ADVANCED INSTRUMENTS

Application Note

Osmolality: A Crucial Medical Tool for a Vast Range of Use Cases

Osmolality testing is a powerful screening tool which allows physicians to make quick and accurate diagnoses for a wide range of disorders.

"One of the reasons why osmolality is so powerful is that it's not looking for a specific analyte. We are taking an overall concentration measurement which gives a tremendous amount of information about what is going on in the patient's body."

Julie MacKenzie, Senior Manager Clinical Product Portfolio at Advanced Instruments

Here is a typical, and overmodest, definition for osmolality: It "indicates the concentration of all the particles dissolved in body fluid".[1] What's hiding behind this dry description is that osmolality is a powerful tool: It delivers crucial information for making accurate diagnoses and establishing proper treatment plans for patients with disorders involving water and electrolyte imbalances. In fact, osmolality testing by freezing-point depression osmometry is essential for getting extremely accurate, and even fast, insights into the pathophysiology of disorders such as hyponatremia, metabolic acidosis and different types of intoxication.

Osmolality: A High-Value, Low-Cost Test

Acute intoxication with alcohol or other substances is frequently seen in emergency departments and constitutes a significant burden on emergency health services.[2,3] Metabolic acidosis[4] and electrolyte disorders[5] such as hypo- and hypernatremia are also common issues in both emergency medicine and intensive care medicine. In the latter two cases, there can be dozens of possible causes for their conditions. As a result, it would be very expensive and time-consuming to test each lab analyte for all possibilities.

For such cases, physicians need one or two fast and accurate tests to narrow down the potential diagnoses to a short list, especially when patient life is at stake. Measured osmolality is

one of these high-value tests since it can be used in a variety of diagnoses, such as:

- Hyponatremia and similar electrolyte disorders
- Alcohol and toxin ingestion
- Metabolic acidosis
- Monitoring of osmotically active drug therapies

For example, in patients with hyponatremia—the most common and potentially life-threatening electrolyte disorder found clinically, affecting up to 30% of hospitalized patients[6]—osmolality of serum and urine is a critical measurement for understanding the underlying pathophysiology. Depending on whether osmolality is low, normal or high, there are many causes for hyponatremia; determining the underlying pathological processes is absolutely essential to ensure proper treatment. In fact, therapies will be entirely different depending on the cause of hyponatremia (i.e. fluid resuscitation vs. fluid restriction).

"When I treat patients with hyponatremia, there are 100 different potential diagnoses that I'm thinking about," explains Neville R. Dossabhoy, MD, Consultant Nephrologist in Shreveport, Louisiana, USA. "Running osmolality allows me to narrow it down to fewer than a dozen. It is a great initial screening tool: Using it leads to significant cost savings and quicker and proper diagnoses. It also eliminates the patient spending days in an ICU bed, waiting for the results of several dozen tests. Just one or two misdiagnosed patients can cost the hospital system as much as the price of the osmometer."

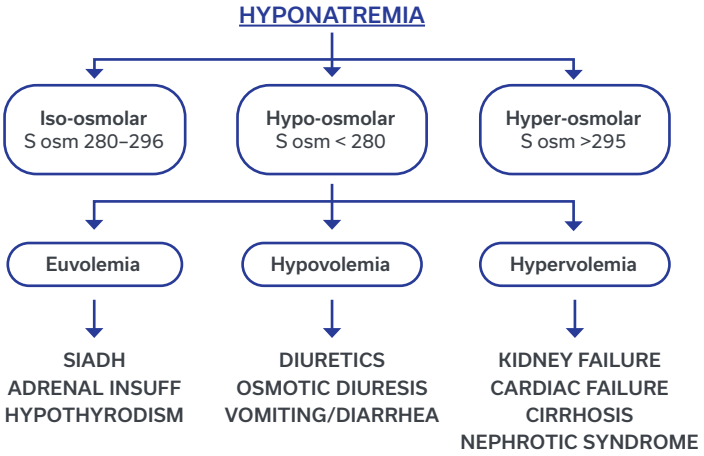

Figure 1. Differential Diagnosis of Hyponatremia

During the COVID-19 pandemic, osmolality testing has become even more critical, with a growing body of evidence in the literature demonstrating that osmolality is an important tool in monitoring and managing COVID patients[7]. Actually, an electrolyte disorder may be an indication that a patient has COVID, and hyponatremia can be the first and only presentation[8]. Moreover, pre-existing hyponatremia and hyperglycemia can be greatly worsened by a COVID-19 infection. In these cases, a quick and proper diagnosis is essential to decide the most appropriate therapy for each patient and thereby to improve quality of care.

In-House Testing: Quicker Diagnoses Have a Profound Effect on Patient Care

A crucial parameter for optimizing the quality of patient care is avoiding delays in analytical processing. "Some hospital labs send patients' samples to external labs for osmolality testing because they have low numbers of samples to process," says Julie MacKenzie. "The results will then take anywhere from a few hours to several days to get back depending on the location of the laboratory doing the testing. This delay causes two major problems. First, the physician—and more importantly, the patient—are waiting for that result, which is needed to begin treatment. The second issue is sample stability: Sending out a sample can compromise its integrity. For example, evaporation can occur, putting the accuracy of the test results at risk."

In-house osmolality testing overcomes these two issues, providing timely and accurate test results for better patient management.

Moreover, while doctors wait for patients' osmolality results, further tests and treatment may be delayed, which can lead to weaker patient outcomes. In fact, patients may not receive the most appropriate treatment in time, which can have detrimental consequences, especially in case of life-threatening conditions needing immediate care. Moreover, inaccurate diagnoses due to premature evaluation of the patients' conditions may result in longer patient-stays, and, hence, in losses of time and money for the whole organization.

These negative consequences can be mitigated by equipping the lab with a dependable osmometer. "Having an osmometer in-house is extremely important for both turnaround times and for the accuracy of the results," remarks MacKenzie. "In-house osmolality testing not only brings savings in terms of time and money. More importantly, it has a positive impact on the quality of care and the patients' well-being. Sometimes labs may not have an osmometer in-house because physicians aren't ordering the test very often, but physicians aren't ordering the test often because labs don't have an osmometer in-house. It's important to break this cycle." In fact, STAT osmolality testing would allow physicians to prescribe this testing every time they need it. The results would include:

- expediting patient treatment;
- mitigating patient specimen stability concerns;
- enabling time-sensitive patient monitoring.

Measured Osmolality: Getting the Whole Picture

Osmolality is not the only concept that may be underestimated in clinical settings. The Osmol gap is defined as the difference between calculated and measured osmolality, and this concept is also more significant than it may initially sound. "Customers often ask me why they have to measure osmolality since they could just calculate it, and the values are usually the same," says MacKenzie. "They are partially right, but what they are missing is that you want to measure osmolality to detect a possible Osmol gap, because this is the most important information. The presence of an Osmol gap suggests that patients have some sort of foreign substance in their bodies. You would miss this if you would just calculate osmolality."

In fact, calculated osmolality values come off an automated analyzer detecting sodium, glucose and blood urine nitrogen (BUN) and do not account for the presence of clinically-relevant, osmotically active substances such as important

toxins or medications. The indicator for the presence of such substances is the Osmol gap. Therefore, measuring osmolality with an in-house osmometer brings significant advantages in terms of speed and accuracy of diagnosis as it provides physicians with all needed information[9].

Driving Workflow Efficiency With Fast and Accurate Osmolality Results

Being able to provide test results as quickly and accurately as possible is a major issue as more and more clinical laboratories struggle with a lack of financial means and staffing shortages. The concurrent increase in osmolality requests puts both small and larger laboratories under great pressure to perform more testing with fewer resources. "Our goal is to support clinical laboratories by driving time and labor savings, and hence improving workflow efficiency," explains MacKenzie. "This is why Advanced Instruments osmometers bring together accurate and reliable osmolality measurement with ease-of-use. These features allow a secure and efficient patient sample analysis."

	Calculated	Measured
Standard solutes (sodium, BUN, glucose)	●	●
Expanded solutes (toxic alcohols, mannitol)		●
Standardized testing method		●
Required for osmolal gap determination	●	●

Measured Osmolality provides a more comprehensive picture of the patient's lab chemistry over calculated osmolality.

Further, multi-sample osmometers such as the OsmoPRO® allow laboratories to free up resources so technicians can focus on other tasks while also dramatically reducing turnaround times from one entire day to a few hours. "Our data security features and the possibility of connecting our osmometers to the LIS reduce the risk of sample mix-ups and ensure a safe and direct transmission of the test results to the physicians with no need of paperwork and, hence, no risk of miscommunication," remarks MacKenzie. In fact, all of these features are essential for labs aiming to ensure accurate and quick turnaround of osmolality results for better patient care.

1. https://www.ncbi.nlm.nih.gov/books/NBK567764/
2. https://www.emcdda.europa.eu/system/files/publications/12725/TD02AY20001ENN.pdf
3. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0226029
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