Hydrostasis aims to be the standard for hydration monitoring. We provide actionable, real-time, and personalized hydration information that impacts health and safety, and performance.

Debbie K. Chen, Ph.D.
Founder, CEO
18yrs Optical Devices & Algorithm Development

UC San Diego
Tufts University
A 14-year-old collapsed and died during football practice at a Florida high school

By Scottie Andrew and Saeed Ahmed, CNN

Updated 4:13 PM ET, Wed June 12, 2019
Major Impacts of Dehydration in Sports

- Cognitive Function
- Cardiovascular System
- Muscle Power & Fatigue
- Aerobic / Anaerobic performance
- Risk of Concussions

2% decrease in hydration significantly impacts Cognitive Function

3% decrease in hydration decreases muscle function by up to 35%

Grandjean AC, Grandjean NR. (2007)
Meyer et al. (2016)
2019 Current State of Hydration Monitoring: urine color charts

Photo taken inside Olympic training center, 2019

Am I hydrated?
Urine Color Chart
Monitor your hydration status by checking your urine

<table>
<thead>
<tr>
<th>Urine Color</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrated</td>
<td>1</td>
</tr>
<tr>
<td>Hydrated</td>
<td>2</td>
</tr>
<tr>
<td>Maybe Dehydrated</td>
<td>3</td>
</tr>
<tr>
<td>Dehydrated</td>
<td>4</td>
</tr>
<tr>
<td>Very Dehydrated</td>
<td>5</td>
</tr>
</tbody>
</table>

Drink 1-2 cups of water before training or competition

Check in with sport dietitian or medicine prior to training/competition

*Some foods, medication and supplements (B vitamins) can change urine color.

Sport Dietitian: Shawn Dolan

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# Existing Methods of Hydration

<table>
<thead>
<tr>
<th>Method</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Manifestations: Thirst, Blood Pressure, Heart Rate</td>
<td>Easy to assess</td>
<td>Low sensitivity and/or specificity</td>
</tr>
</tbody>
</table>
| Blood Analysis: Plasma Osmolality, electrolytes, blood urea nitrogen (BUN) to Creatinine (Cr) ratio, hematocrit | Well-established, accurate in laboratory setting                     | • only sensitive to >3% of body weight  
• Hypertonic dehydration only  
• Invasive, impractical for frequent, portable, time-sensitive use |
| Urine Analysis: color, USG, osmolality, conductivity | Rapid assessment, relatively easy                                   | Unreliable, does not represent acute changes, affected by food, medication and illness          |
| Isotope Dilution                                  | Most reliable for assessing TBW                                      | Impractical for real-time monitoring, high cost, inconvenience, length of time                   |
| Weight Analysis                                   | Simple, accurate over short time periods                             | Large inter-subject variability of tissue composition not captured by weight                     |
| Bioelectric Impedance                             | Non-invasive, rapid, accurate for individuals at rest (laboratory conditions) | Stringent conditions for accurate readings make significant barriers for in-field settings with active individuals |
# Emerging Methods of Hydration

<table>
<thead>
<tr>
<th>Method</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capillary refill time,</td>
<td>Various degrees of sensitivity and specificity</td>
<td>Need development of rapid, economical, portable sensors</td>
</tr>
<tr>
<td>electromagnetic, Saliva</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near-Infrared Spectroscopy**</td>
<td>Linear correlation in NIR signal and skin hydration, non-invasive,</td>
<td>No validated studies with total body hydration, high scattering in human tissues</td>
</tr>
<tr>
<td></td>
<td>portable, continuous</td>
<td></td>
</tr>
<tr>
<td>Sweat</td>
<td>Small footprint: Printed circuit board, impedimetric tattoo,</td>
<td>Short-term use, acute changes, depends on person sweating</td>
</tr>
<tr>
<td></td>
<td>Metabolites: glucose and lactate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrolyte: Na+, K+</td>
<td></td>
</tr>
<tr>
<td>Osmotic Pressure</td>
<td>Minimally invasive, small blood samples, small footprint</td>
<td>Impractical for real-time monitoring (7hrs for max change in signal)</td>
</tr>
<tr>
<td>Acoustical</td>
<td>Promising early studies, continuous monitoring</td>
<td>High variation between subjects, requires precise repositioning of transducers and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>temperature control</td>
</tr>
</tbody>
</table>

Garrett, et al. Review IEEE 2018

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Real Time Information

- Arrival is important to prevention of injury
- The day before a game is deemed more actionable by many
- Departure is critical to recovery
- Those responsible for hydration want to know what’s happening more than 1x per day
- Real time also solves for different weather conditions

“The sun is also a factor, something that tells us today losing more fluids than normal, more beneficial.”

“Knowing going into a practice or game... can we get ahead of it so they’re not cramping or feeling extra fatigue.”

“Just know what it is at different times of day. Don’t realize they have to refill their tank after practice. For them, knowing how much to drink, would be ideal. For him, knowing a number and seeing a pre- and post- practice result.”
Notifications / Alerts

“In a perfect world, you’d have it set it up all the time with all the guys and get warnings if they are coming into a dehydrated state.”

“[Notifications are] critical for the athlete, not so much for coaches. It’s also important to dieticians.”

“I would want to know if it’s accurate and individualized. For example, for notifications, can you turn on or off for athletes. [Described the Gatorade Scale they had at Florida. After the weigh out:] It would tell them how much they need to drink. Some people loved it, some hated it. It was annoying, one more notification coming up on their screen.”
Historical data by Athlete

- Ability to store and access data over a course of a season was deemed critical by some.
- For existing trackers, they would need this to replace their current spreadsheet version.
- There is also a desire to correlate hydration to injury (most commonly stated) and performance.

“[It’s] Very important - you can always look back on certain games, performance, injuries. Very cool to look at that, see a pattern. Give than info to an athlete, and they will learn.”

“I’m thinking about looking back at injuries - where were they at, or if there was cramping and soreness.”
Hydrostasis Aleri™

1. Wearable Sensor
2. Individual Mobile App
3. Decision Maker’s Analytics Platform

Patent Pending:
US Application #16/395,148
International Application #PCT/US19/29224
US Design Application No. 29/682,158
Scientifically Proven
Based on Diffuse Near-Infrared Spectroscopy

Real-time, preventative notifications.
Optimal Hydration Range

Start workout

Personalized Hydration Index

-2%
+2%
-1%
+1%

Over-hydrated

Pre-Overhydration Zone (POZ)

Pre-Dehydration Zone (PDZ)

Dehydrated

Time

Personalized information

Skin Tone
Blood Flow
Fat
Hydration

Hydro Stasis
Personalized Hydration Index Shows Strong Correlation to Athlete Performance and Wellness

### Hydration and Performance Correlation

<table>
<thead>
<tr>
<th>Hydrostasis Hydration Index</th>
<th>Correlation</th>
<th>Performance Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average $\Delta PHI$</td>
<td><strong>Strong 0.81</strong></td>
<td>VersaClimber Distance</td>
</tr>
<tr>
<td>Average Arrival $\Delta PHI$</td>
<td><strong>Strong 0.83</strong></td>
<td>Power Clean</td>
</tr>
<tr>
<td>Average Arrival $\Delta PHI$</td>
<td><strong>Strong 0.85</strong></td>
<td>Back Squat</td>
</tr>
<tr>
<td>Average Arrival $\Delta PHI$</td>
<td><strong>Strong 0.85</strong></td>
<td>Front Squat</td>
</tr>
<tr>
<td>Average Arrival $\Delta PHI$</td>
<td><strong>Strong 0.73</strong></td>
<td>Bench</td>
</tr>
<tr>
<td>$\Delta PHI$</td>
<td>Weak</td>
<td>Weight</td>
</tr>
</tbody>
</table>

### Hydration and Readiness Correlation

<table>
<thead>
<tr>
<th>Hydrostasis Hydration Index</th>
<th>Correlation</th>
<th>Readiness Survey Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta PHI$</td>
<td><strong>Strong 0.74</strong></td>
<td>Water intake</td>
</tr>
<tr>
<td>$\Delta PHI$</td>
<td><strong>Strong 0.71</strong></td>
<td>Soreness</td>
</tr>
<tr>
<td>$\Delta PHI$</td>
<td>Moderate 0.68</td>
<td>Stress</td>
</tr>
</tbody>
</table>

**Other Correlations**

<table>
<thead>
<tr>
<th>Soreness</th>
<th>Moderate</th>
<th>Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soreness</td>
<td>Moderate</td>
<td># meals eaten</td>
</tr>
<tr>
<td>Soreness</td>
<td>Moderate</td>
<td>Sleep</td>
</tr>
</tbody>
</table>

*Tested full solution (Hardware & Software) with Division 1 Women’s Volleyball Team & Football Teams*
Ability to Reach Steady State in 15min

Figure 1. Water biosignal of a single user over 30 minutes of rest. Note the drop in value of 6.07% from start to finish (above). Oxygenated hemoglobin biosignal of a different single user over 30 minutes of rest. This signal increased by 1.32% during the session (below).
Ability to Capture a Single Hydration Event

Signals Show Significant Difference Before And After A Single 16oz Hydration Event

Hydration signal (normalized exponentially weighted mean)

Water (n=30)

Gatorade (n=10)

Before | After
--- | ---

Before | After
Ability to capture 12+ hours of Continuous Hydration Monitoring

We are characterizing at least 8 types of signals that impact hydration status in real-time.

- Hydration: type
- Food intake: sodium level, size
- Urination: color
- Workout: pre/post weight

Lipids/water

Deoxygenated Hemoglobin
Establishing Hydration Monitoring as standard measurement

Heart Rate Monitors

1980

Connected Healthcare

2030

Hydration Monitors

1980

2020

Sports Tech Hydrostasis Aleri™

2030
We need your help!

Set up a 30min phone interview to help us understand your team’s needs.

dchen@hydrostasis.com