

Osmolality: using automation to enhance this powerful screening tool

Osmolality testing is a powerful screening tool which provides quick and accurate diagnoses for a wide range of disorders. With continuing pressure on laboratories and their staff, a new osmometer with increased automation, ease of use, and workflow flexibility also offers further features to minimise errors and simplify the testing process.

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.

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 acidosis⁴ and electrolyte disorders⁵ 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 laboratory 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 a patient’s 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 patients⁶ – 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 (ie fluid resuscitation vs fluid restriction).



In-house osmolality testing means quick and accurate results as samples aren’t compromised by delays or excessive handling/transport.



The OsmoPRO MAX's integrated barcode scanners trace users, minimise errors and simplify the testing process.

"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."

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 patient.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

A crucial parameter for optimising the quality of patient care is avoiding delays in analytical processing. "Some hospital laboratories send patients' samples to external labs for osmolality testing because they have low numbers of samples to process," says Julie MacKenzie, Senior Manager Clinical Product Portfolio at Advanced

Instruments. "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.

"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 laboratories 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 laboratories don't have an osmometer in house. It's important to break this cycle."

Measured osmolality

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 analyser 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

Being able to provide test results as quickly and accurately as possible is a major issue as more and more 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 labour 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."

The OsmoPRO MAX

Suited for laboratories of all sizes, the OsmoPRO MAX revolutionises osmolality testing with innovative flow-through technology that eliminates the need for consumables by pipetting samples directly from primary tubes, performing testing and cleaning within the device. Continuous loading and unloading removes the need to batch test.

By offering unparalleled automation, workflow flexibility, and data management allows laboratories to free up resources so staff can focus on other tasks while also dramatically reducing turnaround times. Connected features also ensure safety and security. "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.

<ul style="list-style-type: none"> ■ Onboard video instructions ■ Primary tube testing ■ Automatic sample identification with onboard barcode scanning ■ Badge scanning capability ■ Programmable replicate testing ■ STAT testing and load more capability ■ Continuous loading and unloading (up to 500 tests) ■ Compatible with multiple primary tube sizes 	<ul style="list-style-type: none"> ■ Automatic testing ■ Automatic cleaning between samples ■ Multi-sample capability ■ Multi-language touchscreen display ■ Integrated barcode scanners ■ Primary vial control testing ■ Real-time QC status indicator ■ Direct QC data upload ■ Out of specification QC alert capability ■ Sample ID traceability ■ User traceability 	<ul style="list-style-type: none"> ■ Two-level, password protected user access ■ Onboard results & events storage (1,000 results/10,000 events) ■ Ethernet for LIS connectivity ■ Multiple USB connections ■ 170 µL minimum required sample volume (small volume inserts) ■ 480 µL minimum required sample volume (primary tubes) ■ Ready-to-use system fluid
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Table 1. OsmoPRO MAX feature set.

In fact, all of these features are essential for laboratories aiming to ensure accurate and quick turnaround of osmolality results for better patient care. A full list of the OsmoPRO MAX's features can be seen in Table 1.

In the development process of the OsmoPRO MAX, Advanced Instruments took onboard the feedback from its customer development panel. "It's so important to talk to our customers, listen to their challenge and create something to meet those challenges," explains MacKenzie. "We can't assume anything and for a new instrument to be worthwhile it must fit seamlessly within a laboratory's workflow."

Workflow benefits

The OsmoPRO MAX has recently been tested in two NHS laboratories.

Katie Hicks is Senior Biomedical Scientist, Biochemistry, at the University Hospital of Wales, Cardiff and Vale University Health Board and her laboratory recently trialled the new osmometer. "The OsmoPRO MAX was very easy to use. I had minimal training and was able to easily navigate around the various screens within the software. The software was very user friendly and it's good that it was very similar to the OsmoPRO software so it felt familiar. Our other members of staff found it very easy to use," she commented.

Katie explained that in her laboratory the osmometer needs to be ready for use at any time of the night or day, so ease of use is paramount. "The analyser was compact with a perfect sized footprint to fit into our laboratory and the staff were very positive about its design. We liked that the maintenance kit has everything in one box and the assurance tag functionality allows traceability of lot numbers and expiration dates."

The biggest all round benefit though is the time saving afforded by the added automation, as Katie explains: "In terms of functionality, it did exactly what we want it to do – a set up and walk away analyser, allowing multi-sample analysis

with minimal user involvement, putting staff back into the laboratory to do other tasks." Summing up, Katie added: "We were very impressed with the analyser and it is definitely the obvious next step for us as a laboratory."

Deborah Beesley, Lead Biomedical Scientist Clinical Biochemistry, Royal Preston Hospital, Lancashire Teaching Hospitals NHS Foundation Trust, also recently completed a trial of the OsmoPRO MAX and had this to say about the instrument: "We trialled the OsmoPRO MAX as we need to replace some aging equipment. It was set up for us by Advanced Instruments and in the time the machine was with us it always operated in range so there were no concerns about accuracy or reliability."

"The relevant staff were provided with a couple of hours of training, which was all we needed as the machine is very simple to use. Osmolality is a stat test which means it has to be turned around within four hours, but ideally within one hour, so the machine is used 24/7."

In common with Katie, Deborah found the freeing up of time enabled by the OsmoPRO MAX's added automation was the biggest overall benefit, she summarised by saying: "The main advantage offered by the OsmoPRO MAX over our existing machines is the ability to load the samples and then walk away – currently our staff have to sit with the existing equipment until the test is completed. With workloads going up and pressures on staffing that feature is really valuable and was the biggest benefit for our laboratory."

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Visit the Advanced Instruments website to see the company's full range of osmometers, including the new OsmoPRO MAX.

✉ emeasales@aicompanies.com
 🌐 www.aicompanies.com/clinical-osmometers/