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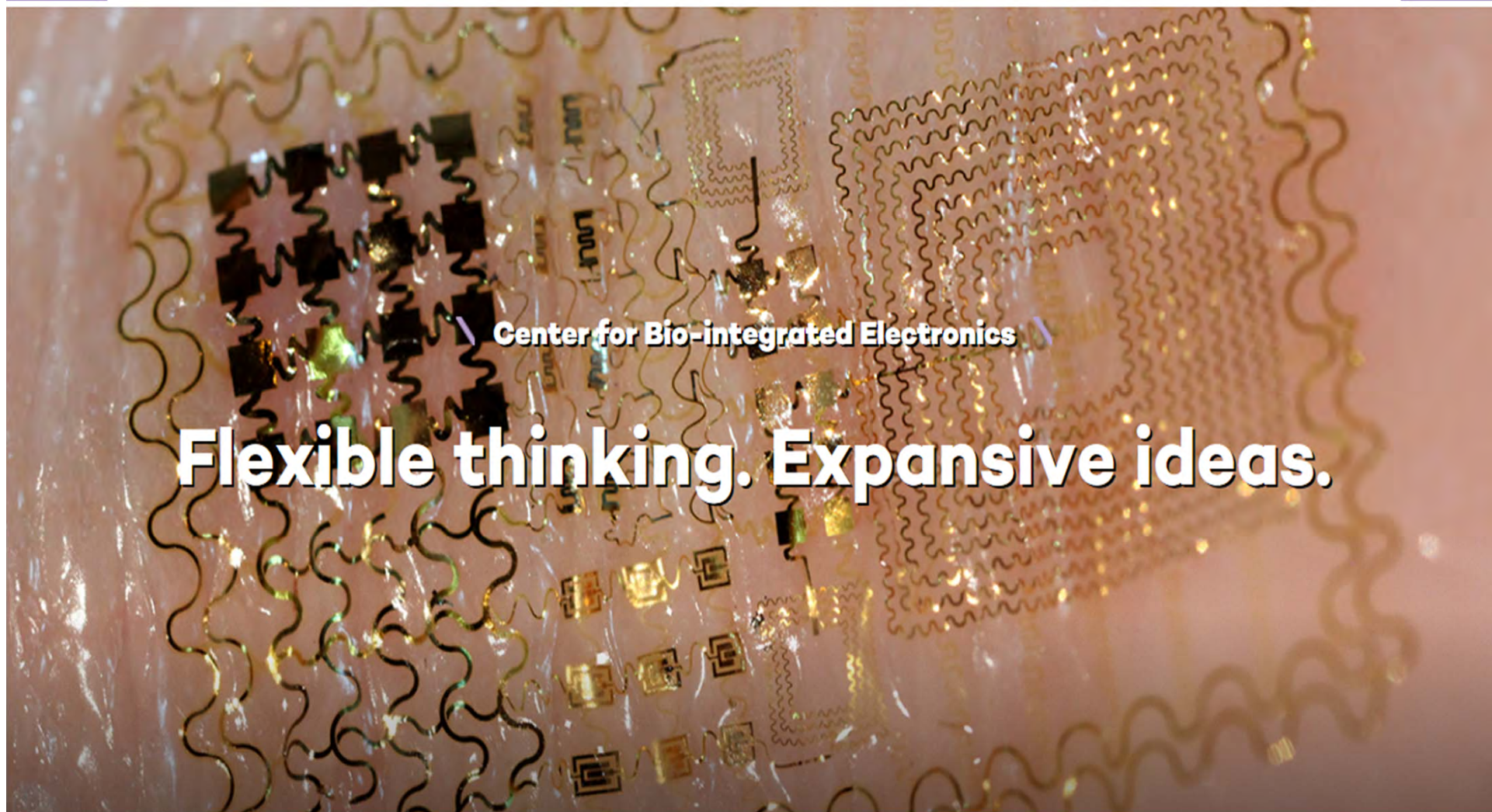
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Center for Bio-integrated Electronics

Flexible thinking. Expansive ideas.





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Research Team



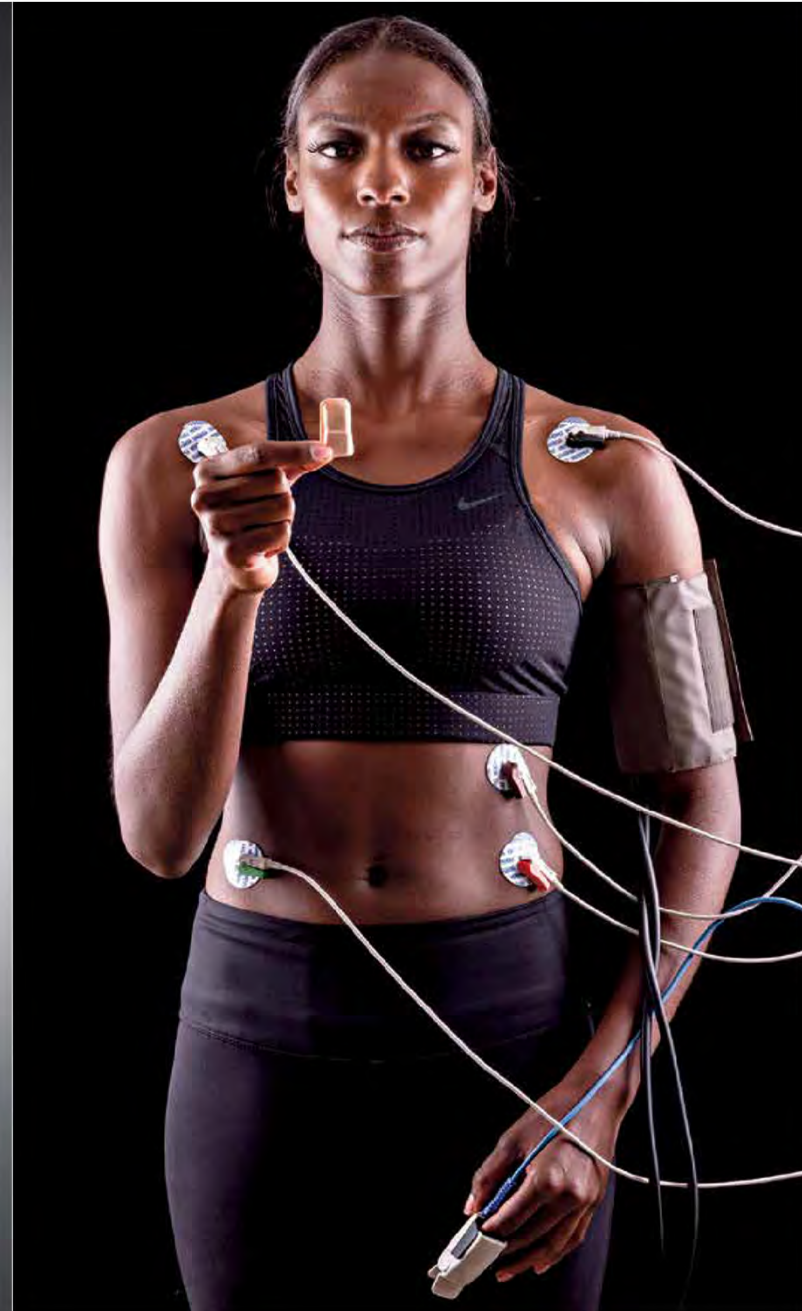
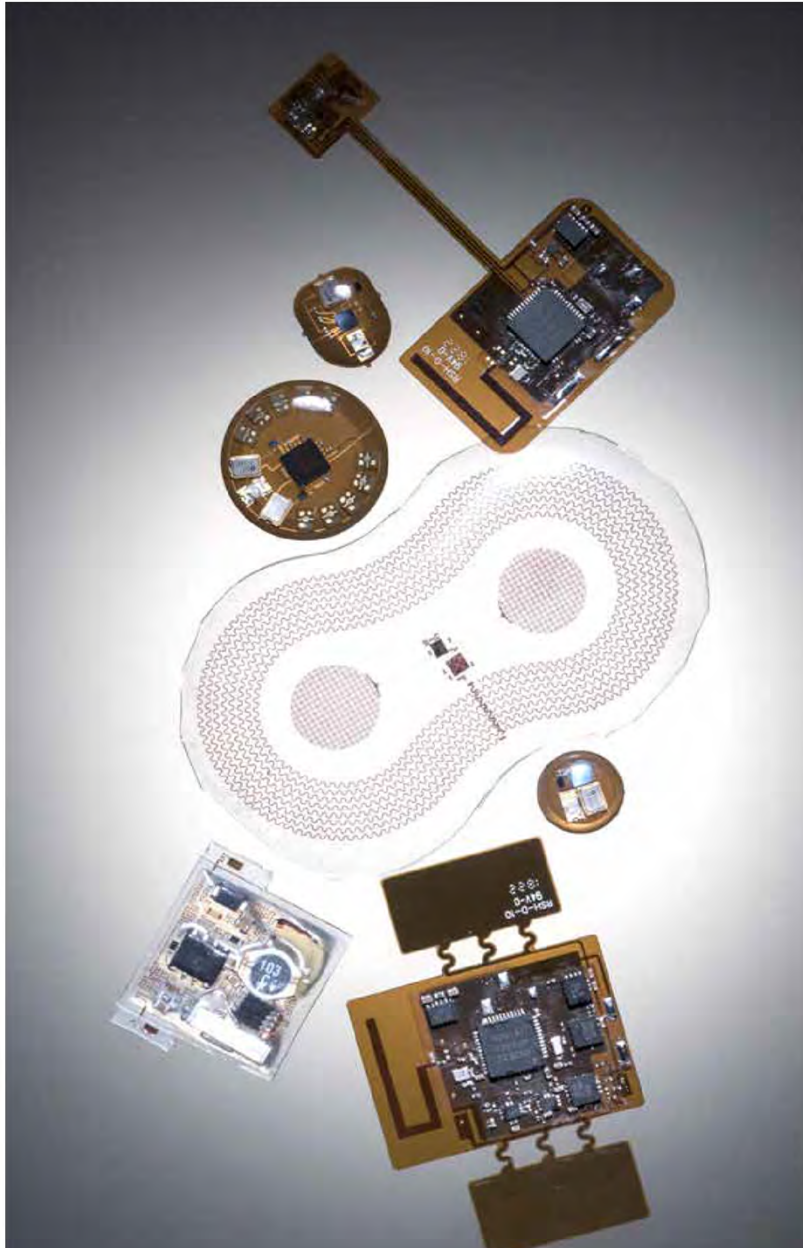


'Epidermal' Electronics

Multimodal, Clinical Quality Data



Science **344**, 70 (2014).
Science **333**, 838 (2011).



National Geographic, 2019

Measurement Capabilities in Epidermal Electronics

Thermal: Thermography, Thermal Transport, Hydration

Electrical: Biopotential (ECG, EMG, EEG), Hydration

Fluidic: Sweat (loss and chemistry), blood flow

Mechanical: Strain, motion, modulus, pressure

Optical: UVA/UVB, oximetry, PPG, vein mapping

Mechano-acoustic – cardiac auscultation, etc.

Big Data: Multiparametric, ICU Grade

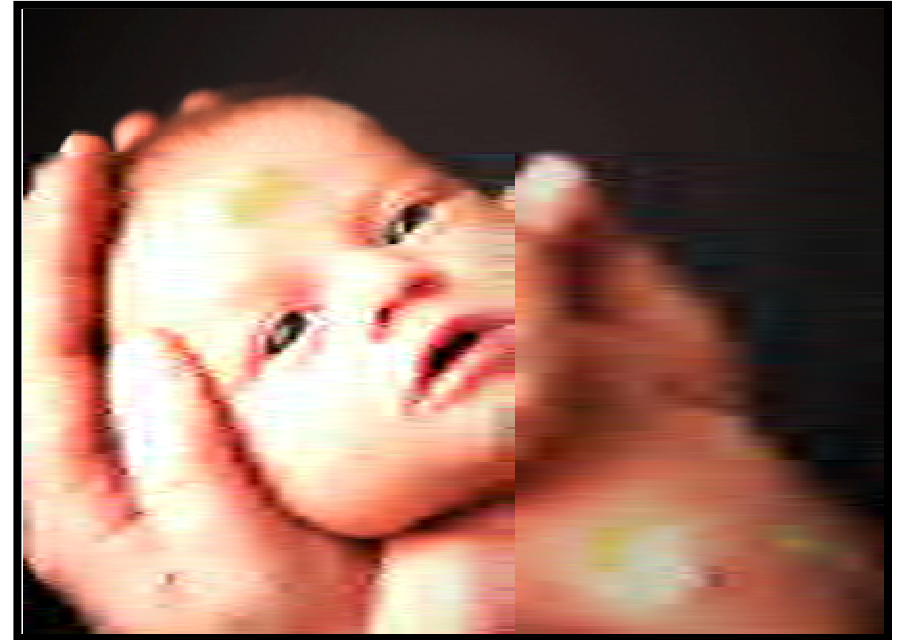


Neonatal Intensive Care

Current



Future





Science **363**, 6430, eaau0780 (2019).



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Save the Children®

Anthem®



Dräger

BILL &
MELINDA
GATES
foundation



5 continents, **17** countries,
increasing to **23** by the end of 2021





Devices Entering the Translational Pipeline

Flow for Hydrocephalus



Pediatric fNIRS



Fetal ECG



**Speech, Swallow for
Aphasia, Dysphagia**



Neonatal EEG



**Surgical Recovery
Neonates, Pediatrics**





Devices Entering the Translational Pipeline

Flow for Hydrocephalus



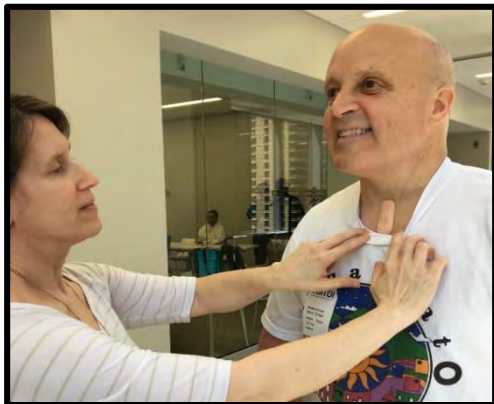
Pediatric NIRS



Fetal ECG



**Speech, Swallow for
Aphasia, Dysphagia**



Neonatal EEG



**Surgical Recovery
Neonates, Pediatrics**



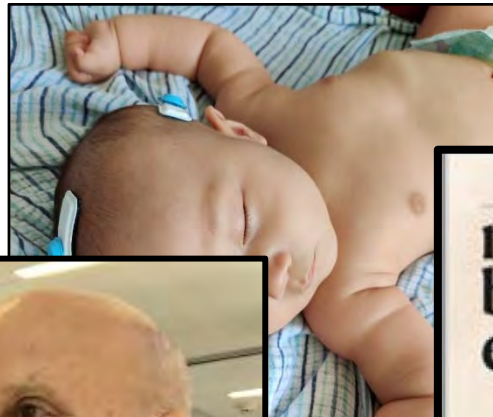


Devices Entering the Translational Pipeline

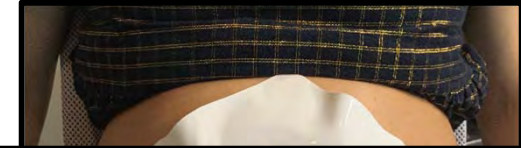
Flow for Hydrocephalus



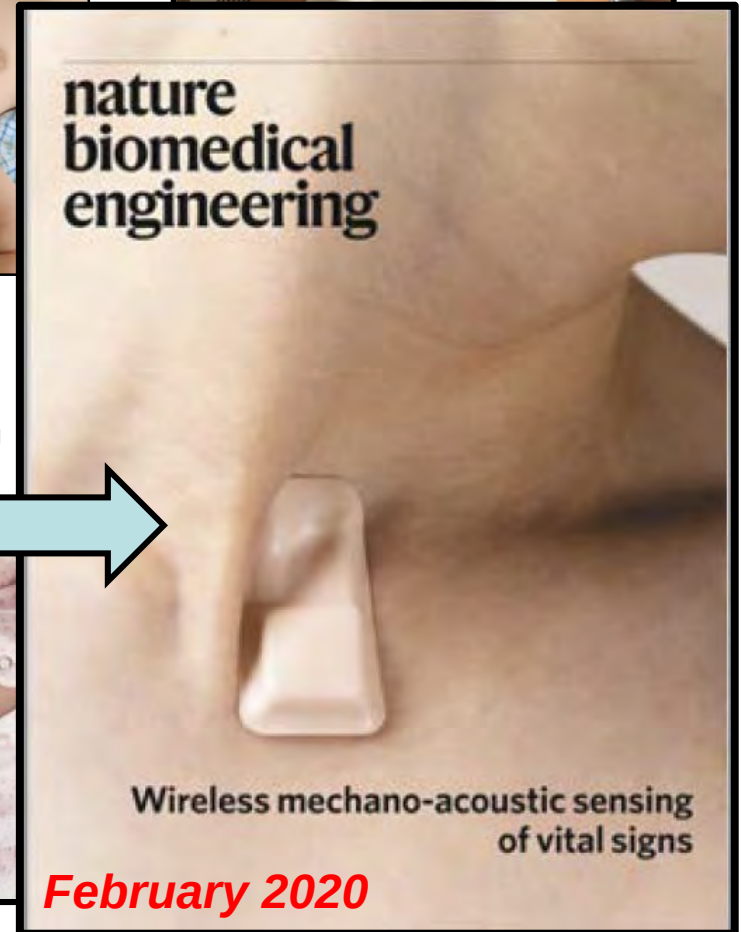
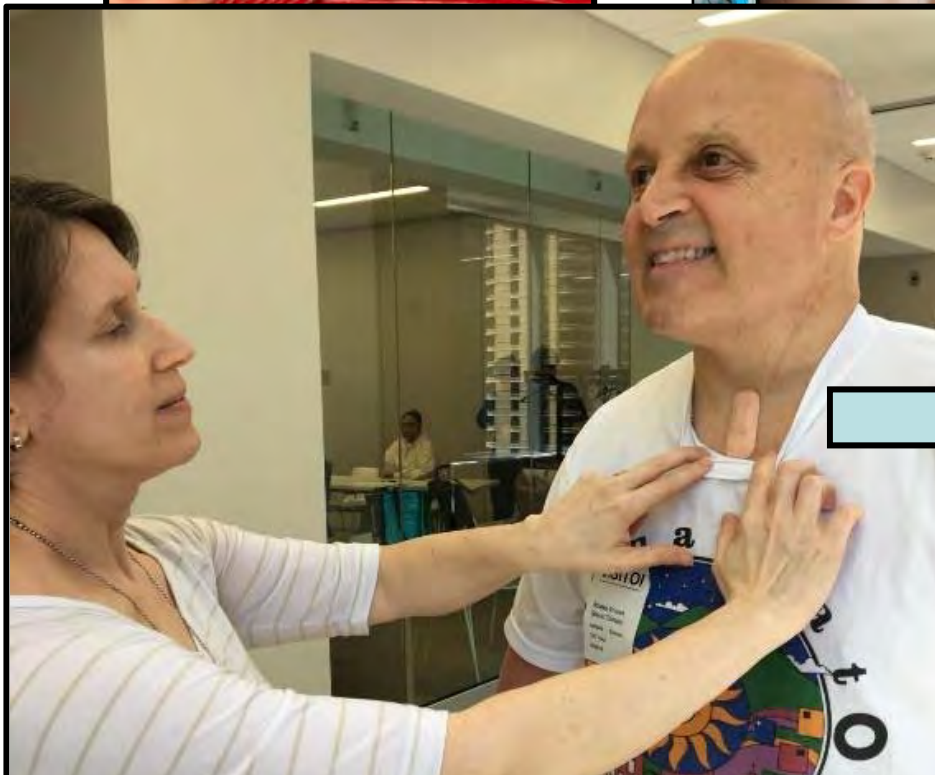
Pediatric NIRS



Fetal ECG



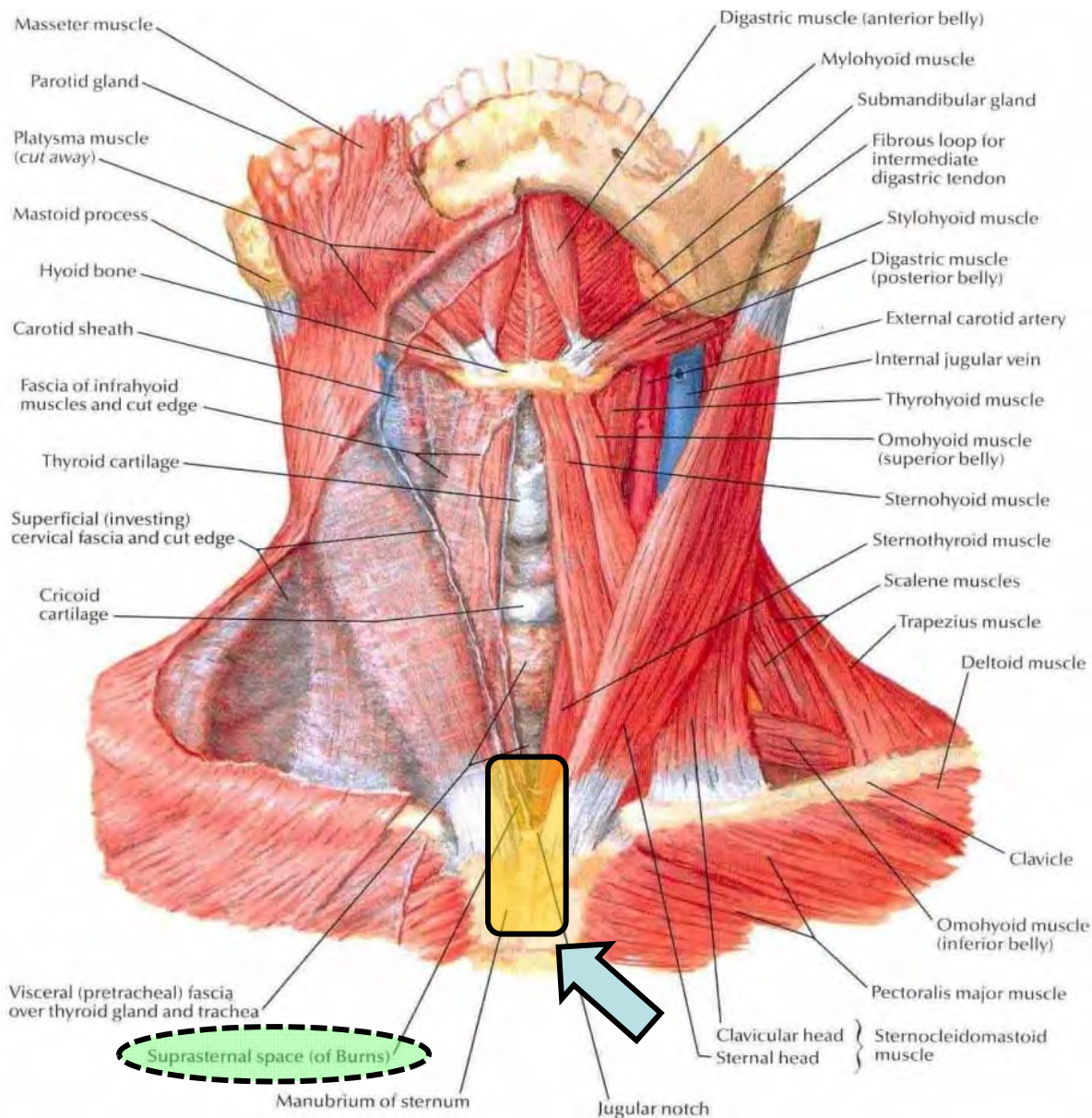
Fetal EEG



Nature Biomed. Eng. **4**, 148 (2020).



Mechano-Acoustic Sensing from the Suprasternal Notch

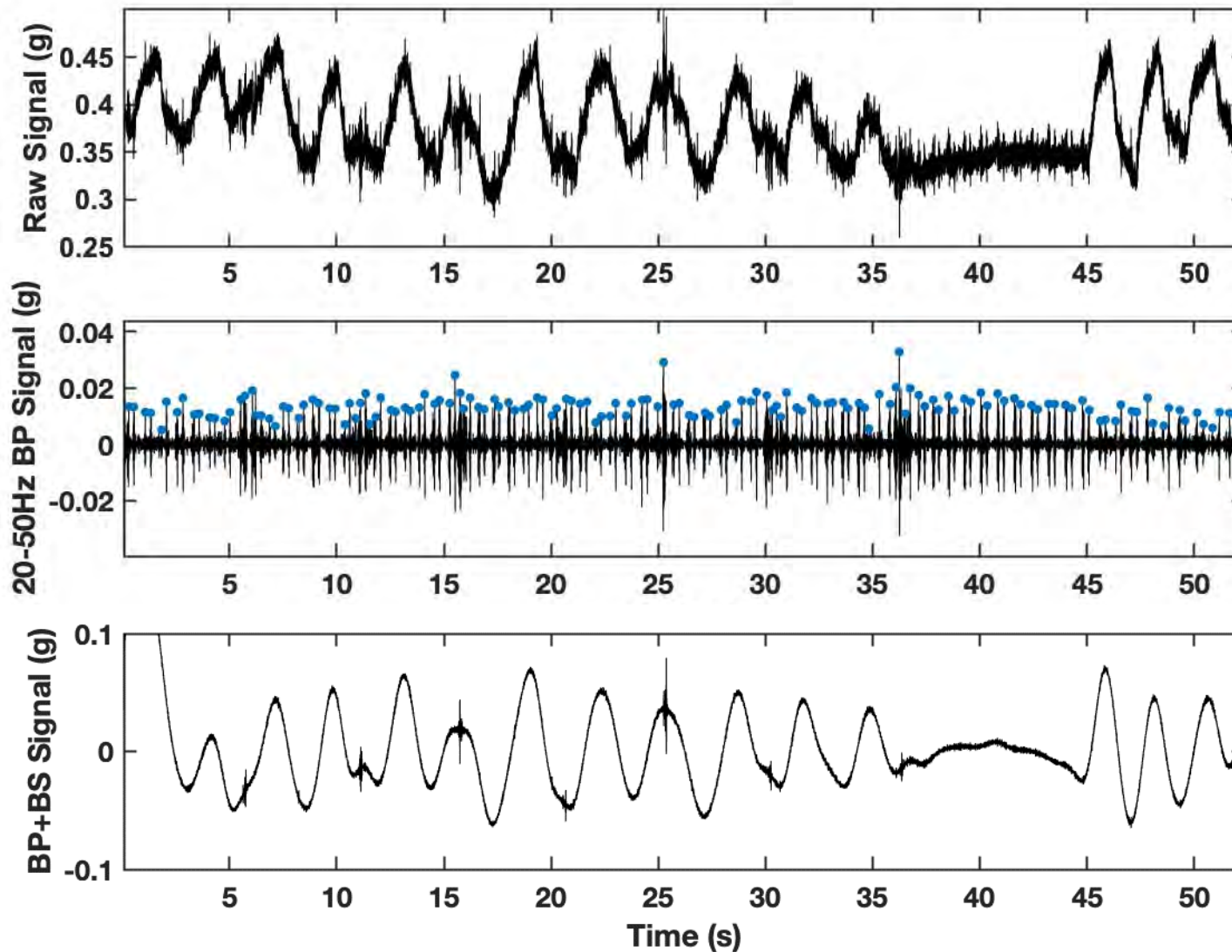


- 1) Speech (time, patterns)
- 2) Swallowing (freq, dyn)
- 3) Heart Rate, Variability
- 4) Respiration Rate
- 5) Respiration Sounds
- 6) Coughing
- 7) Sleep Dynamics
- 8) Motion / Steps
- 9) Orientation

One Device:
Aphasia, Dysphagia
Sleep Apnea, Activity



Respiration Cycles and Swallowing





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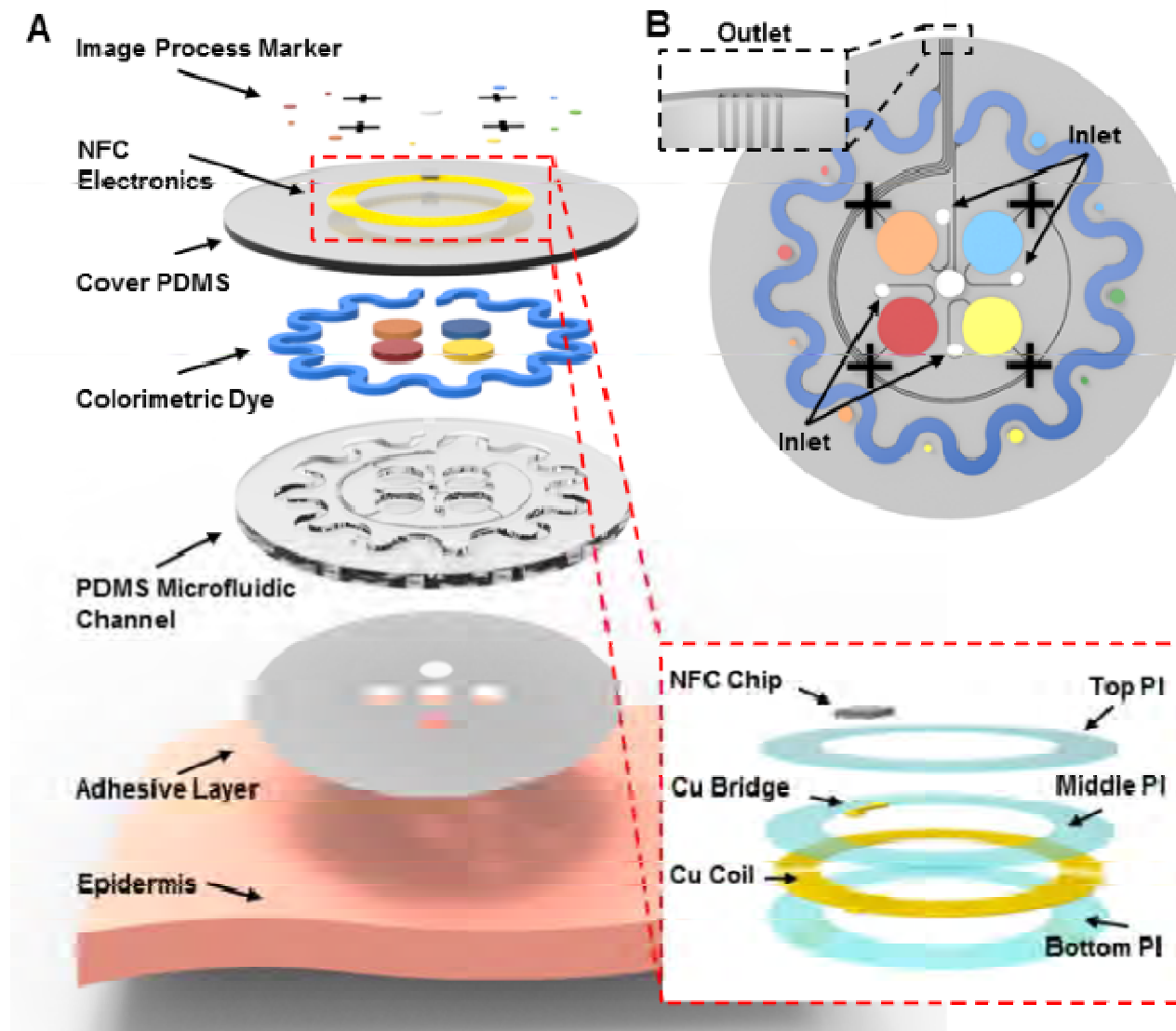


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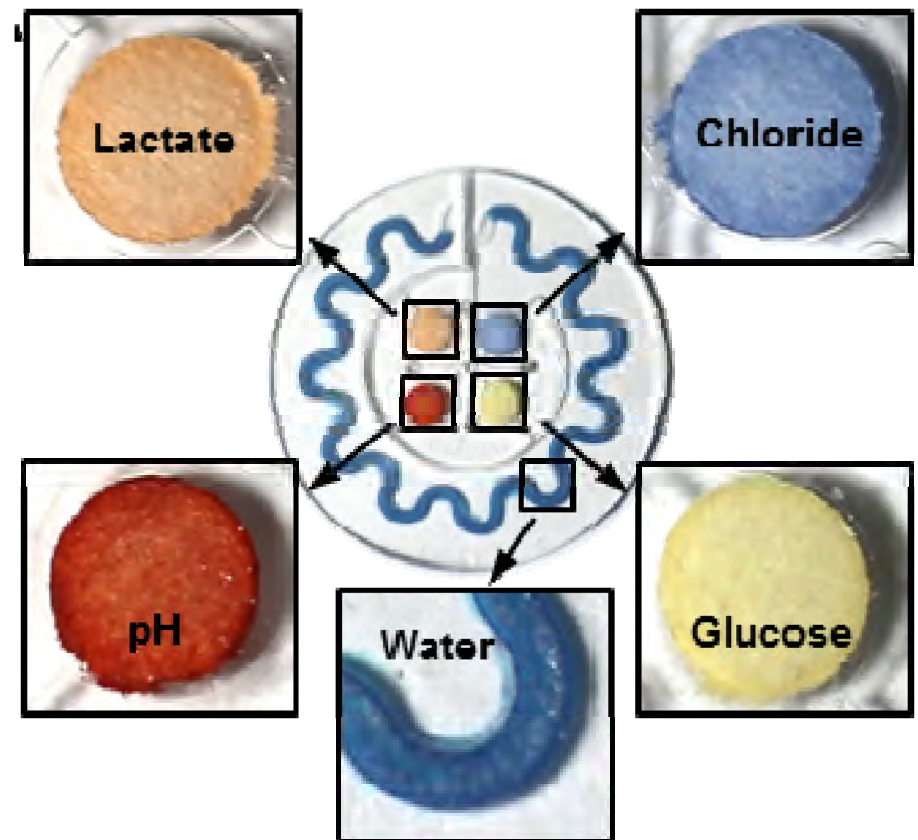
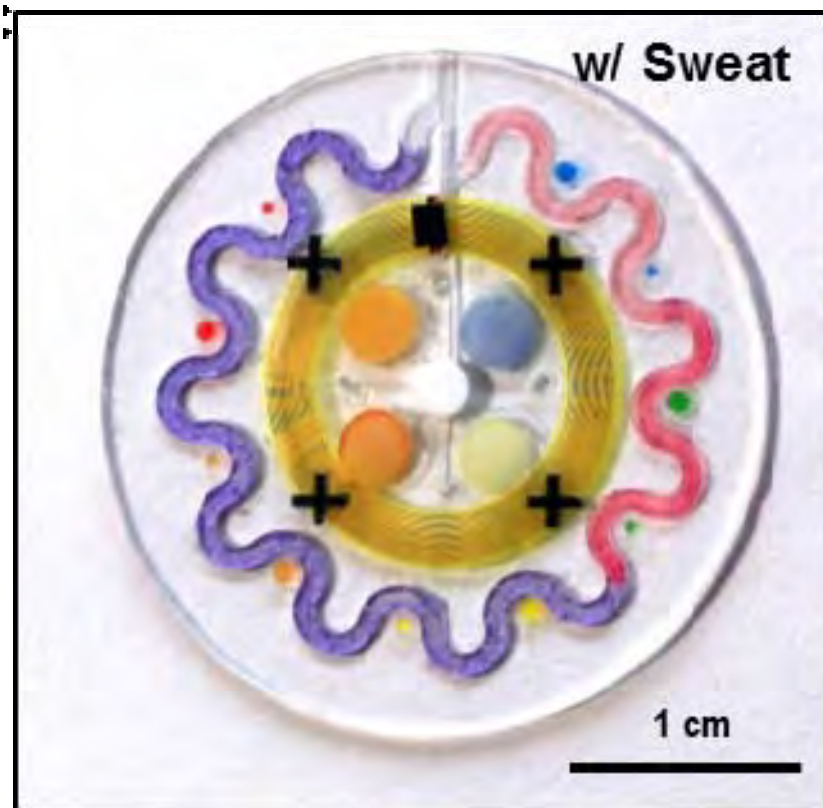
Epidermal Microfluidic Devices and Sweat Analytics



Sci. Transl. Med 8, 366ra165 (2016).



Epidermal Microfluidic Devices and Sweat Analytics





Sci. Transl. Med 8, 366ra165 (2016).





EPICORE
BIOSYSTEMS



Gatorade | You Fuel Us, We Fuel You ft. S. Williams, J. Tatum, C. Pulisic, L. Sanders

104,029,131 views



Gatorade ✓

Published on Dec 21, 2018



SHARE



SAVE



Cystic Fibrosis Screening – Clinical Evaluations

sweat chloride is the gold standard diagnostic technique

current technology



rigid 'puck' design
strap, high pressure interface
~25% failure rate
ex-situ analysis
clinical use only

unpublished

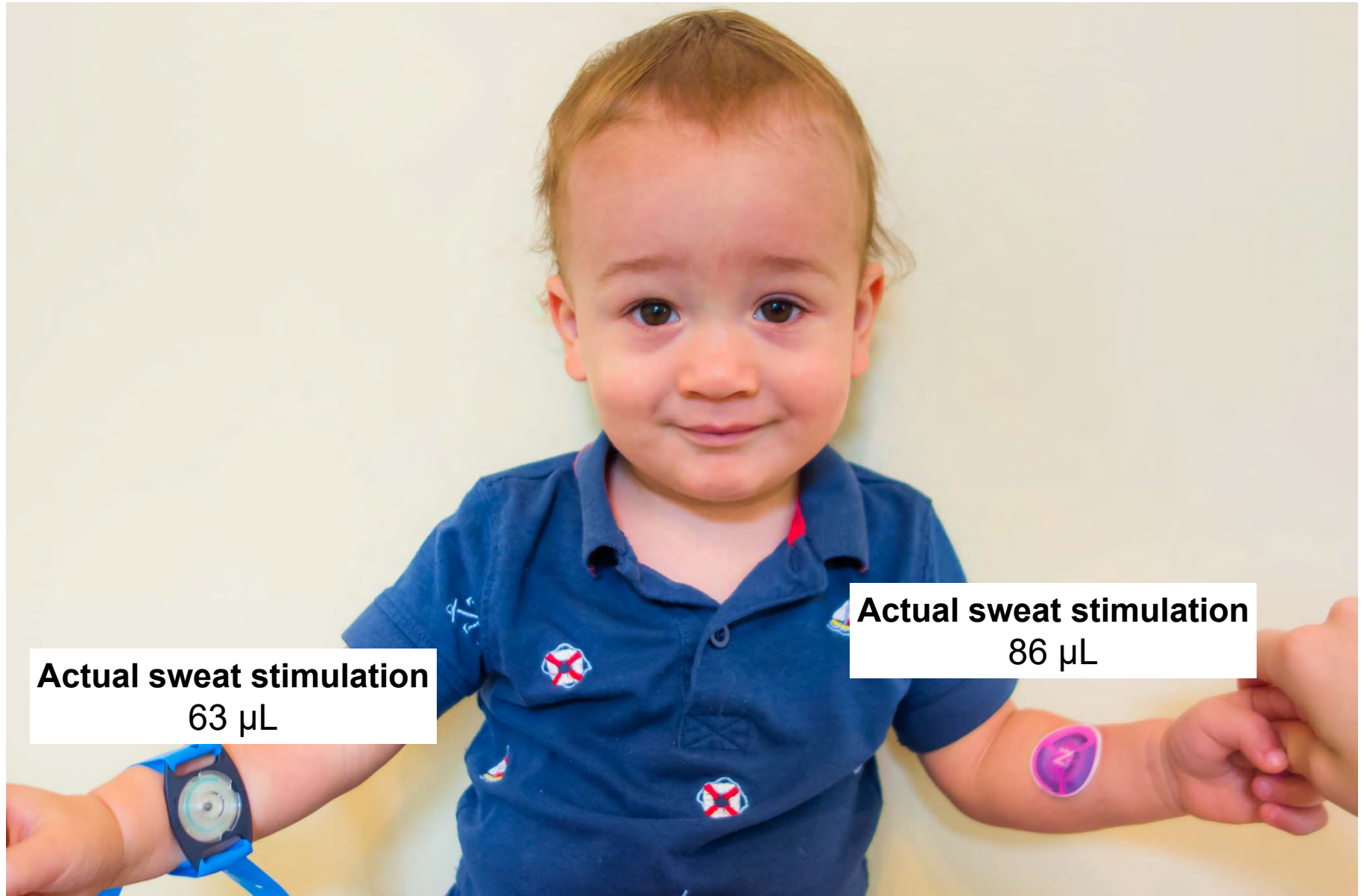
Cystic Fibrosis Screening – Clinical Evaluations

epidermal μ -fluidics

skin-like form factor
soft, zero pressure interface
~0% failure rate
in-situ analysis
clinical or home use



unpublished



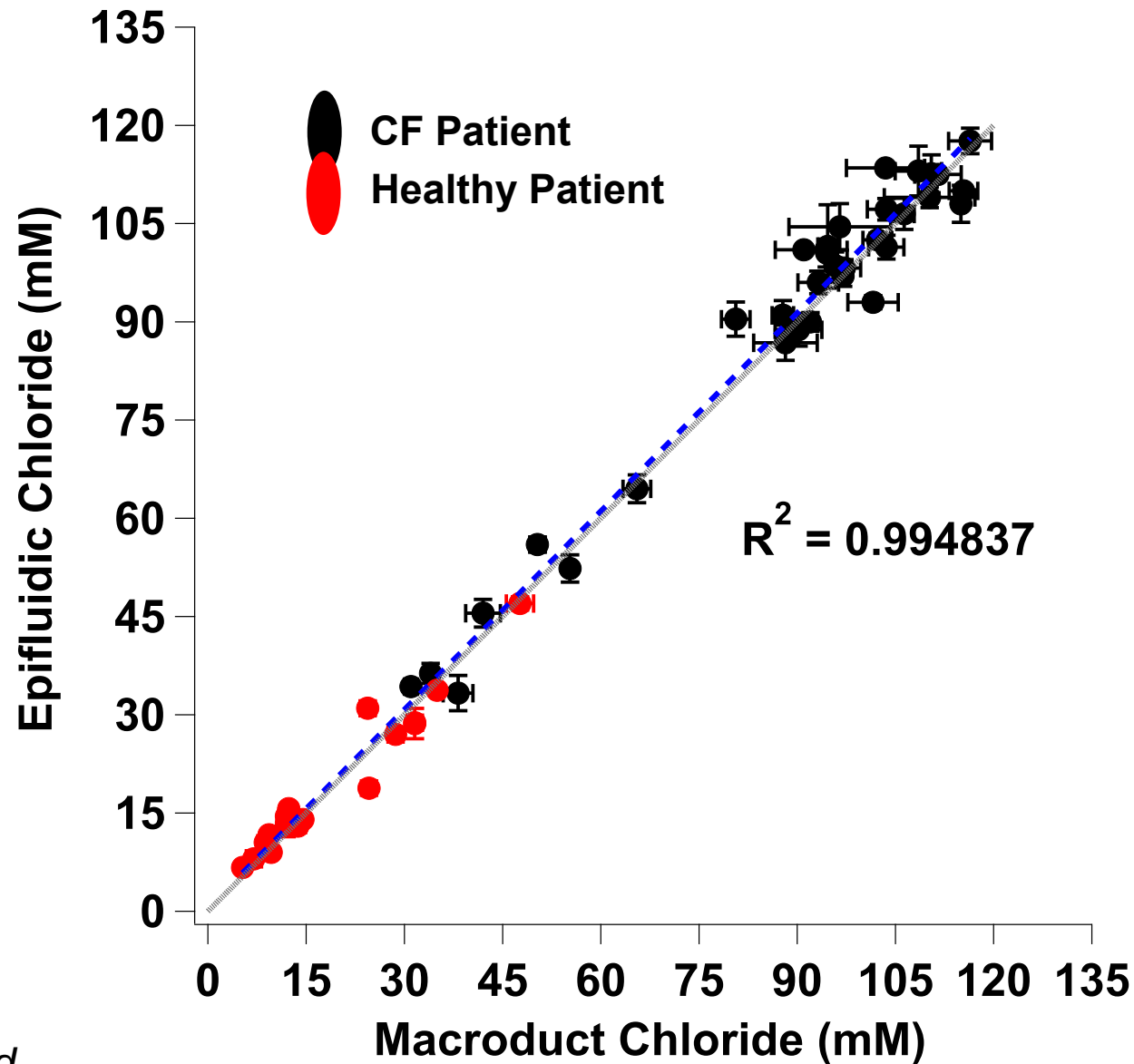
Actual sweat stimulation
63 μL

Actual sweat stimulation
86 μL



unpublished

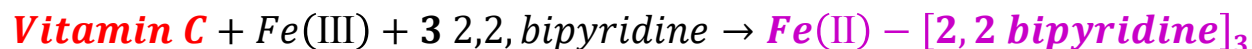
Equivalence in Chloride Analysis



unpublished



Colorimetric Detection of Vitamins/Nutrients in Sweat



Antioxidant

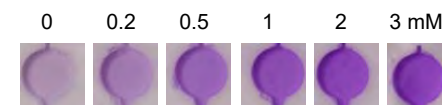
Pink color

Vitamin C

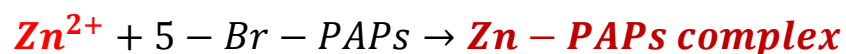


Violet color

Calcium

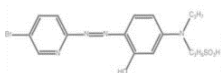


*oCPC: O-cresolphthalein complexone



Deep red (brown) color

*5-Br-PAPs:

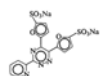


Zinc



Blue color

*Ferene-S:



Iron





Sweat-based Nutritional Monitoring on Human Subjects

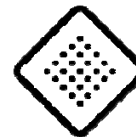


Sweat
Analytics



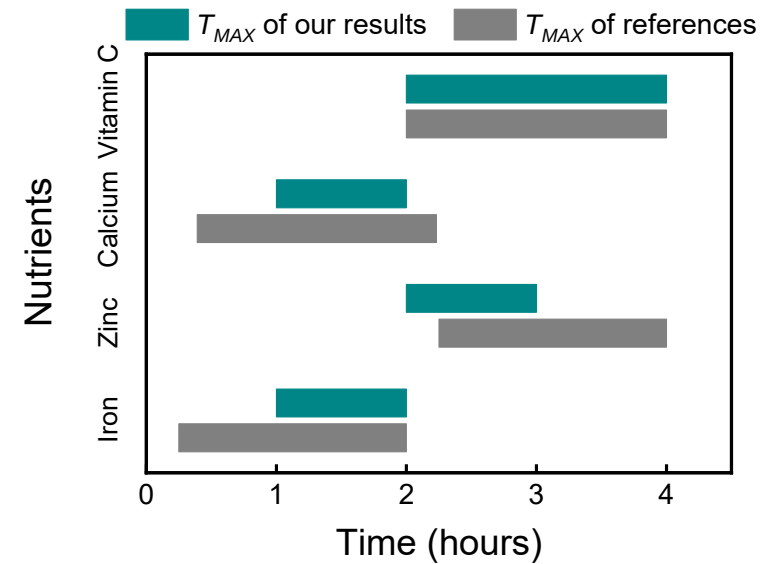
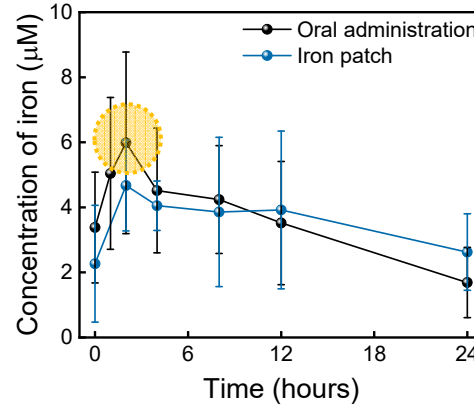
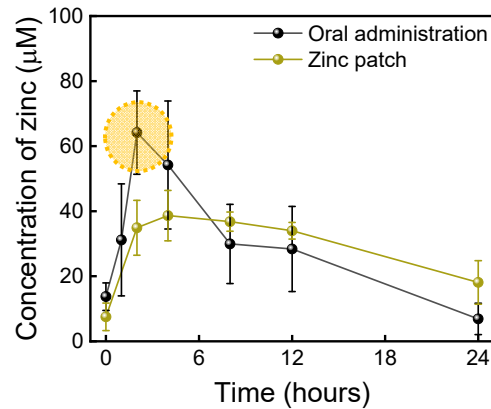
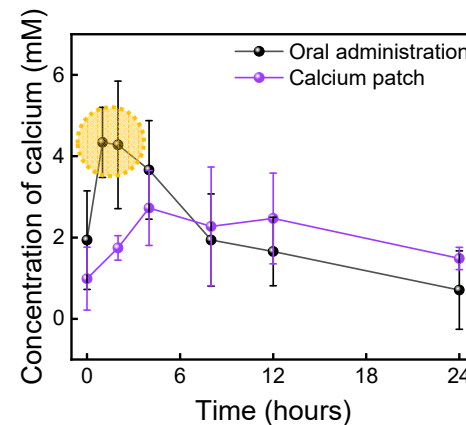
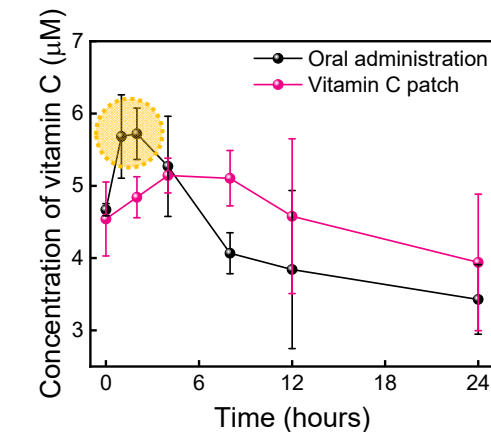
Nutrient tablets

or



Nutrient patches

Sweat
Analytics

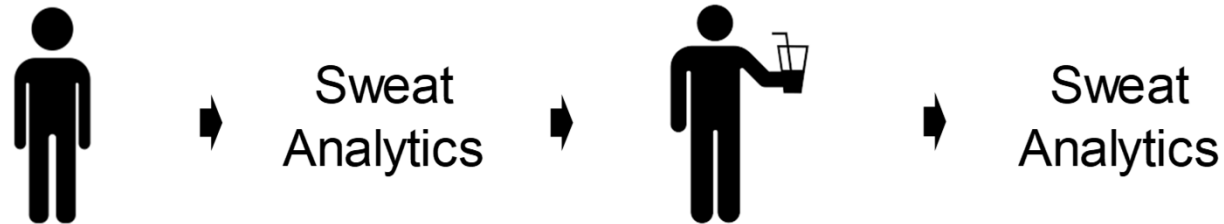


* C_{MAX} : Maximum concentration of analyte

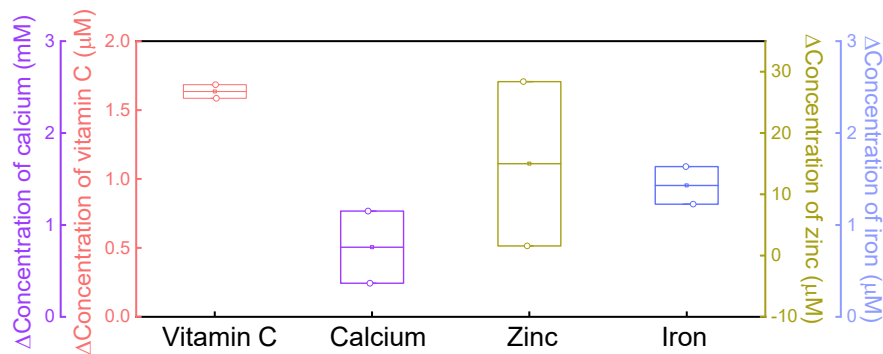
* T_{MAX} : The time taken to reach C_{MAX}



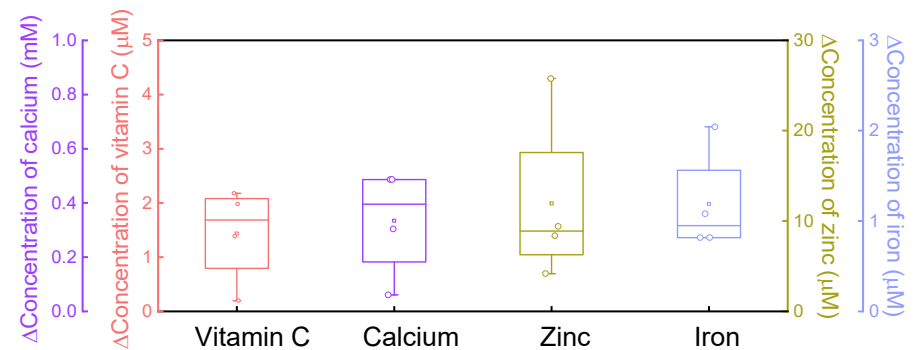
Sweat-based Monitoring of Nutritional Intake



[After drinking a glass of orange juice]

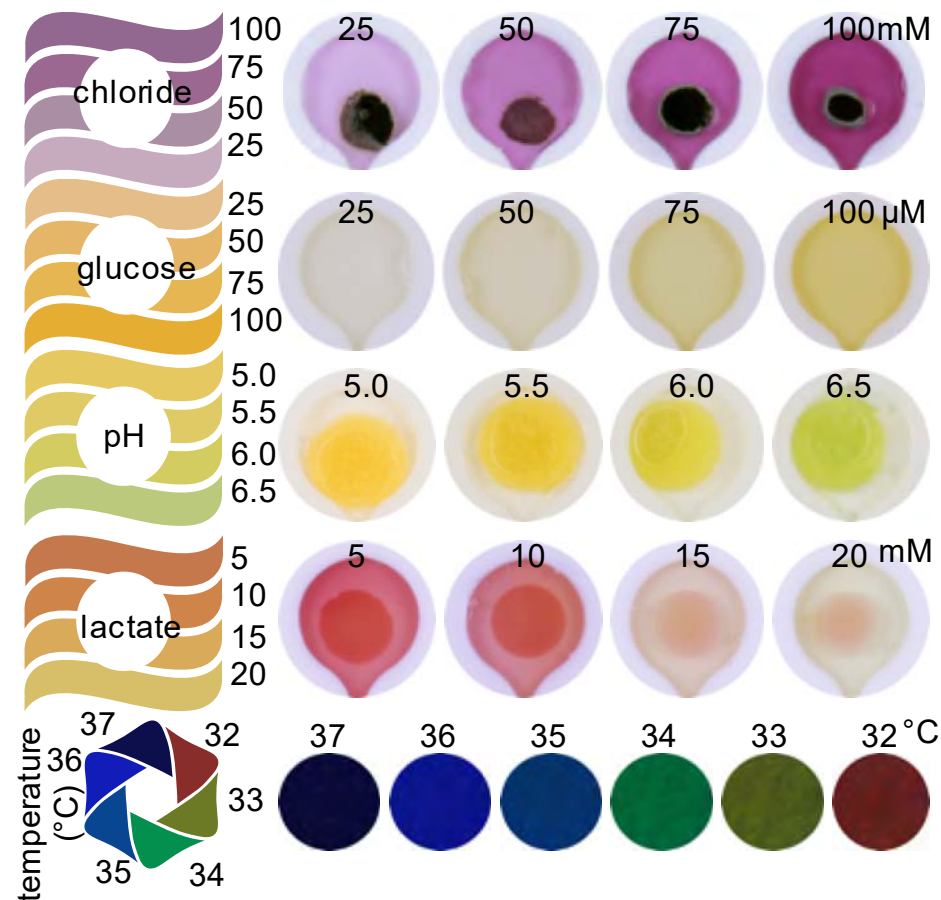
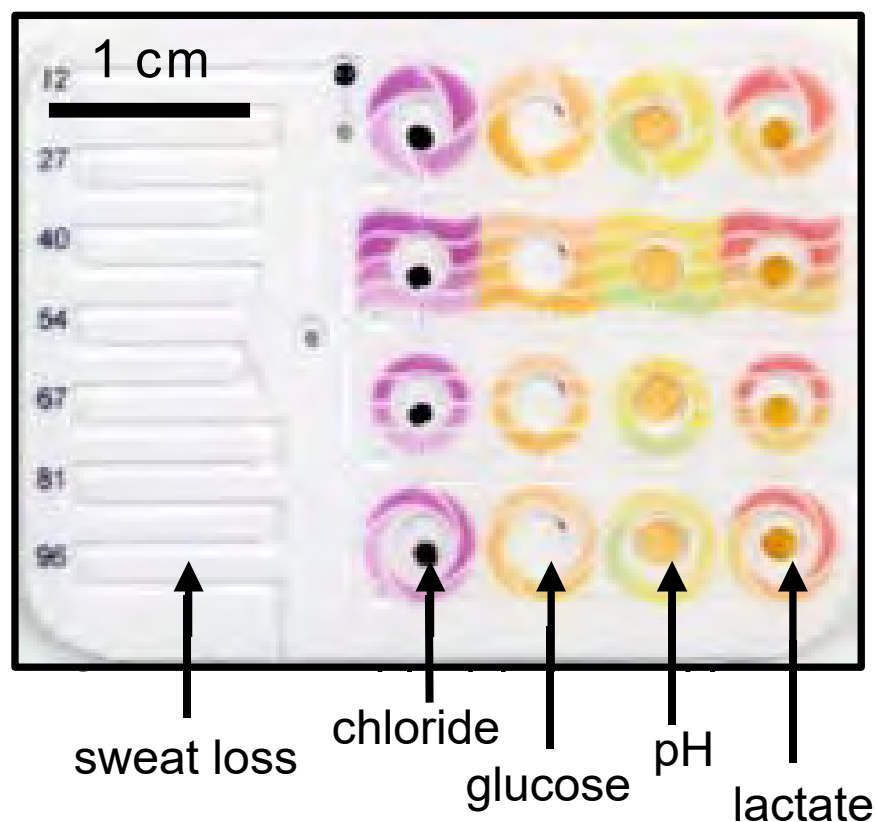


[After drinking a bottle of vitamin water]



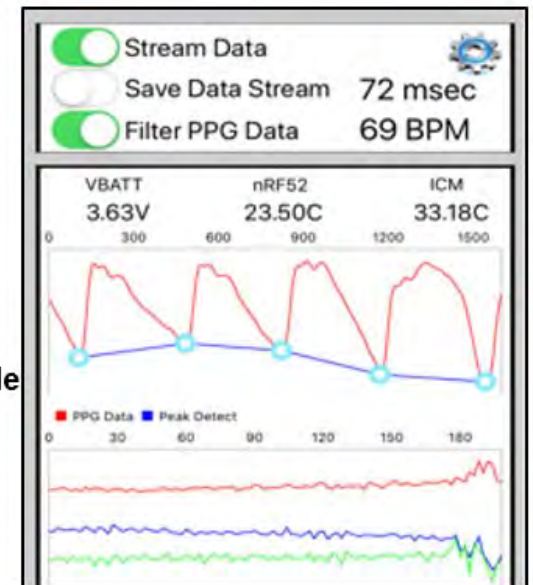
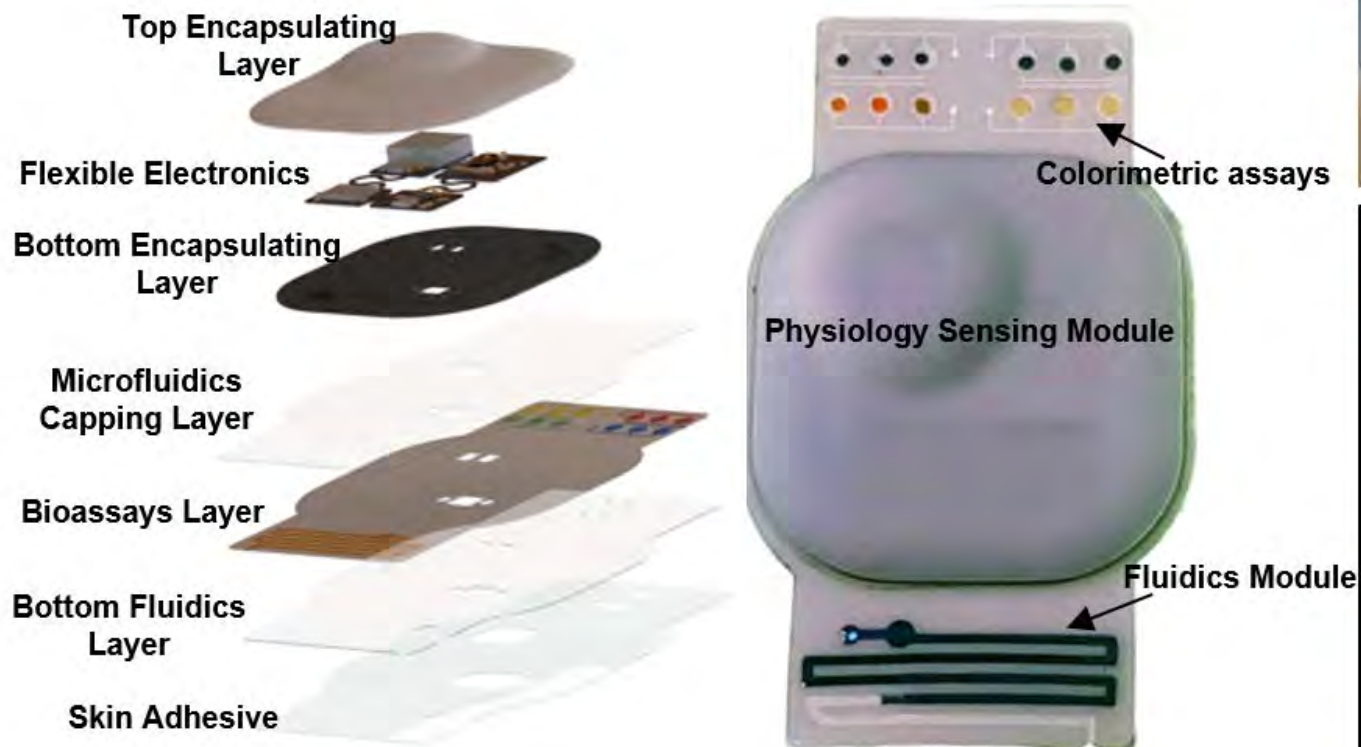


Multifunctional Devices With Chrono-Sampling





Biochemical + Biophysical Monitoring



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