

Principles and tools of Lean Thinking for patient flow management in Emergency Rooms. A narrative review of literature

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ABSTRACT

Introduction: the ER is a complex, high-demand care setting, so it is common to see congestion. The objective of this paper is to search the literature for studies showing the application of Lean Thinking principles and tools for managing patient flow in the ER.

Materials and methods: a literature review was conducted by consulting Medline databases via PubMed, GoogleScholar, Scopus and CINAHL, during the period October/December 2022. Only papers that related to the clinical area of interest, in Italian and English, published within the past 5 years were considered.

Results: the 6 studies included in this review showed, in general, how the introduction of Lean methodology reduced average waiting and length of stay times, decreased the dropout rate, and improved the experience of patients and health care providers.

Discussion: by strictly following the theoretical path, choosing the appropriate tools, involving frontline staff, and applying Lean Thinking principles and methodologies, it is possible to address the most common management issues in the ER.

Conclusions: Lean implementation in ERs has positive spillovers on the entire care process from both the perspective of the patient and the healthcare staff involved.

Key words: emergency department, emergency department flow, lean implementation, lean healthcare, lean thinking.

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Introduction

Lean manufacturing practices were first developed in Japan by the manager of the automobile company “Toyota,” in the 1950s, with the aim of transforming “waste” (anything that does not add value to the final product/service) into “value” in the eyes of customers by providing the desired result and/or service at an appropriate price.

Overall, the Lean approach provides managers with a broad understanding of the organization, allows in-depth analysis of possible problems, and helps find more efficient and cost-effective ways to improve quality and safety in production.¹

Lean principles are fundamentally value-oriented for the customer and are based on five key elements: i) value - define value from the customer’s perspective, ii) value stream - analyze processes to identify those that generate value (those that do not should be modified/eliminated), iii) flow - keep the flow continuous without process interruptions, iv) pull - act only to meet customer demands, v) perfection - pursuing perfection through continuous improvement.² With the increased awareness of the practices and principles of the approach, lean thinking has begun to emerge in various sectors, including healthcare. For some time in healthcare, the lean philosophy for management has become the means of developing a healthcare culture characterized by increasing patient and stakeholder satisfaction through a process involving active participation by professionals who aim to eliminate non-value activities, with a view to continuous improvement.³

This methodology is also a viable framework in complex care settings such as Emergency Rooms (ERs) to deal with phenomena such as overcrowding and workloads that exceed resource availability, which frequently occur in such settings and result in high waiting times, delays in healthcare treatment, and increased average length of hospital stay.

These problems have a negative impact on quality of care and clinical outcomes and can actively affect the rate of adverse events and hospital mortality.⁴

Most ERs are adapting by investing in new infrastructure, technology, and organizational approaches.

In the growing list of quality improvement models, Lean is useful at several levels: patient experience, work design, and nurse experience. How frontline nurses embrace lean potential is critical because the key to success is precisely the human element; therefore, healthcare professionals must be motivated and committed and work together toward a common goal. When waste, in the form of repeated steps, waiting, rework and unnecessary handling, is eliminated, quality improves, time is reinvested and capital is freed up to be invested elsewhere. By adopting a lean mindset it is possible to critically investigate the root causes of waste or dysfunctional processes, and once identified, classified and examined it is possible to apply Lean methods and tools to improve them.⁵ Primary problem analysis is the first step in Lean methodology. The goal must be to effectively and efficiently solve the problem using a concise and shared communication tool.

The A3 is one of the most widely used tools in problem solving in the Lean philosophy.

It is a visual tool, a simple grid that provides a flexible roadmap, reinforces the sequential nature of problem solving, and, given the limited space on an A3 sheet, forces the user to communicate simply and clearly.

A3 allows the scientific method to be applied in a structured manner and follow the steps of PDCA, that management method divided into four phases (Plan-Do-Check-Act) aimed at continuous quality improvement.⁶

To identify issues and sources of waste, the Lean methodology

uses a number of graphical tools: i) Value-stream Mapping (VSM), a representation of the flow of the process, from its beginning to its end, which shows the time and resources used in each step, the expectations between steps, the flow of information and materials, the performance of labor-power, and the time required when moving from one product to another;⁷ ii) Spaghetti diagram, a visual tool that shows the physical movement of a “work object” (a product, employee, or patient) involved in the entire flow and allows for the identification of non-value-added movements that often create congestion and therefore can be eliminated.⁶

Once the analysis is concluded, we move on to the resolution phase by applying Lean based methodologies such as: i) 5S methodology, is generally accepted as one of the milestones for implementing the Lean concept. It represents an acronym for five activities, specifically five Japanese words beginning with the letter “S” that should be undertaken in sequence; Seiri (separate), Seiton (tidy up), Seiso (clean up), Seiketsu (systematize), and Shitsuke (spread/sustain). These activities describe how to organize a work environment for the improvement of efficiency and effectiveness; ii) Visual Management, starting from the fact that most of the information we receive and process from the environment comes from the sense of sight, the Lean concept places significant importance on implementing visual management tools and techniques. It consists of creating a self-explaining, self-ordering, self-regulating and self-improving work environment in which what should happen happens, on time, through visual solutions. It is a concept that involves the use of various visual tools (signs, colors, information boards, lights, etc.) to organize the area, monitor the work and equipment in use. Visual management enhances patient and employee safety through the self-monitoring function.⁷

Materials and Methods

The objective was to search the literature for studies showing the application of the principles and tools of Lean Thinking for the management of patient flow in the ERs, in order to solve the problems of this setting in a rational and standardized manner and to provide an overview of what may be the avenues for nursing professionals to take in managing their work, with a view to effectiveness and efficiency.

A narrative review of the literature was conducted during the period between October 2022 and December 2022 by querying the following Biomedical Databases: Medline (in the Pub-Med interface), Google Scholar, Scopus, and CINAHL (through EBSCOhost). The search strategy used was based on the PICO method (Table 1).

Both the following MeSH terms associated with each other through the use of boo-lean operators (AND, OR) “Lean Thinking” “Lean Implementation” “Lean Healthcare” “Emergency Department” “Emergency Department Flow” and free search were used (Table 2).

Table 1. Search strategy based on PICO method.

Population (P)	Users afferent to the ERs
Intervention (I)	Application of Lean principles and tools
Comparison (C)	
Outcome (O)	Effectiveness in improving patient flow management

Results

From the search of the previously mentioned databases, 24 citations in Italian and English were identified. After removing duplicates a total of 21 citations were screened by checking the relevance of topics by title and abstract. The most recent scientific evidence was considered considering a time frame of 5 years. All studies prior to the previously mentioned time frame, which appeared from the abstract to be irrelevant to the research objectives,

which did not relate to the clinical area of interest, and of which the full text was not available for reference were excluded. Fourteen studies that met the eligibility criteria were considered, and following re-reading of the abstract and full text, 6 studies were included in this narrative review (Supplementary Table 1).

The summary of the citation selection process is described in the Prism Flow chart (Figure 1).

In general, all of the included studies demonstrated how the introduction of Lean methodology improved the average process time at the various stages.^{8,9,10,11,12} It is not only the average waiting

Table 2. Search strings.

PubMed	("Lean Implementation" [Mesh] OR "Lean Thinking" [Mesh] OR "Lean Methodology" [Mesh]) AND (("Emergency Department" [Mesh] AND "Emergency Department Flow" [Mesh] OR "Patient Flow" [Mesh])) AND (y_5 filter)
Google Scholar	"Lean Thinking" AND "Lean Implementation" AND "Lean Healthcare" AND "Emergency Department" AND "Emergency Department Flow" AND "review"
Scopus	(Emergency Department AND Patient Flow) AND (Lean Thinking) OR (Lean Healthcare) Limit TITLE-ABS-KEY Pubyear from 2018 to 2022
CINAHL	"Lean Thinking" AND "Emergency Department Flow"

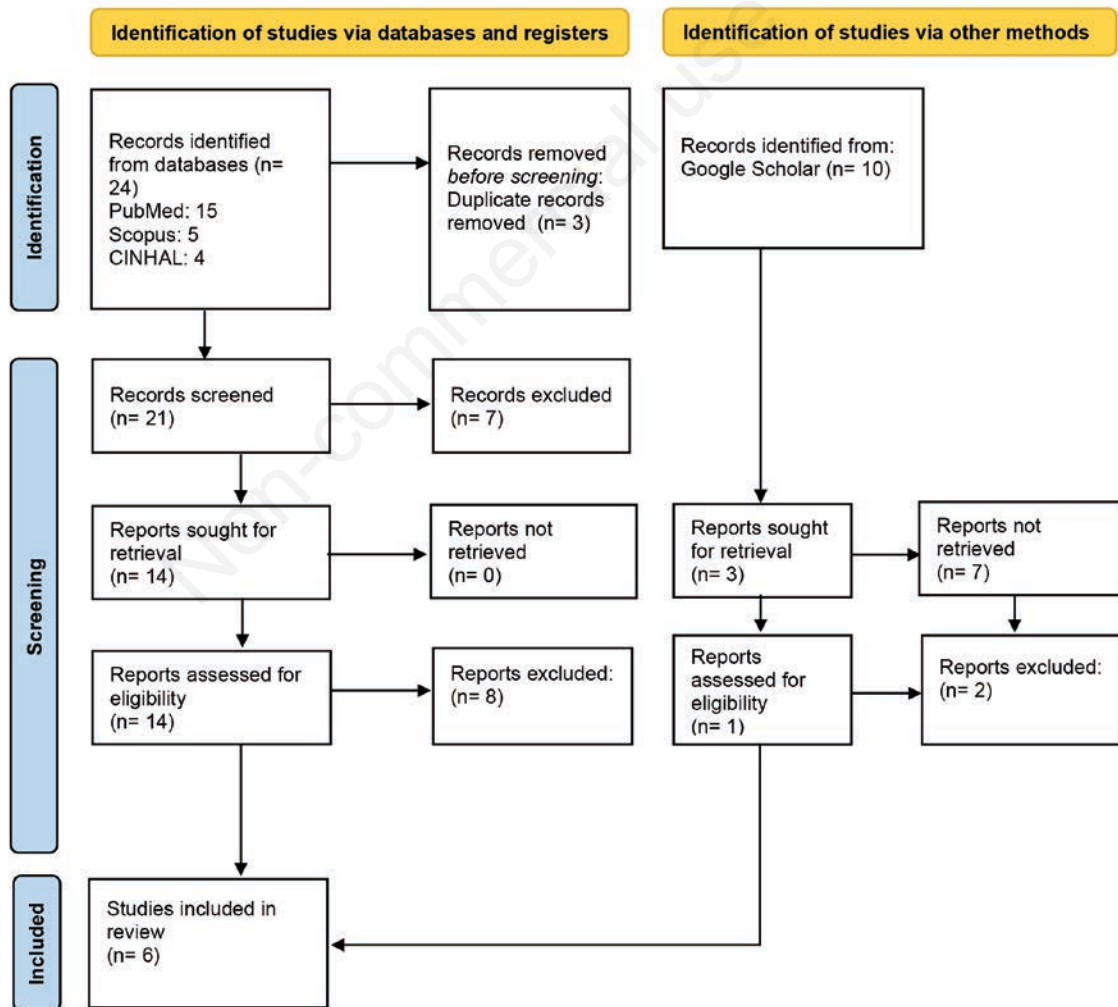


Figure 1. Flow chart of the screening process taken from Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an update guideline for reporting systematic reviews. BMJ 2021;372:n71.

time that has been reduced,^{9,11} in fact three of the included studies,^{9,10,12} also showed appreciable results in terms of LOS reduced by up to 60 minutes.⁹ The adoption of lean based protocols and the use of lean tools have also been shown to be effective in decreasing the dropout rate before receiving health care.^{9,10,11,12} Not to be overlooked is the impact with respect to the experience of care of the patient and the healthcare staff involved, which improves with the application of the right principles of Lean methodology.^{11,13}

Discussion

In the studies considered the Lean interventions introduced allowed the entire workflow to be reviewed with a view to effectiveness and efficiency, devoting time not wasted to the patient, ensuring a higher level of quality and safety, and delivering the same service in shorter LOS.^{8,9,10,11,12}

Among the effective measures considered by this review, the triage system plays a central role. Redesigning the latter, in terms of reorganization and efficiency of pre-existing spaces, has shown relevant results in two studies.^{10,11} Implementation of the triage area represents a low-cost and easily adaptable intervention. Reconstructing the spaces, perhaps by creating more booths equipped with multiparameter monitors, can be a useful strategy to detect patients with time-sensitive diagnoses early, improve the flow and user experience while preserving their privacy and providing the social distance that has become a global necessity especially since the SARS-CoV-2 pandemic.^{10,11} In addition, limiting the waiting time for triage in the ER is important to reduce the possibility of contracting other infections during the stay.

In settings where triage has been redesigned with a Lean perspective, improvements in waiting time, patient safety, patient experience/satisfaction, and staff satisfaction have occurred.^{10,11}

Clearly, despite the low cost and limited use of resources, this project may not be replicable in all settings as not all have the necessary resources or space.

Staff commitment along with the creation and empowerment of a multidisciplinary team are critical to success. Frontline staff have a deeper view of processes, so they need to be involved in finding solutions to problems that create waste, slow the flow and decrease the quality of care.

Clearly, for the application of the principles and tools of Lean methodology an integrated approach is needed.

In addition to the “voice of the process” (VOP), visible with process mapping itself, the “voice of customers” (VOC), is also an important means of redesigning flows.

The approach must be holistic, through the VOP and VOC perspectives of the customer (patients and staff).¹³

Another good result that emerged through Lean implementation concerns precisely the decrease in LWBS due to the reduction of waiting times perceived as “not at value” to the patient.^{9,10,11,12}

Conclusions

The phenomena of overcrowding, long waits, and unavailability of resources in emergency rooms are complex issues to analyze. Through process mapping, the use of tools to reason effectively and rationally, the introduction of protocols, and staff training, it is possible to successfully apply Lean methodology in ERs.

The results achievable through Lean implementation appear to have positive impacts on length of stay, waiting times, abandonment rates, and overall satisfaction with the care experience.

The review provided insights to complement and improve the current system. A cultural change is needed, based on a bottom-up approach instead of a top-down approach so as to involve frontline staff (who need to internalize the methodology) and end users who are the real players in the processes.

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Online supplementary materials

Supplementary Table 1. Data extraction table: characteristics and main findings of the studies included in the literature review.

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