ORIGINAL ARTICLE

# Use of laboratory tests in the emergency department of a hospital in Mexico

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## ABSTRACT

**Objective:** To describe the use of laboratory tests by medical staff assigned to the emergency department of a hospital in Mexico. **Materials and methods:** A descriptive cross-sectional study was conducted from March to July 2022 with data from 351 users of an emergency department. A non-probability convenience sampling was used. The sample included medical records of individuals over 18 years of age, of both sexes, who had a laboratory report and received medical attention in the emergency department in the past seven days. Pregnant women, postpartum women and individuals in shock were excluded. The variables collected from the records included sex, age, diagnosis, admission shift, type of emergency, requested analytes, documentation of laboratory report in clinical notes, analysis of laboratory results, and initiation or modification of medical treatment based on the findings. Descriptive statistics were calculated using frequencies and proportions for qualitative variables. **Results:** The most common reason for consultation was abdominal pain, found in 11.96 % of the reviewed medical records. The most frequently requested analytes were complete blood count (98 %), blood chemistry (97 %) and serum electrolytes (88 %). The laboratory results were not documented in the clinical notes in 63.8 % of cases, not analyzed in 68.9 % and not used to guide medical treatment in 72.1 %. This resulted in an unjustified expenditure of 57,529.34 Mexican pesos on laboratory tests. **Conclusions:** In seven out of ten medical records, the laboratory tests did not contribute to initiating or modifying medical treatments. Strategies are needed to promote the appropriate use of analytes, including measures such as supervision, training and feedback, among emergency department medical staff.

**Keywords:** Laboratory Test; Emergencies; Costs and Cost Analysis (Source: MeSH NLM).

## INTRODUCTION

The emergency department serves as a point of entry to the inpatient area of healthcare institutions. It is here that critical decisions are made regarding whether a patient will be discharged or hospitalized. As such, both diagnostic and laboratory tests play a key role in confirming or ruling out potential diagnoses. However, these tests are not always documented, analyzed or adequately considered when determining the medical treatment [1-7]. In recent years, there has been a growing tendency to replace clinical examination with laboratory testing. Factors contributing to this trend include the practice of defensive medicine, efforts to meet patient expectations and the oversaturation of healthcare services [8].

Laboratory testing accounts for approximately 1.4 % to 2.3 % of total healthcare expenditures. Studies estimate that around 20 % of these tests are overused, and the number of analytes ordered often bears no relationship to the severity of the patient's condition. Notably, increased laboratory spending does not equate to higher quality of care. On the contrary, the excessive and inappropriate use of laboratory tests can lead to prolonged emergency department stay, increased risk of complications and higher overall costs for the healthcare system [9-11].

Three main stakeholders influence laboratory test utilization: patients, physicians and the healthcare system. Patient expectations often lead them to request laboratory tests—encouraged by information from websites or relatives—and to pressure healthcare professionals into ordering unwarranted tests, eventually prompting them to give in to persistent demands. On the other hand, when physicians fail to conduct a thorough medical

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history and physical examination, they may be inclined to order laboratory tests without sufficient clinical justification. In teaching hospitals, where medical specialization programs are offered, students may not be closely supervised by teaching physicians, and laboratory tests are sometimes used indiscriminately, akin to following a "recipe," without adequate clinical reasoning. Moreover, the automation and widespread availability of laboratory tests contribute to their overuse, often resulting in repeated testing across different departments, regardless of previously available results. Overcrowding in emergency departments can also burden healthcare providers, prompting them to repeat tests at each shift or stage of care [12-17].

Despite these issues, few studies in the literature have explored what actually happens once laboratory results are received by clinicians. According to the *Norma Oficial Mexicana, Del expediente clínico* (Mexican Official Standard: Medical Records), diagnostic support services must be documented, analyzed by the attending physician and used in clinical decision-making [6,18].

This study aimed to describe the use of analytes in the initial assessment area of the emergency department at a regional general hospital.

## MATERIALS AND METHODS

### *Study design and population*

This study employed a quantitative, descriptive and cross-sectional design. It included 351 medical records from patients seen in the initial assessment area of the emergency department at a regional general hospital in the State of Guerrero, Mexico. At the time of data collection, the hospital had 331 registered beds, with an occupancy rate of 87 % and an average length of stay of 6.39 days per patient. An additional 145 non-registered beds were available, including 39 in the emergency department, which had a capacity utilization rate of 100.3 % and an emergency visit rate of 112.58 per 1,000 beneficiaries in this second-level healthcare facility.

A non-probability convenience sampling method was used. The sample size was calculated based on a population of 383,354, with a probability of 0.05, a 95 % confidence level and a 5 % margin of error. Data were gathered between March and July 2022. The sample included medical records of patients aged 18 to 65 years, of both sexes, who had a laboratory report and received medical attention in the emergency department in the past seven days. Pregnant women, postpartum women and individuals in shock were excluded.

### *Variables and measurements*

The Área de Informática Médica y Archivo Clínico (ARIMAC – Health Information and Medical Records Department) reviewed the medical records of individuals who received emergency medical attention. From the admission notes, the following variables were collected: sex, age, diagnosis and type of emergency, classified according to the Manchester Triage System. Records in which laboratory tests were requested upon admission were selected. The ordered analytes were extracted from the laboratory reports. Each medical record was examined to determine whether abnormal laboratory results were documented in the clinical notes, whether they were analyzed, and whether they led to the initiation or modification of medical treatment. Subsequently, the cost of the requested analytes was calculated based on the unit cost according to the level of medical care.

The data collection instrument was developed by consensus and reviewed by a multidisciplinary team. A pilot test was conducted using ten records to validate the tool. The three physicians responsible for data collection verified the proper selection of medical records and the accurate extraction of the variables listed in the form.

### *Statistical analysis*

Data were gathered using a data collection instrument. The information was first entered into an Excel spreadsheet and subsequently exported to IBM SPSS Statistics 25 for analysis. In this program, descriptive statistics were conducted: frequencies and proportions were calculated for qualitative variables, while measures of central tendency and dispersion were used to summarize quantitative variables.

### *Ethical considerations*

This research posed no risk to patients, as it involved no deliberate intervention or modification of their physiological, psychological or social conditions. All data were obtained from the retrospective review of medical records. The study did not include vulnerable populations, such as minors, pregnant women, individuals over 65 or people lacking decision-making capacity.

To safeguard patient confidentiality, no identifiable information—such as names or social security numbers—was collected.

The study was conducted with the prior approval of a local health research committee and a local research ethics committee in the State of Guerrero, Mexico. It was also authorized by the Comisión Nacional de Bioética (CONBIOÉTICA – National Bioethics Commission).

## RESULTS

Altogether, 351 medical records from emergency department users were analyzed. Of these, 96.9 % (340/351) were classified as yellow-category emergencies, while 3.1 % (11/351) were categorized as green (non-urgent) cases. Women represented 57.3 % (201/351) of the cases; the remaining 42.7 % (150/351) were men. The mean age of the patients was 48 ± 13 years. Participants were distributed across age groups as follows: 15.4 % were aged 18–30 years, 12.8 % were 31–40 years, 24.2 % were 41–50 years, 24.0 % were 51–60 years and 23.6 % were 61–65 years.

A total of 5,731 analytes were requested for these 351 patients over the five-month study period, averaging 16 analytes per patient at the time of emergency department admission. The total cost of laboratory tests amounted to 77,678.76 Mexican pesos (MXN), with a mean cost of MXN 221 per patient. The most frequently requested tests included complete blood count in 98 % (344/351), blood chemistry in 97.4 % (342/351) and serum electrolytes in 88 % (309/351). The most frequently repeated tests included blood chemistry, liver function tests and serum electrolytes, with blood chemistry being performed up to five times in a single patient (Table 1).

**Table 1.** Expenditure associated with laboratory testing in the emergency department's initial assessment area

| Analyte | Number of tests performed on 351 users | Unit cost (MXN) | Total cost (MXN) |
|---|---|---|---|
| Complete blood count | 348 | 18.21 | 6,337.08 |
| Blood chemistry | 1,735 | 41.78 | 14,497.66 |
| Serum electrolytes | 948 | 25.43 | 8,035.88 |
| Liver function test | 1,528 | 67.45 | 12,882.95 |
| Urinalysis | 179 | 10.44 | 1,868.76 |
| Clotting time | 340 | 50.90 | 8,653.00 |
| Arterial blood gas test | 122 | 77.02 | 9,396.44 |
| Muscle enzymes | 160 | 155.89 | 6,235.60 |
| Amylase | 38 | 8.41 | 319.58 |
| Lipase | 38 | 8.42 | 319.96 |
| Urine culture | 12 | 231.16 | 2,773.92 |
| Blood culture | 9 | 231.16 | 2,080.44 |
| Total | 5,731 | - | 77,678.76 |

A wide range of admission diagnoses were recorded at the emergency department's initial assessment area. Table 2 lists the ten most frequently documented. Review of the medical notes revealed that symptoms were often recorded as the primary diagnosis, with no presumptive diagnosis included. For instance, abdominal pain was reported as the final diagnosis in 42 cases.

**Table 2.** Ten most frequent diagnoses in the emergency department's initial assessment area

| No. | Admission diagnosis | Frequency | Percentage |
|---|---|---|---|
| 1 | Abdominal pain | 42 | 11.96 |
| 2 | Cholecystitis | 30 | 8.54 |
| 3 | Diabetic foot | 17 | 4.84 |
| 4 | Dyspnea | 14 | 3.98 |
| 5 | Appendicitis | 13 | 3.70 |
| 6 | Fractures | 11 | 3.13 |
| 7 | Traumatic brain injury | 10 | 2.84 |
| 8 | Pneumonia | 9 | 2.56 |
| 9 | Pelvic cellulitis | 9 | 2.56 |
| 10 | Hemolytic-uremic syndrome | 7 | 1.99 |

Review of the medical records revealed that in three out of ten cases, laboratory results were documented in the clinical notes; in another three, they were analyzed; and in the remaining four, they were used to guide medical treatment. Only 25.9 % (91/351) of the cases met all three criteria (documentation of laboratory report in clinical notes, analysis of laboratory results and modification of medical treatment), thus justifying the use of such records. These justified cases accounted for a cost of MXN 20,149.42 (Table 3).

**Table 3.** Laboratory test-related parameters assessed in medical records

| Parameter | Yes % (*n*) | No % (*n*) |
|---|---|---|
| Documentation of laboratory report in clinical notes | 36.3 (127/351) | 63.8 (224/351) |
| Analysis of laboratory results | 31.1 (109/351) | 68.9 (242/351) |
| Modification of medical treatment | 27.9 (98/351) | 72.1 (253/351) |
| All three criteria met | 25.9 (91/351) | 74.1 (260/351) |
| Total cost in MXN | 20,149.42 | 57,529.34 |

## DISCUSSION

In the initial assessment area of the emergency department at a regional general hospital, an average of 16 laboratory tests were ordered per patient, at a mean cost of MXN 221 per person. The three most frequent admission diagnoses were abdominal pain, cholecystitis and diabetic foot. The most commonly requested tests were blood chemistry, liver function tests and serum electrolytes. All three criteria (documentation of laboratory report in clinical notes, analysis of laboratory results and modification of medical treatment) were fulfilled in 25.9 % of the medical records. Several studies have reported that blood chemistry analytes rank among the most frequently ordered tests, which is consistent with the findings of this study. In Cuba, León Ramentol et al. identified blood chemistry as the second most frequently requested test, after complete blood count [19]. Similarly, Carbajales et al. reported that blood glucose, a component of blood chemistry, was the second most requested analyte in a Cuban hospital [20]. A 2012 study conducted at the national level in Mexico by the Instituto Mexicano del Seguro Social (IMSS – Mexican Social Security Institute) identified the ten most commonly analyzed laboratory tests as: glucose, complete blood count, creatinine, urea, urinalysis, cholesterol, triglycerides, uric acid, prothrombin time and partial thromboplastin time—six of which are included in blood chemistry [16]. Blood chemistry is frequently requested in the emergency department, as many patients present with chronic comorbidities in addition to the acute condition prompting the visit, making an assessment of their metabolic status essential prior to initiating treatment.

Among the reasons for consultations, Fernández-Cantón reported that the main presenting complaints at IMSS emergency departments included acute respiratory infections, trauma, poisoning and gastrointestinal infections [21]. In Peru, a study found that the most frequent reasons for consultation at emergency departments were upper respiratory tract symptoms, abdominal pain, diarrhea, vertigo and urinary symptoms [22]. In the private sector, emergency consultations were most often related to the digestive system, followed by respiratory and cardiovascular conditions [23]. In these studies, respiratory infections or symptoms ranked among the top three reasons for consultation, whereas in the present study, dyspnea ranked fourth. This discrepancy may be explained by the COVID-19 contingency period during which the study was conducted. Stay-at-home order likely reduced the incidence of trauma cases, and respiratory emergencies were diverted to specialized triage areas, meaning they were not captured in the emergency department's initial assessment records.

Laboratory testing is a valuable tool in clinical decision-making. However, determining whether tests are used appropriately is a key concern. Some studies have sought to identify the appropriate use of laboratory and imaging tests across different healthcare settings. Appropriateness is generally defined as adherence to guidelines established by healthcare institutions or medical associations [24-26]. Another definition relates to the clinical rationale for ordering the test, the diagnostic hypothesis and its application in medical treatment [27]. Appropriate use of laboratory tests involves providing a clinical benefit to the patient; deviations from this may result in underuse or overuse, potentially causing harm to healthcare service users [28].

A systematic review of studies published between 1997 and 2012 reported average rates of analytes overuse and underuse of 20.6 % and 44.8 %, respectively, both considered forms of inappropriate test utilization [9]. In Qatar, Alshekhabobakr et al. found that 50 % of laboratory tests were overused, 35.7 % misused and 14.3 % underused [29]. Kilpatrick reported that 45 % of laboratory test results requested in emergency departments were never reviewed [30]. While the present study did not aim to quantify underuse or overuse directly, it focused on the post-analytical phase, specifically whether the test results were documented, analyzed and used to guide medical treatment. Omitting any of these steps can be considered inappropriate,

as laboratory test results are intended to inform and support actions that improve clinical outcomes.

The strength of this study lies in its examination of how laboratory reports are documented in clinical notes, how results are analyzed and how they are used in clinical decision-making within the emergency department at a regional general hospital. The study found that 27.9 % of tests led to modifications in medical treatment, suggesting that the remaining tests may have been used inappropriately.

However, the study also had several limitations. First, the lack of a precise definition of eligible diagnoses led to a wide and heterogeneous classification of conditions. Second, in the case of blood chemistry, all analytes were considered as a whole. Future research should assess each analyte separately, rather than evaluating the entire test panel as grouped in the request form. The same applies to serum electrolytes, liver function tests and the lipid profile. Third, variables related to medical staff characteristics—such as years of experience, training status, presence of burnout and participation in continuing education—were not evaluated. Likewise, patient-specific factors, such as history of hospitalization, chronic diseases and perceptions of laboratory testing, were not included. Finally, the study did not follow up on whether admission diagnoses matched discharge diagnoses, which would have helped determine the extent of true versus perceived urgency. Further research is recommended to include the variables not addressed in the present study. In addition to identifying the post-analytical phase of the documentation of laboratory report in clinical notes, analysis of laboratory results and modification of medical treatment based on laboratory test results, future studies should also explore the associated factors that influence these practices among healthcare providers, which may contribute to work overload in emergency departments.

In conclusion, in the emergency department's initial assessment area, only three out of ten patients had their laboratory test results appropriately used. Additionally, two-thirds of the associated costs were unjustified, as attending physicians did not use the results in clinical decision-making.

Further research is needed to identify the underlying causes of inappropriate test use and to develop interventions—such as supervision, training and feedback of healthcare personnel—to encourage more effective utilization of laboratory tests for clinical decision-making in emergency settings.

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