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Clinical Laboratory Response Times as a Critical Factor in Delays in Emergency Services: A Systematic Review

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Abstract: Emergency departments are currently facing a sustained increase in demand for care, which is placing significant pressure on their capacity to provide optimal and efficient care. In this context, the turnaround time of the clinical laboratory is of key importance, given that a considerable proportion of diagnostic and therapeutic decisions depend on the availability of analytical results. Consequently, delays in issuing these results can contribute to prolonged hospital stays and inefficiencies in the operation of emergency departments. From this perspective, the present analysis aimed to explore and understand the factors that influence delays in emergency department care, with particular emphasis on clinical laboratory processes. The review was conducted following the PRIMA 2020 guidelines, using a structured search of scientific literature published between 2007 and 2026 in databases such as PubMed, SciELO, and Elsevier. After the selection and evaluation process, 26 studies were included for qualitative analysis. The results highlight the central role of clinical laboratory services in the patient flow within emergency departments. Prolonged turnaround times are consistently associated with longer hospital stays and reduced operational efficiency. Furthermore, factors related to the pre-analytical phase and the overuse of diagnostic tests were identified as contributing to laboratory delays. These findings underscore the need to optimize laboratory workflows and strengthen coordination with emergency services to improve the timeliness and quality of care provided.

Keywords: *Emergency Care Delay, Clinical Laboratory, Pre-Analytical Phase, Response Time, Quality of Care.*

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I. INTRODUCTION

Emergency services are one of the most sensitive indicators of the performance of a health system, as they reflect both operational capacity and the level of trust that patients place in the system during critical situations. In this post-pandemic context, these services have suffered persistent saturation due to a combination of organizational limitations, clinical complexity, and unmet demand from other levels of care.

One of the recurring factors contributing to the demands placed on emergency care is the waiting time for laboratory results necessary for patient reassessment and subsequent decision-making. While often perceived as an administrative delay, every minute spent waiting for analytical confirmation delays diagnostic clarification and therapeutic action. This problem is particularly relevant given that diagnostic and treatment decisions in emergency situations depend heavily on laboratory information.

Evidence suggests that more than two-thirds of medical decisions related to diagnosis or treatment are based directly on laboratory results, underscoring the strategic role of the clinical laboratory within the care process (Salinas M. et al., 2013). Consequently, the demands on laboratory turnaround times extend beyond the analytical phase and permeate the entire emergency care process.

The overcrowding of emergency services is not solely due to the severity of cases. A considerable proportion of patients go to the emergency department because of difficulties accessing outpatient appointments or primary care. This situation contributes to longer waiting times, which are further aggravated when diagnostic tests are required as part of the clinical evaluation (Taype-Huaman, 2009).

In addition to objective waiting times, patients' subjective perception of the delay significantly influences their assessment of the quality of care and their sense of security. Studies indicate that perceived waiting times are

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often longer than actual waiting times, which affects satisfaction levels and overall trust in emergency services (Huyhua-De la Cruz, 2023).

In this context, the present systematic review was designed to explore the relationship between clinical laboratory turnaround times and delays in emergency care. Rather than assigning blame, the objective is to identify structural vulnerabilities, particularly within pre-analytical processes, and to examine alternatives that can optimize workflows, improve efficiency, and enhance patient-centered care.

II. MATERIALS AND METHODS

A systematic review was conducted to analyze the influence of clinical laboratory response time on delays observed in emergency departments. This methodological design was selected for its suitability in integrating and synthesizing existing scientific evidence, allowing for the identification of recurring patterns and factors in different healthcare contexts. The review was developed in accordance with the guidelines established in the PRISMA 2020 statement, ensuring transparency, methodological rigor, and accountability in each of its phases. The search strategy was carried out in recognized scientific databases, including PubMed/MEDLINE, SciELO, Elsevier (ScienceDirect), Web of Science, Scopus, and Google Scholar. Additionally, institutional repositories and specialized scientific journals were consulted to reduce publication bias and incorporate relevant gray literature related to clinical laboratory processes and emergency care. For the construction of the search strategy, three main conceptual axes were defined: the healthcare setting (emergency department), the diagnostic unit (clinical laboratory), and the critical analysis factor (response time and the pre-analytical phase). DeCS and MeSH controlled descriptors were used, as well as natural language terms, adapting the syntax to each database. An example of the Boolean expression used was: (Emergency Department) and (Clinical Laboratory) and (Turnaround Time OR Pre-analytical the eligibility criteria included original articles and systematic reviews published between 2007 and 2026, available in Spanish or English, that explicitly addressed the relationship between clinical laboratory turnaround time, emergency department overcrowding, and quality of care. Studies with significant methodological limitations, low thematic relevance, or incomplete information for the proposed analysis were excluded. The search yielded a total of 730 records. Subsequently, duplicates were removed, and an initial coding phase was performed by reviewing titles and abstracts. Potentially relevant articles were assessed in full text to verify their eligibility. This procedure was carried out independently by two reviewers, with discrepancies resolved by consensus. Finally, 26 studies were included for the final analysis. Data extraction was performed using a matrix specifically designed for this study, recording variables such as authorship, year of publication, country of origin, type of population or healthcare setting, laboratory turnaround time, characteristics of the pre-analytical phase, main findings, and reported limitations. This method allowed for a systematic and organized comparison of the selected evidence. Since this was a review of previously published literature, approval by a research ethics committee was not required. However, a thorough verification was conducted to confirm that the included studies fully complied with ethical principles, such as obtaining informed consent when applicable and adhering to international regulations for research involving human subjects.

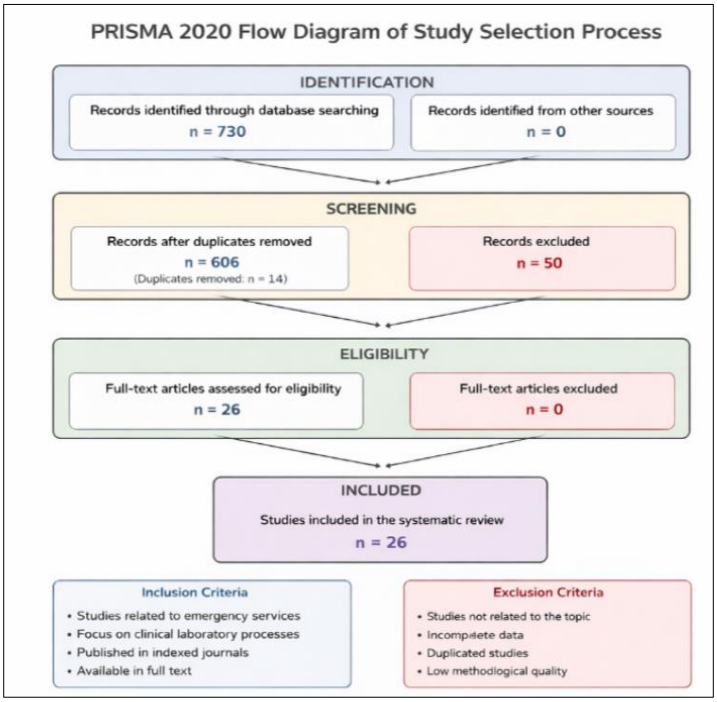

Fig 1 Study Selection Process Based on the PRISMA 2020 Guidelines Applied in this Review
Sources: Prepared by the author in accordance with the PRISMA 2020 guidelines.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr079

- Note: The figure illustrates the sequential process used to retrieve, assess, and include relevant studies, reflecting the methodology applied to ensure consistency and transparency throughout the review.

III. RESULTS AND DISCUSSION

The results obtained confirm that the clinical laboratory occupies a central place within the clinical care and resolution process in emergency services. Scientific evidence agrees that approximately 70% of medical decisions are based directly or indirectly on laboratory results (Salinas et al., 2013). This high level of dependence means that any demand for the delivery of results not only represents an administrative inconvenience but can directly affect diagnostic timeliness, contribute to the unnecessary occupancy of beds, and prolong hospital stays. In this context, the clinical laboratory ceases to be perceived as a complementary service and becomes an essential component of the diagnostic and therapeutic process.

➢ *Behavior and Accuracy of Demand in General Emergency Services*

Emergency departments differ from other hospital areas due to their unique care dynamics, characterized by the need to make clinical decisions within very short timeframes. Several studies indicate that the overcrowding of these services cannot be explained solely by the volume of patients treated, but rather by the interplay of multiple factors, including the organization of patient flow, the availability of diagnostic resources, and the degree of coordination between different levels of the healthcare system.

The COVID-19 pandemic provided important lessons for healthcare systems but also presented new organizational challenges. In the post-pandemic period, a decrease in certain specific respiratory conditions was observed; however, the overall demand for care in emergency services remains high. Patients are seeking care for a wide variety of pathologies, which significantly increases the demand for diagnostic tests, as described by Salinas M. et al. (2013). Consequently, the increased number of patients translates into a higher volume of processed samples and, potentially, prolonged waiting times when diagnostic resources are not managed efficiently.

Furthermore, the literature has shown that a significant proportion of visits to emergency departments do not correspond to true medical emergencies. In many cases, the decision to go directly to these services is influenced by social factors, such as difficulty accessing timely primary care, the presence of psychosocial problems, or the perceived need for immediate medical evaluation. This overcrowding broadens our understanding of the phenomenon of hospital overcrowding and demonstrates that the demand for emergency services in general does not respond exclusively to clinical need, but also to structural social determinants of healthcare systems.

The integrated review of scientific evidence reveals certain interpretive tensions regarding the functioning of emergency services, especially in relation to the role of the clinical laboratory in medical decision-making. Although there is consensus that laboratory results are fundamental for guiding diagnosis and defining therapeutic management, (Salinas et al., 2013)the time required to obtain them can significantly influence the length of a patient's stay in the emergency department. In this regard, Taype-Huaman (2009) reports that the average stay in the emergency department is approximately 2.9 hours and that this tends to increase when diagnostic studies are required, situations that are also associated with a subjective perception of the waiting time being longer than the actual time.

The exclusive use of diagnostic tests has become a significant issue within the emergency department. It is estimated that between 25% and 30% of requested tests do not strictly correspond to a clearly justified clinical need. However, although there is limited evidence to translate this overuse into concrete costs for healthcare systems or to systematically evaluate the vulnerability of alternative models, such as the partial decentralization of diagnostic services, these elements suggest that optimizing clinical laboratory turnaround times is essential to ensuring timely diagnoses, reducing unnecessary hospital stays, and improving the experience of patients and their families during emergency care.

➢ *Temporary Variations in Demand*

Scientific literature describes temporal patterns in the use of emergency services. Demand typically increases during the afternoon, particularly between 4:00 p.m. and 10:00 p.m., coinciding with the closure of outpatient clinics. This pattern suggests that a significant portion of patients resort to emergency services due to their inability to access other levels of care in a timely manner.

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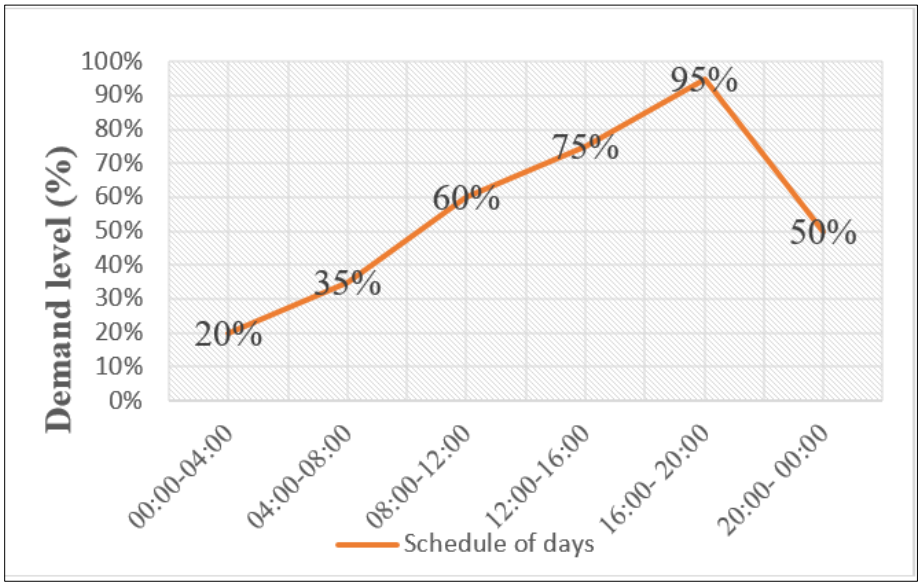

Fig 2 Estimation of Demand by Time of Day During Emergency
Sources: Prepared by the author based on a literature review

- Note: The figure reflects the times of greatest patient influx in the general emergency service, observing a maximum saturation level of 95% during the period between (16:00-20:00).

However, these patterns are not replicated in the same way across all healthcare settings. Taype-Huaman (2009) describes a higher volume of patients on Mondays between 7:00 and 11:00 a.m., with an approximate waiting time of 35 minutes for the initial assessment and an average stay of 2.9 hours, which increases when special tests or consultations are required. The differences observed between studies indicate that the dynamics of demand are closely linked to the internal organization of each hospital and the specific characteristics of the healthcare system in which it operates.

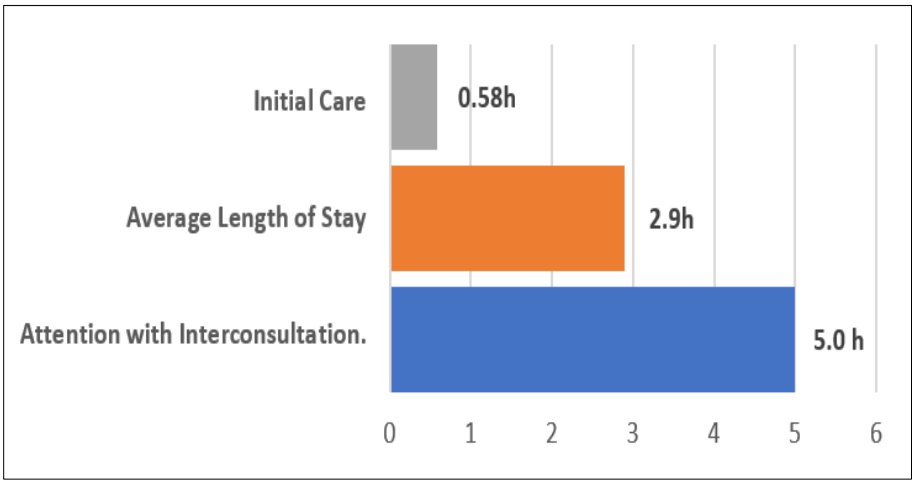

Fig 3 Waiting Time and Stay in Emergency
Source: Prepared by the author based on data from Taype-Huaman, (2009).

- Note: "Waiting and stay times vary depending on the need for interconsultation, with an average stay of 2.9 hours and an initial care time of less than one hour."

The available evidence suggests that the overdemand in emergency services is a multifactorial phenomenon. Various stakeholders identify the coexistence of internal factors, such as the limited availability of hospital beds, with external factors—linked to the seasonality of certain diseases, especially respiratory and gastrointestinal illnesses (Gracia et al., 2021). Added to this scenario is the practice known as bypassing outpatient visits, whereby patients skip outpatient appointments and go directly to the emergency department. According to the reviewed studies, this utilization pattern could represent between 30% and 40% of the visits recorded in these services, contributing significantly to the overload of care and the operational pressure on the system.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr079

➢ *The Clinical Laboratory as the Hub of the Diagnostic Process.*

The impact of the clinical laboratory on emergency care is amplified by the centralization of diagnostic services in most hospitals. In many centers, a single central laboratory processes samples from multiple areas, including the emergency department, inpatient wards, and outpatient clinics. While this model may seem efficient from an administrative perspective, in practice it often leads to bottlenecks, especially when urgent samples must compete with routine analyses within the same workflow.

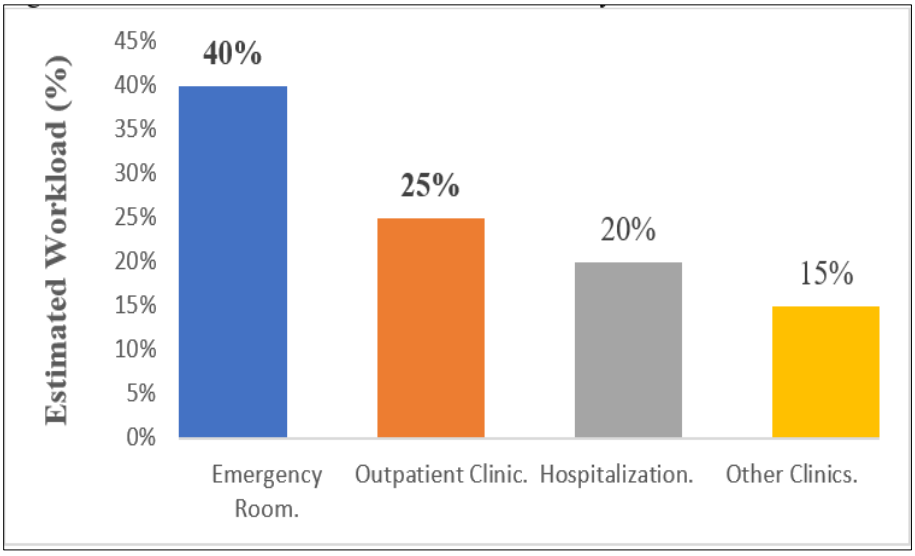

Fig 4 Distribution of Services of the Central Laboratory
Sources: Prepared by the author based on Moraga and Cascante (2011).

- Note: Estimated percentage distribution of the clinical laboratory workload according to the area from which the samples originate.

This situation becomes even more relevant considering that delays in laboratory results can postpone critical clinical decisions. As Salinas M. et al. (2013) point out, when diagnosis depends on laboratory tests, any delay in their processing directly impacts the timeliness of treatment and the patient's flow within the emergency department.

➢ *Vulnerabilities in the Pre-Analytical Phase and Their Implications for Patient Safety*

Within diagnostic processes, the pre-analytical phase of the laboratory is recognized as one of the most vulnerable points, as it encompasses all activities from the test request to the receipt of the sample for analysis. Various studies indicate that approximately 71% of diagnostic process errors occur at this stage (Cubero Cabañas, 2019), making it a critical component from a patient safety perspective. Among the most frequent errors are hemolyzed, clotted, misidentified, or insufficient samples.

The ENEAS study reports that between 25% and 30% of laboratory errors have direct repercussions on patient care, while between 6% and 10% can lead to significant adverse events. Importantly, between 75% and 84% of these incidents are potentially preventable, suggesting that the problem is related more to technological limitations than to organizational processes and staff capabilities.

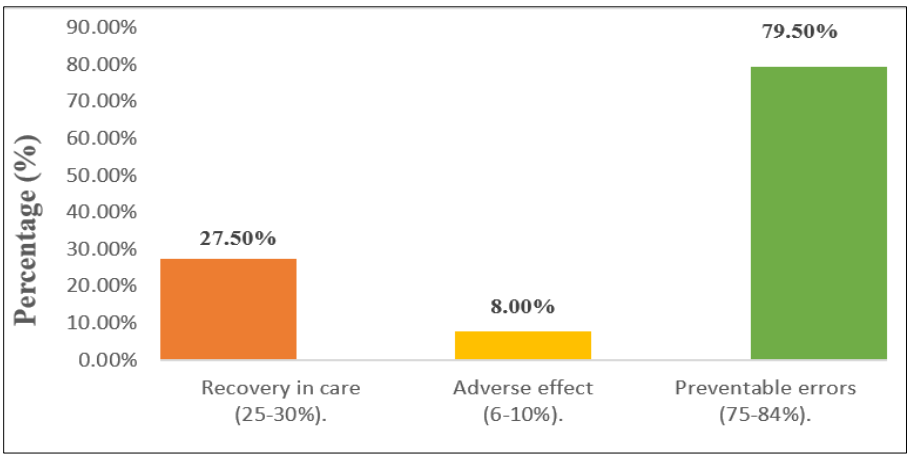

Fig 5 Impact and Prevention of Errors in the Clinical Laboratory (ENEAS Study)
Sources: Prepared by the author using data from the ENEAS study.

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- Note: Representation of clinical laboratory errors.

In the context of emergency services, the incidence of pre-analytical errors tends to increase. Quiroz-Arias (2010) indicates that approximately 37% of rejected samples come from this service, due to factors such as patient volume, high staff turnover, and the involvement of multiple professionals in the sample collection and transport process. These situations affect diagnostic quality, requiring repeat procedures and prolonging hospital stays, also generating patient dissatisfaction (Sánchez-Romero et al., 2019).

The pre-analytical phase of clinical laboratory work accounts for a considerable proportion of errors that occur throughout the diagnostic process, although in many cases these incidents are not documented with the necessary level of detail. In this context, the study conducted by Cubero Cabañas (2019) analyzed the events that occurred in this stage and revealed patterns consistent with those described in another research. The results show that approximately 72% of pre-analytical errors are related to inadequate samples, 22% of incidents correspond to the absence of a sample, and around 5% are associated with labeling errors. Although some of these percentages may seem small, their consequences can be significant for patient safety, especially in high-pressure healthcare settings.

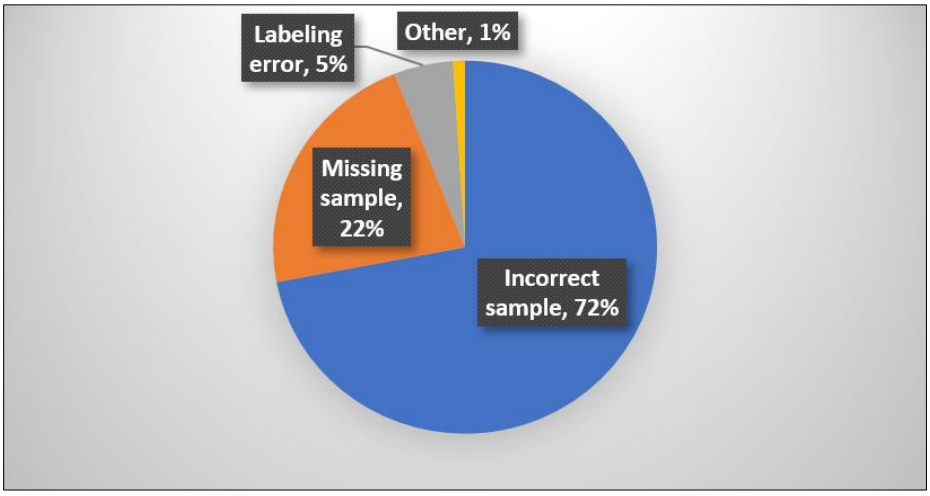

Fig 6 Pre-Analytical Incidence (Data 2019)
Sources: Prepared by the author based on (Cubero Cabañas, 2019)

- Note: Distribution of incident types in the pre-analytical phase of the laboratory.

➢ *Technological Innovation and Automation*

Given the limitations identified in traditional diagnostic processes, automation and technological innovation have been proposed as fundamental strategies for improving the efficiency of clinical laboratories. In this context, Salinas et al. (2011) highlights that technological advances have significantly increased both the productivity and accuracy of analytical processes.

Recent studies support this claim, indicating that the implementation of automated systems generates substantial improvements in various dimensions of service. Specifically, Aquieta Masapanta and Guangasig Toapanta (2024) report that automation can optimize diagnostic quality and accuracy by up to 95%, increase operational efficiency by approximately 90%, and reduce the error rate by approximately 86%. Taken together, these findings demonstrate that the incorporation of diagnostic technologies, coupled with organizational improvements, significantly contributes to strengthening the reliability of results and optimizing clinical laboratory response times.

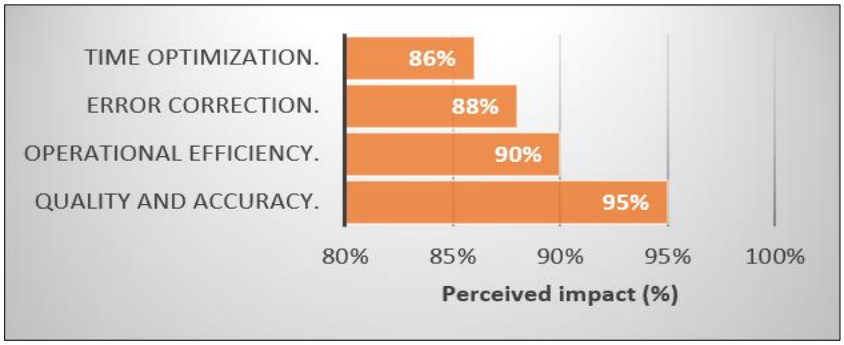

Fig 7 Main Benefit of Technical Development in the Laboratory.
Source: Own elaboration based on Aquieta Masapanta and Guangasig Toapanta (2024).

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr079

- Note. They represent the quantitative benefits of automation in the clinical laboratory.

➢ *Impact of Waiting Time on Patient Satisfaction*

The way patients perceive the care they receive in emergency services is a key indicator for evaluating service quality. In this context, several studies have shown significant discrepancies between actual waiting times and those perceived by users. For example, Fontova-Almató (2015) reports that an actual triage time of approximately 5.9 minutes was perceived by patients as 16.7 minutes, highlighting the influence of emotional and communicative factors on the user experience.

Similarly, García-Alfranca et al. (2018) found that satisfaction in emergency departments is primarily associated with the service's problem-solving capacity (95%) and the speed of care (92%), above other factors such as interpersonal skills or the information received. Taking together, these results indicate that the perception of efficiency plays a determining role in patients' assessment of the quality of care they receive.

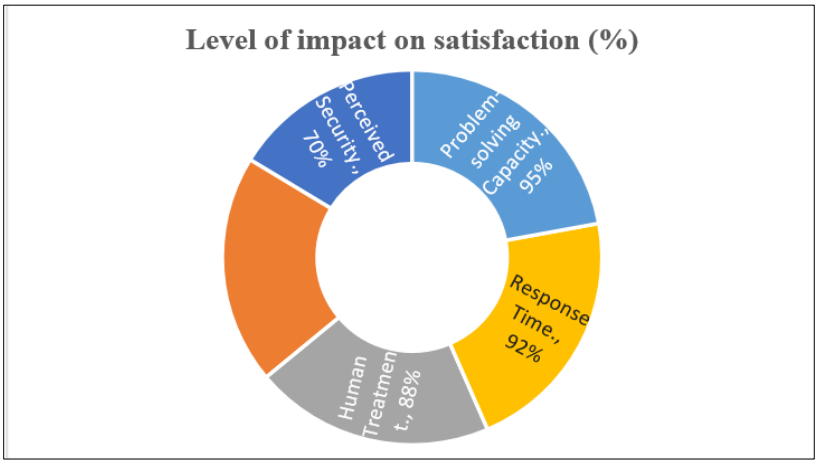

Fig 8 Determining Dimension of Patient Satisfaction.
Source: Prepared by the author based on García-Alfranca et al. (2018).

- Note: Graphical representation of the dimensions evaluated in relation to patient satisfaction.

➢ *Economic Impact of Overutilization of Laboratory Tests*

In the current context, optimizing resource use in hospital emergency services is not an option, but a critical imperative for global health systems. Therefore, the literature also highlights the economic impact associated with the use of laboratory tests. Although direct laboratory costs represent between 3% and 5% of the hospital budget (Gil Ruiz y Martínez Huedo, 2014), various studies estimate that between 25% and 30% of the tests ordered may be unnecessary (Benítez-Arvizu, 2016).

Recent research indicates that many tests are routinely ordered, even when they do not influence clinical decision-making. Jaimes-Pita and García-Morales (2024) observed that tests such as complete blood counts or blood chemistry are ordered for almost all patients admitted to the emergency department, even though in more than 70% of cases the results do not change clinical management.

In this context, strategies such as the standardization of diagnostic protocols, the implementation of rapid point-of-care testing (POCT), and the strengthening of communication between clinicians and laboratory technicians are emerging as a viable alternative to optimize the use of resources without compromising patient safety.

IV. CONCLUSIONS

Analysis of scientific evidence leads to the conclusion that the overcrowding of emergency services is not solely due to the number of patients seeking care, but rather to a combination of factors related to the organization of the system and to availability and management of diagnostic resources. The studies analyzed show that the demand for care varies throughout the day and week, creating periods of peak pressure on services and increasing waiting times and the length of time patients spend in the emergency department.

One of the most relevant findings is the critical role played by the pre-analytical phase of the clinical laboratory, identified as the most vulnerable link in the diagnostic process. A significant proportion of errors associated with sample collection, identification, or transport occur at this stage, which can lead to repeated procedures, delays in diagnosis, and risks to patient safety. This situation is compounded by the high demand for diagnostic tests, some of which are not always based on strictly justified clinical indications, increasing the laboratory's operational workload and healthcare system costs.

Evaluating care in emergency services requires a broader perspective that goes beyond traditional clinical outcomes. Factors such as speed of care and timely availability of diagnostic results are crucial. In this context, implementing strategies aimed at optimizing care processes is essential.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr079

Based on these premises, it is necessary to reconfigure processes to make them more fluid and effective. This includes incorporating automation technology, performing diagnostic tests directly at the point of care, standardizing clinical protocols, and strengthening the ongoing capacity of staff. Together, these actions significantly contribute to improving the efficiency of the diagnostic process, promoting more timely, safe, and patient-centered care.

Taken together, the findings suggest that effective coordination between the clinical laboratory and emergency services, along with the decentralization of the clinical laboratory, are key elements for optimizing care, reducing unnecessary stays, and promoting the rational use of available resources within the healthcare system. Strengthening pre-analytical processes and more efficient management of diagnostic demand also contributes to better workflow organization, reducing inefficiencies, and sustaining more functional care models within high-pressure environments such as emergency departments.

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