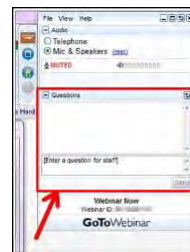




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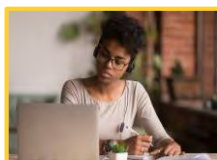


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ACS Efforts and Resources on COVID-19



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www.acs.org/covid-19

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GIANTS IN SENSING

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VIRUS DETECTION
What were we doing before COVID-19 changed the world

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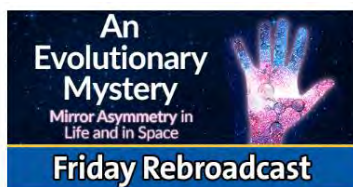
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Can Wearable Devices Detect Health Abnormalities?

Co-produced with: **PARTNERSHIP FOR clean competition** **ACS SENSORS**

THIS ACS WEBINAR WILL BEGIN SHORTLY...

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Can Wearable Devices Detect Health Abnormalities?



Lawrence Silverman
Professor (emeritus) of Pathology,
University of Virginia



Heather Clark
Professor, Departments of Bioengineering and
Chemistry, Northeastern University

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CAN WEARABLE DEVICES DETECT HEALTH ABNORMALITIES?

Lawrence Silverman, PhD

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History of Wearables – Hype versus Hope



Heart rate receivers linked to chest strap transmitter– **Polar** (1977 for the Finnish National Cross Country Ski Team). Suunto (2004), and Garmin (2009) also developed wearables to facilitate heart rate training in exercise



Chest straps replaced by optical heart rate receivers, worn on wrist, finger, arm, head, or ear – **Apple** (2015), Fitbit (2009), Xiaomi, Huami, Huawei, Oura

Additional sensors and algorithms to measure % oxygen saturation, heart rate variability, skin temperature, respiration rate, sleep cycle metrics, etc.

19

Audience Survey Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT



Approximately, how many health wearables are worn worldwide?

- 75 million
- 100 million
- 350 million
- 500 million
- 770 million



** If your answer differs greatly from the choices above tell us in the chat!*

20

CHARACTERISTICS OF A USEFUL HEALTH WEARABLE



Health wearables must be comfortable (sleep) with long battery life >24hrs.

Fitness wearables can have shorter battery life and be less comfortable, such as hearables (earbuds) or chest heart rate straps.

Currently, there are >770 million devices worldwide.

21



22



23



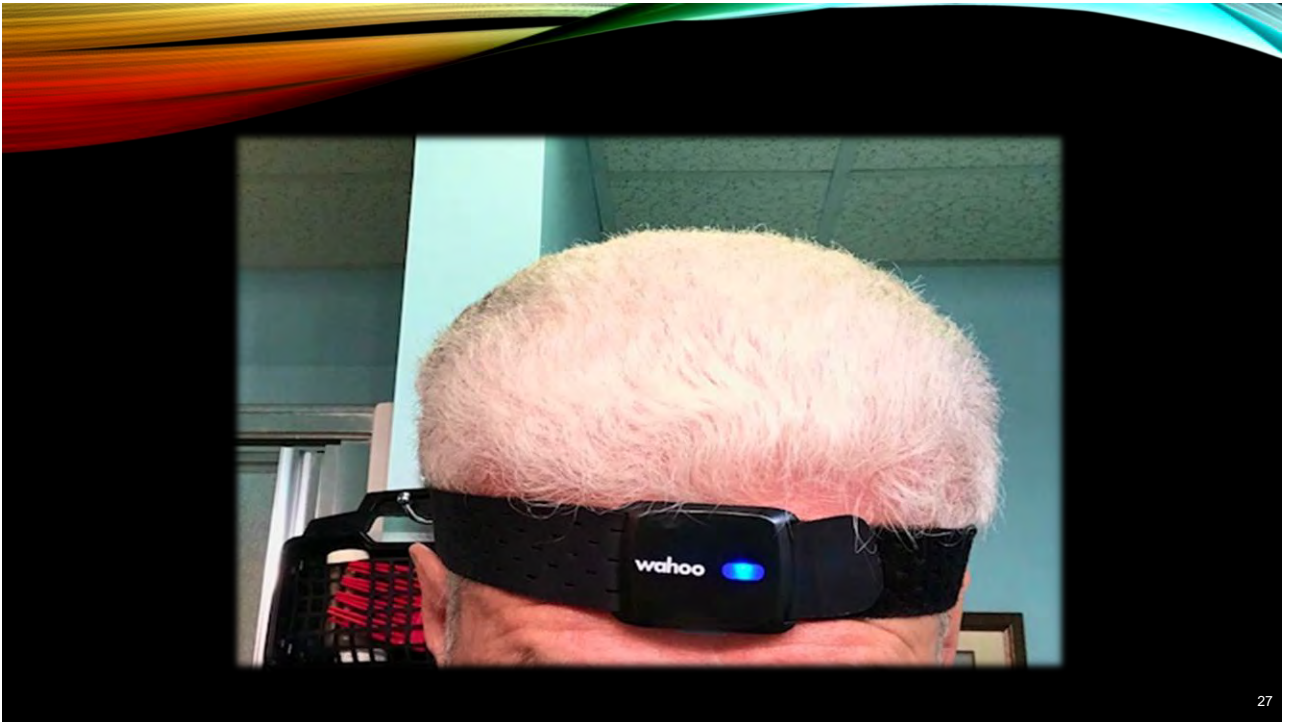
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WEARABLE DEVICES COMPARISON

ACTIVITY TRACKERS, HEART RATE MONITORS AND SMARTWATCHES

- **Activity trackers** measure steps, calories, stairs, sleep, etc using accelerometers, gyroscopes, and barometers. Examples: *Fitbit, Xiaomi, Amazfit, Garmin*
- **Heart rate monitors** add heart rate to the above, either by measuring optical pulse rate (PPG) or electrical impulses (EKG) with a chest strap.

Photoplethysmography (PPG) is an uncomplicated and inexpensive optical measurement that **uses a light source and a photodetector at the surface of skin to measure the volumetric variations of blood circulation**. Heart rate, heart rate variability, oxygen saturation, respiratory rate, and blood pressure can be derived from PPG.

Examples: *Garmin, Polar, Suunto, Fitbit, Apple Watch, Oura*

- **Smartwatches** add wireless, bluetooth, or cellular connections for data transfer to all of the above. Examples: *Apple Watch, Samsung, Amazfit*

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Audience Survey Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT



What kind of wearable devices have you used before?

(Select all that apply)

- Activity trackers
- Heart rate monitors
- Smart watches
- None of the above



** If your answer differs greatly from the choices above tell us in the chat!*

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METRICS AVAILABLE ON WEARABLE DEVICES

- HEART RATE
- HEART RATE VARIABILITY
- SKIN TEMPERATURE
- RESPIRATION RATE
- MOTION (ACCELEROMETER)
- BAROMETER
- OXYGEN SATURATION (SpO2)

30

SpO₂ LEVELS IN HEALTHY INDIVIDUALS

Oxygen Saturation refers to the percentage of hemoglobin that is bound, usually to oxygen.

Normal range is 94-99%. The gold standard is Arterial Blood Gas analysis involving a arterial blood sample.

Pulse oximetry is more common involving a device placed on a finger, ear lobe, or wrist by which an incident light source is either transmitted or reflected to a detector and free versus bound hemoglobin is measured by light absorbance.

31

INCIDENTAL FINDINGS, ANECDOTAL REPORTS, AND CONFIRMED STUDIES

- INCIDENTAL FINDINGS ARE OBSERVATIONS THAT CAN BE ASSOCIATED WITH MEDICAL CONDITIONS
- ANECDOTAL REPORTS ARE INCOMPLETE OBSERVATIONS THAT CAN BE CONFIRMED BY ADDITIONAL STUDIES (HYDROXYCHLOROQUINE)
- CONFIRMATION BY REVIEW

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APPLE RESEARCH STUDIES



COMPLETED

- Apple Heart Study – 9/2018
400,000 individuals studied for rhythm disturbances over an 8 month period leading to current Afib screening on Apple Watch 4&5 (ecg)

<https://www.nejm.org/doi/full/10.1056/NEJMoa1901183>

CURRENT



- Apple hearing study (Univ. of Michigan)
<https://publichealth.umich.edu/applehearingstudy>
- Apple heart and movement study (Birgham Research Institute)
<http://www.bwhresearch.org/appleheartandmovementstudy>
- Apple women's health study (Harvard T.H. Chan School of Public Health)
<https://www.hsph.harvard.edu/applewomenshealthstudy>

HEADLINES FROM CNN – ESPN – WASHINGTON POST




- Pro Golfer Nick Watney - How WHOOP Warned Him Of COVID-19

- The NBA Is Offering 2000 Oura Rings To Players To Track COVID-19
 - Wearable Tech Can Spot Coronavirus Symptoms Before You Even Realize You're Sick



What WHOOP Can Tell You About COVID-19

Pro Golfer Nick Watney on How WHOOP Warned Him of COVID-19



WHOOP PODCAST

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WHOOP Podcast

Pro Golfer Nick Watney shares how WHOOP warned him of COVID-19

10:58 | 2020

<https://www.whoop.com/thelocker/podcast-80-pro-golfer-nick-watney-covid-19>

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Apple Watch, Fitbit data can spot if you are sick days before symptoms show up

A Stanford study is showing how wearables have promise in helping to keep a lid on coronavirus infections.

By Jo Best | July 1, 2020 -- 09:51 GMT (10:51 BST) | Topic: Digital Health and Wellness



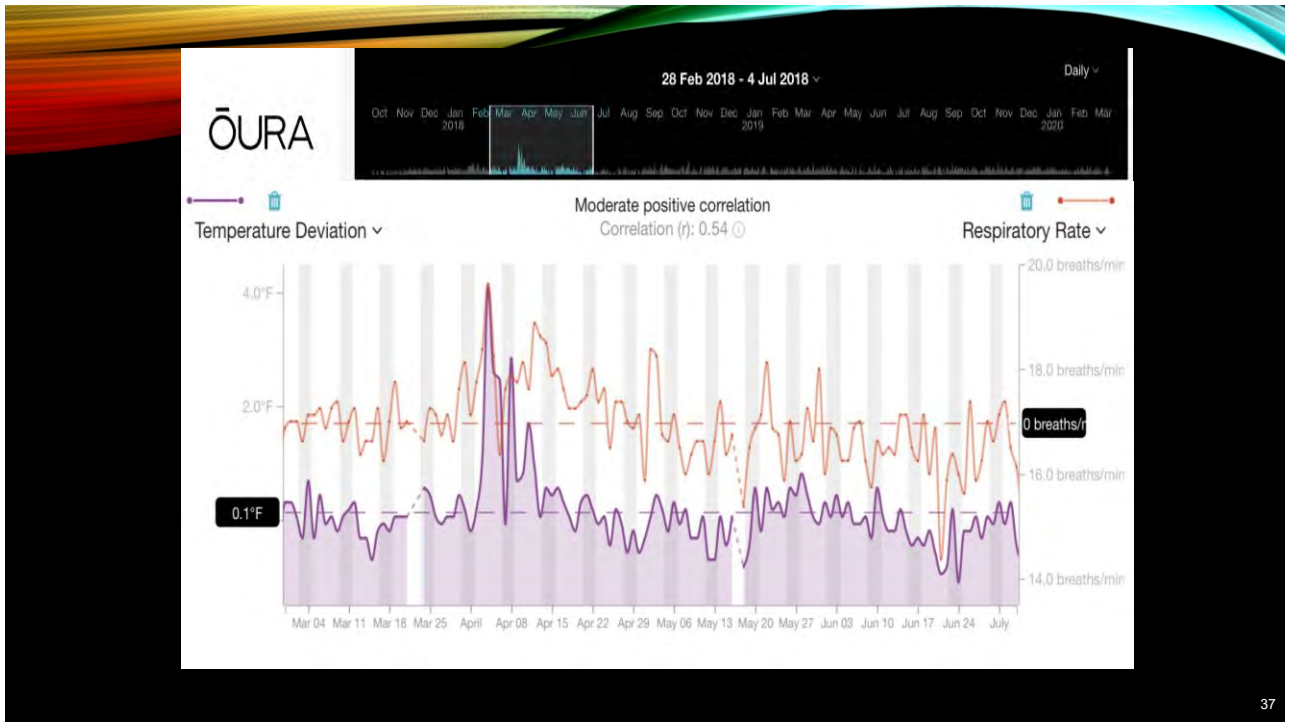
Stanford University is hoping to turn wearables like the Apple Watch and Fitbit's health-tracking bands into the latest weapon in the fight against coronavirus.

The Stanford Medicine's Healthcare Innovation Lab launched the [Coronavirus Wearables Study](#) earlier this year to research whether wearables can be used to detect if someone has COVID-19 before they start showing any symptoms (if they ever do).

The study, which is currently recruiting for participants, will ask users to give data from their wearables -- such as heart rate, skin temperature, and blood oxygen saturation -- through an app created by Stanford's bioinformatics team. (The system currently works with Apple Watch, Garmin, and Fitbit devices, among others.) Would-be participants will also need to fill in a symptom checklist regularly and can optionally also share details from their medical records.

<https://www.zdnet.com/article/apple-watch-fitbit-data-can-find-covid-19-infections-days-before-symptoms-show-up>

36



Doctor credits Apple Watch for saving his life

By Amber Neely | 4 hours ago

The Apple Watch has saved another life, according to a story shared by a California-based anesthesiologist who claims it helped him discover his own hidden heart condition that requires corrective surgery.

Apple claims that the Apple Watch is only capable of detecting atrial fibrillation — also known as aFib — a form of irregular, rapid heart rate that can cause poor blood flow. However, one Californian doctor says his Apple Watch helped detect underlying heart disease in himself.

<https://appleinsider.com/articles/20/07/01/doctor-credits-apple-watch-for-saving-his-life>

38

When Endurance Training Can Be Deadly for Older Athletes

— This case shows the danger of one asymptomatic condition in particular

by Kate Kheisel, Contributing Writer, MedPage Today June 8, 2020



Several recent and ongoing studies using wearable technology to detect **Atrial Fibrillation** in the outpatient setting may answer some outstanding questions, the case author notes.

<https://www.medpagetoday.com/casestudies/cardiology/86934>

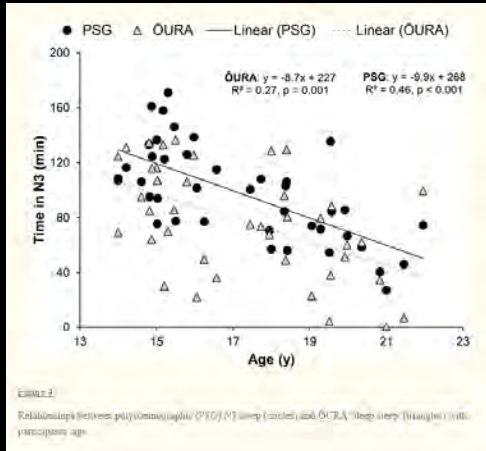
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ADVANCED METRICS

- SLEEP
- BLOOD PRESSURE
- HYDRATION
- RECOVERY
- EXERTION

40

SLEEP – THE NEXT FRONTIER



Polysomnography = sleep study measuring heart rate, eeg, O2 levels, respirations, arm and leg movements.

Multisensor sleep trackers, such as the **ÖURA ring** have the potential for detecting outcomes beyond binary sleep-wake using sources of information in addition to motion.

While these first results could be viewed as promising, future development and validation are needed.

The Sleep of the Ring: Comparison of the ÖURA Sleep Tracker Against Polysomnography, [Behavioral Sleep Medicine 17\(3\):1-15 · March 2017](#)

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CAN WEARABLE DEVICES DETECT HEALTH ABNORMALITIES?

- CAVEAT EMPTOR – PEER REVIEWED
 - CONFIRMATORY REPORTS
e.g., Cardiac dysrhythmias
 - ANECDOTAL REPORTS
e.g., COVID-19, Sleep Disturbances

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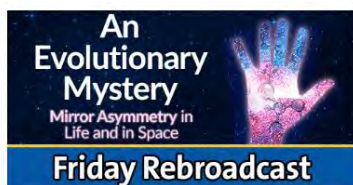
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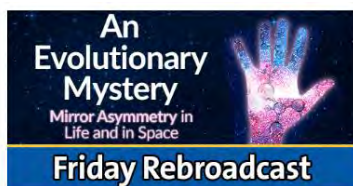
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