

# Improving healthcare processes through lean methodology: the case of the Orbetello emergency department

Simone Nykieforuk,<sup>1</sup> Sonia Peri,<sup>2</sup> Gabriele Taddei,<sup>3</sup> Simona Pontrandolfo<sup>4</sup>

<sup>1</sup>Nurse, Nursing Manager for the Hospital Emergency and Urgent Care Area, USL Tuscany South-East, Emergency Department, Orbetello Hospital; <sup>2</sup>Nurse, Nursing Manager for the Hospital Emergency and Urgent Care Area, USL Tuscany South-East, Emergency Department, Grosseto Hospital; <sup>3</sup>Director, Professional Operational Unit "Organizational and Managerial Integration of Nursing and Support Resources and Activities in the Emergency and Urgent Care Area", USL Tuscany South-East; <sup>4</sup>Nurse, USL Tuscany South-East, Emergency Department, Grosseto Hospital, Italy

## ABSTRACT

**Introduction:** there is an increasing need to ensure a patient-centered approach that defines the most suitable pathway for each patient from the first contact. In the Orbetello Emergency Room (ER), a passive waiting period often occurred between the triage phase and the blood test procedure, negatively impacting patients' length of stay in the ER. This problem led to the development of a Lean improvement project.

**Materials and Methods:** a structured project was carried out following the Lean methodology, aiming to eliminate the waiting time between triage and blood sampling and, consequently, reduce the length of stay in the ER.

**Results:** the project allowed for a reorganization of the blood testing process in the ER, reducing passive waiting times and patients' overall length of stay.

**Discussion:** to improve the quality of care provided in the ER, it is essential to rethink the organization of processes to reduce waiting times and waste, placing the patient at the center of the organizational structure.

**Conclusions:** the implemented Lean project fostered greater awareness among the entire ER medical and nursing team about the importance of continuously working on and revising processes for ongoing improvement.

**Key words:** emergency room nursing, emergency care, triage.

**Correspondente:** Simone Nykieforuk, Nurse, Nursing Manager for the Hospital Emergency and Urgent Care Area, USL Tuscany South-East, Emergency Department, Orbetello Hospital  
E-mail: sim.nyk@hotmail.it

## Introduction

Around the world, emergency departments are characterized by overcrowding and excessive waiting times. Additionally, these delays significantly increase patient mortality and result in inefficient use of resources, compromising both employee and patient satisfaction.<sup>1</sup> Overcrowding is also linked to an increase in the number of patients leaving without being seen by a physician.<sup>2</sup> The multidimensional nature of emergency department overcrowding has made it difficult to design interventions that address its many stress factors.<sup>3</sup>

These challenges have prompted institutions and healthcare professionals to seek new care models capable of initiating early patient management from the moment of arrival and actively utilizing waiting times.<sup>4</sup>

Protocols for diagnosis or treatment initiated by nurses before physician evaluation have been suggested as a potential strategy to improve patient flow.<sup>5</sup> Many emergency departments have introduced a physician into the triage phase or implemented predefined tests that can be ordered by triage nurses based on the patient's main symptom. These interventions aim to shorten process times and reduce the Length Of Stay (LOS) in the emergency department.<sup>2</sup> Overall, actions should be aimed at streamlining the care process and facilitating a timely transition out of emergency care to ensure effective and prompt treatment and admission.<sup>6</sup>

As established by Regional Decree No. 806 of 24-07-2017, every emergency department must implement specific organizational measures to strengthen the triage point and evaluation/treatment areas in order to handle situations of high influx.<sup>7</sup>

Triage is the most critical clinical risk management tool in emergency departments.<sup>8</sup> The comprehensive evaluation of the patient should generally not exceed five minutes for adults, while pediatric patients may require additional time.<sup>9</sup>

There is an increasing need to define the most appropriate pathway for each patient from the first point of contact, to ensure effective management of the full spectrum of cases, improve internal flow, and enhance user satisfaction.<sup>10</sup>

The application of Lean principles in healthcare dates back to the late 1980s. At the core of Lean philosophy is the concept of value, defined as everything the customer is willing to pay for.<sup>11</sup>

Lean is considered a quality improvement method. Its key element is the elimination of waste by identifying non-value-adding activities, such as waiting times. This organizational philosophy emphasizes identifying the root causes of delays or problems using a bottom-up approach that facilitates understanding. In emergency departments, this includes queues, delays in clinical assessments or lab results, and transport to radiology. Since 2005, Lean has been applied globally to address hospital departmental issues and improve care delivery performance and process efficiency.<sup>12</sup>

Various authors report evidence of lean management applications in emergency departments, showing improved patient flow and efficiency, reduced waiting times and waste, increased user satisfaction, and enhanced continuous improvement strategies as key elements of change.<sup>13-15</sup>

In healthcare, two types of variability are recognized: i) natural variability: inherent and unavoidable, linked to the nature of healthcare activities (diversity of diseases, simultaneity between service delivery and consumption, and the role of healthcare professionals); ii) artificial variability: avoidable through organizational interventions, stemming from inappropriate clinical and organizational behaviors and dysfunctions in production processes.<sup>16</sup>

By adopting a process-based approach, the goal becomes

eliminating artificial variability and managing natural variability through accurate measurement: "you can't manage what you can't measure."<sup>17</sup>

Another key aspect is waste management. Administrative structures must reorganize their processes both to support core activities and to identify waste in non-core activities. For example, "MUDA due to waiting" occurs when process phases are not synchronized, creating idle time and delays throughout the process.<sup>11</sup>

Emergency care processes often require blood sampling as a first step, providing essential diagnostic information.

In the Orbetello emergency department—like in most regional EDs—blood tests were traditionally ordered by physicians after evaluation, based on symptoms and the presumed diagnosis. Labels were printed, and blood samples were taken by the assigned nurse.

While wait times for emergency and urgent cases are generally 10–15 minutes, for other codes, the wait for a medical evaluation averages 35–45 minutes and can be even longer in overcrowded settings, which are increasingly common.

As a result, blood tests are often prescribed more than an hour after the patient's arrival and triage, which delays the start of the diagnostic-therapeutic process and increases the patient's length of stay.

A Value Stream Map (VSM) revealed that the process of performing blood tests in the ED had an estimated completion time of 162 minutes (Figure 1).

The VSM is a key tool for identifying opportunities to reduce waste and improve process integration. It graphically represents the key people, resources, activities, and information flows needed to deliver a product or service.<sup>11</sup>

The San Giovanni di Dio Hospital in Orbetello, part of the USL Toscana Sud Est hospital network,<sup>18</sup> serves the Presidio Ospedaliero delle Colline dell'Albegna. The region has a population of about 22,000 residents.<sup>19</sup> In 2023, the Orbetello ED recorded approximately 19,000 visits—the highest in the post-COVID period, as access rates had dropped during the pandemic.

Patient volume varies seasonally, doubling in summer months. Triage is staffed 24/7 by a dedicated nursing unit.

## Objectives

Through the implementation of a structured project based on the Lean methodology, the following objectives were set: i) reduce the waiting time between triage and blood sampling (to less than 10 minutes); ii) reduce the length of stay in the emergency department (by more than 30 minutes); iii) ensure the appropriateness of blood test prescriptions made by triage nurses.

Secondary qualitative objectives were: i) make early patient management more evident to users; ii) improve the management of patients in the waiting area by nursing staff; iii) increase patient safety by reducing diagnostic time.

## Materials and Methods

A retrospective observational study was conducted before and after the execution of a Lean-based project in the emergency department of Orbetello Hospital. The project followed the Lean methodology and involved the development of an A3 report and the use of tools such as the Value Stream Map, Flow Chart, and Ishikawa Diagram (Figure 2) to analyze root causes and propose countermeasures.

To implement the project, a new organizational procedure for the ED was formalized and shared at the company level. This

procedure was approved by hospital management and the clinical risk department to provide all professionals involved with a clear reference, to guide and standardize behaviors, and to prevent doubts or conflicts during the implementation of identified countermeasures.

The core of this procedure involved shifting the responsibility for ordering blood tests from the medical evaluation phase to the triage phase, making it the responsibility of the triage nurse rather than the physician.

At the same time, it was crucial for the entire emergency team to clearly understand the objectives of this reorganization, to feel engaged in the process, and to participate in drafting the procedure. This was achieved through a plenary meeting chaired by the ED's medical director and nursing coordinator.

To ensure consistency and support this new responsibility, the procedure included predefined blood test profiles based on the symptoms reported by patients. According to the assigned triage code, the signs and symptoms, and the triage assessment, the nurse could request the appropriate blood tests, print the labels for the samples, and—together with a second nurse—perform the venous blood draw.

An additional key element was logistical adaptation. The triage area required structural changes to make it suitable for performing blood sampling. This included reorganization of space and repositioning of furniture to accommodate a blood sampling station. Another identified root cause was the lack of privacy. To address this, curtains were installed, and the glass window was covered with frosted film.

To make the triage area fully operational, an upgrade of the IT equipment was necessary, including the installation of a label printer connected to the computer for printing labels to be applied to blood sample tubes.

Before implementation, brief training sessions were held for nurses on using the software functionality for requesting blood tests and applying the predefined test profiles.

The preparation phase lasted approximately six weeks, and the new organizational procedure was officially implemented on February 1<sup>st</sup>, 2023.

A Gantt chart (Figure 3) was used to plan all related activities effectively.

In 2024, approximately 11 months after implementation, a retrospective evaluation was carried out to assess whether the initial objectives had been met. Data extraction was performed jointly by two authors.

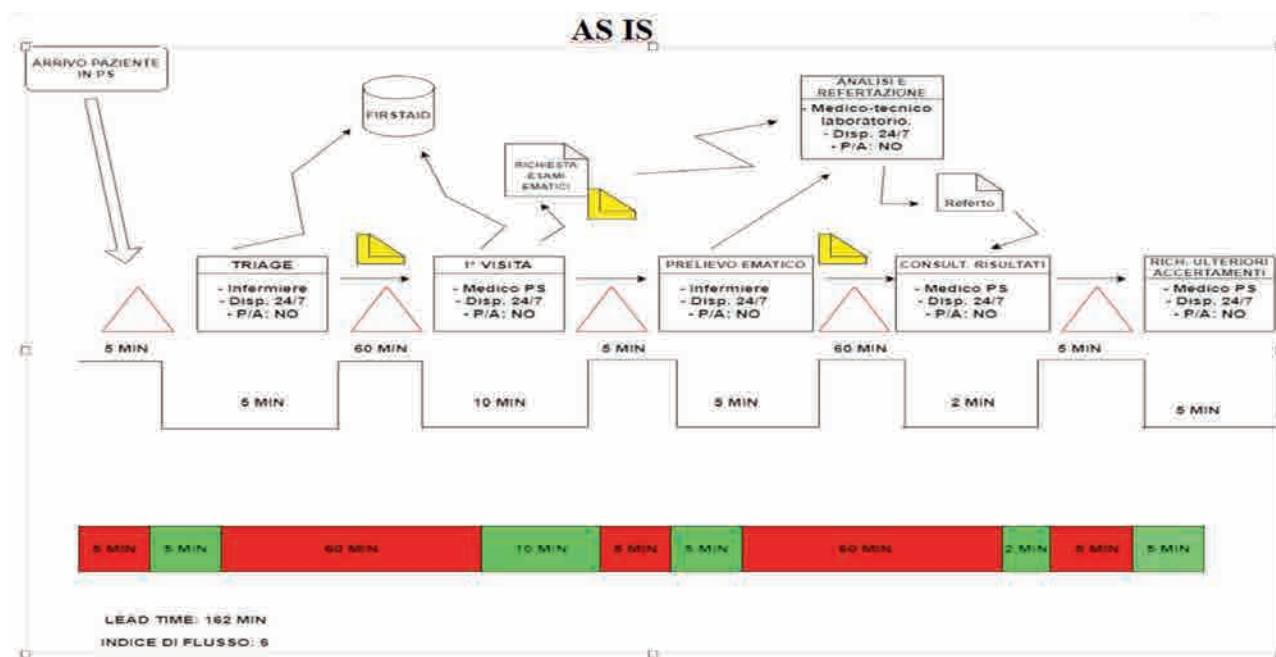
The research question was structured using the PICO model:

- P (Population): Patients assigned a triage code of 3 or 4 who underwent blood sampling;
- I (Intervention): Blood sampling performed directly at triage;
- C (Comparison): Blood sampling performed after medical evaluation;
- O (Outcomes): Waiting time between triage and blood sampling, length of stay in the ED, and appropriateness of test prescriptions.

Data were collected using the statistical software embedded in the emergency department's system. By setting specific parameters (Table 1), the software was able to provide the required data points, described as indicators. After applying inclusion and exclusion criteria (Table 1), the sample size consisted of 5,436 patients. As noted in Table 1, the study focused only on triage codes 3 and 4, as these are the categories in which test ordering during triage could have the greatest impact. For codes 1 and 2, waiting time is minimal, and for code 5, blood tests are not typically indicated.

## Results

The implementation of the project enabled a reorganization of the blood test process in the emergency department, resulting in a significant reduction in estimated passive waiting times (Figure 4).



**Figure 1.** Value Stream Map, AS IS.

In 2024, an evaluation of the results was conducted in relation to the previously established objectives, based on data collected from the period February 1, 2023 (implementation date) to December 31, 2023.

Data were extracted using the FirstAid BI4H Dedalus software system.

The number of blood tests ordered by triage nurses was quantified, showing that they were performed immediately after triage, with virtually no waiting time.

Data from 2023 revealed that the vast majority of blood tests were ordered during triage by nurses, rather than during the medical evaluation phase (Figure 4). This suggests that approximately 71% of patients presenting to the ED had no waiting time for blood tests, as they were performed immediately upon triage.

The second key objective was to reduce the length of stay (LOS)

in the emergency department, with a targeted reduction of at least 30 minutes. A comparison was made during the post-implementation period between cases in which blood samples were taken during triage and those in which, due to organizational issues, this was not possible. The results showed a significant reduction in LOS when the triage nurse both ordered and performed the blood draw, for both triage codes 3 and 4 (Table 1).

An additional analysis was carried out focusing on patients who had been discharged from the ED and had a length of stay of less than 8 hours. This was done to exclude patients whose stays were prolonged due to other reasons, such as required observation periods as per clinical guidelines. Among these patients, the LOS was reduced by approximately 33 minutes in cases where the blood draw was performed during triage compared to when it was performed after the medical evaluation (Tables 2 and 3; Figure 5).

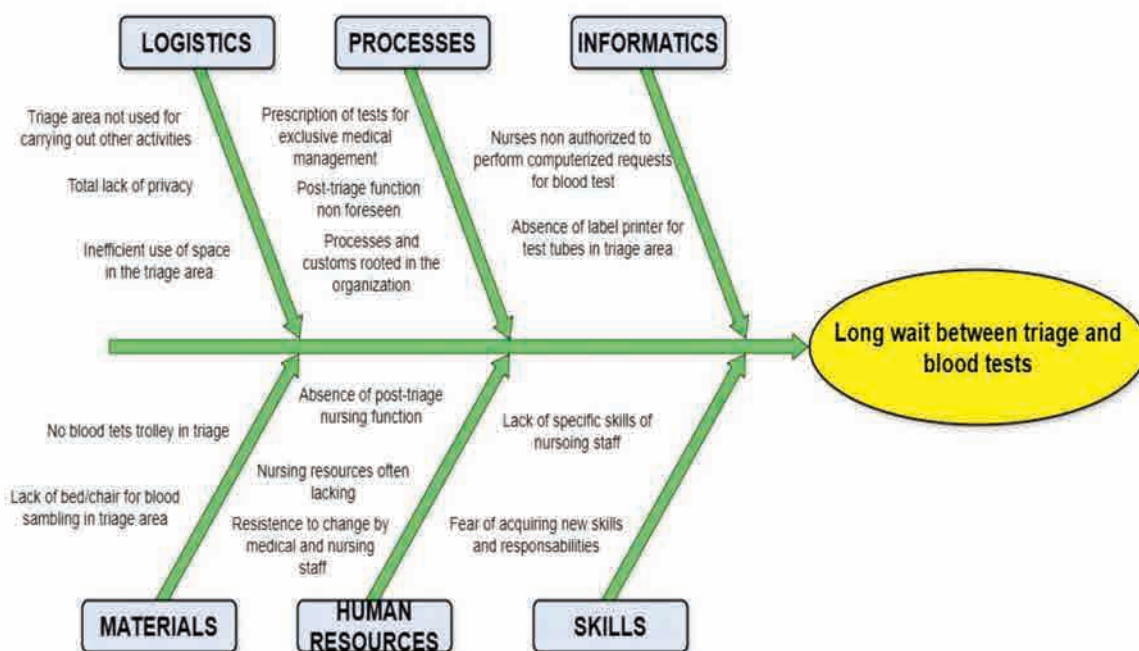


Figure 2. Ishikawa diagram.



Figura 3. Gantt diagram.



## Discussion

The causes of prolonged waiting times or extended lengths of stay in the emergency department are undoubtedly multifactorial. They are primarily linked to the high volume of daily admissions that the facility must handle. However, internal organizational structures, relative to the complexity level of the facility, can also contribute significantly.<sup>7</sup>

In light of the above, to improve the quality of emergency care, enhance patient outcomes, and prevent episodes of aggression against healthcare personnel, it is essential to rethink emergency department processes with the goal of reducing delays and waste, while placing the patient and value-adding activities at the center of the organizational structure.

The first guiding principle of the project was to adopt a patient-centered perspective, aiming to understand what could add value to a patient's experience in the emergency department. The answer was clear: in addition to resolving their health problem, the patient journey should conclude as quickly as possible. Excessive length of stay, aside from creating a negative and unpleasant experience, also impacts the work environment, increases care-related costs, and elevates the risk of adverse events and violence. Since certain technical times in the emergency process are non-reducible, the only viable strategy was to eliminate passive waiting periods for patients.

Creating the Value Stream Map (VSM) of the process made it possible to highlight and quantify non-value-added time for patients,

while also revealing workload imbalances among professionals at different stages of the process.

The VSM is considered the first and possibly most important Lean tool. It should be used at the beginning of the improvement journey because it identifies where other tools should be applied and helps build a comprehensive and effective action plan.<sup>12</sup>

From the analysis of the results following project implementation, a slight improvement in the examined indicators was observed.

Regarding the primary objective—reducing the time between triage and blood sampling—it can be stated that nearly three-quarters of patients experienced no waiting time, as the sample was collected immediately during the triage phase. The indicator used to monitor this objective was the number of tests ordered by triage-qualified nurses during the “waiting” phase.

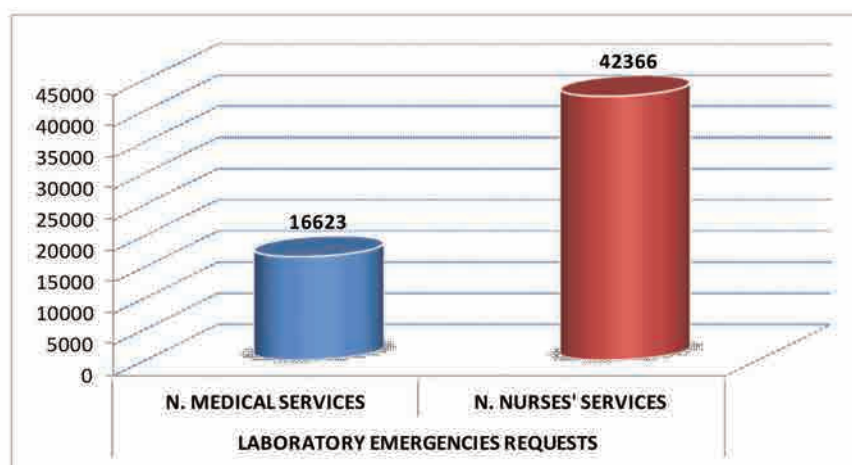
Moreover, the difference in LOS between patients who had blood drawn at triage and those who did not is significant, as shown by the LOS indicator, and this confirms the effectiveness of the implemented organizational change.

Gottlieb et al.'s review found that triage nurse-ordered lab tests had moderate accuracy, but did not identify a clinically significant reduction in LOS.<sup>2</sup>

In contrast, Improta et al. emphasized that by rigorously following the theoretical path and applying Lean Thinking tools and methods to healthcare processes, it is possible to increase service efficiency, reduce waiting time waste, and improve the work

**Table 1.** Inclusion and exclusion criteria.

Reference period	01/02/2023 - 31/12/2023
<b>Inclusion criteria</b> - triage code assigned to the user: 3 - 4 - user outcome: discharge - user outcome: hospitalization, death, transfer	<b>Exclusion criteria</b> - triage code assigned to the user 1 – 2 -5 - services performed: emergency laboratory
<b>Indicators</b>	- waiting time between triage and blood collection - time stayed in er (los)
<b>Data source</b>	Bi4h
Number of er accesses in the observed period with discharge outcome	14.862
Number of er accesses in the observed period code 3-4	12.628
Number of users who performed blood collection	5.436



**Figure 4.** Requests for emergency laboratory services.

environment for healthcare workers.<sup>1</sup>

Similar conclusions were drawn by Souza et al., whose literature review reported improvements in emergency departments in terms of waiting times, patient flow, costs, safety, and length of hospital stay.<sup>20</sup>

Douma et al. also agreed that targeting specific patient groups with written protocols can improve test turnaround times, timeliness of treatment, and in some cases, even reduce emergency department LOS.<sup>5</sup>

The systematic review by Rowe et al. on Triage Nurse Ordering (TNO)—specifically for X-rays—concluded that it effectively reduces LOS, particularly for trauma or suspected fractures, although the available evidence is limited by the small number of studies, poor methodological quality, and incomplete reporting.<sup>3</sup>

Although Lean principles have been applied in healthcare for many years, it is still not possible to draw definitive conclusions about their effects. Nonetheless, a human-centered approach, top management support, standardized workflows, resource allocation, and local adaptation appear to be critical to success, as emphasized by Bucci et al., who also noted the need for higher-quality studies.<sup>12</sup>

A review by Oredsson *et al.* found limited scientific evidence that triage nurse-ordered lab tests or X-rays significantly reduce waiting times or length of stay in emergency departments.<sup>21</sup>

Overall, the results of this study can be considered positive, but the multiple factors that influence LOS in the emergency department prevent us from confirming the organizational intervention as the sole determining factor—an issue addressed further in the study limitations section.

### Observed organizational impacts

Regarding the secondary qualitative outcomes, triage nurses reported an improved ability to manage patients in the waiting area. Patients appeared calmer and reassured by the early start of the diagnostic process, knowing that during the wait for the medical evaluation, their blood samples were already being analyzed and reported.

Nurses also described a greater sense of safety in performing triage. On several occasions, the early availability of laboratory results allowed for re-evaluation of patients, leading to an upgrade

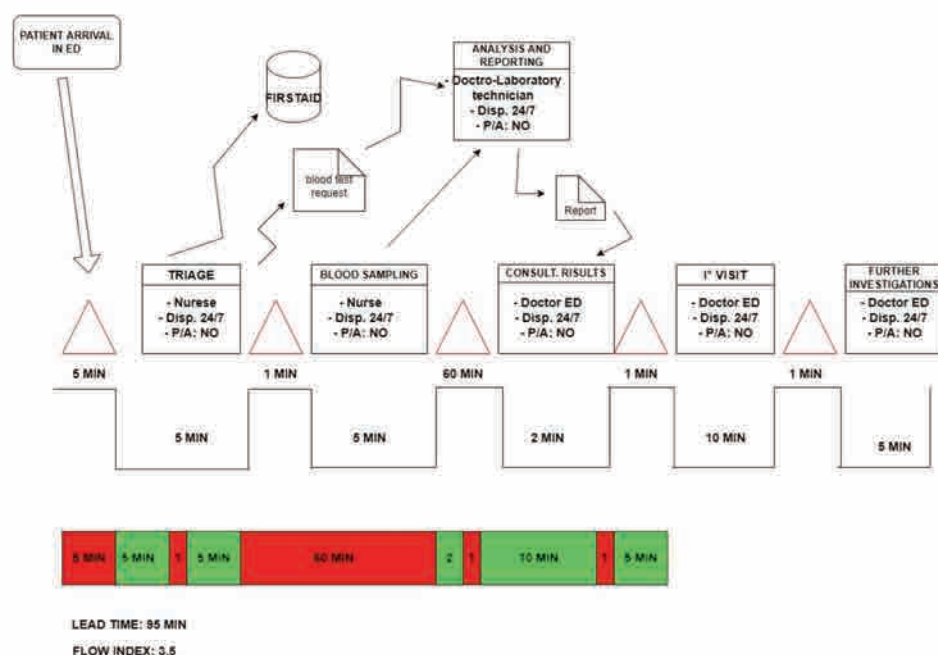


Figure 5. Value Stream Map, TO BE.

Table 2. LOS (Length of stay)

	Code 3			Code 4		
	Triage tests	Examinations after medical visit		Triage tests	Examinations after medical visit	
LOS (Length of stay)	6,31 h	8,45 h	-26%	4,16 h	4,42 h	-6%

Table 3. LOS (Length of stay) < 8 h.

Users with stay < 8 hours			
	Triage tests	Examinations after medical visit	
Los (Length of stay)	3,32 h	4,05 h	- 18%

in triage priority codes (when significant abnormal values were detected), or, alternatively, a confirmation of the initial triage code, supported by normal lab findings.

Overall, according to emergency department staff, the process became smoother and faster, contributing to improved workflow and perception of efficiency.

### Future perspectives

Maintaining the organizational standards achieved through this intervention will likely represent a major challenge in the future. Continuous improvement of the process should be pursued, ideally integrated with additional organizational measures aimed at providing increasingly effective responses to patients attending the emergency department. Further studies exploring the qualitative perceptions of patients regarding the reorganization and implemented processes could also offer valuable insights for future development.

### Limitations of the study

This study did not involve advanced statistical analyses or significance testing. Furthermore, due to the considerable variability and complexity inherent in emergency department (ED) processes, potential confounding factors may have influenced the results obtained; these represent the primary limitations that could challenge the study's findings.

The results were not compared with data from the same period of the previous year because the authors considered the two periods insufficiently comparable. This lack of comparability is mainly attributable to medical and nursing staff turnover in the ED, organizational changes affecting processes in some services such as radiology and laboratory analysis, and differences in the volume of ED visits.

Regarding ED length of stay, multiple variables likely impact this outcome, including human factors and the specific healthcare professionals on duty, as well as external services integral to ED processes. Critical determinants include the timing of radiological examinations, the duration required for specialist consultations, and the waiting times for transportation services for non-ambulatory patients being discharged, all of which significantly affect length of stay. In conclusion, patient complexity, combined with boarding and overcrowding phenomena, substantially influences ED time metrics.

Concerning secondary qualitative outcomes, no structured assessments were conducted; evaluation was limited to informal discussions with ED team members.

Similarly, no specific or quantitative evaluation was performed regarding the appropriateness of diagnostic tests prescribed during triage.

### Conclusions

In light of the findings, the implemented Lean project facilitated increased awareness among the entire ED medical and nursing team regarding the importance of continuously working on and revising processes to achieve ongoing improvement. This approach helps avoid complacency and reliance on long-standing, unaltered practices. Change, often a source of anxiety and discomfort from leaving one's comfort zone, frequently leads professionals and organizations to miss opportunities for growth, improvement, and embracing new organizational methods that can add value to the care provided to ED patients.

### References

1. Improta G, Romano M, Di Cicco MV, et al. Lean thinking to improve emergency department throughput at AORN Cardarelli hospital. *BMC Health Serv Res* 2018;18:914.
2. Gottlieb M, Farci DA, Moreno Lisa A, et al. Triage nurse-ordered testing in the emergency department setting: a review of the literature for the clinician. *J Emerg Med* 2021;60:570-5.
3. Rowe B H, Villa-Roel C, Guo X, et al. The role of triage nurse ordering on mitigating overcrowding in emergency departments: a systematic review. *Academia Acad Emerg Med* 2011;18:1349-57.
4. Linee di indirizzo nazionali sul triage intraospedaliero. Ministero della salute; 2019. [Ministry of Health. National guidelines on intra-hospital triage. 2019.]
5. Douma M J, Drake, C A, O'Dochartaigh D et al. A pragmatic randomized evaluation of a nurse-initiated protocol to improve timeliness of care in an urban emergency department. *Ann Emerg Med* 2016;68:546-52.
6. Indirizzi operativi per prevenire e gestire i fenomeni di overcrowding e boarding negli ospedali della Regione Toscana. Delibera n.532 del 15-05-2023. [Operational guidelines to prevent and manage the phenomena of overcrowding and boarding in the hospitals of the Tuscany Region. Resolution No. 532 of 15-05-2023.]
7. Modello organizzativo per percorsi omogenei in Pronto Soccorso. Linee di Indirizzo. Regione Toscana. Delibera n. 806 del 24-07-2017. [Operational guidelines to prevent and manage overcrowding and boarding phenomena in hospitals of the Tuscany Region. Resolution no. 532 of 15-05-2023.]
8. Bambi S, Ruggeri M. Tempistica del processo di triage: studio descrittivo prospettico in un DEA di 2° livello. [Timing of the triage process: a prospective descriptive study in a level 2 Emergency Department]. *Professioni Infermieristiche* 2017;70:12-7.
9. Bambi S, Ruggeri M, Sansolino S, et al. Emergency department triage performance timing. A regional multicenter descriptive study in Italy. *Int Emerg Nurs* 2016;29:32-7.
10. Manuale di formazione del sistema triage toscano (TTS). Modello organizzativo per percorsi omogenei. Regione Toscana 2019. [Training manual of the Tuscan triage system (TTS). Organizational model for standardized pathways. Tuscany Region, 2019.]
11. Agnetis A, Guercini J, Bianciardi C e al. Lean thinking e A3 report: manuale operativo di project management in sanità. [Lean Thinking and A3 Report: Operational Project Management Manual in Healthcare EDRA 2018.
12. Bucci S, de Belvis AG, Marventano S, et al. Emergency Department crowding and hospital bed shortage: is Lean a smart answer? A systematic review. *Eur Rev Med Pharmacol Sci* 2016;20:4209-4219.]
13. Villa S. L'operations management a supporto del sistema di operazioni aziendali. Modelli di analisi e soluzioni progettuali per il settore. [Operations Management Supporting the Business Operations System: Analytical Models and Design Solutions for the Sector]. Padova. Cedam 2012.
14. Sánchez M, Suárez M, Asenjo M. Improvement of emergency department patient flow using lean thinking. *Int J Qual Health Care* 2018;30:250-6.
15. Ng D, Vail G, Thomas S. Applying the Lean principles of the Toyota Production System to reduce wait times in the emergency department. *CJEM* 2010;12:50-7.
16. Tiso A, Crema M, Verbano C. A framework to guide the

- implementation of lean management in emergency department. J Health Organ Manag 2021;35:315-37.
17. Kaplan R, Norton D. Strategy Maps. Converting intangible assets into tangible results. Boston: Harvard Business School Press; 2004
18. Azienda Usl Toscana Sud Est. Ospedale San Giovanni di Dio – Orbetello. Available from: <https://www.uslsudest.toscana.it/ospedali/ospedale-di-orbetello>
19. Colline dell' Albegna e del Fiora. Available from: <https://www.maremma.it/colline-dell-albegna-e-del-fiora.aspx>
20. Souza DL, Korzenowski AL, Alvarado MM, et al. A Systematic Review on Lean Applications' in Emergency Departments. Healthcare (Basel) 2021;9:763.
21. Oredsson S, Jonsson H, Rognes J. A systematic review of triage-related interventions to improve patient flow in emergency departments. Scand J Trauma Resusc Emerg Med 2011;19:19:43.

---

Conflict of interest: the authors declare no potential conflict of interest, and all authors confirm accuracy.

Ethics approval: not applicable.

Patient consent for publication: not applicable.

Availability of data and materials: all data generated or analyzed during this study are included in this published article.

Received: 6 November 2024. Accepted: 28 June 2025.

*This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0).*

©Copyright: the Author(s), 2025

Licensee PAGEPress, Italy (on behalf of ANIARTI, Italy).

Scenario 2025; 42:613

doi:10.4081/scenario.2025.613

*Publisher's note: all claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article or claim that may be made by its manufacturer is not guaranteed or endorsed by the publisher.*