Normal physiological values

The results of diagnostic tests on body fluids, such as blood and urine, are commonly used in the screening, diagnosis and clinical management of patients.

'Reference ranges', or 'reference intervals', are a statistical calculation of the range of results expected to be found in 95% of 'healthy individuals' unless otherwise specified.[1] They are method and laboratory specific, so, although most laboratory methods are standardised, inter-laboratory differences may occur due to differences in specimen collection and analysis method. Reference ranges may be influenced by patient characteristics such as age and gender and factors such as time of collection, exercise, and the presence of food or some drugs.

Unless otherwise referenced, reference ranges and terminology in this section of the handbook are standardised to those found at the time of publishing in the manual published by the Royal College of Pathologists of Australasia (RCPA).[1]

Units of measurement

Reference ranges are generally expressed in SI (Système Internationale) units. The litre is the standard unit of 'volume', and 'mole' is preferred to 'gram' whenever possible for describing values of concentration. Readers may note some North American textbooks use conventional units (e.g. g/100 mL) when discussing laboratory results. Conversion tables are available in most medical dictionaries. Values of concentration may be expressed in gram units rather than moles when the:

- analyte being measured is a heterogenous group of compounds with differing molecular weights; and
- the molecular weight of the analyte being measured is not precisely known.

The accepted SI unit where functional activity rather than molecular mass is measured (e.g. enzymatic activity) is the International Unit (IU), defined as that quantity of enzyme that will catalyse the reaction of one micromole of substrate per minute.

Interpretation of laboratory test data

Individual results should ideally be interpreted using the reference intervals of the pathology laboratory performing the test and the clinical status of the patient.

The sensitivity and specificity of individual laboratory tests influence the clinical significance of test results.

Pharmacists should adopt a holistic approach when interpreting laboratory test results and, where possible, consider the combined results of several analytes, as well as the health status and medication profile of the patient.

Blood studies[1,2]

Electrolytes

Aluminium

..... <0.30 micromol/L

Toxic level..... >7.4 micromol/L

Because of the ubiquity of aluminium compounds, natural human exposure is unavoidable, and moderate amounts of the element enter the body constantly through inhalation of atmospheric dusts and ingestion of food and drink. Despite an oral intake ranging from 5–10 mg daily, little aluminium is absorbed, and serum levels are usually <0.30 micromol/L. Tissue aluminium levels are very low. No biological function for the metal has been found. Aluminium is readily excreted in the urine in normal renal function. In patients with chronic renal failure undergoing long-term haemodialysis, however, aluminium may accumulate, resulting in dialysis dementia and osteodystrophy. In dialysis patients, serum aluminium >7.4 micromol/L generally leads to clinical symptoms of aluminium toxicity. Levels >3.7 micromol/L are of clinical concern and close surveillance is required, while levels >2.2 micromol/L need attention.

Anion gap

..... 8–16 mmol/L

if potassium not included..... 4–13 mmol/L

The calculated anion gap (AG) is the difference between the cations and anions in the extracellular space. It is equal to $(Na + K) - (Cl + HCO_3)$, although some laboratories do not include K in the equation. AG is used to investigate the cause of metabolic acidosis.

Increased AG occurs in lactic acidosis, diabetic ketoacidosis, renal failure and alcohol intoxication. Lithium toxicity reduces the anion gap.[1,2]