Catlab Informa

Bulletin No.153

Main pre-analytical incidents in emergency laboratory

The analytical process is classically divided into three phases: pre-analytical, analytical, and post-analytical.

The pre-analytical phase encompasses everything from the laboratory request to sample reception and pre-analysis handling, including both extra-laboratory processes (analytical request, patient preparation, sample collection, and transport) and intra-laboratory processes (sample reception, handling, and preservation), and involves numerous professionals. According to the literature, the highest percentage of laboratory errors occurs during the pre-analytical phase. Therefore, to guarantee the quality of the results and patient safety, it is crucial to be aware of these errors and to identify and minimize their consequences.

These incidents, if they are detected, can lead to the rejection of the sample; but if they are not, can lead to the issuance of dubious quality results. They can have consequences such as repeating analyses (new request and extraction) and they can delay patient's care and the team's decision making.

In emergency laboratories, in particular, the type of patient, the high workload, the shorter response times, and the relatively rapid decision-making by clinicians based on the results issued, can mean that pre-analytical incidents immediately affect the patient's safety.

Furthermore, the suppression of results in inadequate samples is associated with clinical consequences (delay in diagnosis), economic consequences (need for new extraction) and organizational consequences (longer stay in emergency department, delayed discharge…).

The aim of this bulletin is to explain the main incidents we encounter in the Catlab emergency laboratories, in order to minimize errors.

Pre-analytical errors related to extraction

- Wrong patient identification
- Clotted samples
- Hemolyzed serums
- Tubes that are not filled up to the line
- Incorrect container for the determination
- Contaminated or diluted samples during the extraction process.

Patient identification error:

The most serious error we encounter in the laboratory is patient identification error, whereby we receive a sample from one patient but assign it to another. If this is not detected, it results in a mix-up of results between patients.

This can occur at the time of making the sample's request (by requesting using the name of another patient), or during patient identification, labeling of samples and/or during the labelling of the request.

This error is sometimes detectable from the laboratory, especially when we observe that the results of a patient with a recent history undergo very significant changes in parameters that are, by definition, stable.

If an identification error is suspected, the laboratory contacts the nurse and/or physician responsible for the patient and questions the validity of the samples. If the suspicion persists, new samples are requested to verify the results. If a patient identification error is confirmed, all samples from the affected patients are discarded, and a non-conformity report is filed in our quality control system.

To avoid identification errors, all patients must be correctly identified, proactively and by seeking their attention, by asking the following questions: "What is your name?" and "What is your date of birth?". For correct identification, at least two identifiers should be used (patient name and date of birth) and preferably an additional identifier such as: postal address, health card number, medical record number, national identity document or any other unique personal identifier.

In the case of patients who cannot respond, identification will be done by the nurse using the identification bracelet.

It is very important to label the tubes in front of the patient and assign the number at that same time, thus preventing a cross-contamination of patients if several analyses are activated simultaneously.

The consequences of this error can be very serious, depending on the results incorrectly assigned to the patient, which may lead to unnecessary actions on them, like the assignment of incorrect diagnoses that may generate anguish in the patient and their family or, on the contrary, fail to diagnose and therefore fail to act accordingly to some potentially urgent pathology.

In Catlab's emergency laboratories, monthly monitoring is conducted using an indicator that reflects the number of identification errors found in the emergency departments of each hospital relative to the total number of requests processed. The graph shows each center's position relative to the average of the three, and this information is shared with the department heads.

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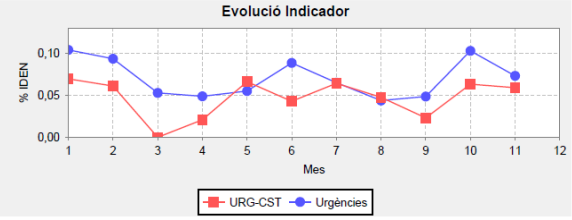
I1. Petició anul·lada. Error en la identificació del pacient (IDEN)

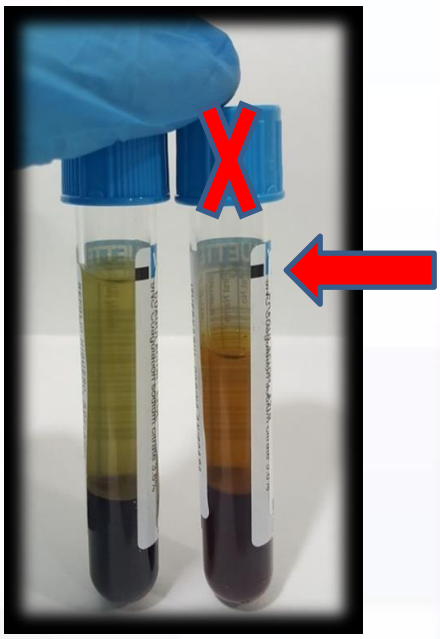
Mes: Novembre	URG-CST	Urgències
Incidències	3	15
Peticions	5091	20549
Indicador	0.06	0.07



Errors related to the state of the samples

Citrate tubes that are not properly filled:

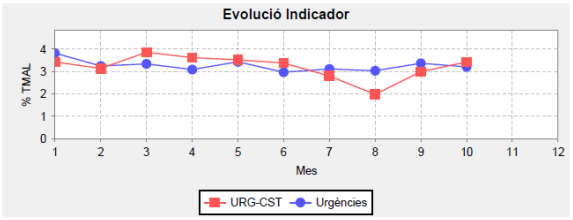
This tube is primarily used for coagulation tests. It is very important to fill the tube up to the fill line, as for accurate analysis and interpretation there must be one part citrate (anticoagulant) to nine parts blood. If this 1:9 ratio is altered by using less blood in the tube, the coagulation time results (PT, prothrombin time, and aPTT, partial thromboplastin time) will be affected, resulting in prolonged results that may not accurately reflect the patient's condition.



Each month, an indicator is obtained that shows the percentage of citrate tubes received from the emergency department in which results could not be delivered due to a filling error.

I5. Emplenat incorrecte del tub. La quantitat de mostra correcta s'indica per la marca visible del tub (TMAL)

Mes: Octubre	URG-CST	Urgències
Incidències	71	241
Nº T. Protombina	2075	7525
Indicador	3.42	3.2



Clotted samples:

Clotted samples primarily invalidate the results of blood counts, coagulation tests, and blood gas analyses.

In the case of the blood count, the presence of clots will cause lower than actual values to be obtained in the blood cell counts, especially altering the platelet result.

In coagulation studies, the formation of clots causes the consumption of coagulation factors, which will falsely lengthen the times of the parameters measured.

Finally, the presence of clots in blood gas analyses leads to a loss of sample homogeneity and inaccurate results, as well as potentially damaging the equipment.

Analytical interferences:

Hemolysis, jaundice, and lipemia are the most frequent interferences in the clinical laboratory.

Hemolysis is the process of red blood cell destruction, which involves the release of intraerythrocytic contents into the plasma, altering its composition. The main intraerythrocytic molecule is hemoglobin, which has an absorption spectrum characteristic of the heme group, with a peak at 405 nm and several peaks between 500–600 nm, producing a reddish color in the plasma proportional to the amount of hemoglobin released. Free hemoglobin is only found in the plasma in diseases that cause massive destruction, exceeding the capacity of the body's recovery systems (intravascular hemolysis).

By far, the most frequent cause of hemolyzed samples is the deterioration that occurs in the extralaboratory pre-analytical phase, mainly during sample collection, but also during transport and processing.

Causes of hemolysis related to phlebotomy:

- Type of vascular access device. Vacuum system preferred over syringe-needle.
- Needle gauge.
- Puncture with a syringe and transfer to an empty tube. Never puncture the empty tube directly with the syringe; instead, use transfer devices or open the tubes and let the blood run down the sides slowly.
- Turnstile time
- Puncture site: cubital fossa is preferred
- Capillary puncture is always traumatic, especially if the area is massaged to induce bleeding.
- Incomplete vacuum tube
- Sample homogenization: excessive or insufficient mixing

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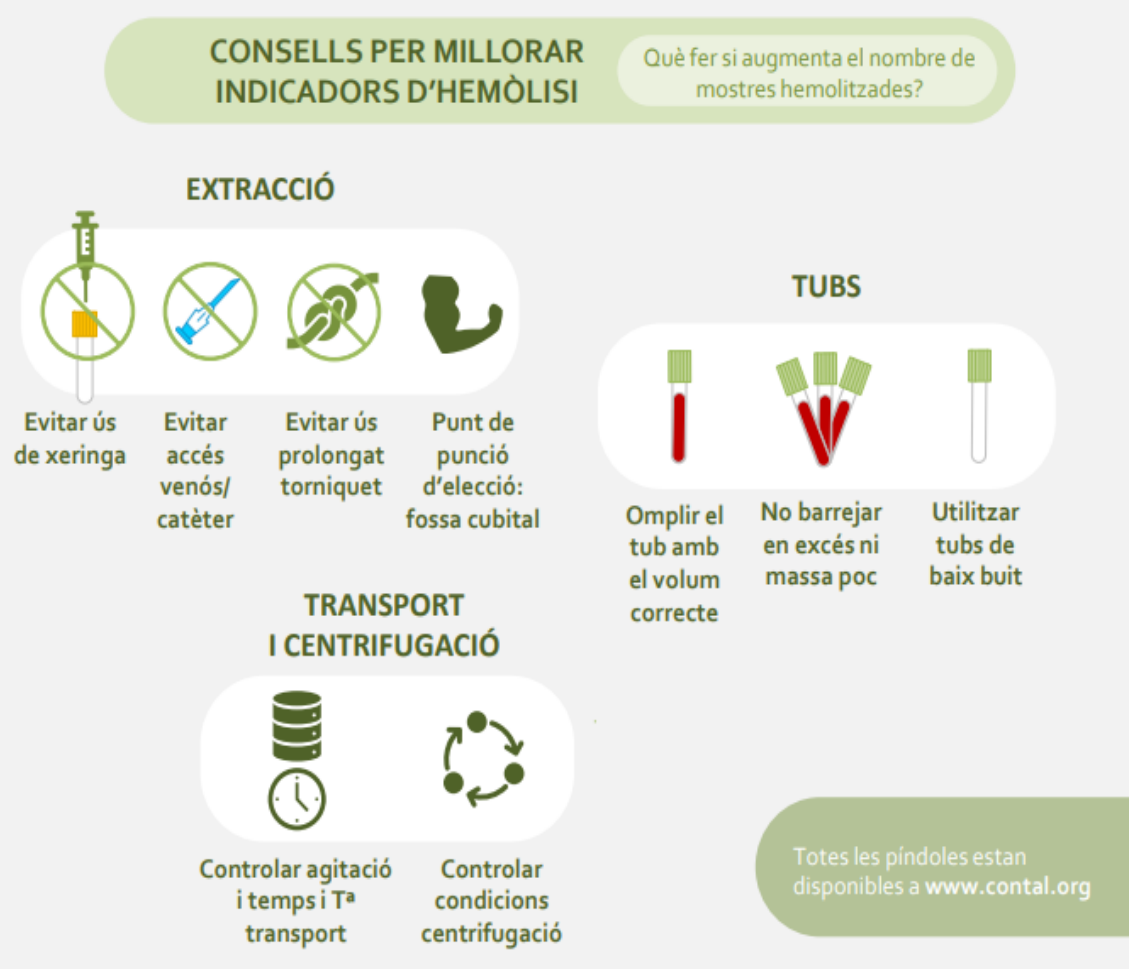
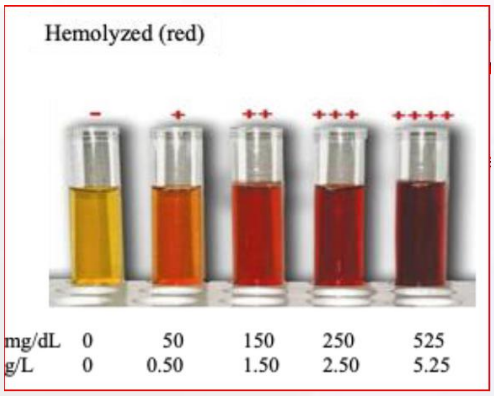


Hemolysis in the laboratory is automatically measured by biochemistry analyzers, and it does not affect all results equally. Depending on the degree of hemolysis, different parameters will be affected.

Interference by hemolysis usually occurs due to the release of intraerythrocytic content such as LDH, AST or K, although chromatic interference can also occur as is the case with troponin.

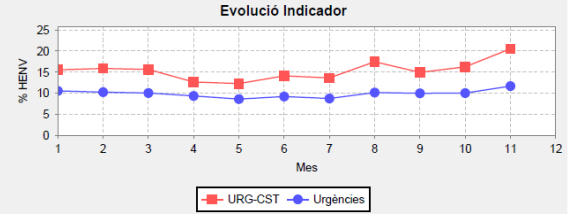


In Catlab's emergency laboratories, monthly monitoring is conducted using an indicator that refers to the number of analyses in which some parameter has been rejected due to hemolysis, comparing it to the total number of serums analyzed in the laboratory.

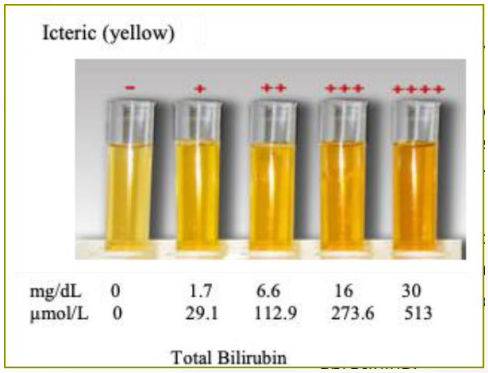
This indicator is very high every month in emergency laboratories, well above the indicator for samples received from primary care and outpatient clinics. This difference is probably due to the characteristics of the patients treated in hospital emergency departments and their operation, but it is important to remember that the main cause of hemolysis is related to the blood collection technique.

I2. Sèrum hemolitzat. Resultat no valorable (HENV)

Mes: Novembre	URG-CST	Urgències
Incidències	751	1520
Nº index hemolítics	3657	13010
Indicador	20.54	11.68

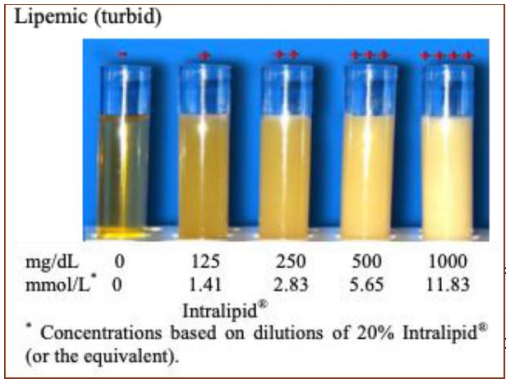


The interference from **jaundice** is endogenous to the patient. The presence of bilirubin in the sample can produce spectral interferences due to its high absorbance at wavelengths between 400 and 500 nm. This can lead to falsely elevated or falsely decreased results. If the result may be altered for this reason, a comment is included in the report warning of the possible positive or negative interference.



Lipemia interference is endogenous to the patient, although it can sometimes be due to contamination from parenteral nutrition or medication (propofol, amphotericin, etc). If the patient is receiving parenteral nutrition, the sample should be taken from the arm opposite to the one receiving the nutrition.

Some parameters, such as liver enzymes, creatinine, or electrolytes (pseudohyponatremia), can be altered if the serum shows true lipemia. To obtain reliable results, the sample is subjected to ultracentrifugation in the laboratory, which allows the separation of the lipid fraction and analysis of the affected parameters in the lipid-free fraction.



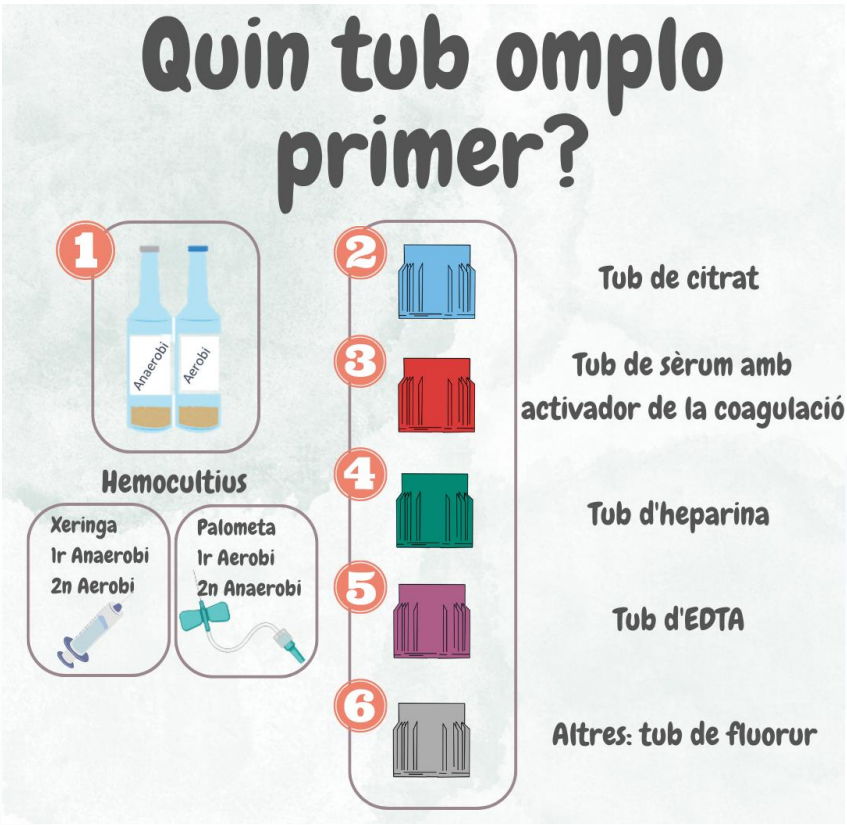
Samples contaminated during extraction

Obtaining blood samples by direct puncture should be prioritized, but in cases where the only option is catheter extraction, special attention should be paid to the procedure to minimize the risk of hemolysis and contamination of the sample by serum, glucose serum, heparin, or other drugs.

The different blood supplies should be stopped before performing the extraction, and 10 mL of the catheter should be discarded in order to avoid contamination/dilution of the sample to be analyzed and affecting the results obtained.

We frequently detect these contaminations in the laboratory. They are suspected when there is a history of several generally stable parameters that drop drastically between analyses. The referring physician is contacted to determine if the drop in values corresponds to any clinical change in the patient, and if doubt persists, a new sample is always recommended to verify the results.

On the other hand, to avoid the risk of contamination with different additives, it is important to follow the order recommended by the laboratory for filling the tubes. For example, the di- or tripotassium EDTA in blood count tubes can contaminate the serum tube, falsely increasing the potassium result due to the anticoagulant and decreasing the calcium result due to its chelating effect.



Which tube has to be filled first? Catlab infographic .

Conclusions:

As noted in this bulletin, most laboratory errors occur in the pre-analytical phase and are largely preventable. If they do occur, and although they can sometimes be detected, they have consequences at various levels and pose a risk to obtaining quality results.

In this sense, becoming aware of the importance of each of the steps in this phase, from the request for tests, through the correct identification of the patient and samples, the performance of the correct extraction technique... to the transport, preservation and processing in the laboratory would allow minimizing these risks and their effects.

Furthermore, training and education of the staff involved throughout the entire process is essential, as well as effective communication between the laboratory and the rest of the healthcare staff.

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