

# White Paper: Use of the MX3 Hydration Testing System for hydration assessment

## Medical Disclaimer

The MX3 Hydration Testing System (HTS) is not registered as a medical device (outside of the United States) and is not intended to diagnose, cure, mitigate, treat or prevent any disease or health condition.

## The Importance of Hydration

- **Occupational Health and Safety**

Dehydration can make workers feel more fatigued, less alert, and more prone to mistakes, especially in hot environments. It reduces productivity by lowering energy levels and the ability to sustain work over time. It also increases the risk of heat-related issues, which can lead to more breaks, lost work time, or even serious health incidents.

- **Sport and Fitness**

Fluid loss greater than 2% of body mass loss (BML) results in reduced endurance and muscular strength which adversely affect exercise performance, particularly in hot and/or humid conditions.

- **Military and Defense**

In addition to the above, fluid loss in military personnel can compromise mission objectives. Dehydration as little as 2% (BML) causes significant performance deficits and much greater dehydration - up to 6% BML - has been reported in short duration (<125 mins) training flights and missions.

## The use of SOSM as a Hydration Biomarker

**Salivary Osmolarity (SOSM):** defined as the number of solute particles per litre of saliva.

The majority of evidence for SOSM as a hydration biomarker has been collected in the context of exercise performance and occupational health and safety. Several studies

have demonstrated the utility of SOSM and its strong correlation to blood-based markers (e.g., plasma osmolality) and body mass loss.

Details of these specific studies can be found in the complete version of this White Paper.

## **Limitations of SOSM hydration assessments and how these are addressed by MX3**

### **Inter- and Intra-Individual Variability**

SOSM values can vary both within and between individuals, requiring multiple measurements across days to properly characterise typical ranges. The MX3 HTS enables practical and accessible data collection, allowing users to establish a personalised baseline when well hydrated for more accurate hydration assessment. This baseline can be created using the MX3 app to define an individual's normal SOSM range in a given environment. If baselining is not feasible, population reference ranges can still be used, as dehydration typically causes much larger changes in SOSM than normal day-to-day variation. Baselining should be repeated if the environment changes (e.g., changes in ambient temperature).

### **Sample Collection Difficulties**

Saliva collection can be challenging after intense exercise due to reduced saliva volume or naturally viscous saliva in some individuals. Traditional osmometers require relatively large sample volumes, making measurement difficult in these conditions. The MX3 HTS overcomes this by requiring less than one microlitre of saliva, enabling testing even with minimal sample availability. Its microfluidic test strip design also allows accurate measurement of highly viscous saliva.

### **Recent Food or Drink**

Recent food or fluid intake can distort SOSM measurements, with water lowering values and high-osmolarity drinks or foods increasing them. To minimise this, users are instructed to produce fresh saliva and wait at least 5 minutes after eating or drinking before testing. The MX3 app can prompt users to confirm compliance with this guideline at the time of measurement. Additionally, abnormal readings are flagged by built-in algorithms and reported to administrators to identify potential misuse.

**Check out our [Understanding Saliva Variability](#) for further information.**

## Analytical Performance of the MX3 HTS

The MX3 HTS has been benchmarked against a conventional osmometer in two independent studies. Both report a very strong correlation between the MX3 and reported SOSM values.

- Study 1:  $R^2 = 0.95$  (Fig 1)
- Study 2:  $R^2 = 0.92$

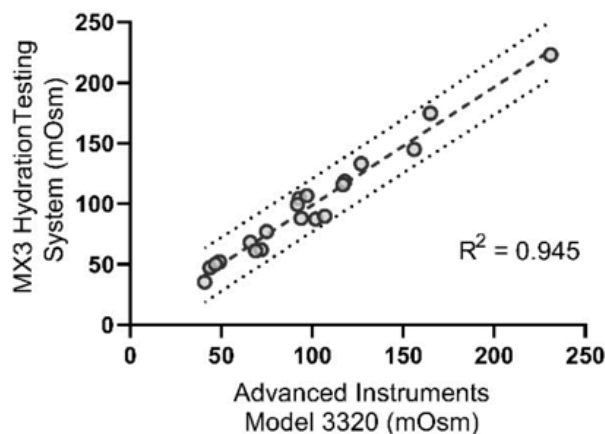


Fig 1. Correlation of SOSM readings measured by the MX3 HTs and a benchtop osmometer.

SOSM measures directly off the tongue will exhibit a larger amount of variation due to the confounding effects of sampling variation. As such, measurements may vary by ~20 mOsm.

## Impact of Health Conditions and Medications on SOSM

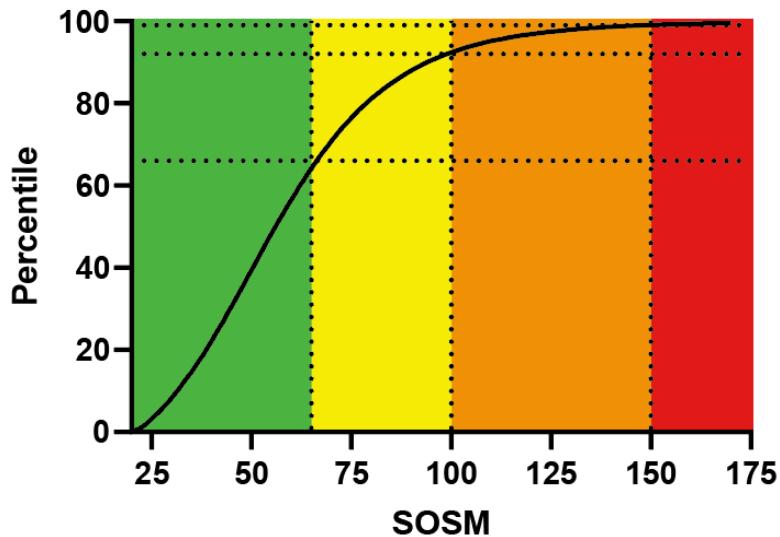
SOSM measurements may be influenced by medications and health conditions that alter salivary flow, such as those associated with dry mouth (xerostomia) or excessive saliva (sialorrhea). To improve accuracy, individuals should establish a personalised baseline when fully hydrated, ensuring sampling consistency (e.g., swallowing prior saliva or briefly hydrating in cases of dry mouth). Re-baselining is recommended whenever medication regimens or health status change to maintain reliable interpretation of SOSM data.

## Hydration Classification with the MX3 HTS

The MX3 HTS reports the SOSM in milliosmoles (mOsm) and into one of four hydration categories:

- Hydrated (<66 mOsm)
- Mildly Dehydrated (66-100 mOsm)
- Moderately Dehydrated (101-150 mOsm)
- Severely Dehydrated (>150 mOsm)

A distribution of over 250,000 SOSM measurements (**Fig 2**) conducted by our customers. Approximately 66% of measurements are below 65 mOsm, 92% of measurements are below 100 mOsm and 99% of measurements are below 150 mOsm during regular use.



**Fig 2.** Distribution of >250,000 MX3 SOSM measurements conducted between Jan 2019 and Dec 2021. Colours represent default MX3 HTS hydration categories.

## Comparison of SOSM and Urine Specific Gravity

Spot-checks of urine specific gravity (USG) are commonplace in sporting organisations and occupational settings. Recent evidence suggests that USG spot-checks have a very poor performance and are influenced heavily by recent fluid intake, physical activity and diet.

Our own internal testing of **well-controlled first-morning voids** have found good correlations ( $R^2 = 0.55$ ) between USG and SOSM (Fig 3).

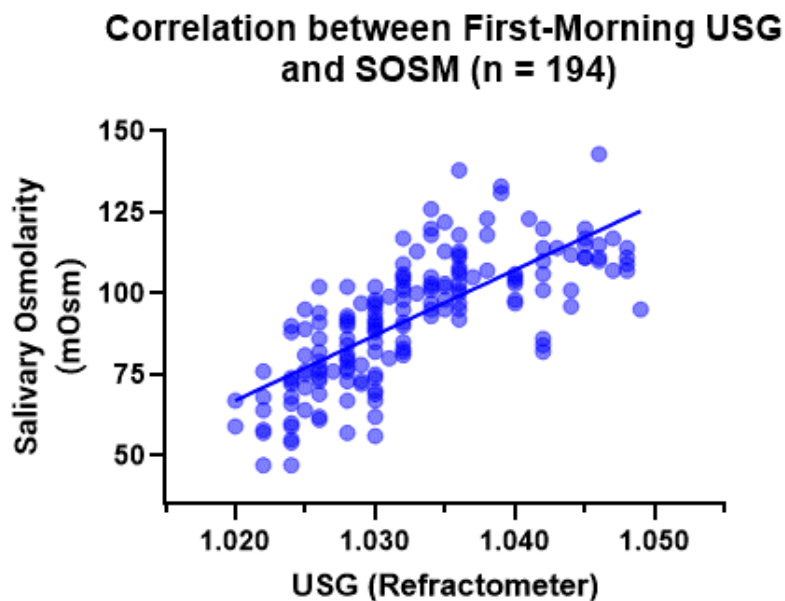


Fig 3. Correlation of first-morning void USG and SOSM.

When looking to validate the performance of MX3 measurements a more appropriate comparison is between MX3 SOSM measurements and nude BML during active dehydration. Plasma osmolarity, considered to be a gold standard for water loss dehydration, is also an appropriate comparator, but will not likely be accessible in a workplace or sport environment.

## Example Testing Protocol using MX3

1. Confirm with the individual that they have not ingested any food or fluids for at least 5 mins.
2. Log into the MX3 App using a unique account for each user and operator, ensuring measurements are correctly assigned.
3. Follow app prompts to prepare the device, optionally confirm no recent food or fluid intake, and have the user generate a fresh saliva sample on the tongue.
4. Ensure adequate, non-bubbly, debris-free saliva before collecting the sample with the test strip until the device beeps.
5. Allow the analysis to complete, view the result in the app, and then safely eject the test strip.

## Interpretation of MX3 Results

Measurement interpretation will be specific to your environment and should be considered in combination with other heat stress and dehydration indicators. MX3 hydration classifications provide general guidance on hydration status before and after work or exercise, helping users make informed decisions about fluid intake and recovery. These classifications are not medical advice and should be interpreted alongside environmental conditions and other indicators of heat stress. If symptoms of dehydration or heat strain occur, individuals should stop activity and seek medical attention.



**Example of the MX3 smartphone application after a mildly dehydrated test.**

[Check Out our User Manual for More Information](#)

## Published Research using the MX3 HTS

The MX3 HTS has been used to quantify hydration status in [several peer reviewed articles](#). A snapshot of some of these are provided here:

### Sport and Exercise

[A 2025 study](#) in 40 male footballers found that 52% of players were NOT optimally hydrated before kick-off across four matches (Fig 4).

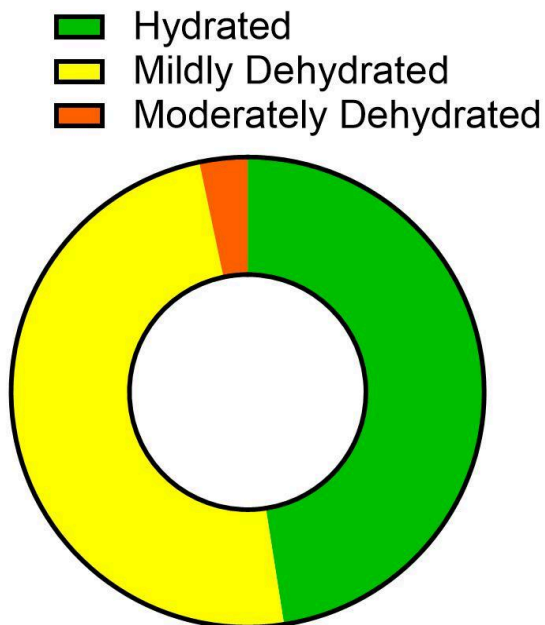


Fig 4. Percentage of elite male footballers in each MX3 Hydration Category prior to a match. Data from Schwarz et al. 2025.

## Occupational Health and Safety

[Across a 13-week Fire School](#), SOSM values significantly decreased over time (Fig 5), indicating an improved hydration status.

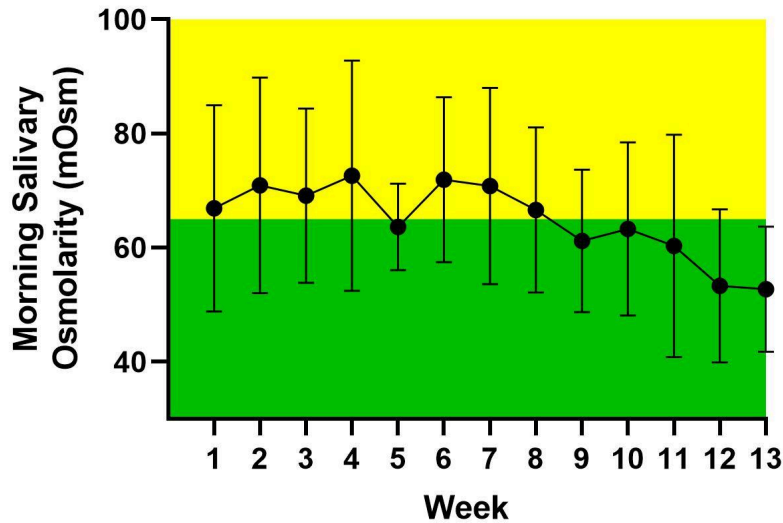


Fig 5. Morning SOSM data of 23 firefighters attending Fire School. Reprinted from Holland-Winkler et al. 2025. Green area represents adequately hydrated. Yellow area represents mild dehydration.

## Medicine

In [older adults with hypertension](#), SOSM strongly correlated with **first-morning USG** and also demonstrated strong diagnostic performance in identifying dehydration (Fig 6).

### Predictive Performance of SOSM Hydration Categorization

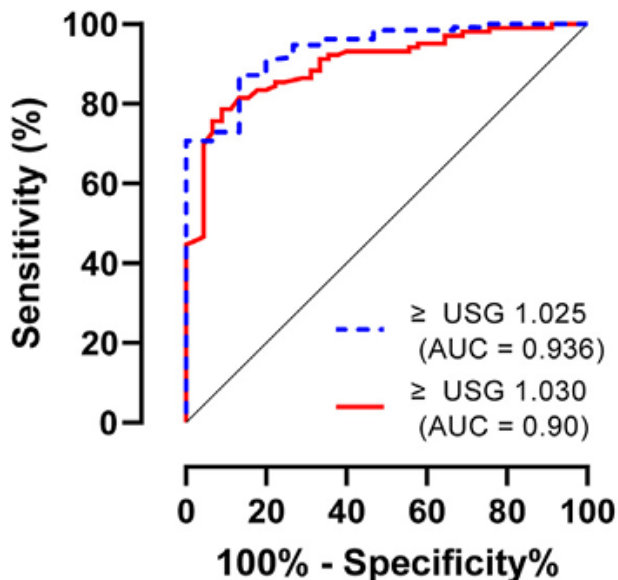


Fig 6. ROC curve of the SOSM test benchmarked against 2 USG threshold values. The diagonal line indicates the line of identity. Data from Atjo et al. 2022.

## Contact Us For Further Information

Website: [MX3 Diagnostics - Ensure Optimal Hydration](#)

Additional Resources: [Biomarker Testing Resources - MX3 Diagnostics](#)

Frequently Asked Questions: [MX3 Diagnostics FAQ](#)

Email MX3 Support: [support@mx3diagnostics.com](mailto:support@mx3diagnostics.com)