Nursing Management in Blood Sample Collection. Organization, Preanalytical Phase, and Quality of Care (English Version)
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Diagnostic quality and the preanalytical phase in nursing practice

Calidad diagnóstica y fase preanalítica en la práctica enfermera

Clinical analysis laboratory

Diagnostic tests are tools to aid in clinical decision-making. Their use is considered adequate or appropriate if the result answers the question that the clinician had asked before requesting the test and, at the same time, if it helps them decide on a therapeutic action that benefits the patient. Therefore, requesting tests that provide little or no information for clinical decision-making or omitting others whose results would be relevant to the process in question is considered inappropriate use.[9]

Venous blood collection is one of the most frequent nursing interventions in emergency departments, as is a conclusive diagnostic test for establishing a clinical judgment.[10]

A diagnostic test is a tool to aid in clinical decision-making and should only be requested if its results will be useful to healthcare professionals and enable them to decide on a course of treatment. With this premise in mind, strategies must be developed to improve the use of the laboratory. In this context, some strategies used over the years have proven to be effective, such as the redesign of request forms, the training of clinicians, and demand guided by evidence-based medicine (EBM) protocols developed by consensus among clinical and laboratory professionals.[9,11]

One of the main purposes of laboratory test results is to reduce the doubts that arise in medical reasoning as a result of the clinical history and physical examination.[12] For the clinical laboratory to adequately serve this purpose, all phases of patient care must be carried out in accordance with the highest principles of technical correctness, taking into account the existence and importance of various biological variables that significantly influence the final quality of the work.

The contributions of the laboratory, alongside unstoppable technological development, continue to be of extraordinary value to the medical sciences. In general, during the application of the clinical method to the diagnostic process, especially from the hypothesis testing stages onward, the clinical laboratory skills that have been developed by physicians are key in supporting the achievement of accurate and timely diagnoses.[13]

The most important thing is for nursing staff to be aware of the stages a blood sample goes through from the moment the patient arrives at the healthcare center until the final results of a blood test are recorded in the patient's medical record. Importantly, both nursing and medical practices in relation to the preanalytical phase influence the laboratory and, as a whole, determine the achievement of a rapid, effective, reliable (accurate and precise), and efficient diagnosis.[14]

Nursing care process for blood sampling

The days when nursing, on the basis of paradigmatic models, was dedicated to performing more or less precise routines have given way to more profound practices in the profession. The holistic approach to the specialty, supported by the nursing care process (NCP) and scientific

research methods, points toward a detailed understanding of all the processes involved and ensures that actions are taken in a conscious manner.[15]

The practice of medicine today relies heavily on laboratory tests to confirm or refute clinical hypotheses, and often, the course of treatment and the patient's progress depend on the results of these tests.[15,16]

In this process, the physician is responsible for knowing the available tests and ordering them as appropriate, and the laboratory technician, supported by their knowledge, is responsible for rigorously using the technical and material resources that guarantee fast and reliable results. Moreover, nursing staff, who are responsible for taking samples, must also be familiar with the characteristics and requirements of each test to ensure that they arrive at the laboratory in a timely manner and in good condition.[15]

Any failure in the process involves risks for the patient and can lead to unpredictable difficulties, which are difficult to address owing to their diversity. Therefore, in the interest of providing excellent care, the authors set out to assess the effectiveness of nursing work in sample collection.[15,17]

Nursing actions are versatile, highly flexible, and multidisciplinary in nature. We are asked to develop critical thinking and analytical skills and to consider the elements of globalization that affect health systems. We are also required to have a very high level of technical competence while maintaining a high degree of sensitivity in our treatment of individuals in health and illness situations. In this scenario, the conditions of professional practice tend to change daily not only because of the effects of technological development and computerized communication systems but also because of the impact of changes in the epidemiological landscape.

However, beyond the diversity and change that nurses face in health care and in the professional practice of nursing, care is the raison d'être of the profession and constitutes the driving force behind our work and, therefore, our focus of attention and object of study in nursing as a professional discipline.[18]

Nursing staff must ensure patient identification, perform correct blood collection, and use appropriate containers to avoid possible analytical rejections, achieving the highest possible quality in the results.[14]

Nursing staff need to know how to approach and perform these tasks, which means that they must have knowledge of the process and the characteristics that a patient must have before performing any type of test, such as fasting, to subsequently identify the considerations that need to be taken into account at the time of the procedure itself, i.e., how the sample is taken for each of the tests and, finally, what the process is for its transfer.

Blood collection process by the nursing staff[12]

1. Introduce yourself, confirm the patient's identity, and explain the procedure.
2. Check that the necessary conditions (physical and mental) are met before performing venipuncture.
3. Position the patient comfortably (sitting or lying down) with their arm extended on a flat surface so that their hand is lower than their elbow.
4. Sanitize, wash your hands, and put on gloves.
5. All the necessary equipment should be prepared, and the room with only the

necessary tubes and spare tubes should be entered.

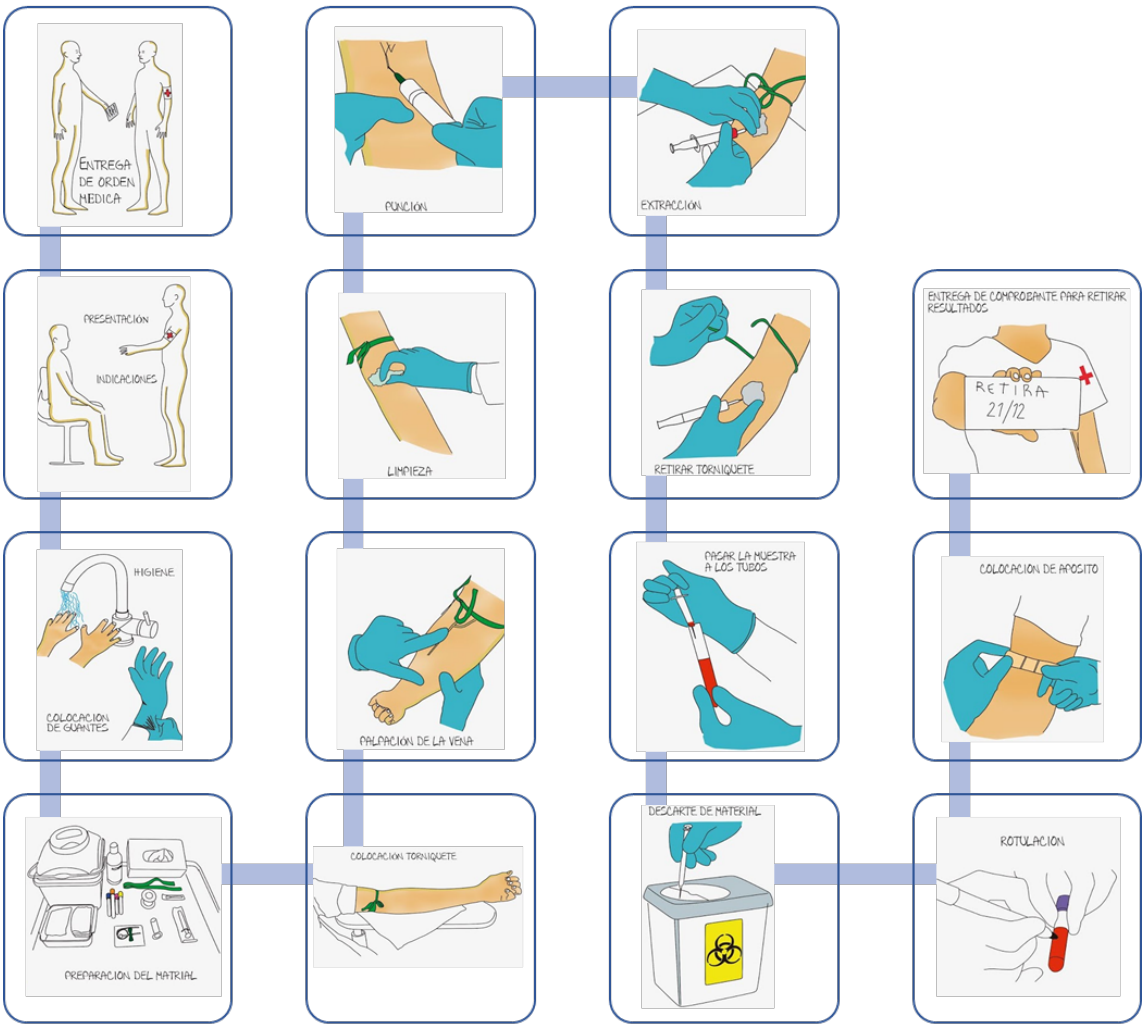
6. The vein was selected considering its condition, the amount of blood needed, and the patient's age.
7. The vein was palpated to determine its depth, caliber, elasticity, etc.
8. The area was disinfected with chlorhexidine in a 2 % aqueous or alcoholic solution, a 0,5 % alcoholic solution, or 70 % alcohol via circular movements.
9. Hand hygiene was performed, and clean, nonsterile gloves were used.
10. If necessary, the compressor was placed 8–10 cm above the chosen site.
11. To make the veins more prominent, heat can be applied with a cloth or hot water, or the area can be massaged in the opposite direction to the venous flow.
12. The needle or butterfly needle is placed in the syringe or adapter.
13. Hold the vein with your nondominant hand.
14. The needle was inserted into the vein with the bevel facing upward, in the opposite direction to the blood flow, at an angle of 20°-30°.
15. After two unsuccessful attempts, an experienced colleague was asked to take the sample.
16. If a syringe is used, the blood at the connection between the needle and the syringe should be checked, and the required amount of blood should be drawn gently.
17. If a vacuum blood collection system is used, the needle and adapter are stabilized with one hand and pressed with the thumb and index finger of the other hand to pierce the tube. The flow of blood through the tube and the amount needed for the test were checked.
18. Once the tubes were full, they were gently shaken 4–6 times.
19. The compressor was released before the needle was removed from the vein, and a dressing was applied to the puncture site. The needle was gently removed without twisting it.
20. Once the needle has been removed, moderate pressure is applied to the dressing (5 to 10 minutes), or the patient is asked to do so, keeping the arm straight and never bent. If necessary, a strip of adhesive tape was applied.
21. The contaminated material was disposed of in appropriate containers, the gloves were removed, and the hands were washed.
22. The samples were sent to the laboratory and clearly identified with the codes corresponding to the request.

Figure 1 shows the step-by-step procedure for blood collection by the nursing staff in a process diagram.

Phases of the blood sample analysis process

The phases involved in this analytical process are as follows:

- Preanalytical phase: this phase includes all processes from the clinician's request for analysis to sample processing.
- Analytical phase: this phase covers all procedures directly related to sample processing.
- Postanalytical phase: this phase is based on the validation of results and the preparation and issuance of the report by the laboratory.



Source: http://www.areasaludplasencia.es/wasp/pdfs/7/711092.pdf
Figure 1. Blood collection process

Laboratory results are estimated to affect up to 70 % of medical diagnoses, thus impacting the course of treatment and prognosis of patients. Therefore, excellent quality control is necessary throughout the laboratory process to ensure that the results released to the clinician are reliable and accurate. There are accreditation models such as the ISO 9000 series that ensure quality in production, installation, and process service, which include a number of clauses that provide guidance for the implementation of quality systems. The clinical laboratory is a type of service where an ISO standard can be applied.[19,20,21,22]

An adverse event can be defined as a defect or error that can occur at any stage of the laboratory process. Historically, adverse laboratory events have been classified according to their cause, stage of the test at which they occur, responsibility, and impact on the patient.[20,21,22]

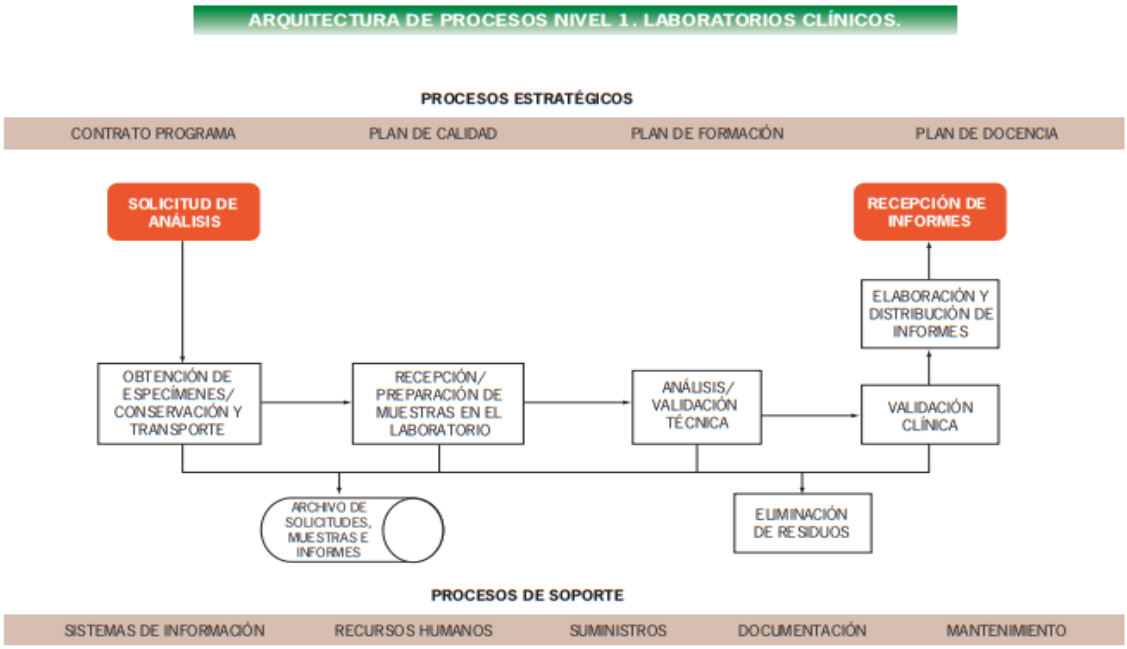


Figure 2. Phases of the Analytical Process

It has been shown that most incidents occur in the preanalytical and postanalytical phases due to the limited control that the laboratory still has over these phases.[20,23,24]

Although almost 70 % do not affect patients, 19 % are associated with unjustified costs, and 6,3 % result in inappropriate therapy. The importance of quality management and error reduction has always been recognized in laboratory management, with the aim of reducing adverse events in patients.[20,21]

Efforts to reduce errors have been guided by regulatory requirements from various accrediting agencies. The Clinical Laboratory Improvement Amendments of 1988 (CLIA 1988), the Joint Commission (JC), and the College of American Pathologists (CAP) have developed standards for clinical laboratories, such as quality controls, efficiency programs, and periodic inspections. Professional laboratory organizations such as the Clinical and Laboratory Standards Institute and the International Organization for Standardization have also developed guidelines that positively influence the quality of clinical laboratories.[20,21,22,25]

The importance given to the preanalytical phase is by no means arbitrary; for example, it includes errors due to inappropriate medical requests, errors due to nursing malpractice in blood collection, errors due to poor patient identification, and errors due to poor transport and storage of samples, which will result not only in a high percentage of errors but also in a loss of reliability in the results obtained, with a greater economic impact, since repeating the venipuncture will require the reuse of resources, both those related to the extraction and those specific to the laboratory, and, in general, will result in a longer hospital stay, not to mention the significance that an erroneous result, or a result assigned to the wrong patient, can have on diagnoses, treatments, or care decisions.[14,24,26,27]

Most frequent preanalytical errors due to direct nursing action

In the field of patient safety, an error is understood to be the failure to carry out an action as planned or an action carried out with incorrect planning. In the preanalytical process, there is a wide variety of errors covering several areas, including those related to the request for analysis sanguíneo, i.e., that it is inadequate or incorrectly performed, lost, or misidentified.[14]

Misidentification is a very serious error that jeopardizes patient safety, but it is a part of the circuit where it is easy to detect risks and reduce the incidence rate, a point at which nursing action is key.[14]

Other important errors are related to sample collection, which will be the focus of the empirical study of the work, since it is the full responsibility of the nurse to carry out these procedures, avoiding sample rejections by the laboratory and harm to the patient.[27,28]

Among these incidents related to sample collection, we can list the following:

1) Insufficient sample quantity.
2) The presence of blood clots due to not mixing well with the anticoagulant in the container.
3) Blood is obtained from a heparinized peripheral line, with saline solution, or from a line through which medication or any other type of fluid is being administered.[14,29]

Insufficient sample-poor clotting[14,30]

We refer to an insufficient sample when the blood collection has not been successfully completed, i.e., the exact amount of blood that should be in the tube is less than the required volume, and it is impossible to perform all the requested analytical parameters.

Laboratory analyzers are linked to the volume of blood because each biological parameter requested requires a minimum amount for analysis. Therefore, if this volume is lower, the analyzer will have problems and will be unable to complete the analysis correctly, and the results obtained will either not be available or will not be accurate.

These rules must be followed for coagulation tests since the amount of anticoagulant used in relation to blood is 1 part anticoagulant for every 9 parts of whole blood.

If this ratio is changed and the volume is insufficient, coagulation times will be prolonged because the blood will be more diluted than the technique specifies, thus creating another preanalytical error called poor clotting.

This error is particularly important because, if an (erroneous) result is obtained from the analyzer, it can have an adverse effect on the patient if it goes unnoticed or if another blood sample has to be taken, with all that this entails, if it is detected.

If the extraction involves only a single sample for coagulation, the ideal procedure would be to first purge the cannula of the butterfly needle (or extraction system) with a tube that will be discarded prior to filling the coagulation container to ensure proper filling and thus avoid vacuum errors.

Coagulated sample[14,31]

With respect to blood collection and subsequent analysis, when blood is removed from a biological system and transferred to an *in vitro* system, stress is produced that triggers the

activation of the coagulation cascade and platelet aggregation. Furthermore, this process is accentuated when the blood comes into contact with negatively charged h and surfaces, such as those found in the tubes used to collect these samples.

In certain tests, this is necessary, such as in samples for biochemistry, so the tube does not contain any anticoagulant and is called a dry or serum tube. Its wall contains silica particles that activate coagulation and an inert separating gel at the base of the tube, which, after centrifugation, forms a stable barrier between the serum (the liquid component of blood free of coagulation components) and the blood clot (hematocrit or cellular component of blood).

A coagulated sample is one that shows partial clotting or total coagulation and is extracted in a tube with anticoagulant. This may be due to slow extraction, incorrect mixing of the anticoagulant with the sample, or a defect in the anticoagulant itself. There are tests, such as complete blood counts and coagulation tests, whose results are altered when this problem occurs.

Transfer an EDTA-K tube to a serum tube[14,30,31,32]

Importantly, under no circumstances should blood be transferred from one tube to another when different anticoagulants are used, as the composition and conditions of the sample will be irreversibly altered depending on the containers with which it comes into contact.

When blood for a biochemical study is mistakenly drawn into a tube containing EDTA-K, calcium binds to the EDTA, and potassium is released into the medium, as the former has a greater affinity for EDTA than does the latter. Thus, the calcium content decreases, and the potassium content increases[25] according to the analytical results, even if the blood is subsequently transferred from the EDTA-K tube to the dry biochemistry tube.

Similarly, when blood containing EDTA-K is transferred to a tube with citrate, coagulation parameters such as fibrinogen, thromboplastin time, and activated partial thromboplastin time are significantly prolonged.

The following order is recommended:[33]

1. Blood cultures are performed first anaerobically and then aerobically.
2. Sodium citrate tubes were used for coagulation.
3. The tube was dried for biochemical tests.
4. An EDTA tube was used for blood count.
5. Blood gas tests and additional tubes.

Hemolysis[12]

Hemolysis is defined as the release of intracellular constituents into plasma or serum when blood cells rupture, which can interfere with the results of some analytes. It is generally characterized by the red coloration of serum or plasma after centrifugation or sedimentation, caused by hemoglobin released during the rupture of erythrocytes. Thus, interference can also occur at low hemoglobin concentrations, which are invisible to the naked eye.

Hemolysis does not always affect hematocrit breakdown, as interfering factors can also arise from the lysis of platelets and granulocytes, which can occur, for example, when blood is stored at low temperatures and does not freeze.

Good practices prior to extraction to prevent hemolysis:

- The alcohol was allowed to dry before the puncture was started.
- The use of smaller-gauge needles was avoided. This type of material is used only when the patient's vein is thin or in special cases.
- Blood drawn from an area with a hematoma was avoided.
- For vacuum draws, the patient's vein was punctured with the bevel facing up. The vein was pierced with the needle at an oblique angle of insertion of 30 degrees or less. This prevents the blood from hitting the tube wall hard, causing hemolysis of the sample, and prevents blood from flowing back from the tube into the patient's vein.
- In tubes with insufficient or excessive blood volume, the correct blood/additive ratio can be altered, resulting in hemolysis and incorrect results.
- When a syringe and needle are used for blood collection, it is necessary to ensure that the needle is properly attached to the syringe to prevent foaming.
- Do not pull the syringe plunger too hard.
- Even when a syringe is used, the needle should be removed, and the blood should be carefully slid down the wall of the tube, avoiding contamination of the tip of the syringe with the anticoagulant or clot activator contained in the tube.
- Do not stick the needle into the plastic cap of the tube to transfer the blood from the syringe to the tube, as this could create positive pressure, which, in addition to hemolysis, could displace the tube cap, causing the equipment to break.

Hemodilution of the sample[14]

Samples are referred to as hemodiluted when blood has been drawn from a peripheral line or any type of catheter or from a vessel adjacent to a line. In this process, the sample is diluted with the fluids used in the perfusion of serum (glucose/saline) or medications for the treatment of the patient.

This will influence the results, underestimating any analytical parameter due to dilution or overestimating specific parameters such as glucose in the case of interference with a glucose serum.

In these cases, blood should be drawn from the opposite arm to the one where the intravenous infusion is being administered, avoiding any extraction point from that vein. It is also necessary to know that if the extraction is not going to be performed directly from the vein and if a catheter is going to be chosen, the infusion must be stopped at least 15 minutes before and at the time of blood extraction, and the exact milliliters that are going to be introduced into the tube must be discarded.

Blood culture contamination[14,34,35]

Blood cultures are used to detect possible bacteremia in patients, allowing the etiology of the infection and the sensitivity of the microorganism to various antibiotics to be determined.

For this reason, they are very important tests for diagnosis, and the nursing staff in charge of the extraction must ensure a correct process, with the maximum possible asepsis, to increase diagnostic sensitivity and avoid contamination that would lead to false positives, increasing the patient's hospital stay and unnecessary resources and treatments.

The following should be taken into account when performing this technique:

- The sterile technique involves the use of sterile gloves and maintaining asepsis at all times.

- The area and blood culture bottles were disinfected with chlorhexidine.
- The anaerobic bottle was inoculated first, followed by the aerobic bottle, with 5 ml.
- This technique must be performed when the patient's fever is at its peak.
- Samples should preferably be taken before antibiotic treatment.

Possible sources of error in this preanalytical phase involving nursing staff are shown in figure 3.

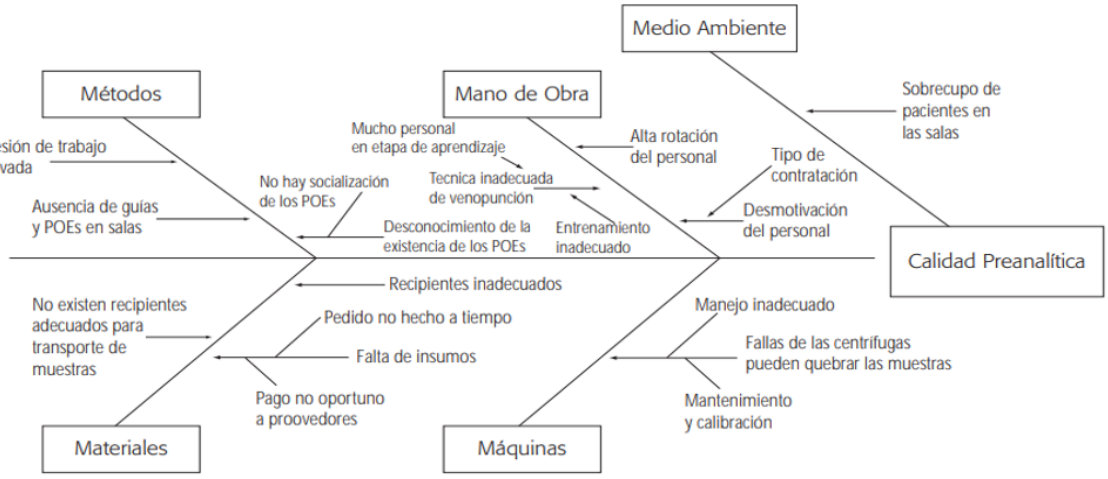


Figure 3. Possible sources of preanalytical errors

Consequences of preanalytical errors. A nursing management approach

Preanalytical errors are the most common. Various studies estimate their frequency to be between 17 % and 75 %, with some authors even finding a rate of 84 %. Because many different factors come into play in the preanalytical phase, these differences can be explained by different evaluation criteria or by an increase in the variables in the study. However, the errors most frequently described in the literature are those related to the quality of the sample received in the laboratory: hemolyzed, lipemic, insufficient, incorrect, or coagulated samples. Two stages can be distinguished in the preanalytical phase: the first outside the laboratory and the second inside the laboratory. The errors that can occur vary in significance and are difficult to measure, as some become apparent in the analytical phase and others are not evident.[33]

Currently, public and private sector organizations are immersed in a completely globalized world that demands high levels of competitiveness. In this environment, the quality of health services constitutes a strategy for differentiation and excellence, reflected in a greater number of users and patients.[36,37,38]

Success is further guaranteed if all institutions adopt standards that serve as a frame of reference associated with international quality standards supported and accepted by principles of proven effectiveness.[38]

In this context, every healthcare institution dedicated to service must ensure, through continuous improvement, that its service meets the expectations and needs of its customers or users. To meet this requirement, quality management must be enhanced by developing a series of planned actions aimed at management, policies, strategies, and resource and people

management and must orient all of the organization's processes toward the user, thereby achieving a positive impact on society.[38,39]

In the health sector, quality and efficiency are essential requirements for maintaining a competitive environment from a social, labor, and technological point of view. With the reform of healthcare processes currently underway in most Latin American countries, users' perceptions of healthcare services have been considered an important aspect in the formulation of social policies and, in particular, public health policies, accepting that a higher degree of satisfaction, associated with perceptions of higher quality, is a desirable social outcome for hospital management.[38,40]

Within healthcare institutions, public healthcare laboratories generate products and services for patients, the community, their own staff, healthcare institutions and authorities, and other companies. Therefore, health and safety requirements, as well as legal requirements and market laws, oblige them to incorporate the concept of quality into their daily routines.[38,40]

State of the art

The most relevant results of some research related to the research problem under study are mentioned below: a thesis presented by Jessica Domínguez García at the Pontifical University of Comillas, developed at the Infanta Cristina Hospital in Parla, reported a 7,6 % preanalytical error rate in 2017. Nursing staff are responsible for blood collection and for these errors, and it is where the intervention will be carried out, with the aim of reducing these errors within a year. This research analyzed actual data from Infanta Cristina Hospital and obtained the following error rates: insufficient samples for the requested tests, 3,2 %; coagulated samples, including hematology, coagulation, and blood gas analysis, 6,5 %; poorly leveled samples for coagulation, 8,8 %; probable transfer from EDTA tubes to serum tubes, 0,2 %; probable hemodilution of the sample, 0,9 %; and contaminated blood cultures, 7,67 %.[14]

The article "Minimization of preanalytical errors and their impact on clinical laboratory control" published in the Revista del Laboratorio Clínico (Clinical Laboratory Journal) states that errors occurring in clinical laboratories have been studied for a long time and are currently a very important part of quality management systems within the framework of patient safety culture. In recent years, we have relied on technological and computer advances in the field of diagnostics to minimize errors in the clinical laboratory. The great management capacity of laboratory computer systems, together with the trend toward concentrating much of the routine work in a central laboratory, or corelab, means that today's laboratories are prepared for increasing test requests, minimizing the errors associated with handling a high volume of samples. Within the classification of errors according to the phase in which they occur, analytical errors have decreased the most owing to automation, whereas errors in the pre- and postanalytical phases are more difficult to control, as aspects such as sample extraction or the interpretation of certain results are not susceptible to automation. This article highlights the most common errors, mainly those occurring during the preanalytical phase, including both those resulting from inappropriate use of laboratory test requests and those caused by the design of the clinical laboratory space.[41]

The article "Identification of preanalytical errors during phlebotomy in outpatient patients" published in the Mexican Journal of Clinical Pathology and Laboratory Medicine aimed to identify the frequency of errors during blood sample collection in outpatient patients. To this end, a descriptive, cross-sectional study was conducted to identify errors in the preanalytical phase in a clinical laboratory over a period of one month. The data were collected via a validated form.

A total of 164 patients were observed, 80,48 %, 81,09 %, 19,5 %, and 91,46 % of whom presented with inadequate asepsis, tourniquet time, tube order, and homogenization during venipuncture, respectively. It was concluded that phlebotomists should receive training in accordance with international guidelines to avoid such errors and be aware of the important role they play in the clinical laboratory.[42]

The article "Preanalytical variables and their influence on clinical laboratory results" published in the Mexican Journal of Clinical Pathology and Laboratory Medicine aimed to evaluate the influence of preanalytical variables on the results of clinical chemistry determinations. To this end, a descriptive observational study involving 303 subjects who attended the clinical laboratory was designed. A survey was administered to patients with the main variables of interest, and the preanalytical process was monitored in each case. Statistical analysis was performed via the x2 test and correlation analysis. Preanalytical variables dependent on the patient, the physician making the request, and the clinical laboratory staff were identified, revealing that incomplete test requests, lack of guidance prior to sample collection, toxic habits, medication intake (diuretics, antihypertensives, and salicylates), and stress were the preanalytical variables significantly related to the parameters studied. A greater statistical association was obtained between the parameters of blood glucose and cholesterol and the aforementioned preanalytical variables. These results highlight the occurrence of errors and demonstrate that controlling preanalytical variables is the first step in obtaining reliable laboratory results.[29]

The article "Evaluation of the quality of management of a hospital clinical laboratory in Costa Rica," published in the Costa Rican Journal of Public Health, aimed to evaluate the quality of management in the Clinical Laboratory of Hospital México between June and August 2009. A quantitative exploratory study was conducted in which 369 people were surveyed between June and August 2009. A descriptive analysis of the main variables recorded was carried out to determine the quality of management at the Hematology Laboratory of Hospital México. Among the main results are that external customers (doctors, nurses, and outpatient users) are satisfied with the timeliness of the service, with 94,1 % (269/286) expressing this opinion. Treatment and warmth were rated as good by 86,4 % (247/285) and 82,9 % (237/285), respectively. For internal clients (microbiologists, technicians, and administrative staff), 64 % (16/25) of microbiologists consider job expectations to be good, whereas the highest percentage of technicians, 71,4 % (30/42), have received fewer than 10 training sessions. Among administrative staff, the need for work prevails, with 56,3 % (9/16). In terms of physical space, most internal customers consider it to be average. The opinion of Technicians and Administrative Staff is that the furniture is considered good, but 56 % (14/25) of Microbiologists consider it average. The study concluded that internal and external customer satisfaction should be evaluated to improve quality management in the Clinical Laboratory of the Hospital México.[43]

The article "Satisfaction of users who attend public and private clinical laboratories" published in the journal Técnicas Administrativas argues that user satisfaction constitutes a rational or cognitive experience, derived from the comparison between expectations and service performance, subordinated to factors such as expectations, moral and cultural values, personal needs, and those of the healthcare organization itself, according to the economic performance sought. Therefore, this study sought to compare the level of satisfaction of users who attended public and private clinical laboratories in the municipality of Maracaibo. A comparative study with a cross-sectional and field design was carried out by applying a survey to users of laboratory services in the municipality of Maracaibo, Zulia State, from January–April 2012. The results

revealed mostly positive assessments in private institutions, with the worst-rated indicators in public institutions being comfort in the laboratory, instructions for sample collection, and late delivery of results. It was concluded that some areas of public laboratory services should be strengthened, mainly to improve patient satisfaction.[44]

The article "Comparison of four antiseptic preparations for skin in the prevention of contamination of percutaneously drawn blood cultures: a randomized trial" published in the Journal of Clinical Microbiology, this randomized clinical trial sought to compare the efficacy of four skin antiseptics in preventing contamination of blood cultures in a randomized, crossover, investigator-blinded study conducted in an emergency department and inpatient wards of a university hospital. The patient group included all patients from whom blood samples were obtained percutaneously for culture. Skin antisepsis was performed with 10 % povidone-iodine, 70 % isopropyl alcohol, iodine tincture, or povidone-iodine with 70 % ethyl alcohol (i.e., Persist). The blood culture contamination rate associated with each antiseptic was then determined. A total of 333 (2,62 %) of the 12 692 blood cultures were contaminated during the study period, whereas 413 (3,21 %) of the 12 859 blood cultures were obtained during the previous 12-month period (relative risk = 0,82; 95 % confidence interval, 0,71-0,94; p=0,006). During the study, the contamination rates were 2,93 % with povidone-iodine, 2,58 % with iodine tincture, 2,50 % with isopropyl alcohol, and 2,46 % with Persist (P = 0,62). We did not detect significant differences in blood culture contamination rates among these four antiseptics, although there was some evidence suggesting greater efficacy among alcohol-containing antiseptics. Among the antiseptics evaluated, isopropyl alcohol may be the optimal antiseptic for use prior to obtaining blood for culture, given its convenience, low cost, and tolerability. 21 %) of 12,859 blood cultures obtained during the previous 12-month period (relative risk = 0,82; 95 % confidence interval, 0,71-0,94; P = 0,006). During the study, the contamination rates were 2,93 % with povidone-iodine, 2,58 % with iodine tincture, 2,50 % with isopropyl alcohol, and 2,46 % with Persist (P = 0,62). We did not detect significant differences in blood culture contamination rates among these four antiseptics, although there was some evidence suggesting greater efficacy among alcohol-containing antiseptics. Among the antiseptics evaluated, isopropyl alcohol may be the optimal antiseptic for use prior to obtaining blood for culture, given its convenience, low cost, and tolerability. 21 %) of 12,859 blood cultures obtained during the previous 12-month period (relative risk = 0,82; 95 % confidence interval, 0,71-0,94; P = 0,006). During the study, the contamination rates were 2,93 % with povidone-iodine, 2,58 % with iodine tincture, 2,50 % with isopropyl alcohol, and 2,46 % with Persist (P = 0,62). We did not detect significant differences in blood culture contamination rates among these four antiseptics, although there was some evidence suggesting greater efficacy among alcohol-containing antiseptics. Among the antiseptics evaluated, isopropyl alcohol may be the optimal antiseptic for use prior to obtaining blood for culture, given its convenience, low cost, and tolerability. 71 to 0,94; P = 0,006). During the study, the contamination rates were 2,93 % with povidone-iodine, 2,58 % with iodine tincture, 2,50 % with isopropyl alcohol, and 2,46 % with Persist (P = 0,62). We did not detect significant differences in blood culture contamination rates among these four antiseptics, although there was some evidence suggesting greater efficacy among alcohol-containing antiseptics. Among the antiseptics evaluated, isopropyl alcohol may be the optimal antiseptic for use prior to obtaining blood for culture, given its convenience, low cost, and tolerability. 71 to 0,94; P = 0,006). During the study, the contamination rates were 2,93 % with povidone-iodine, 2,58 % with iodine tincture, 2,50 % with isopropyl alcohol, and 2,46 % with Persist (P = 0,62). We did not detect significant differences in blood culture contamination rates among these four antiseptics, although there was some evidence suggesting greater efficacy among alcohol-containing antiseptics. Among the antiseptics evaluated, isopropyl alcohol may be the optimal antiseptic for use prior to obtaining blood for culture, given its convenience, low cost, and tolerability. We did not detect significant

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The article "Antisepsis in blood culture collection. The blood culture contamination rate" published in the journal Medicina Intensiva is a review of blood culture, which is the main method of etiological diagnosis of bacteremia, but false positives are relatively frequent, mainly due to skin contamination at the time of sample collection. Proper skin antisepsis is important for reducing the bacterial load and the chance of contamination, but there is currently no consensus on the best antiseptic: alcohol has a powerful immediate bactericidal effect, and there is some scientific evidence in favor of the superiority of the combination of chlorhexidine and alcohol, but most studies are heterogeneous and inconclusive. Some authors even suggest that, with proper collection techniques by properly trained personnel, the antiseptic chosen is of little relevance to the contamination rate of blood cultures.[46]

The article "Importance of the order in which nurses fill blood sample tubes," published in the journal NURE investigación: Revista Científica de enfermería, states that the extraction of blood samples for laboratory analysis is a common technique in nursing practice. Errors are relatively common in obtaining samples, leading to erroneous results and, on occasion, rejection of the sample by the laboratory, which means that a new extraction must be performed. The responsibility of the nursing professional is to prevent, avoid, and minimize possible errors. The method of obtaining blood samples is important for ensuring high-quality results. The order in which blood tubes are filled can alter some results, so it is necessary to know the correct order of filling. The aim is to reduce the number of rejected samples, avoiding the risk of misinterpretation in patient diagnosis and the inconvenience caused to patients by the repetition of analytical tests.[47]