

Health monitoring ideas

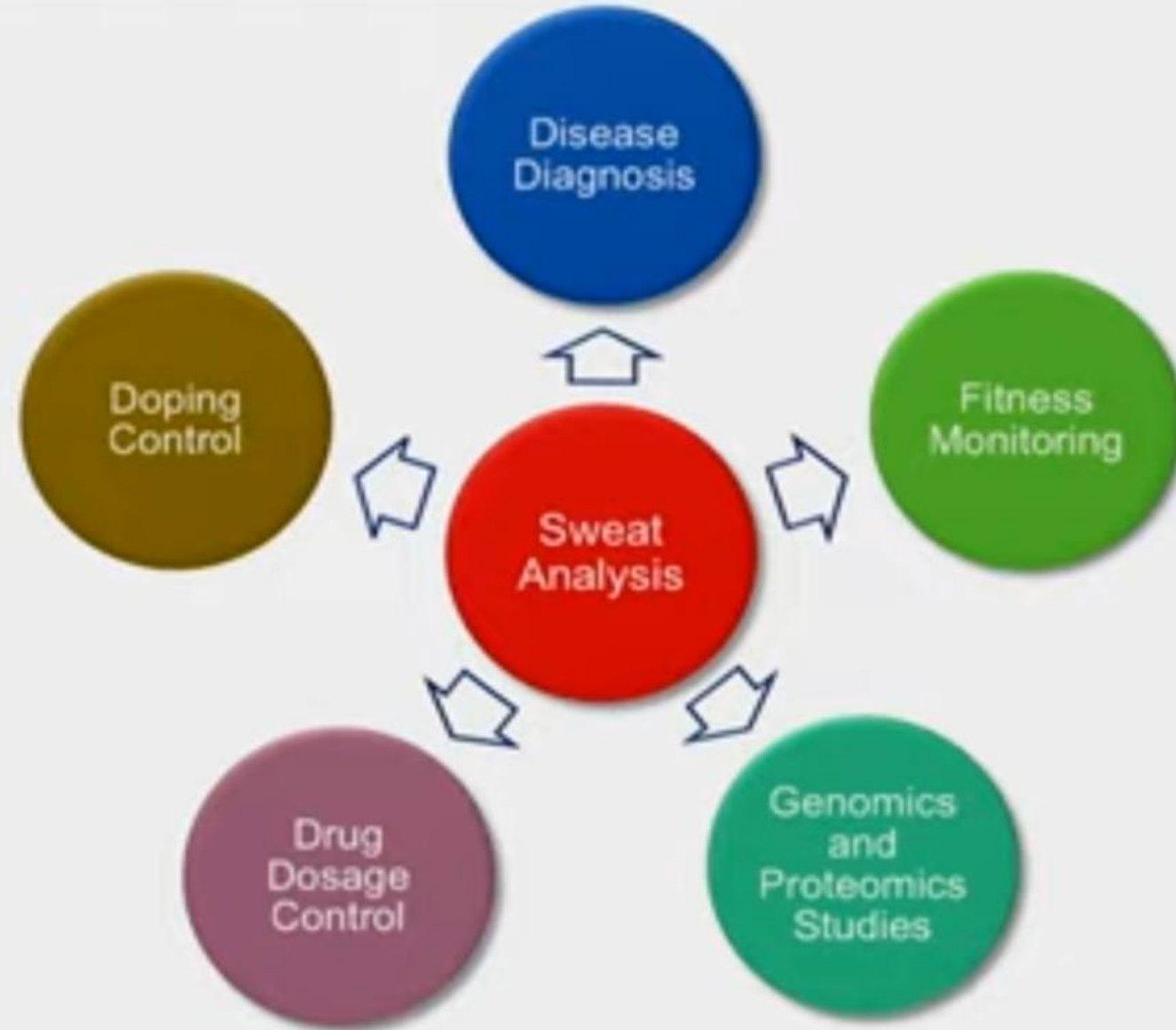
Wearable Biosensors for Personalized Medicine



Commercial health monitors can mainly track **physical activities and vital signs**

Challenges and opportunities: **physiological monitoring at molecular levels**

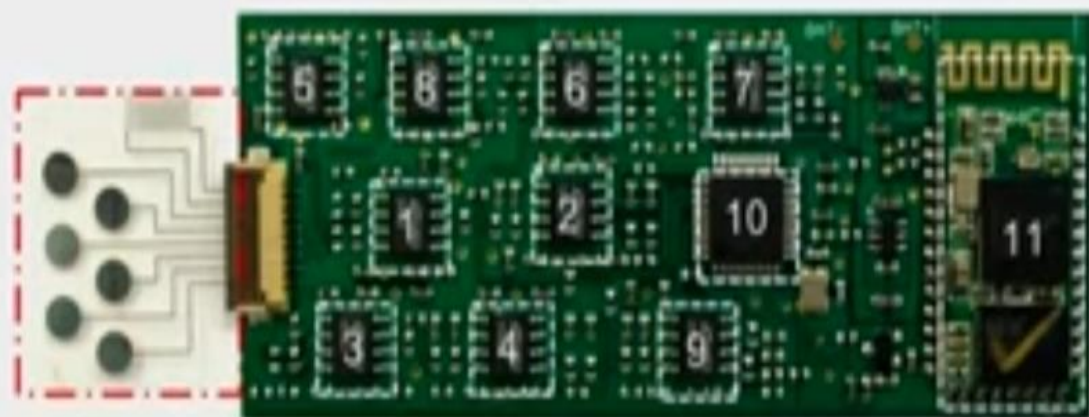
The Current Healthcare Applications of Sweat Test



Fully Integrated Wearable Sensors for Perspiration Analysis

- Real time in situ monitoring:
 - Metabolites (glucose, lactate)
 - Electrolytes (Na^+ , K^+)
 - Skin temperature.
- On site signal conditioning, processing, wireless transmission.
- Real time sensor reading calibration.
- Data display on cell phone.
- Data aggregation on cloud server.

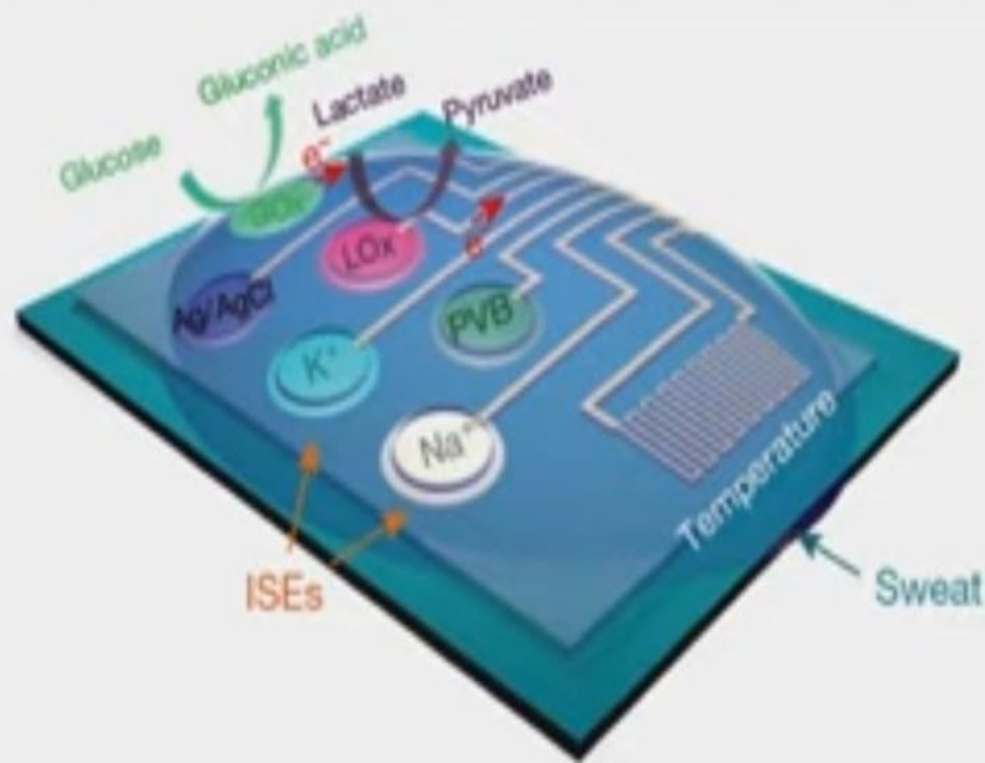




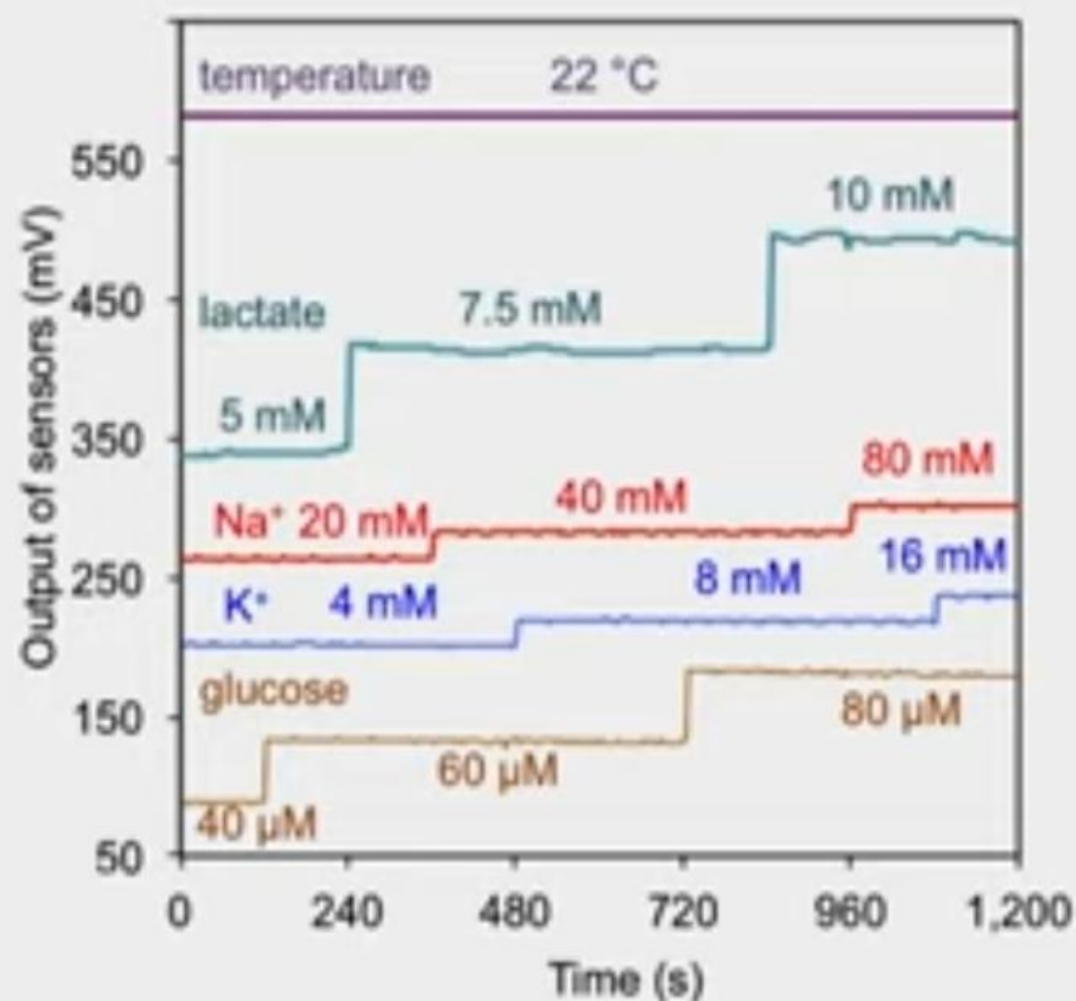
The platform consists of **disposable sensor patch** and **reusable flexible printed circuit board**.

The selection of targeted biomarkers

- Metabolites (glucose, lactate)
- Electrolytes (Na^+ , K^+)
- Skin temperature.

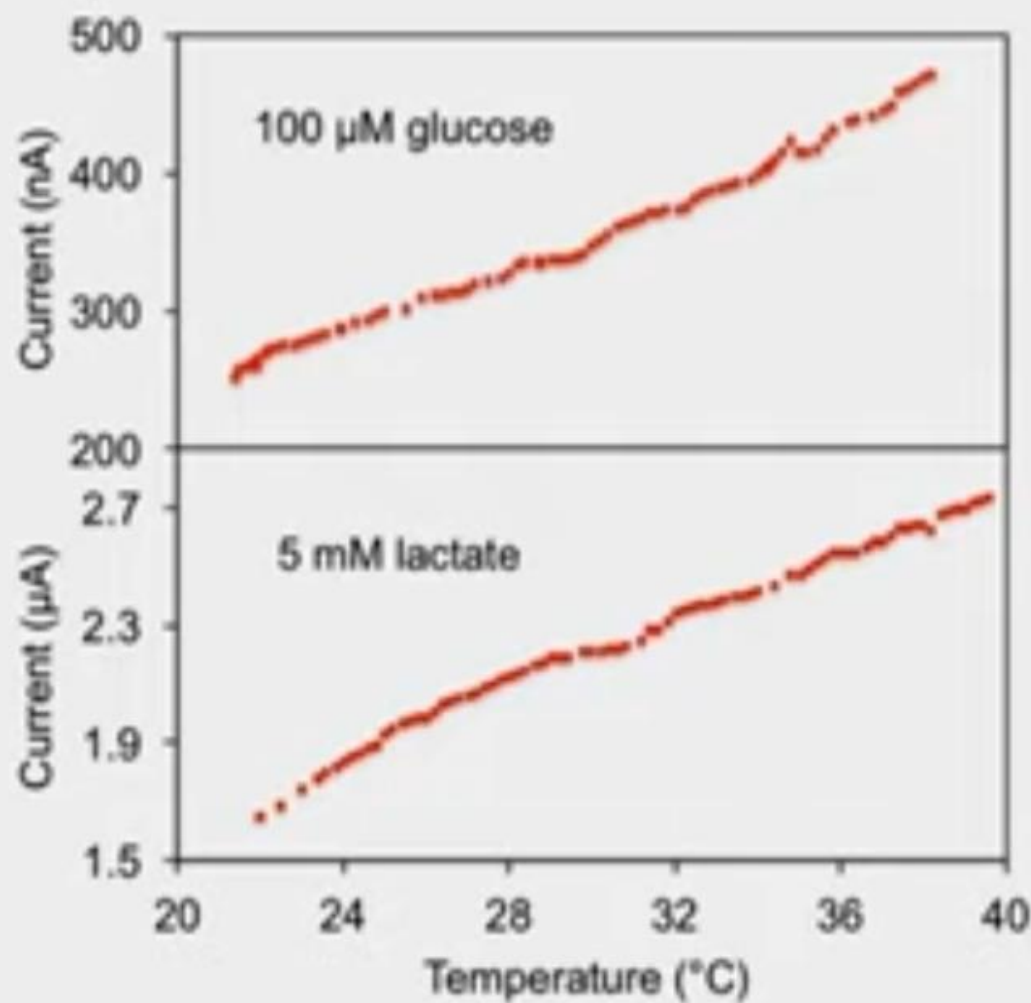


Interference Study



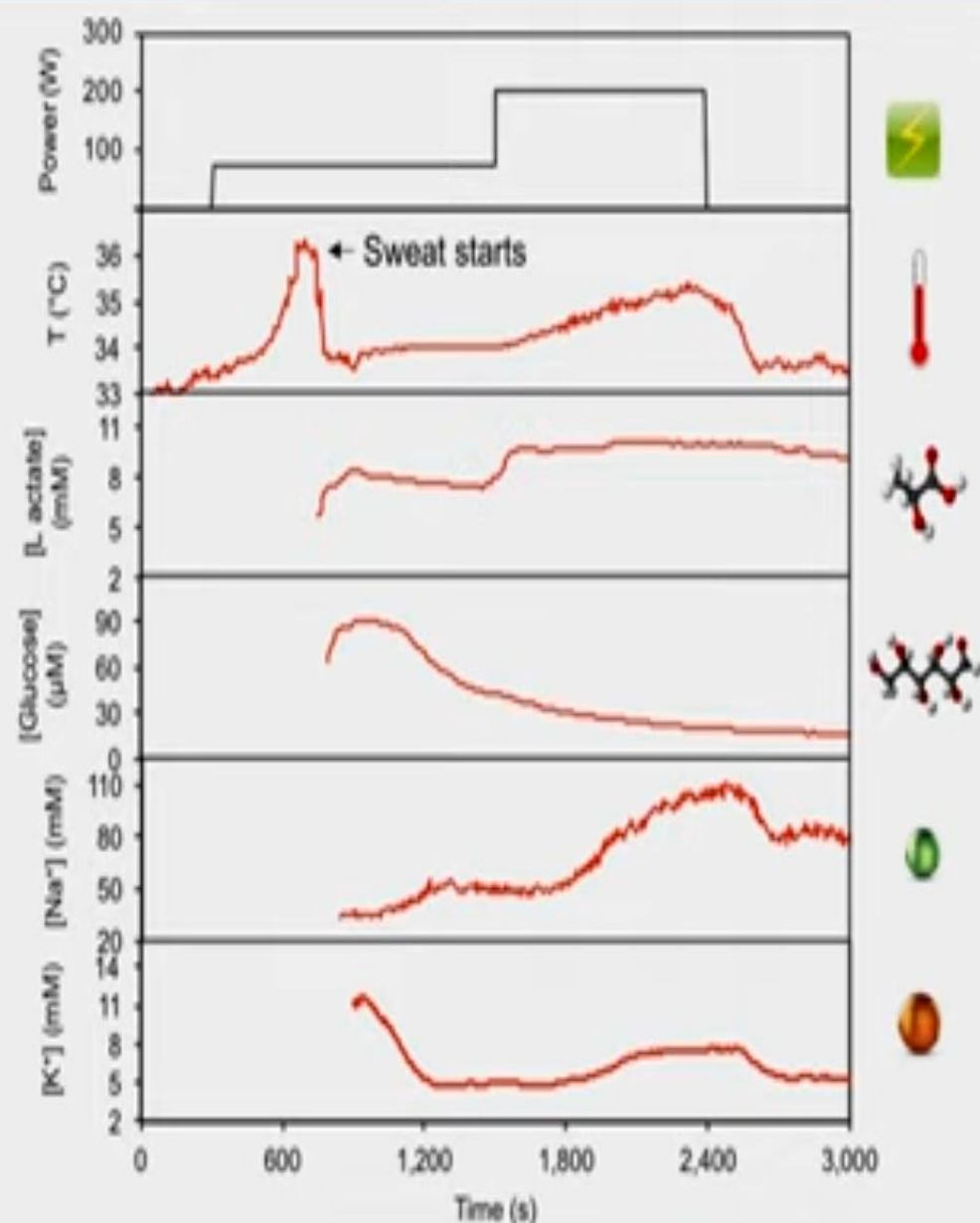
The chemical sensors have good selectivity.

Temperature dependence

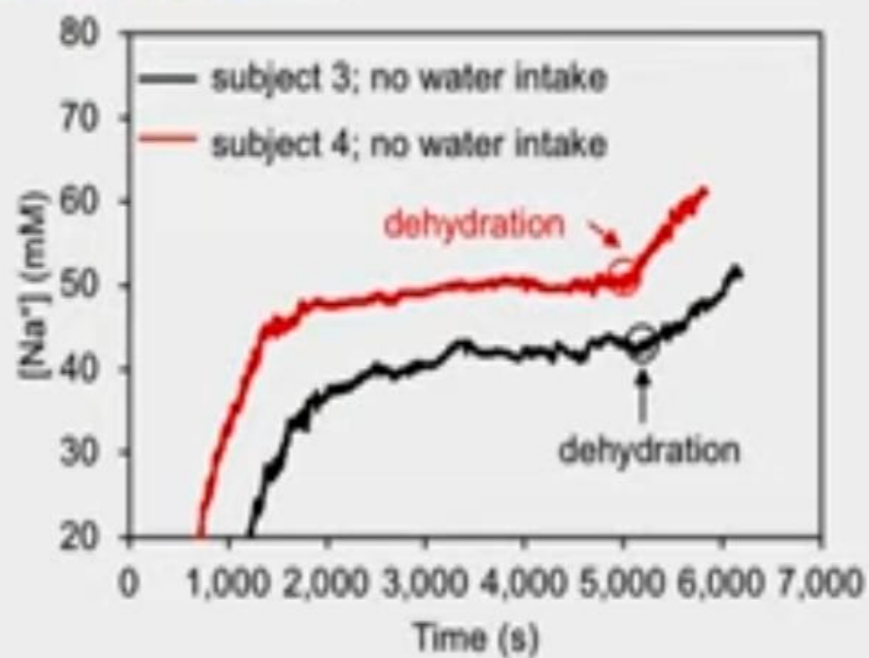
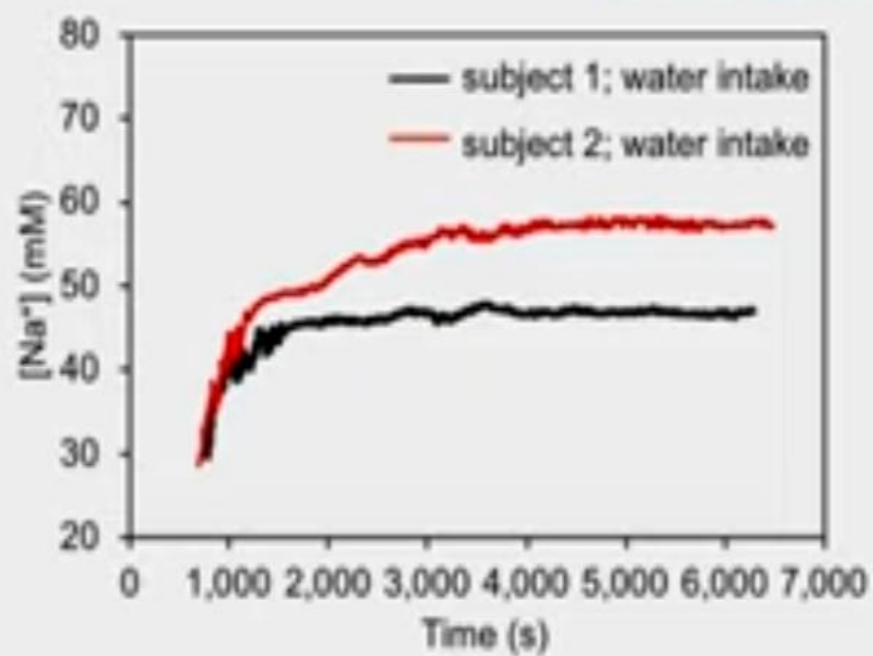


Real time temperature compensation is necessary.

Real time multiplexed sweat analysis during indoor cycling



The device can be used to measure detailed sweat profiles and to collect big data.

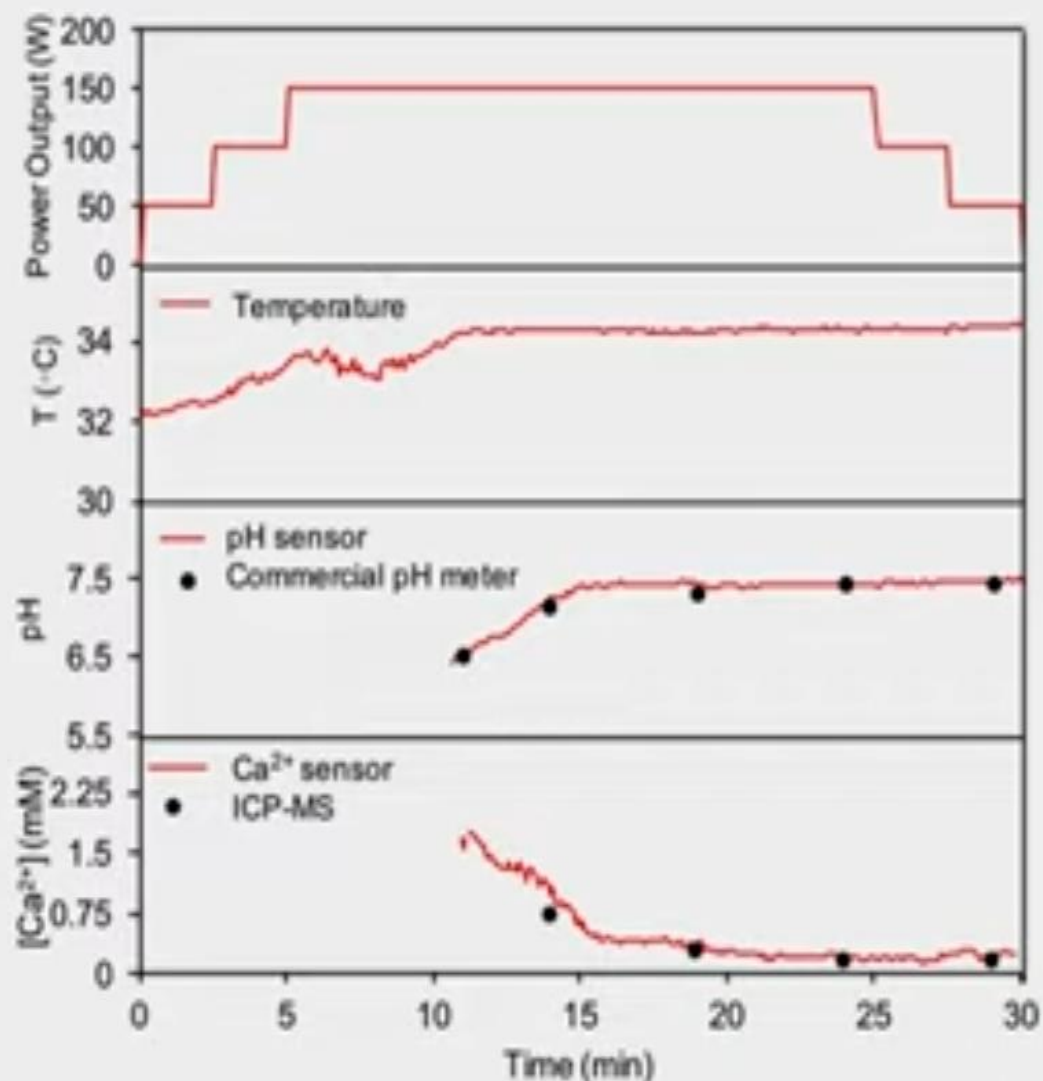
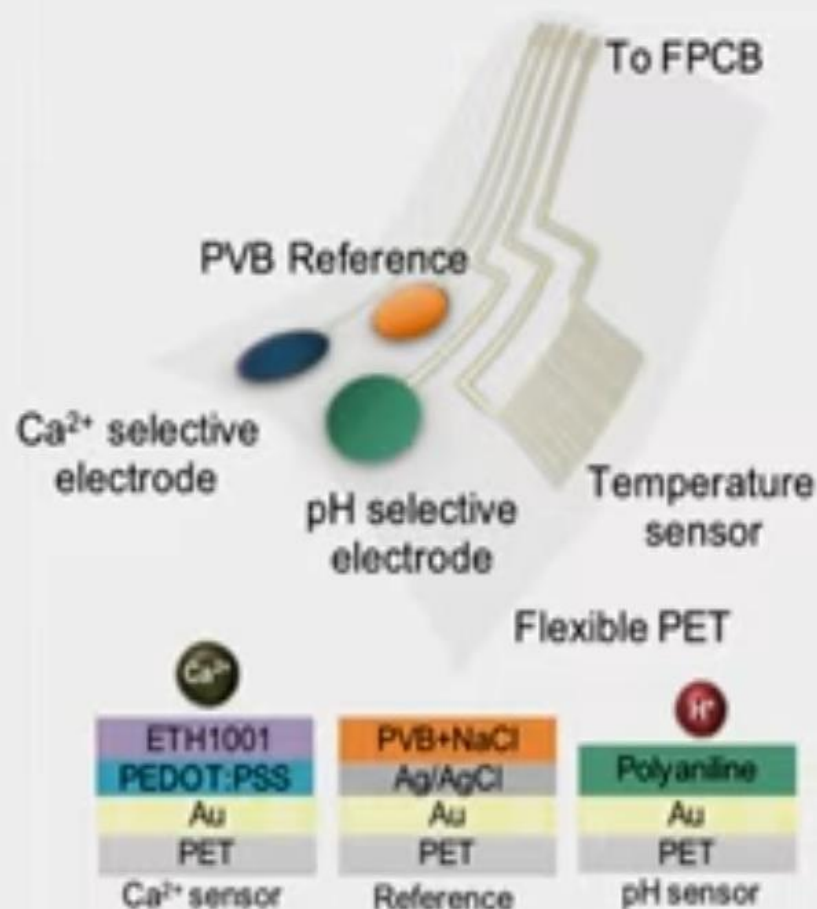


Sweat sodium can potentially serve as a biomarker for dehydration monitoring.

Wearable Sensors for Ca^{2+} and pH Monitoring

Kidney function monitoring

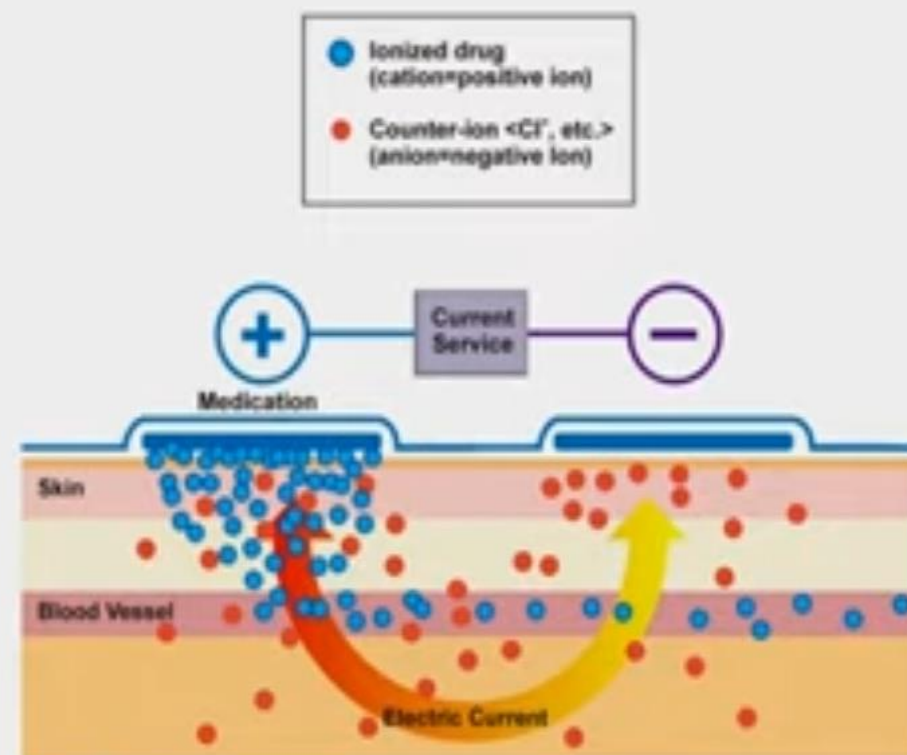
Ca^{2+} level in body fluids is dependent on pH



Simultaneous monitoring of Ca and pH is essential for accurate Ca analysis.

How to Access Sweat Sample Without Exercise?

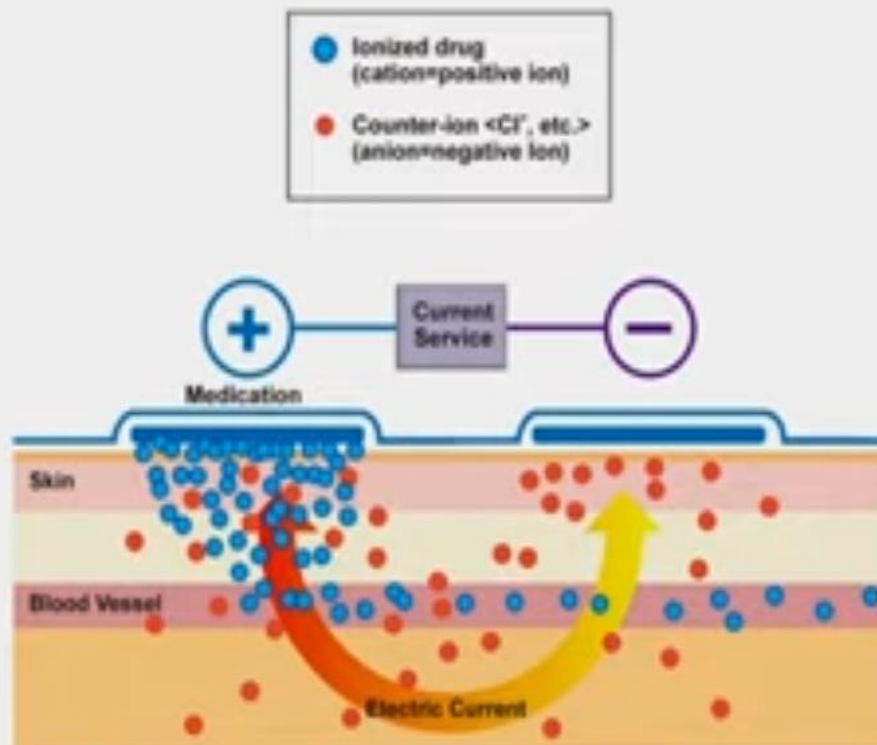
Beyond physical exercise: **iontophoresis** based sweat extraction



Sweat can be induced on demand through iontophoresis.

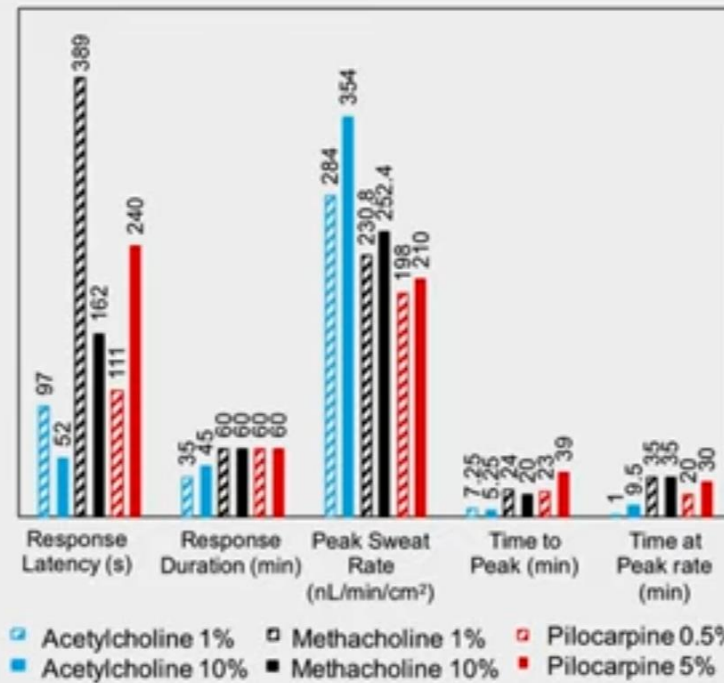
How to Access Sweat Sample Without Exercise?

Beyond physical exercise: **iontophoresis** based sweat extraction



Sweat can be induced on demand through iontophoresis.

Iontophoresis based Sweat Extraction



Sweat extraction can be controlled by type of drugs and the drug dosage.

PNAS. 2017. 114. 4625

Example Applications of Wearable Sweat Biosensors

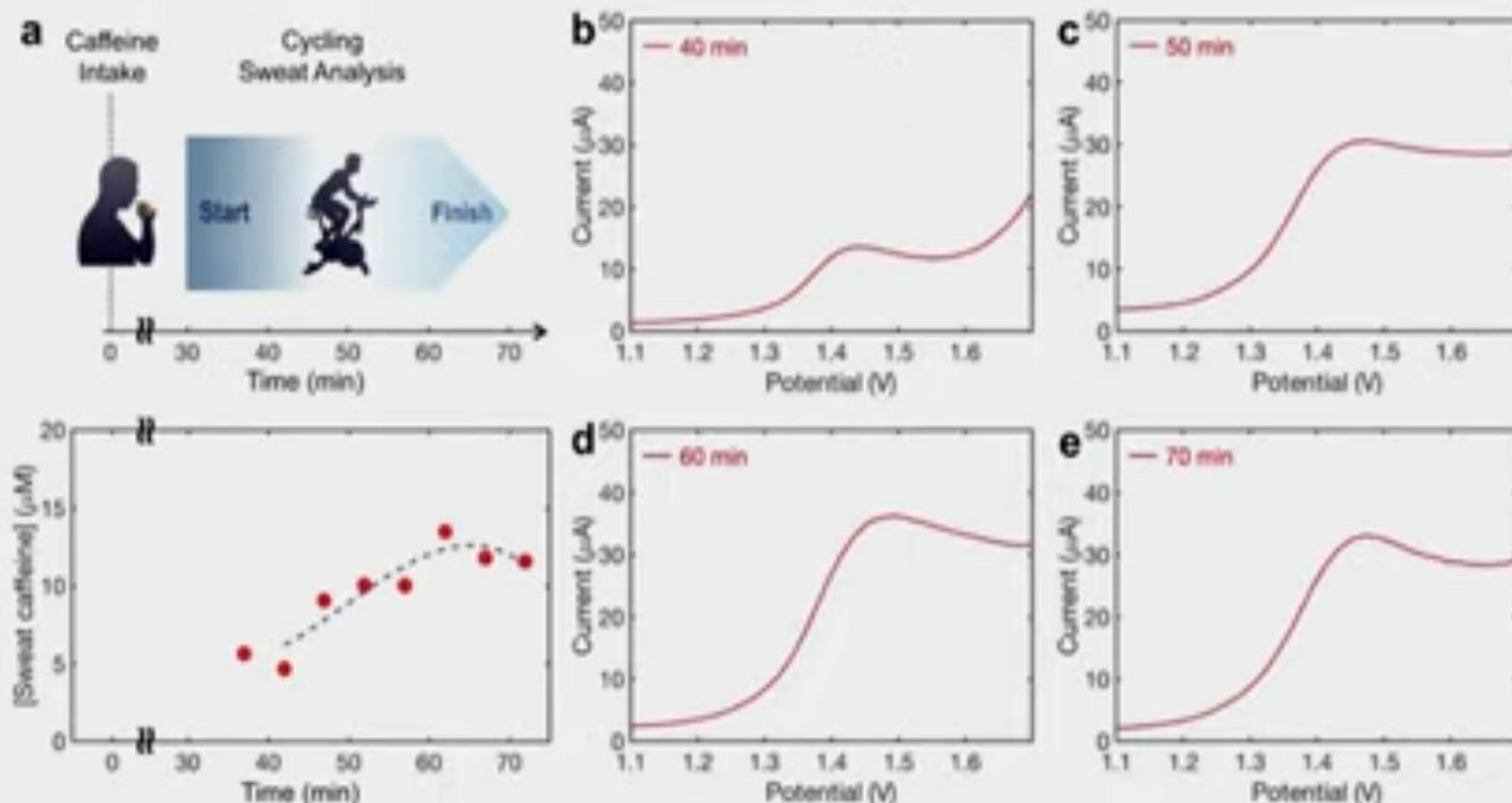
Medical monitoring and diagnosis without accessing blood

Non-Invasive Glucose Monitoring




Methylxanthine Drug Monitoring with Wearable Sweat Sensors

Dynamic drug metabolism monitoring



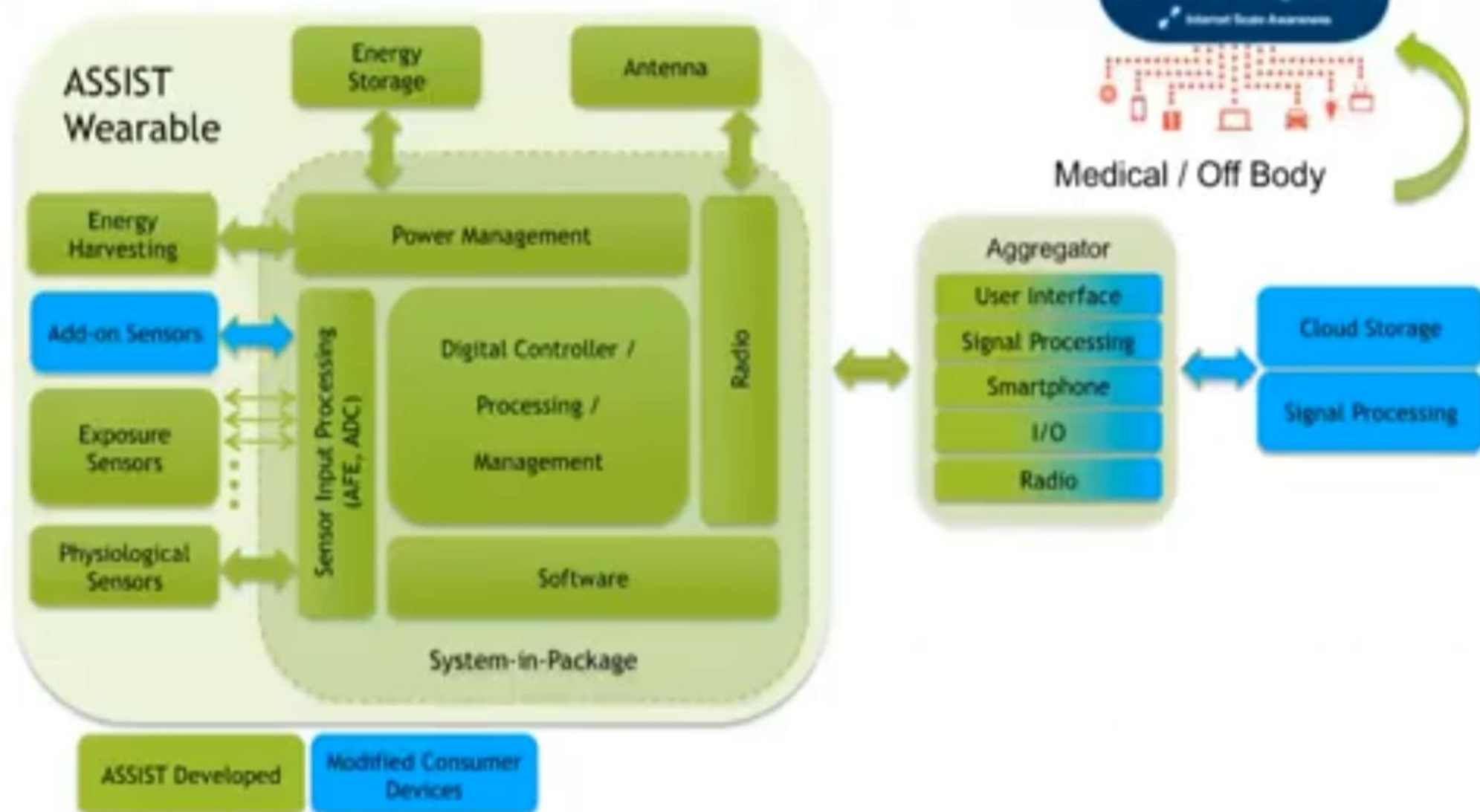
Promising use in clinical pharmacology and precision medicine, such as therapeutic drug monitoring, drug abuse intervention, and other aspects of the drug-related healthcare system.



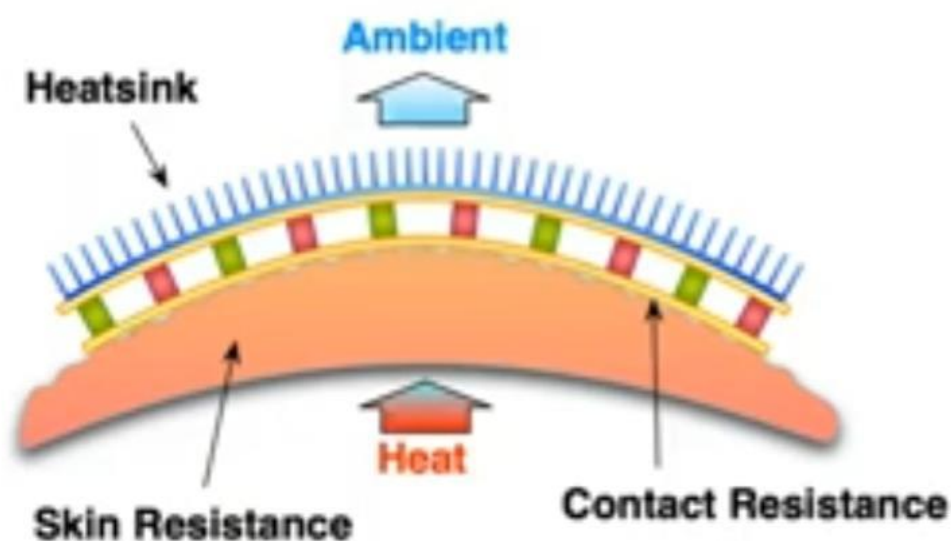


Long-term monitoring and management of multiple chronic disease health targets can lead to a paradigm change in health outcomes

ASSIST's Engineered System



Harvesting Heat from the Body



Flexible thermoelectric generators (TEGs) are desirable:

- ▶ Conformal to the body
 - ▶ Better contact with the skin
- ▶ Large area harvesting
 - ▶ Simple Integration
 - ▶ Aesthetics – Comfort – Compliance



Large Area (40 cm^2) Flexible TEG on the wrist

