Comparison of Point Of Care Testing (POCT) Methods and Central Laboratory Methods for Key Electrolytes
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The measurement of electrolyte—sodium, potassium, chloride and bicarbonate—levels in blood is extremely common and often provides vitally important data used in the care of critically ill patients. Nearly all medical centers in the U.S. use both point of care and central laboratory methods to determine the concentrations of these key analytes.

Many techniques are available to measure electrolytes: ion-selective electrodes (ISE), atomic absorption, spectrophotometry and flame photometry. Most central laboratories and point of care testing (POCT) devices use the ion-selective electrode method, with the other (more demanding) methods employed almost exclusively by large reference and research laboratories.

Indirect ISE devices use diluted plasma (or serum) samples, and the results are generally comparable to flame photometry (the reference method).¹ Direct ISE devices use whole (undiluted) blood samples; these measurements are not equivalent to those results obtained by the flame photometry or indirect ISE methods. The difference is mostly due to the variation in plasma water concentration, which depends predominantly on lipid and protein content. Another fundamental difference is that direct ISE is measured as ion activity while indirect ISE and comparable methods generate results as concentration (mmol/l). To avoid confusion, the CLSI (Clinical Laboratory and Standards Institute, formerly known as the NCCLS) recommends that ion activity results obtained by the direct ISE methodology be adjusted to resemble those obtained by procedures that measure plasma concentration.¹ Most instruments using direct ISE have built-in conversion algorithms that give results in concentration terms that are comparable to the reference method (flame photometry) for specimens with normal plasma water.

There are no practically accessible “absolute” plasma values for electrolytes as seen with other analytes such as glucose, where a known amount of solute is added to a sample. This is because there is no practical way of accurately obtaining exact measurements for any ions. The CLSI, however, recommends flame photometry as the most precise reference method to which all other
laboratory tests for sodium, potassium and calcium (as well as lithium and barium) are compared. The reference ranges or "normal values" of any ion are simply the statistical mean of a compilation of results for that ion obtained from several large laboratories.

A consistent difference between central laboratory values and POCT values for common electrolytes has been noted.\textsuperscript{2} This is theorized to be due to the differing ratios of the volume of anticoagulant to patient sample used in POCT devices versus that used in central laboratory tests. However, this does not fully explain the differences in measurements between the two methodologies. When residual plasma from central laboratory testing is subjected to POCT methods, these differences still remain. This may reflect actual differences in precision, bias and sensitivity.

The values derived from POCT devices and central laboratory methodologies are frequently used interchangeably. In many circumstances this practice is acceptable, but there are limitations to substituting one set of values for another. The differences in value obtained from POCT and central laboratory electrolyte measurements may not be clinically significant for individual electrolytes, but calculated parameters, such as the anion gap \((\text{[Na}^+\text{]}+\text{[K}^+\text{]}-\text{[Cl}^-\text{]}-\text{[HCO}_3^-\text{]})\) and the strong ion difference \((\text{[Na}^+\text{]}+\text{[K}^+\text{]}+\text{[Mg}^{2+}\text{]}+\text{[Ca}^{2+}\text{]}-\text{[Cl}^-\text{]}-\text{Lactate})\), can suffer from statistically significant compounding effects. Morimatsu et al\textsuperscript{2} compared the anion gap and the strong ion difference of critically ill patients using results obtained from a central laboratory analyzer and a POCT device. They showed that the values calculated using the different methodologies were significantly dissimilar. The divergent calculated results could lead to considerably different clinical interpretations and consequent therapeutic decisions. As with all POCT analytes, it is strongly recommended that central laboratory results be used when critical management or therapeutic decisions must be made.

POCT results can be significantly affected by pre-analytical variables such as hemolysis (especially potassium concentrations), fibrin clots within the specimen, inadequate mixing of the specimen with anticoagulant and varying the ratio of blood sample to anticoagulant. Other factors that could contribute to aberrant results include blood samples contaminated by ambient air and the use of expired or suboptimally stored cartridges. With indirect POCT devices, the use of plasma versus serum can make a significant difference in potassium measurements, with values from serum consistently being higher than plasma, due to potassium released during clotting.

The College of American Pathologists and Clinical Laboratory Improvement Amendments of 1988 (CLIA) maintain that all non waived laboratory methods used at an institution for measuring the same analyte must be compared, and the interrelationship be documented at least twice a year. This requirement includes testing done under different CLIA certificates.
Many POCT staff may not be aware of the importance of quality control and proper procedure if controls fail. When controls fail and appropriate corrective action is not taken, then all patient test results subsequently derived from the device are invalid. It is recommended that appropriate central laboratory staff be informed when controls fail, as this creates opportunities to review procedural steps with POCT staff and ultimately results in a better educated point of care team.

References