Weill Cornell Medicine

Wearable Sensor for Monitoring Respiratory Failure in Opioid Users

Lead Inventors:

Julianne Imperato-McGinley, Ph.D.

The Abby Rockefeller Mauzé Distinguished Professor of Endocrinology in Medicine, Medicine , Weill Cornell Medical College

Professor of Medicine, Weill Cornell Medical College

Ana Krieger, M.D., MPH

Chief, Sleep Neurology

Professor of Clinical Medicine, Weill Cornell Medical College

Professor of Medicine in Clinical Neurology, Weill Cornell Medical College

Professor of Clinical Genetic Medicine, Weill Cornell Medical College

Edwin Kan, Ph.D.

Professor, Electrical and Computer Engineering, Cornell University

Business Development Contact:

Donna J. Rounds

Interim Senior Technology Licensing Officer

(646) 962-7044

djr296@cornell.edu

Wearable Sensor for Monitoring Respiratory Failure in Opioid Users

Background & Unmet Need

- Drug overdose deaths are the number one cause of deaths for Americans under fifty years old
- Opioids are currently the main driver of drug overdose deaths, accounting for ~ 75 K deaths in 2021
- In most cases, opioid-related deaths occur due to respiratory depression that progresses to respiratory arrest and asystole
- Current approaches to monitoring respiratory events use physical-contact body sensors and related methods that have various drawbacks, including high cost, poor comfort due to the need for direct skin contact, and complex operation requirements
- **Unmet Need:** Comfortable and unobtrusive wearable device capable of detecting respiratory events in opioid users, allowing for rapid emergency response

Technology Overview

- **The Technology:** A non-invasive, non-contact and low-cost wearable sensor that uses a near-field coherent (NCS) sensing multiplexing antenna to monitor respiratory failure and provide alert signals
- The NCS techniques work on the principle that body movement can be clearly and unambiguously retrieved from the RF antenna characteristics, and then be correlated with vital signs
- **PoC Data:** The vital signs are digitally recorded and broadcast by the tag in the outdoor environment, and a ceiling-mounted reader connects to the sensing tag to retrieve the wearer's vital signs (Fig. 1)
- The sensor successfully detects different respiratory events (Fig. 2)
- The initial data showed that the invention's accuracy in cardiopulmonary functions is comparable to RIP and phonocardiogram (PCG) measurements (Fig. 3)

Inventors:
Julianne Imperato-McGinley
Ana C. Krieger
Edwin Kan

Patents:
PCT Application Filed

Publications:
Hui et al. *Sci Adv.* 2019.

Biz Dev Contact:
Donna Rounds
(646) 962-7044
djr296@cornell.edu

Cornell Reference:
D-7785, D-8812

Weill Cornell Medicine

Wearable Sensor for Monitoring Respiratory Failure in Opioid Users

Technology Applications

- Monitor respiratory events in opioid users
- Device may also be useful in patients with breathing disorders
- Could be employed to detect and/or monitor sleep apnea

Technology Advantages

- No immediate skin contact or tension belts
- Minimal constraint of user range of motion
- Cost-effective implementation, anticipated cost < $5 under mass production
- Equivalent accuracy compared to RIP, ECG, and phonocardiogram (PCG)
- Minimal RF radiation for user safety and limited interference to other wireless modules

Supporting Data / Figures

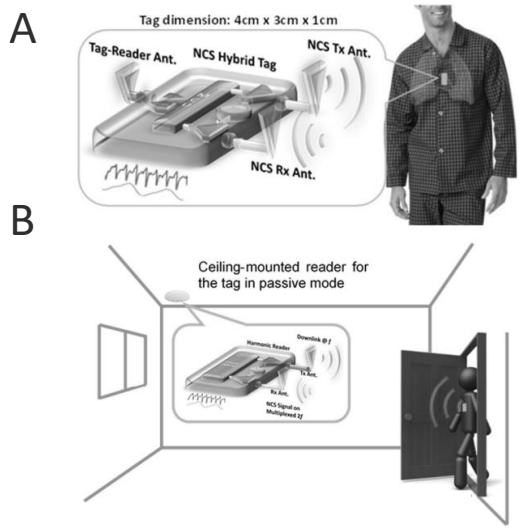

Figure 1: Depicts the NCS system components. **A:** Shows the tag in active mode, powered by its on-board battery in an outdoor environment. **B:** Shows the tag operates in a passive mode in an indoor environment or the tag with a low battery.

Inventors:
Julianne Imperato-McGinley
Ana C. Krieger
Edwin Kan

Patents:
PCT Application Filed

Publications:
Hui et al. *Sci Adv.* 2019.

Biz Dev Contact:
Donna Rounds
(646) 962-7044
djr296@cornell.edu

Cornell Reference:
D-7785, D-8812

Weill Cornell Medicine

Wearable Sensor for Monitoring Respiratory Failure in Opioid Users

Supporting Data / Figures

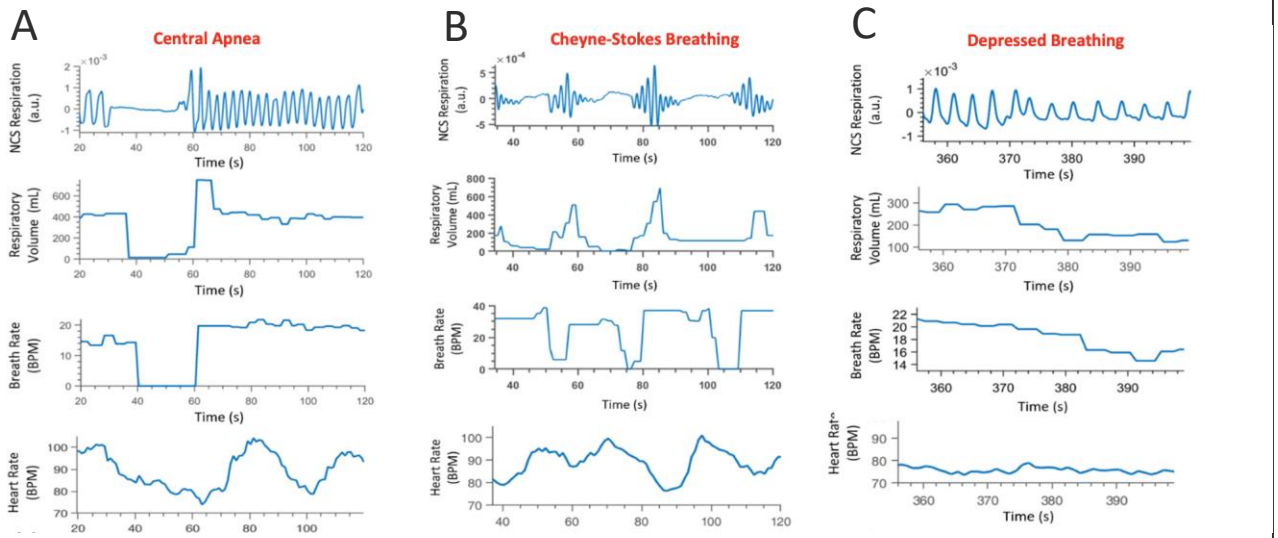

Figure 2: NCS raw waveforms, respiratory volume, breath rate, and heart rate vital sign waveforms for **(A)** breathing simulating central apnea, **(B)** simulating Cheyne-Stokes**,** and **(C)** simulated depressed breathing.

Inventors:
Julianne Imperato-McGinley
Ana C. Krieger
Edwin Kan

Patents:
PCT Application Filed

Publications:
Hui et al. *Sci Adv.* 2019.

Biz Dev Contact:
Donna Rounds
(646) 962-7044
djr296@cornell.edu

Cornell Reference:
D-7785, D-8812

Weill Cornell Medicine

Wearable Sensor for Monitoring Respiratory Failure in Opioid Users

Supporting Data / Figures

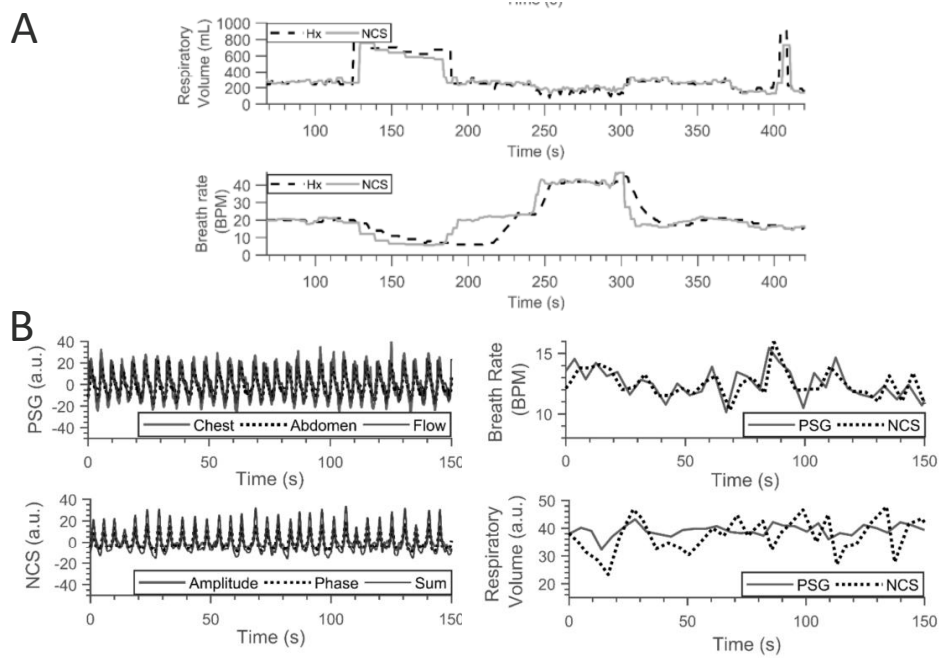

Figure 3: NCS shows comparable accuracy in cardiopulmonary functions to RIP and PSG. **A:** Vital-sign comparison between NCS with a single chest tag and Hexoskin (Hx) with respiratory inductive plethysmography (RIP) thorax and abdomen belts in various autonomous breathing exercises, top: extracted respiratory volumes; bottom: extracted breath rates. **B:** Shows a preliminary comparison for sample extracted breath rates and respiratory volumes using PSG and NCS.

Inventors:
Julianne Imperato-McGinley
Ana C. Krieger
Edwin Kan

Patents:
PCT Application Filed

Publications:
Hui et al. *Sci Adv.* 2019.

Biz Dev Contact:
Donna Rounds
(646) 962-7044
djr296@cornell.edu

Cornell Reference:
D-7785, D-8812

Weill Cornell Medicine

Weill Cornell Medicine