





Revolutionary Hydration Health Center

Revealing the Hydration-Health Connection

By Christine Umbrell



More and more, research is revealing the role of consistent consumption of water in promoting health and contributing to the prevention of chronic health issues as we age. The recently launched Hydration Health Center (HHC), at the University of Hartford (UHart), is on a mission to make known and reinforce the many benefits of drinking water by defining “optimal hydration practices and characteristics to promote health and well-being” through new and comprehensive scientific research. Founded in 2023, HHC staff have a vision for the Center to be an educational resource that leverages state-of-the-art technologies and methods to study how the distinct patterns and profiles of hydration behaviors and status determine the pace, breadth, and extent of the impact of habitual water intake on acute and chronic health.

Leading the way are two research scientists who co-founded the HHC: Colleen X. Muñoz, PhD, an associate professor of health sciences at UHart and director of HHC, and Michael F. Bergeron, PhD, FACS, a visiting scholar in the Department of Health Sciences at UHart and senior advisor of the HHC. They are spearheading the HHC, publishing and promoting key hydration-related information, and leading studies that will incorporate artificial intelligence (AI) and machine learning models to characterize and predict outcomes in terms of hydration and health. In fact, the respect for and support of the work that is coming out of the HHC inspired the Drinking Water Research Foundation, a non-profit that educates the public about drinking water and the associated benefits of consuming water, and Niagara Cares, the charitable

arm of Niagara Bottling, to make monetary contributions to help the Center initiate and continue its innovative studies and message. By sharing insights from the HHC's research, IBWA members can not only help educate the public about the benefits of drinking water but also play a supporting role in improving the health and well-being of millions of consumers.

Go-To Resource for Consumers and Researchers

Evidence-based research serves as the basis for the HHC. "You would think that there's a lot of [health-specific hydration information] available right now—but there's really not," says Muñoz. The HHC fills that void by serving as a "one-stop-shop" for information related to healthy hydration practices and outcomes. The HHC "gives the public a rational guideline as to the utility of water and its health-promoting advantages—not only in the immediate sense, but long-term, and to be the go-to resource," adds Bergeron.

Educating the public—via evidence-based research—has become even more important with the rise of social media

HOW MUCH WATER IS "ENOUGH"? CHECK YOUR URINE

Water consumption is not a one-size-fits-all activity, according to the co-founders of the Hydration Health Center. Some global health organizations recommend that women should drink at least 2 liters (~68 fl. oz.) and men at least 2.5 liters (~85 fl. oz.) of fluids every day. But that approach is much too generalized, say Colleen X. Muñoz, PhD, and Michael F. Bergeron, PhD, FACSM.

Some people might need to drink more fluids to maintain their body water balance—"for example, spending time outside in warm-to-hot weather and participating in strenuous physical activity will require you to drink more," says Muñoz.

As a quick-and-easy self-evaluation, Muñoz and Bergeron recommend checking your urine color to help guide your fluid intake needs: If your urine is dark (like apple juice or iced tea) it's time to drink more water. Conversely, if your urine color is clear or almost clear, then reduce your fluid intake for a while.

"The goal is to have urine color that is similar to light-colored lemonade," says Muñoz. "Whereas more research is needed to help us determine how much, what, and when people across the lifespan should be drinking, we encourage you to examine your urine color regularly to assist in your efforts to feel and perform at your best."

and misinformation. "There's a lot of information on the internet that's not necessarily true," explains Muñoz. "I think people need to appreciate the quality of resources" they access for reliable information. For bottled water companies and consumers, "we need to focus on pointing people toward scientifically based resources," such as the HHC.

In the scientific realm, "several investigations have shown data that suggest that the general public is frequently underhydrated," says Muñoz. Given that knowledge, "we generally focus on working to get people to drink more water. But there are scenarios where it can go too far," she says. "Healthy and effective hydration is a balance of pure water and other solids, or particles—like electrolytes and macronutrients. So, if you're eating pretty regularly and you're routinely drinking a good amount of water, then you're probably OK. But also pay attention to your urine color, and if it's getting to where it's clear, then you want to back off on drinking water for a couple of hours. Clear and frequent urination suggests excessive water in circulation from overdrinking."

"If the pace of water intake exceeds the capability of your kidneys to get rid of it, your blood becomes dilute," adds Bergeron. "Healthy hydration is not water intake alone—it's the pattern, the pace of intake, the frequency of intake, and what you're drinking, and with what else," says Bergeron. "A well-hydrated person encompasses the right amount of total body water and proper distribution."

In addition to informing the public, the HHC serves a secondary purpose in the world of academia and research: "to stimulate more scientific research from fellow colleagues who already reside in the hydration science world, or those who have expertise in other aspects of science and medicine who also want to apply their research to a hydration and health scenario," says Muñoz.

"We want the HHC to advance this field in an innovative, evidence-informed, and holistic way—because that's where the current gaps are," adds Bergeron. "People have been traditionally looking at hydration in a very narrow single-mechanism or correlational way, but our approach is to examine numerous interconnected and interdependent simultaneous connections in a longitudinal manner to better reveal the real-world impact from regular, appropriate consumption of water every day to health."

One of the key tenets of the HHC is that individual hydration needs and impact should be considered across an age-based continuum, from youth through advanced age. Muñoz and Bergeron hope to clarify these age-specific insights by determining the distinct patterns and profiles

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of hydration behaviors, status, and resulting physiological influences that determine the pace, breadth, and extent of the impact of habitual water intake on acute and chronic health at all stages of life.

“We’re looking at a life-cycle approach,” emphasizes Bergeron. “We’re not looking at just an elderly population [or] a disease-risk population; we’re really looking at the entire continuum. Rather than being solely responsive, the goal for hydration health is to be preventative.”

Bergeron says one of the questions the HHC’s approach will consider is: “Are there indications in an adolescent, or a young adult, that might suggest there’s something beginning to evolve that would put you at greater health risk later if this were to continue?” He explains, “The temporal changes across the life cycle are where there is going to be great value in looking at that youth through advanced age approach—in the context of one’s own continuum of hydration-related health. And we should appreciate that your hydration behaviors as an adolescent likely have a measurable impact as an adult.”

Hydration Registry

While some tools and processes are still under development, Muñoz and Bergeron are setting the foundation to build a very large-scale data set, or “registry,” of hydration-related information. They plan to securely collect, organize, store, and analyze current and new physiological and behavioral metrics and biomarkers and other data within a dedicated evolving registry that will be used to reveal individual signatures of hydration-related health and clinical risk. They expect the registry to one day encompass both a local database and a cloud-based platform for profiling hydration behavior and health, guided by AI, advanced analytics, and modeling.

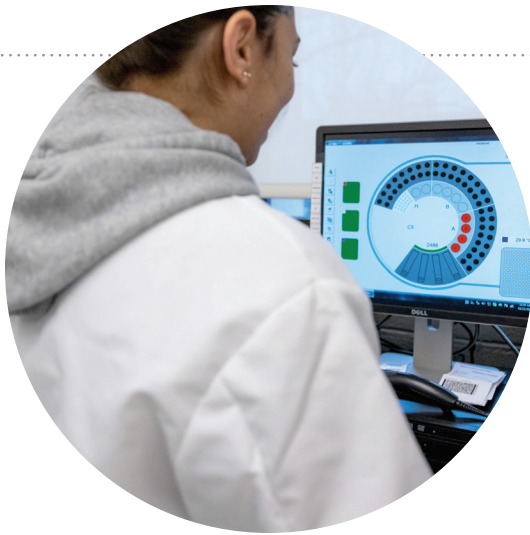
The registry will store data “from a lot of different populations, under different contexts, so that we can be a novel

and comprehensive hydration-related data resource” to other researchers and academicians, says Muñoz, and “support and incorporate many different scientific investigations.” To get things started, “the majority of the data will come from the HHC”—meaning investigations led by HHC staff—but they will in time expand the registry and allow others to contribute and utilize the information.

The types of information included in the database “will be very broad,” explains Muñoz. They plan to include descriptive characteristics and demographic factors such as sex, age, ethnicity, race, behaviors, and underlying disease states. “On top of all the hydration markers, we’ll include metrics that are either already established, or could be indirectly aligned with certain health conditions,” says Muñoz, “whether that be proteins in the blood associated with the blood’s ability to clot, or certainly numerous metrics related to kidney health. We’ll use all of those to determine and define patterns and interactions amongst the hydration variables, as well as the impact on and clinical indications of health.”

“We intend to start with healthy populations, but then our plan is to expand to selected clinical populations as well,” she says. The database will be robust enough “that if something scientifically interesting or clinically relevant pops up—such as a novel relationship that’s discovered, or a paradigm that nobody’s considered before in terms of interactions with hydration-related variables—then we have a new basis to turn to” to search for supporting evidence or similar patterns.

“The larger and more harmonized we get across data sets, the more utility such a database will have as far as providing research norms, or population normative values,” adds Bergeron. “As other researchers are looking to screen people, or to compare their data,” they can turn to the registry to help guide their own research.



When you put a lot of information in a very complex machine learning environment, those metrics can be examined in aggregate and new meaningful relationships become evident.

Clinical Tools

In addition to developing a database, the HHC team expects to develop some clinical tools, leveraging advanced technologies, that can be used more commonly in a clinical setting to assess and evaluate hydration. These tools may also assist in gathering data that could be housed in the registry.

KEY ROLE OF HYDRATION IN YOUTH ATHLETES—ON AND OFF THE FIELD

For youth who participate in sports, daily hydration management and habitual hydration status are key considerations that may too often be overlooked, according to Hydration Health Center Co-Founder Michael F. Bergeron, PhD, FACSM. In his recently published article “The Healthy Youth Athlete—Reinforcing the Role of Hydration,” Bergeron shares that daily hydration management assists young athletes both during and after practice and play.

Daily water intake patterns “profoundly impact and shape countless physiological processes aligned with growth and development,” according to Bergeron. Proper hydration can positively influence young people’s mental, physical, and thermoregulatory capacities.

Parents and coaches can model healthy hydration behaviors and help establish sensible hydration behaviors for youth athletes, but as they age, the athletes must learn to manage their own hydration needs and strategies—which will help them embrace healthy hydration habits that follow them into adulthood and contribute to long-term health. Read and download the full article on the Gatorade Sports Science Institute website: <https://www.gssiweb.org/en/sports-science-exchange/Article/the-healthy-youth-athlete-reinforcing-the-role-of-hydration>.

One possibility is new technology designed to track hydration, or to consider someone’s individualized hydration needs in relation to other factors. “We envision such an instrument initially being an in-house software platform,” says Bergeron. “Down the road, it could develop into a remote application for personal handheld devices.” Or their registry and platform could also be integrated with contemporary evaluation devices developed by outside entities, according to Bergeron.

Developing a tool that can offer immediate feedback, “based on models built from our dataset,” would offer “some additional diagnostic clinical support,” explains Bergeron. Such a tool would be “driven by behind-the-scenes validated models, to give you an immediate ability, either for yourself, or for persons you’re treating or researching, to say that based on X, Y, and Z”—for example, sex, age, health history, and some biometric parameters—“here’s an initial impression as to your potential risk” for underhydration. “An application—whether that’s a physical tool, or software application, or both—that can be updated remotely in an ongoing fashion—will be a simple and effective way to connect the users closer to the most current information we have on hand.”

Bergeron and Muñoz have been evaluating some of the metrics that have commonly been used to measure hydration, to determine which features to include in their database and any tools they develop. One key metric is urine color and concentration—and notably first-morning urine.

Last year, Bergeron and Muñoz published their initial findings on the value of studying first-morning urine samples in “Characterizing Hydration Practices in Healthy Young Recreationally Active Adults—Is There Utility in First-Morning Urine?” published in the *International Journal of Sport Nutrition and Exercise Metabolism*. In studying the diagnostic accuracy of first-morning urine, they concluded it is a cost-effective and relatively

easy way to accurately assess underhydration and routine hydration practices.

For data collection purposes, Muñoz points to “the ease in collection of a first-morning single sample, versus carrying a container around with you all day with your urine.” Such a sample is “minimally invasive and low burden” compared to blood collection or going to a lab. First-morning samples were found to be “very indicative of drinking behavior, not only over the last 24 hours, but over the past five days,” says Muñoz. “You can see the value, particularly as we’re trying to connect how much we’re drinking on a daily basis and chronic health outcomes—potentially for things like cardiometabolic and renal diseases,” in being able to generally assess one’s own hydration profile.

“It’s particularly helpful if we put even a simple measure such as first-morning urine color in the context of more information,” says Bergeron, which is where the database comes in. “If you take a single urine sample metric and you consider it under the influencing scenario and conditions inferred by other information, for instance physical activity, environment/climate, and drinking behavior—and if you incorporate some additional simple personal parameters such as age, and put all that into a validated model [from our database] to classify your likely hydration status, then there’s much more value in that single [urine] metric.”

“Modeling will be a big part of what we do,” adds Bergeron. The hope, for example, is “to take an individual’s profile, or a group’s profile of information, and objectively relate it to hydration status by a predictive model or ensemble of models that will classify that person for diagnostic clinical support.” By building “a very robust, multidomain registry of information, our models are more valuable. The bigger we get, the smarter our models will be.”

Integrating AI

Once the registry is up-and-running and populated with a wide variety of data, the scientists will leverage advanced technologies to study hydration. “We’re actually implementing AI and some machine learning to address complex relationships that are not reductionist-oriented—that is, single mechanism only,” says Muñoz.

“Part of the problem with the traditional scientific approach is: You come up with a hypothesis using specific variables that you think are causal,” adds Muñoz, “but it’s important to make sure biases aren’t getting in the way.” Using more objective and robust AI tools, HHC’s

CONTRIBUTE TO HHC

Interested in donating to the Hydration Health Center (HHC) at the University of Hartford? Visit www.hartford.edu/hydrationhealth and scroll down to access the “Contact Us” form, located at the bottom of the webpage. The HHC team will reply and provide donation instructions.

early research is showing that some of the “psychological data,” such as attitudes, beliefs, and behaviors surrounding hydration, have significant impact on hydration status. “To our surprise, the most important features that were related to someone’s hydration behavior were their attitudes and beliefs about their hydration, as opposed to their physiology, that was driving their intake patterns,” says Muñoz.

“Rather than solely traditional, easily interpreted correlations,” says Bergeron, “when you put a lot of information in a very complex machine learning environment, those correlations are there, but they may not be as strong—not as evident—and meaningful as when the metrics are examined in aggregate. Those underlying networks of higher-order relationships are more likely to reveal the real-world influences of hydration.”

“This is how the human body works—as a complex psychobiological network,” says Bergeron.

More To Come

Bergeron and Muñoz are excited about the HHC and the information and insights they are already collecting regarding hydration and health. “All the work we’ve outlined so far is going to take us into the next several decades,” says Muñoz.

Along the way, the researchers hope to boost their funding, and suggest that companies consider making contributions. “We are going to need support,” says Muñoz. “People see the value in the scientific information but forget that it costs a lot of money to do well.” **BWR**

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