ERRORS IN THE LABORATORY

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random errors inconsistent/unpredictable

Systematic errors consistent trend/shift in values
could occur due to wrong procedure, incorrect standard and calibration procedure.
Calibration error

Error can occur in any of the limb of the cycle of events occurring in a hospital starting from the physician examining the patient and back to the physician

(preanalytical/ analytical/postanalytical).

Preanalytical

The pre-analytical system shall take care of the following aspects as each can have a major effect on the accuracy of the result :

- Patient preparation
- Request forms

- Specimen collection, containers, labeling and phlebotomy equipment and procedure.
- Specimen transport
- Specimen preparation
- Specimen storage

Pre-analytical errors:

Clinician must select appropriate investigations

Patient properly prepared for the test

Patient slip correctly filled in.

Note taken of the affect of age, sex, diet, nutritional state, time on the particular test.

Patient was fasted or was not fasted overnight.

Effect of fist clenching

Contraction of forearm muscles causes release of potassium

Intracellular electronegativity declines during depolarization of muscle cells favoring release of potassium rather than its uptake

Can cause 1-2 mmol/L increase

As much as 2.7 mmol/L increase reported -*Lancet 1961;1:478-480*

Patient variables
Patient and specimen identification
Dietary Status, Medications
Body Position (standing, sitting, supine)
Site of Phlebotomy *vs* site of infusion
Tourniquet (placement, duration)
Quality of Phlebotomy (trauma, duration, etc.)

Posture (sitting versus lying) can cause a 5% variation in some tests. For total cholesterol and HDL cholesterol it may be a 15% variation

Vigorous exercise can increase total cholesterol by 6%

Smoking or stress

Wrong container used K EDTA for electrolytes, ALP and calcium

Collection related factors
Filling of Tube (blood: additive ratio)
Order of Draw
Type of Tube (glass *vs* plastic)
Type of additive (none, anticoagulant, stabilizer, separator)

Order of Specimen Collection
Blood culture tube
Coagulation tube (citrate)
Serum tube (with or without clot activator or gel separator)
Heparin (with or without gel separator)
EDTA
Oxalate/ Fluoride
NCCLS (CLSI) H3-A5 standard, 2003

Transport related causes

Transport

- **pneumatic tube**
- **courier**
- **shipment**

Temperature & Humidity

Time

Specimen Integrity

Exposure to light

Process Related Causes
Time
Centrifuge
Temperature
Storage

Sample taken from drip arm while drip running: If it is a dextrose saline drip it will falsely increase glucose, decrease sodium, chloride, urea and creatinine

Is the specimen volume adequate?

After centrifugation does the specimen show haemolysis, icterus, lipaemia

Effect of tourniquet
Greater hemoconcentration: 3 min vs 1min
Venous stasis lead to increased anaerobic glycolysis, accumulation of lactate, pH low
Hypoxic effect leads to leakage of K from cells: cause spurious increase in serum K
Drop in blood pH result in release of ionic Ca & Mg bound to albumin
Drop in blood pH: increase in free drug level

Exogenous Interference by Patients' Medication

* **Several drugs are known to interfere with certain parameters.**

* Laboratories should try to contact the manufacturer for Drug interference or perform studies to confirm the extent of interference from drugs e.g Phenytoin affects measurements of certain enzymes ALP & Gamma GT and lowers serum levels of FSH, T4 etc.

Instructions for specimen collection should be given to laboratory users in a primary sample collection manual

Specimen collection, container, centrifuge speed

Time lapse in transport for blood gas analysis or delay in analysis

Storage conditions . In some cases sample must be frozen after separation in other cases it must not be frozen. Freezing of whole blood will cause haemolysis

Refrigerating whole blood may also cause haemolysis.

Substances in higher concentration inside the red cells will leak into serum

Higher concentration in red cells than in serum :

K, phosphate, AST, LDH

Lower concentration in red cells than in serum :

Na, Cl and carbon dioxide

Concentration about equal in red cells and serum: creatinine, glucose, urea, urate

Rejection after Processing and Analysis

* **Serum indices are high – Bilirubin , Lipids, Hb**

- These channels in the analyser will be dedicated for these indices.

- Bilirubin is known to interfere with Creat, Chol, Glucose, TG and Uric acid.

Analytical

The following aspects shall be monitored, evaluated, implemented and maintained to ensure accuracy and precision of the test carried out:

- Quality of distilled water
- **calibration** of measuring and testing instruments including analysers, balances, incubators, centrifuges and semi-automatic pipettes, and **regular servicing and maintenance of equipment.**

• use standard/calibrator which is traceable to national/international reference material.

• include quality control specimens in each procedure on a daily basis

Analytical errors may be systematic or random

All data relating to the laboratory's internal QC practices and performance in external quality assessment schemes (scoring, ranks, etc.) should be recorded, reviewed and corrective actions implemented.

Stability of reagents

Laboratory personnel should be aware that the stability of all reagents kept at room temperature shall be reduced from the stated values if the temperature exceeds 35^0C.

Use of calibration graphs

A fresh standard curve should be carried out whenever:

- the calibrator is changed
- new reagents are introduced
- problems with QC are encountered

Post-Analytical

In order to avoid transcriptional errors in the results of the test, the reporting/signatory technicians shall verify the results entered manually or through on-line instrument interfaces before the results are reported or dispatched.

Post-analytical errors

Transcription errors

Excessive delay in reporting values

Correct interpretation

Rectification of lab errors

It is therefore essential to continually ask the following questions.

1. Is there an analytical error?
2. If so, what type of error is this?
3. What could have been the causes for this error?
4. How to rectify this error?