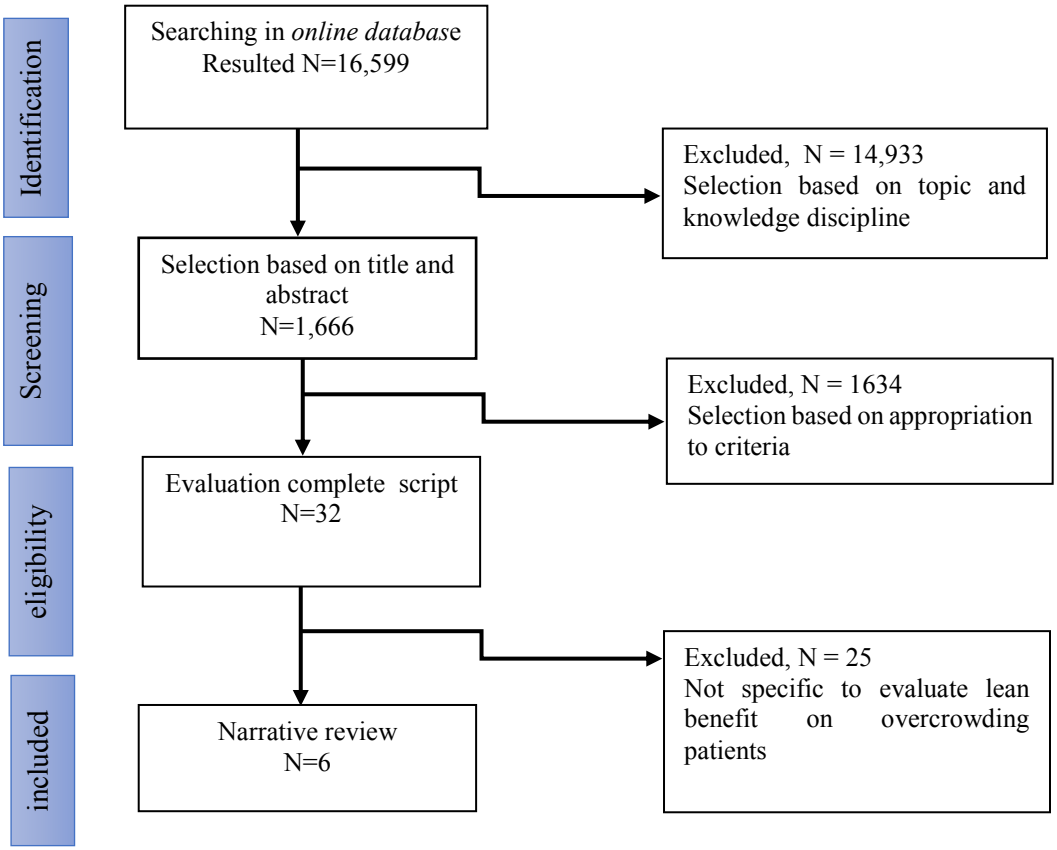
This paper is intended to identify whether there is a positive impact of the application of lean strategy in overcoming and facilitating the problems in the ER, in case of the patients overcrowd.

METHOD

This review was based on PRISMA-Protocol. Literature search was conducted by using the online database from the University of Indonesia such as PubMed, Science Direct on December 5^{th,} 2017. All references were evaluated to fit the topic of these articles. When the literatures did not present the data on lean strategies in ER *i.e.,* streaming, fast track, POCT, nurse requested X-rays, waiting time, length of stay, patients leaving the ER without being seen by doctors, those was excluded in this review. All articles searched were related to lean strategies and overcrowded ER published in some journals. The keywords used to search were "emergency department/room or emergency medicine" and "overcrowding" and "lean"; however, the search is limited to references published in the year of 2010 to 2017.

Those are 14,899 articles obtained from the PubMed, and 1,700 articles were obtained from Science Direct, of which 14,933 articles were excluded. The selected 1666 articles included 32 full articles were evaluated, and the remaining articles only evaluate the abstract. After reading all articles only six articles were appropriate for narrative review.

Figure 1. PRISMA-Protocol search result



RESULT

The references review include the article outline by Holden (2010), Oredsson et al. (2011), Crawford et al. (2013), Chan et al. (2015), Bucci et al. (2016), and Richard & Jarvis (2016). All author cited that after practicing lean strategy in the ER, the health care services at the ER tend to improve positively even if the patients overcrowded [1,2,9,10,11,12]. Interestingly these articles utilized the data obtained from the Unit States, Australia, Hong Kong, England, and Italy. Below is a table of critical appraisal summary outcomes of the six articles covering researchers, published year, title, study design, results, and conclusions.

Table 1. Critical Appraisal

Research, Country, Year,	Research Title	Method	Result	Conclusion
Holden, Richard J United States of America (USA) 2010	Lean Thinking in Emergency Departments: A Critical Review	Systematic review Reviewing 18 articles about ER lean implementation in United States of America, Canada, and Australia	This review reveals some of the changes made by the ER: By streaming, support by the management, the latest technological changes, communication systems, changes and reorganization of staff and rooms/buildings. Service to patients has improved After implementing Lean, several ER reported progress with reducing length of stay (LOS), waiting times, and the proportion of patients leaving the ER without being examined by a doctor. The study did not reveal the patient's quality or safety, and patient satisfaction.	There is a significant impact on improvements in patient care, especially reducing LOS and the waiting time.
Oredsson S, Jonsson H, Rognes J, Lind L, Göransson. KE, Ehrenberg. A, Asplund K, Castrén M and Farrohknia N Sweden 2011	A Systematic Review of Triage-Related Interventions to Improve Patient Flow In Emergency Departments	Systematic review Reviewing 33 articles about ER lean implementation in the United States of America, Canada, Australia, New Zealand	Interventions were grouped into streaming, fast track, team triage, point-of-care testing (POCT), and nurse-requested x-ray Scientifically proven from the 33 studies have shown that there is a positive impact on the fast track on waiting time, LOS, and left without being seen (LWBS), and the number of patients who leave the ER before being examin by a doctor.	The fast track can be performed on patients suffering from mild disease or mild illness → waiting time, LOS is shorter A triage team consisting of a proficient doctor and nurse can also reduce waiting times and LOS. There is not enough evidence to suggest that streaming and performing laboratory blood tests early in arrival as well as x-rays by nurses can reduce waiting times and LOS

Research, Country, Year,	Research Title	Method	Result	Conclusion
Crawford K, Morphet J, Jones T, Innes K, Griffith D, Williams A Australia 2013	Initiatives to Reduce Overcrowding and Access Block In Australian Emergency Departments: A Literature Review	Literature review Reviewing lean implementation in Australia	Based on some articles stated that the initiative made has proved significantly that it can shorten waiting times, LOS, and increase the flow of patients that can be served in the ER. The presence of a nurse who is responsible as a triage officer can increase the target of the National Emergency Access which requires all patients to be served within less than four hours *i.e*. the patient has been admitted to hospital or referred to another hospital	The change of nurses mindset and workload from traditional towards more responsive and sprightly is needed to achieve LOS targets and short waiting time.
Chan SW, Cheung NK, Graham CA, Raines TH. Hong Kong, 2015	Strategies and Solutions to Alleviate Access Block and Overcrowding In Emergency Departments	Systematic Review 22 scientific articles	The solution identified from some of these studies was divided into 2 categories: (1) strategies to reduce the number of patients in the ER, make the primary inspection room in the ER, fast track and the presence of qualified nurses in ER (2) addressing access block management strategies: immediate discharge of unnecessary patients, maintain patient flow, The need for attention from the management in order to prioritize the problem of overcrowding patients.	From the review, it was found that lean strategies used to overcome access block problems and overcrowded patients in ER give a positive impact towards improvement
Jarvis RPE, England, 2016	Improving Emergency Department Patient Flow	Systematic Review	Based on the review of several articles, it was obtained that in order to reduce the number of patients in the emergency room and increase the flow / flow of patients in the ER: Implementation of Triage by physician, Fast track, rapid assessment, and co-location of primary care clinician at ER have shown significant positive impact. In addition, implementing new patterns can also shorten waiting times, LOS and reduce block access.	Lean strategies have been shown to shorten patient waiting times, reduce the overcrowded patient, and also reduce the blocked access and accelerate the patient flow

Research, Country, Year,	Research Title	Method	Result	Conclusion
Bucci S, De Belvis AG, Marvento S, De Lava AC Italy, 2016	Emergency Department crowding and hospital bed shortage: is Lean a smart answer? A systematic review	Systematic Review	Almost all of the reviewed articles stated that there was a significant improvement in the increasing number of patient visits as well as the shorter waiting times and LOS, and the increasing patient satisfaction of the intervention. Only one case reported that the service at the ER was worse after lean was implement	After Lean method implemented in ER, there was a positive improvement in patient waiting time and LOS which is getting shorter

Table. 1 shows that the lean strategy conducted to overcome patient overcrowding are team triage, streaming, POCT and nurse request x-ray [1,2,9,10,11,12] The evaluated outcome from these strategies were waiting time, LOS. After lean strategies have been applied, almost all of the review articles stated that there was an improvement in shortening the waiting time and LOS and also accelerate the patient flow in ER [1,2,9,10,11,12].

DISCUSSION

Most studies indicated that lean interventions contributed to the ER's performance improvement, specifically in reducing the waiting time duration, LOS, and reducing the number of patient left without being seen (LWBS) [2,7,10-13].

In terms of streaming, there was a positive impact on the flow and a reduction in the patients "bottlenecks" in receiving treatments and also reduce the crowds [1,2,11]. Dividing patients into multiple streams helps to speed up waiting time despite insufficient evidence [1].

In relation to the Fast track, there was a positive impact on both waiting time and LOS [2, 10] , after the fast track was implemented, the average waiting time decreased by 50% , LOS by 10%, and LWBS by 1% [2].

The triage team constituted a mean to group patients based on the severity of their diseases by a group of trained medics and paramedics. The triage officer plays an important role in improving the efficiency, accuracy of disease management and in the occurrence of natural disasters or massive traffic accidents, under which the casualties should be assessed based on the degree of illness' complexity and severity [2,5,10,11]. Patients whom required resuscitation should be treated first. Based on these articles, triage may reduce the LWBS numbers [2].

Point of care testing (POCT) is an examination by laboratory personnel in the ER, this actions is conducted to accelerate the diagnosis in the ER [1,2,11,10,13]. A randomized study conducted in Canada indicated a positive POCT impact on speeding up the reading of laboratory result by physician. Nevertheless, the study did not provide strong evidence on the shortening LOS and waiting time [2]. A systematic review conducted in 2011 stated that POCT plays a role in reducing the patients' LOS in ER. Another study suggested that POCT facilitated a biomarker examination for heart attack with unspecific myocardial infarction symptoms which resulted in a successful recovery rate by 20% higher than the delayed examined patients [1,2,13].

Requested X-rays must be ordered by well-trained or proficient nurses at triage line who were authorized to make X-Ray requests for patients with suspected bone fractures (limit to certain parts of extremities, *i.e.* forearms and lower leg) [2]. Based on a review by Orredsson et al (2011), it was stated that POCT improved the patients fracture diagnosis but there was no strong evidence in shortening the waiting time and LOS [2]. Crawford et al (2013) [11], Chan et al (2015) [12] suggested that the presence of a skill medical officer or nurse could help improve to smooth the patient exchange/flow in the ER so it can reduce the patients crowding. The lean strategy could also be provided by making short observation rooms (short term observations) to accommodates patients requiring observations of more than 4 hours to less than 24 hours [11]. The existence of this short observation room can help smoothen the patients flow in the ER [11,12].

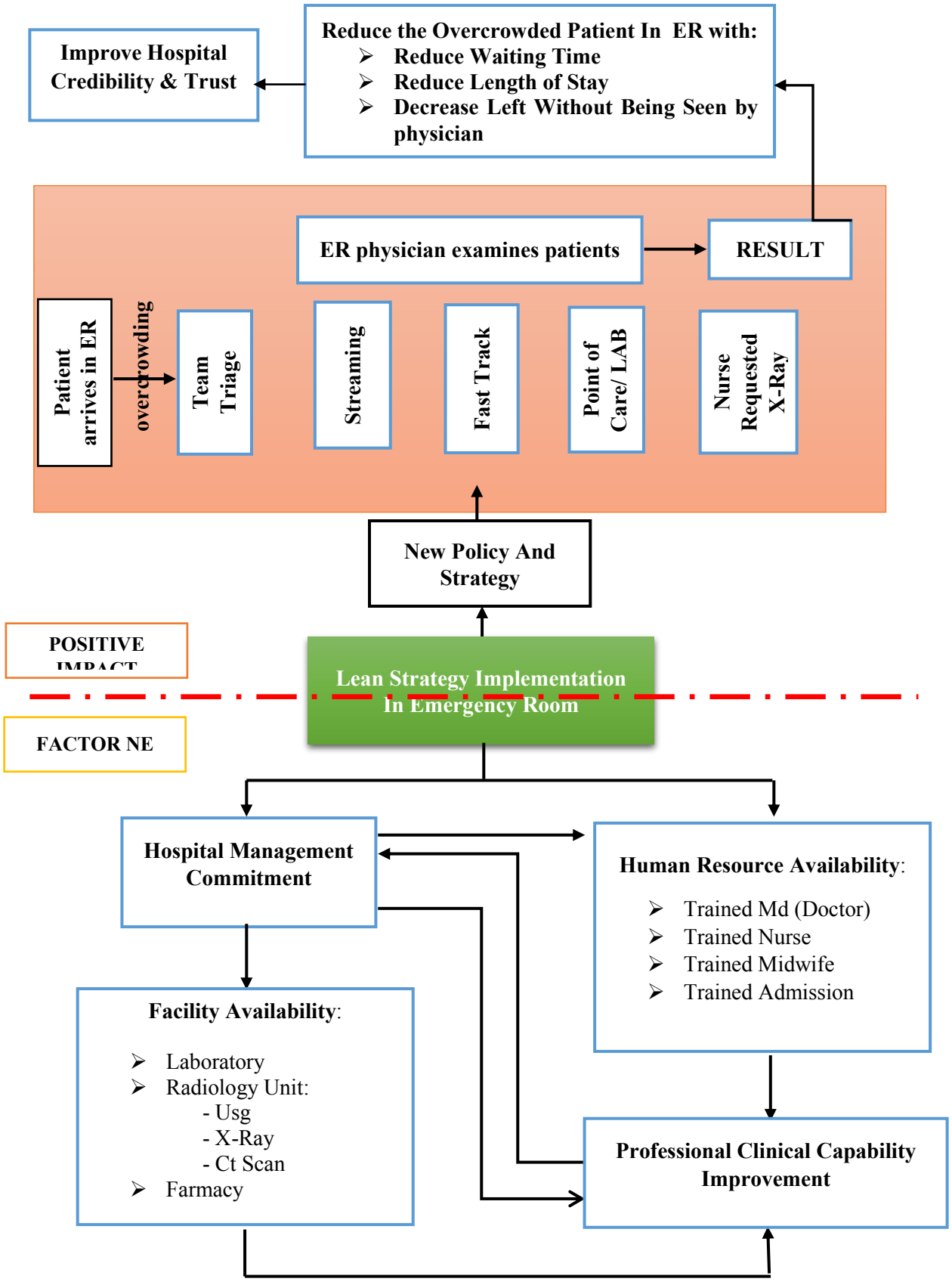
Lean strategies should be applied based on a human-centered approach by regarding the value of the people, patients, and workers, top management support, resource allocation and adaptation to the local needs. In addition, a strong leadership is required to build motivation, drive the changes and lead improvement projects [13]. Hospital management must have a strong commitment to implementing the lean method strategy. These interventions were focused on the whole process instead of specific problems. It involves everyone, not only the top management [7,10] but also the entire frontline staff. Employees were either directly and indirectly affected by lean interventions [13]. The positive

perception effect of the lean strategy for the front-line staff suggested that their duty include participating in controlling this situation, but the negative perceptions are they have an overload work and being monitored by the management [6,7,10].

The hospitals need to educate and train their employees (such as physician/doctors, nurses, midwifes, and also admissions worker) about lean strategy. Hospitals are obliged to pay attention to the adequacy of supporting facilities of medical services which consist of: laboratory unit, radiology (ultrasound, X-ray, CT scan, etc.), and pharmacy [1,2,13]. Any equipment damaged and or lack of raw materials or reagents, and also lack of medicines should be considered as disruption to the smooth flow of patient in the overcrowded ER. It is recommended that equipment is always maintained, calibrated and if they are broken or damaged, they should be repaired immediately. Being lean in the overcrowded ER is not merely about shortening the time to treat by physicians but it also means that the ER team should give all they have to bring good quality healthcare [4,6,7,10]. An excellent clinical care could be provided to the patients if all ER staff and supporting facilities units and management are synergized [15,16,17].

The framework and logical empirical tree of Lean implementation in overcrowded ER can be seen in Figure 2 as follows:

Figure 2. Logical Empirical Tree Lean Implementation in Emergency Room



Based on the literatures, the lean strategy was helpful for ER's personnel in providing health services in the crowded ER. When implemented in the ER, the lean strategy could shorten the waiting time, LOS, accelerate the patient's flow and decrease the number of LWBS. These aspects could increase the patient's satisfaction rate so that the hospital confidential and the credibility increases [1-14]. The triage of the patient's condition was the first steps in applying the ER depend on the severity of a patient [13,14,15,16]. The commonly used triage classification based on severity are resuscitation, emergency, urgent, semi-urgent (semi emergency), non-urgent (non-emergency and) [5]. Based on these categories, services and treatment should be prioritized for more life-threatening patients who need resuscitation [5,14,15]. The ratio of nurse to patient in ER should be set at 1:1 for trauma or resuscitated patients, 1:2 for critical patients, 1:4 for other ER patients [18]. Therefore, lean implementations in ER have to be applied if the nurse to patients' ratio is higher than 1:4 [18].

CONCLUSION AND RECOMMENDATION

From this study, it can be concluded that lean implementation in the overcrowded ER contributed positive impact in shortening the waiting time and LOS, and improving the patient flow to other supporting units. These strategies should be applied if the ratio of ER nurse to patients' is greater than 1:4. The ultimate goal of this implementation is to reduce unnecessary delays and to assure better patient outcome. The application of lean approach can improve the patient flow in ER.

REFFERENCES

1. Paul Richard Edwin Jarvis. Improving emergency department patient flow. Clin EXp Emerg M 2015. 3(2):63-68 http://ceemjournal.org/upload/pdf/ceem-16-127.pdf
2. Oredsson S, Jonsson H, Rognes J, Lind L, Göransson KE, Ehrenberg A., Asplund K, CastrénM, Farrohknia N. A Systematic Review Of Triage-Related Interventions To Improve Patient Flow In Emergency Departments. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine 2011, 19:43 doi:10.1186/1757-7241-19-43
3. Polly Davenport. The relationship between emergency department wait times and inpatient satisfaction. Ann Arbor: The University of Alabama at Birmingham; 2014.
4. Carter EJ, Pouch SM, Larson EL. The Relationship Between Emergency Department Crowding and Patient Outcomes: A Systematic Review. Journal of nursing scholarship: an official publication of Sigma Theta Tau International Honor Society of Nursing / Sigma Theta Tau. 2014;46(2):106-115. doi:10.1111/jnu.12055.
5. Aacharya, R. P., Gastmans, C., & Denier, Y. Emergency department triage: An ethical analysis. BMC Emergency Medicine 2011, 11, 16. doi:http://remote-lib.ui.ac.id:2073/10.1186/1471-227X-11-16
6. Lawal AK, Rotter T, Kinsman L, Sari N, Harrison L, Jeffery C, Kutz M, Khan MF and Flynn R. Lean Management In Health Care: Definition, Concepts, Methodology And Effects Reported (Systematic Review Protocol) Systematic Reviews 2014; 3:103. doi:10.1186/2046-4053-3-103
7. Ng D, Vail, Gord, Thomas S, Schmidt N, R.N. Applying the Lean principles of the Toyota Production System to reduce wait times in the emergency department. CJEM : Journal of the Canadian Association of Emergency Physicians 2010 01;12(1):50-7.
8. Boyle A, Beniuk K, Higginson I, Atkinson P. Emergency Department Crowding: Time for Interventions and Policy Evaluations. Emergency Medicine International, vol. 2012;1-8. https://doi.org/10.1155/2012/838610
9. Toyota Production System http://www.toyota-global.com/company/vision_philosophy/toyota_production_system/
10. Holden, Richard J. Lean Thinking in Emergency Departments: A Critical Review. Annals of Emergency Medicine 2010; 57 3: 265 – 278. doi:10.1016/j.annemergm.2010.08.001
11. Crawford K, Morphet J, Jones T, Innes K, Griffiths D, Williams A. Initiatives to reduce overcrowding and access block in Australian emergency departments: A literature review. Collegian. 2014; 21, 359-366 http://dx.doi.org/10.1016/j.colegn.2013.09.005
12. Chan SSW, Cheung NK, Graham CA, Rainer TH.. Strategies and solutions to alleviate access block and overcrowding in emergency departments. Hong Kong M J. 2015; 21 (4):345–52 DOI: 10.12809/hkmj144399
13. Bucci S, De Belvis AG, Marventano S, De Leva AC, Tanzariello M, Specchia ML, Ricciardi W, Franceschi F. Emergency Department crowding and hospital bed shortage: is Lean a smart answer? A systematic review. European Review for Mical and Pharmacological Sciences 2016; 20: 4209-4219
14. Harding KE, M.P.H., Taylor NF, PhD., Leggat SG, PhD. Do triage systems in healthcare improve patient flow? A systematic review of the literature. Australian Health Review 2011 08;35(3):371-83.
15. Reinhardt MR. A Systematic Approach to Evaluation of Performance Deficiencies in Triage. Journal of Emergency Nursing 2017 Jul 01;43(4):329-332.. http://dx.doi.org/10.1016/j.jen.2017.01.003
16. Alavi-Moghaddam M, Alamdari S, Amini A, Forouzanfar R, , Shahrami A, Kariman H. Application of Queuing Analytic Theory to Decrease Waiting Times in Emergency Department: Does it Make Sense? Arch Trauma Res. 2012;1:101–107. doi:10.5812/atr.7177.

17. Akbulut S, Baydin,A, Erenler Ak, Cetinkaya H, Guzel M, Karaca A, Turkoz A. Reasons for Overcrowding in the Emergency Department: Experiences and Suggestions of an Education and Research Hospital. Turkish Journal of Emergency Medicine. 2014;14(2):59-63. doi:10.5505/1304.7361.2014.48802
18. Crouch R, Dall'Ora C, Drennan J, Griffiths P, Jones J, Recio-Sauco A. Safe Staffing for Nursing in Accident and Emergency Departments. Draft Evidence Review. 2014; https://www.nice.org.uk/guidance/gid-sgwave0762/documents/safe-staffing-guidelines-accident-and-emergency-departments-evidence-review2