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Pre-analytical errors in the phlebotomy process in a national hospital in Lima

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ABSTRACT

Errors in the clinical laboratory are very frequent, most of which are mostly during the pre-analytical phase. That is why this research work proposes the identification of pre-analytical errors in the external office area of the Dos de Mayo National Hospital. To do this, a form was applied, filled out by the researcher at the time of supervision of the sampling. The instrument was validated by the joint recommendations of the EFLM-COLABIOCLI (European Federation of Clinical Chemistry and Laboratory Medicine) and the Latin American Working Group of the Pre-Analytical Phase (WG-PRE-LATAM) of the Latin American Confederation of Clinical Biochemistry. It was obtained as a result, among the most outstanding, that more than 90% of the patient was not recommended to rest for 5 minutes at the end of the phlebotomy, 80% did not register the identity of the phlebotomist in the request for examinations, in 40% there was a poor homogenization of the tubes, about 12% did not instruct the patient to apply pressure at the extraction site and 10% the barcode was not labeled in the presence of the tubes of the patient. It is concluded that the sampling personnel, phlebotomists, should follow the established standards and reinforce the previous knowledge through continuous supervision by the health personnel and pathologist.

1. Introduction

Globally, it is known that most errors during laboratory sampling occur in the pre-analytical phase. This process ranges from the time the order is received from the requesting physician until the sample is analyzed (Brian et al., 2018). Technologies exist that help detects errors by using label production software to label tubes, including instruments to measure levels of hemolysis, lipemia, and jaundice (Meneses-Claudio et al., 2021). However, despite this, there are still events on the part of health personnel that impair a correct blood sample. South American countries such as Argentina and Bolivia present a large percentage of pre-analytical errors in their statistics, the first of these being the one that reaches up to 80% of errors in the sample application for admission (Rodríguez Ravelo and Marcel, 2007; Alonso et al., 2015).

In Peru, due to high turnover rates in areas by a phlebotomist, lack of understanding of good laboratory practices, inadequate training of health personnel, misidentification of the patient, collection devices, and inadequate containers; are all those possible circumstances that may occur during the pre-analytical phase (Donayre-Medina et al., 2016; Meneses-Claudio et al., 2021).

In the Hospital dos de Mayo, there is a protocol for standardizing the phlebotomist technique, where they must follow certain steps to obtain a quality sample it can be analyzed without finding errors in its reading. However, due to the pressure, the steps are ignored or not fulfilled in their entirety, which leads to errors (Donatus et al., 2018).

That is why the objective of this research work is to identify pre-analytical errors in the external office area of the national hospital dos de Mayo through the application of an instrument based on the joint recommendations of the EFLM-COLABIOCLI (European Federation of Clinical Chemistry and Laboratory Medicine) and the Latin American Working Group for the Pre-Analytical Phase (WG-

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PRE-LATAM) of the Latin American Confederation of Clinical Biochemistry) for venous blood sampling.

2. Literature review

Plebani (2006) identified that most of the pre-analytical errors that are committed in the laboratory are caused by the human factor and this is due to the inadequate training of nursing techniques in the collection of samples, lack of knowledge regarding the incorrect maintenance of temperature conditions and delays in the delivery of laboratory samples. To this end, they proposed reducing the number of rejected samples from primary care; to this end, a quasi-experimental pretest and posttest study was designed, comparing preanalytical errors in urine samples between February 2009 and February 2010. The total number of errors was found to be 480 samples per origin from January to June 2009 and 180 in 201; this is because most of the errors are caused by the disorganization and lack of normalization of the processes. Therefore, it was determined that clinical updating sessions and academic training contribute to the reduction of errors of samples received in the laboratory, therefore, improving the management of health expenditure.

Romero Ruiz et al. (2009) identified that within the 3 phases of the analytical period; it is in the pre-analytical period where the greatest number of errors occur that lead to the rejection of the samples. It was detected that most of these rejected samples came from primary care where the nursing staff was responsible for obtaining the blood sample. For this, they proposed the realization of an educational intervention in the form of a clinical update session in all health centers through a quasi-experimental study before-after, detecting the errors the number of errors of primary care during a month and a new count of the errors six months after the end of the educational sessions. In their result, it was found that of 26,410 blood samples, 613 errors were detected regarding the quality of the blood sample. On the other hand, from 19603 samples 498 errors related to poor transport conditions were detected. It was concluded that by conducting the clinical update sessions for the inpatient nursing staff, it was possible to reduce errors in the biochemistry and hematology samples.

Quiroz-Arias, (2010) established that most of the errors in the laboratory occur in the pre-analytical area, where the sample is rejected generating reprocesses since it must be requested again; likewise, it implies a delay in the delivery of the result, leading to losses for the institution in costs and time of hospital stay. To this end, it was proposed to determine the frequency and type of pre-analytical errors caused by the referral of inadequate samples to two sections of the clinical laboratory through a descriptive pilot study. For this study, all samples that were rejected for processing were recorded during November 2008, classifying them as inadequate. In their results, of a total of 20,268 rejected samples, 818 were considered pre-analytical errors; On the other hand, among the most common causes of rejection were the coagulated sample (41.9%), hemolyzed (25.2%) and inadequate sample volume (23.1%). In conclusion, an improvement plan must be designed with corrective and preventive actions to reduce and mostly eliminate these causes of pre-analytical errors.

Donayre-Medina et al. (2016) determined that within the phases of analysis of a sample in the clinical laboratory, the pre-analytical phase represents more than 50% of the total error due to hemolyzed samples, insufficient volume, inappropriate transport of the samples and mostly due to error in the identification of the patient. To do this, it was proposed to identify the frequency of these errors during the collection of the blood sample, through a prospective, descriptive, and cross-sectional study. Patients from an outpatient clinic were observed and through the application of a data collection sheet based on the CLSI H3 guideline, certain variables to be studied (adequate asepsis, tourniquet time, among others) were evaluated. In their results, it was observed that, of 164 patients, 91.4% presented the error of inadequate homogenization during venipuncture, 80.4% problems in asepsis, 81% prolonged tourniquet time and 19.5% regarding the order of the tubes. The authors conclude that health personnel, in this case phlebotomists, should receive training based on international guidelines to reduce pre-analytical errors.

Gil et al. (2016) found that if a laboratory error is found, it leads to the rejection of the sample, therefore, the generation of the patient's discomfort when the blood extraction process has to be repeated, generating higher costs to the hospital and delay in the delivery of the result. For this reason, it was proposed to evaluate the pre-analytical errors of all daily income to the laboratory plant. Using a descriptive, cross-sectional study, the percentage of admissions with one or more pre-analytical errors, the frequency of each error, and their distribution by service each day of the week was calculated. It was found that, of a total of 9141 errors, 91% were due to errors in the application/entry of the sample. It is concluded that the origin of pre-analytical errors involves hospital staff, so it is important to raise awareness to obtain better quality results, fundamental for medical decision-making.

Arellano Nuñez (2018) found that of the total errors in the laboratory, 68% are pre-analytical errors and that various health professionals are responsible. Therefore, it is proposed to determine the frequency of pre-analytical errors in the analysis of arterial gases. The study was of a descriptive, observational, prospective, and transverse approach. There was a study population of 2498 blood samples with their respective laboratory orders between the months of March, April, May, and June 2018. The data collection technique was the observation where the conditions in how the sample arrived were described. In their results, illegible requests for

arterial gas analysis were 13%, as well as samples without a stopper were 56%. In conclusion, it was possible to identify the critical points in the pre-analytical phase of arterial gas analysis. It is recommended to implement quality policies and acquire purchase suitable devices for sample collection.

3. Methodology

3.1. Type of research

The present research, due to its properties and the way of collecting data according to the variables present, is a quantitative approach, of descriptive methodological design, non-experimental and cross-sectional (Hernández-Sampieri et al., 2018).

3.2. Population and sample

The population consists of 252 patients who came by External Office to the Hospital Dos de Mayo, being a considerable number for database processing, the total population was considered as the sample of the study.

3.3. Inclusion criteria

- Patients 18 years old and older.
- Patients who had 2 or more different blood sample tubes drawn.

3.4. Technique and instrument

Face-to-face supervision was conducted in which the form was completed using the instrument for venous blood sampling.

The instrument consists of 11 questions with short answers of "YES" and "NO", regarding the pre-analytical phase of blood sampling (Martín, 2011).

The validity of the instrument to identify pre-analytical errors was based on the joint recommendations of the EFLM-COLABIOCLI (European Federation of Clinical Chemistry and Laboratory Medicine) and the WG-PRE-LATAM (Latin American Working Group for the Pre-Analytical Phase) for venous blood sampling (Martín, 2011).

3.5. Place and application of instrument

The application of the instrument was conducted in person 2 meters from the phlebotomist, without maintaining any type of communication and visualization with the phlebotomist, at the time of taking a blood sample in the external office of the Hospital Dos de Mayo.

The data collection was conducted by researchers who are health personnel from the area of Clinical Pathology.

First, the objective of the research work was explained to the ethics committee of the Dos de Mayo Hospital, to then obtain approval and perform the tests with the instrument.

Then, a strategic place was coordinated to be able to apply the instrument without the phlebotomist feeling uncomfortable when evaluated by the examiner.

Finally, from the completion of the form by the examiner, the necessary data were obtained for the visualization of the results of this research work.

4. Results

In Table 1, we can identify the results obtained for each question. Then Fig. 1 is obtained, where the most alarming indices have been simplified.

We found in our research work that more than 80% of the identity of the phlebotomist was not registered in the request for examinations, and this is due to the time pressure that is had during the sampling, considering the great demand of patients who are treated around the outpatient.

On the other hand, about 10% did not label the barcode, of the exams to be processed, in the sample tubes in the presence of the patient. Several of them did so after the patient was retiring from the phlebotomy site. While the rest, 90%, did it properly. And this may be due to forgetfulness by some of the phlebotomists.

In 11.9% they were not instructed to apply pressure at the time of finishing the blood draw and not to bend their arm. While 88.1% did. These results reflect that not all phlebotomists remember the recommendations established in the ELFM–COLABIOCLI and WG-PRE-LATAM standards.

Of the total number of blood samples taken, about 40% of them did not present a correct homogenization for each tube extracted; and this may be since in some patients about 8 tubes were removed, not reaching the correct number of inversions for each of them. While in 60% if it was done correctly.

Likewise, about 79% remove the tourniquet at the time of extraction of the first tube, thus avoiding pre-analytical errors and subsequent processing. However, more than 20% did not do that procedure, as some of the patients had difficult venous access.

Finally, the most statistically relevant was that 95.2% did not advise the patient to rest for 5 minutes to ensure that the bleeding has stopped. While less than 5% did. The error could be due to the accelerated flow and the great demand that is in the care of the patient in outpatient consultation.

5. Discussion

Regarding the data obtained during the study, 702 errors were detected at the time of sampling, equivalent to 13% of the total, not having a correlation with what was reported by Quiroz-Arias (2010) of 4%. And this is because in our study another instrument was applied with 20 items with respect to the joint recommendations during the venous blood sampling.

Table 1: Results of the applied survey

Did the phlebotomist verify the request for examinations?	YES	249
	NO	3
Did the phlebotomist correctly identify the patient?	YES	252
	NO	0
Did the phlebotomist verify that the patient is fasting and prepared for phlebotomy?	YES	228
	NO	24
Does the phlebotomist have all the necessary supplies before extraction?	YES	252
	NO	0
Did the phlebotomist properly position the patient?	YES	249
	NO	3
Did the phlebotomist place fingers (10cm) above the venipuncture site?	YES	252
	NO	0
Was a venipuncture site selected as suitable for the recommended practice?	YES	252
	NO	0
Did the phlebotomist put on a pair of gloves?	YES	252
	NO	0
Was the venipuncture site meticulously cleaned and not touched after it had been cleaned?	YES	252
	NO	0
Did the phlebotomist release the tourniquet when the first tube began to fill?	YES	198
	NO	54
Were the tubes filled properly?	YES	252
	NO	0
Did the phlebotomist follow the correct filling order?	YES	240
	NO	12
Were all sample tubes homogenized according to the manufacturer's indications?	YES	153
	NO	99
Was the needle removed safely and immediately?	YES	252
	NO	0
Did the phlebotomist place clean gauze over the venipuncture site?	YES	249
	NO	3
Was the patient instructed to apply pressure until the bleeding stopped and not to bend the arm?	YES	222
	NO	30
Was the patient advised to rest for 5 minutes to make sure the bleeding had stopped?	YES	12
	NO	240
Were the tubes labeled in the presence of the patient?	YES	228
	NO	24
Did the phlebotomist register his identity in the examination request?	YES	45
	NO	207
Did the phlebotomist inform the patient about the date of delivery of the results?	YES	249
	NO	3

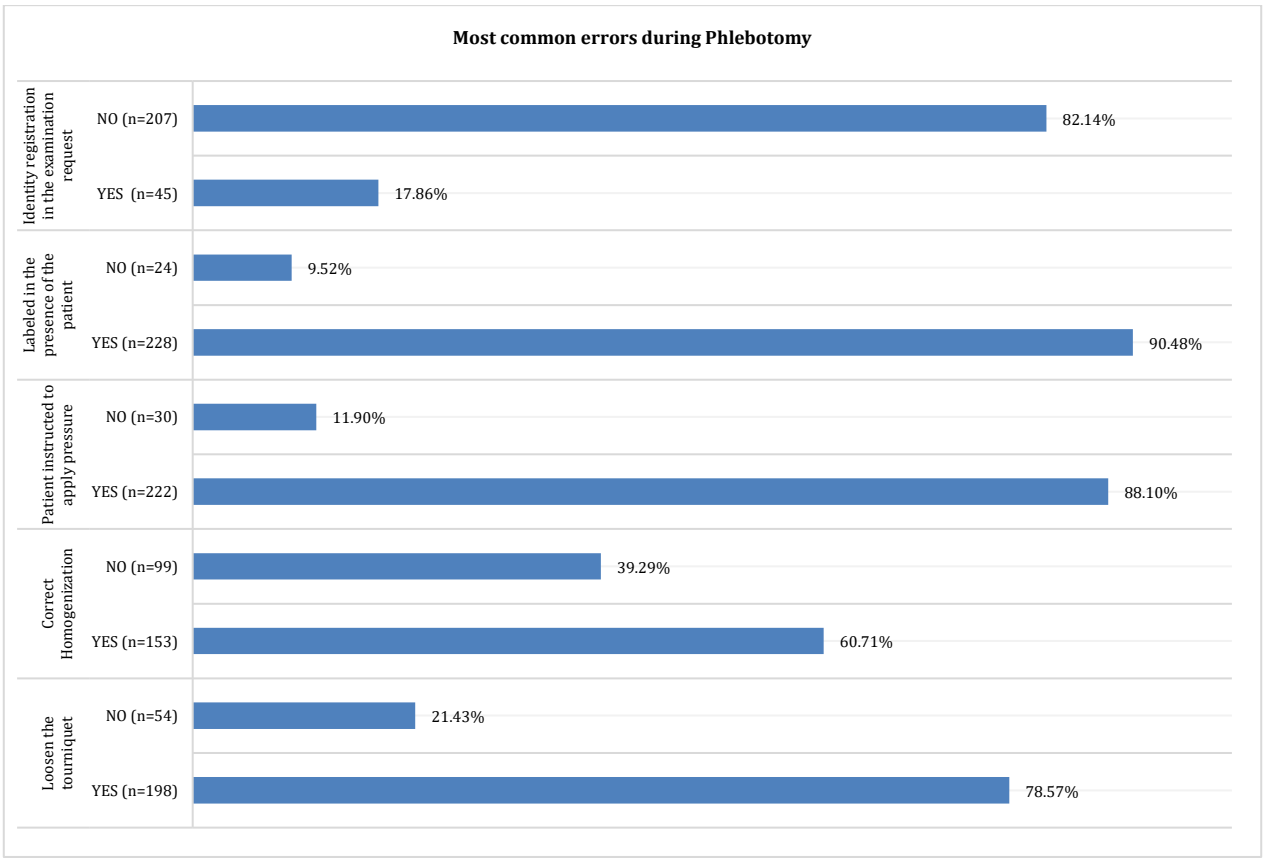

Fig. 1: Most common errors during phlebotomy

The research work showed that the most frequent error (90%) was the item of not advising the patient for a period of 5 minutes to ensure that the bleeding has stopped. One of the options for this alarming result is that it works with a great demand for patients in the outpatient area and in some cases,

this item is ignored to accelerate the flow of care. However, for Quiroz-Arias (2010), the coagulated sample was the most relevant, being found in 42%," having as its main error the collection of blood samples. While in the study by Gil et al. (2016), 91% of errors were the request/sample, being the problem in the identification of tests requested by the sampler.

Of a total of 252 sample collections, 28% are based on poor homogenization of the tubes. Likewise, this result may be due to the fact that in some patients up to 8 tubes were extracted and this was an impediment to the correct homogenization of them since according to the manufacturing instructions they have a number of investments that must be made, to avoid alterations in their analysis and as a consequence in the final result. However, in research performed by Donayre-Medina et al. (2016), it occurred in more than 90%, not specifying the causes.

Regarding the correct use of the tourniquet at the time of blood extraction, in our study it was found that 21% did not release the tourniquet at the time of filling the first tube; a recommendation established in the guide of the European Federation of Clinical Chemistry and Laboratory Medicine and CLSI H03- A6. On the other hand, in the work of Donayre-Medina et al. (2016), the prolonged time of the tourniquet was 81%, unrelated to our study.

Likewise, the registration of the identity of the phlebotomist in the request for examinations of the patient is a crucial factor because it allows for the identification responsibility on the part of the phlebotomist in the taking of samples and correcting some observations in a personal way.

In our study, 100% of the blood extractions were filled properly, and this is because, in the laboratory of the Hospital Nacional dos de Mayo, there are tubes of the BD brand with a Vacuum System, which facilitates the extraction of a correct volume considering the sample/coagulant ratio, so as not to lead to error in its subsequent analysis. However, Gil et al. (2016) reported that 23% presented a bad filling of the tubes, the cause being mostly insufficient.

Finally, the correct order of filling the tubes is an elementary process, since it mostly affects hemostasis and biochemistry tests; that is why, in our research work, it was found that 5% of this type of error was committed because some phlebotomists did not agree on the correct order during the extraction process. On the contrary, in the study of Gil et al. (2016); it occurred in less than 2%, deducing that it has informed and trained personnel in blood collection.

6. Conclusion

It is concluded that the research work provides the main aspects to consider during the phlebotomy process, due to the importance of each item evaluated. The main error that was found was not to advise the patient for the period of 5 minutes after the phlebotomy process, in more than 90%; this is an item of utmost importance since it avoids immediate side effects, such as fainting, post puncture bleeding, and headache. For this reason, knowledge must be strengthened through continuous training.

Likewise, the non-registration of the identity of the phlebotomist in the request for examinations occurred in a significant percentage, thus avoiding identifying the person responsible for the sampling. To do this, it is advisable to supervise staff routinely during the phlebotomy process.

However, the item regarding the correct homogenization of tubes obtained an error of almost 40%, caused by the time pressure that is had at the time of care and the great demand of patients that is managed in the outpatient area. However, more sampling staff should be hired to provide better patient care at the time of phlebotomy, in addition to reinforcing the knowledge mentioned in joint recommendations of the ELFM -COLABIOCLI and WG-PRE-LATAM standard.

A limitation presented in the research work was the disagreement of the hospital with the data presented because they indicated that all their phlebotomists knew about the protocol, but in the end, with the support of a teacher from the same hospital, they indicated errors in the directive and on the training approach to reduce and eradicate the most common errors identified.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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