

NORTHEAST CENTER

FOR OCCUPATIONAL HEALTH AND SAFETY



Preparing Northeast farmers, foresters and fishermen for the everyday dangers they face on the job.



Using wearable technology to track logging and fishing workers health and sleep

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Capturing Sleep Data at Sea

- USCG concerns relating to sleep, fatigue and links to fatalities and injuries
- Actigraphy often used in clinical setting
- Measures motion to estimate sleep length
- Hard to use at sea-vessel movement
- Can't assess sleep stages or brain activity



Initial NEC sea trials of actigraph watches

Expanded “At-Sea” Trials

Fit Bit



Data Points:

- Heartrate
- Accelerometer Data
- Proprietary Algorithm

Hexoskin



Data Points:

- Heartrate
- Respiration
- Accelerometer
- Raw Data

Actigraph Watch



Data Points:

- Accelerometer
- Used in Sleep Studies
- Raw Data

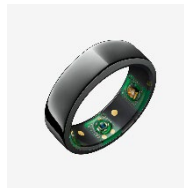
Dreem Device



Data Points:

- Heartrate
- EEG Data
- Movement
- Breathing
- Raw Data

Oura Ring

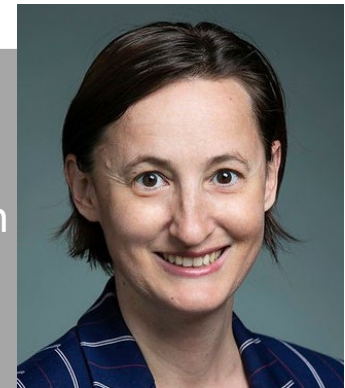


Data Points:

- Heartrate
- Body Temp
- Accelerometer
- Raw Data

Multiple devices used at the same time to compare results!

Led by Leigh McCue-Weil,
George Mason
University
Mechanical
Engineering



Expanded “At-Sea” Trials

Surveys with 29 fishers, at-sea trials with 5 fishers

Device	Data Storage Type	Water Resistant	Sleep Stages	Noteworthy Considerations
Fitbit Charge 3	Cloud	Yes	Yes	<ul style="list-style-type: none"> - Most recent 7 days stored locally - Lack of access to raw data - Safety of wrist wear - Does not log sleep if heart rate is not recorded (relevant for ankle wear) - Classifies sleep stages, i.e. Awake, REM, Light, Deep
Actigraph wGT3X-BT	Device (micro-USB)	Yes	No	<ul style="list-style-type: none"> - Accelerometer only - 30 day battery life - Classifies sleep as Awake or Sleep
Dreem 2	Cloud	No	Yes	<ul style="list-style-type: none"> - Battery life limited - Discomfort associated with headband while sleeping - Classifies sleep as Awake, REM, N1, N2, N3
Oura 2 nd Gen	Cloud	Yes	Yes	<ul style="list-style-type: none"> - Must customize fit - Safety of finger-wear - Lack of access to raw data - Classifies sleep as Awake, REM, Light, Deep
Hexoskin Smart	Cloud	Yes	Yes	<ul style="list-style-type: none"> - Must customize fit - Optimally supported with manual sleep log for activity tagging - Classifies sleep as Wake, REM, Non-REM

Logger Wearable Trial

Continuous BP Armband
UConn/CPH-NEW, Insoo Kim



Comfortable, easy to work in, more difficult to replace alone

Hexoskin



Comfortable, breathable, easy to work in, consider alternative placement for data pack

Empatica E4



Some loggers didn't mind, but others acutely aware of wrist device - hit against machines

Wearable Tech Challenges

User Considerations...

- Entanglement risks – worker experiences are important for identifying safest options
- Durability – outdoor (wet!) work environments, extreme weather, physically demanding
- Comfort – always a concern, but especially for sleep studies as it can compromise data
- Privacy concerns – devices could be used to track location, regulatory access to sleep data

Device Challenges

- Data Storage – some devices can store up to 180 days (Actigraph)
 - often synced to a cellphone device
 - coordinating data dump can be tricky
- Battery Life - for Hexoskin only 36 hours, for Dreem device charge only lasts one night
- Internet Connectivity – often required for data storage
 - lack of connectivity can result in data loss (Fitbit)

Wearable Tech Challenges

- Commercial vs. Lab built
 - Differences in comfort, durability, access to raw data
- Device set-up
 - Some are 'set and forget'
 - Others require more technical skills to apply/start
- Sizing
 - Hexoskin & Oura ring are size specific
 - Many wrist and arm wearables are adjustable
- Evolving technology
 - Always something new around the corner
- Cost - Varies widely
- Basic Considerations
 - What will/can workers wear?
 - What data can be captured given work environment?
- Next Steps
 - Additional field trials
 - Potential for lab studies to mimic vessel motion
 - Keeping an eye on new technology



**THANK YOU FOR
YOUR INTEREST!**

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