Can a smartwatch impact the well-being of aging adults?

My experience using my apple smartwatch

Dan Abell

OBJECTIVES
(AT THE END OF THIS PRESENTATION YOU SHOULD BE ABLE TO…)

- **IDENTIFY** SMARTWATCH FEATURES AND CAPABILITIES THAT MAY BE BENEFICIAL IN SUPPORTING THE WELLBEING OF AGING ADULTS
- **BECOME AWARE** OF CHALLENGES AND LIMITATIONS IDENTIFIED BY THE PRESENTER'S EXPERIENCE USING A SMARTWATCH
- **UTILIZE** THE INFORMATION PRESENTED TO EVALUATE THE POTENTIAL FOR THE USE OF SMARTWATCH TECHNOLOGY WITHIN YOUR ORGANIZATION AND CLIENT BASE TO ADDRESS SPECIFIC MONITORING AND BEHAVIORAL METRICS

Survey 1

Identify yourself as:

1. Social Worker
2. Nurse
3. MD
4. Researcher/Professor
5. Student
6. Older Adult (like me ☺)

ZURICH

FRUIT OF THE LOOM

UNIVERSITY OF MARYLAND BALTIMORE COUNTY
UMBC
1966

BLACK & DECKER

30TH AIRLIFT SQ
UBIVIS QUANDO VIS

BainCapital
PRIVATE EQUITY
broder

LOYOLA
UNIVERSITY MARYLAND

WP
WhitePoint
Associates

KODIAK
FINANCE

CCBC
Community College of Baltimore County

MY INTEREST STARTED …

2011 WITH MOM

- MED ADHERENCE
- O_2 MONITORING
- FALL DETECTION

JOHNS HOPKINS
UNIVERSITY

COURSE
CERTIFICATE

Sep 2, 2020

Daniel Abell

has successfully completed

Systems Thinking In Public Health

an online non-credit course authorized by Johns Hopkins University and offered through Coursera

EDUCATION FOR EVERYONE
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David Bishai, MD PhD
Professor, Population, Family and Reproductive Health
Bloomberg School of Public Health

Ligia Paina, PhD
Assistant Scientist, International Health
Bloomberg School of Public Health

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Mila Kivipelto
MD, PhD, Professor, Senior Geriatrician
Karolinska Institutet

Completion Date 19-Mar-2021
Expiration Date 18-Mar-2024
Record ID 41689809

valid for renewal of certification
ough CME.

Massachusetts Institute of Technology Affiliates

Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wda899d14-9875-464a-bf01-8e10a853ee04-41689809

A Boomer's View On How Technology Can Help Older Adults Thrive In An Independent Living Environment

2019

Dan Abell
dkabell@gmail.com

CAN ROBOTICS HELP SENIORS MAINTAIN INDEPENDENCE AND AGE IN PLACE?

2020

Dan Abell
dkabell@gmail.com

THE DESIRE TO AGE IN PLACE

- Quality of life
- Avoid disruption
- Sense of well being
- Least cost to society

Boomers Want to Stay Home. Senior Housing Now Faces Budding Glut.

The Wall Street Journal

https://www.wsj.com/articles/boomers-want-to-stay-home-senior-housing-now-faces-a-budding-glut-11573554601?emailToken=a2fb3811e0db84fcdea5bfb8e39b0725sm6QoMiXOrKbzL9tR6Gcp1hczl6GNPpphYQF+AO01F6bdNhzW312QKkqaZQc3O3fYlOqbw2OaKWrobRPa9wMIFPXFQC3friS4Op/NLeiueY/AFG1q8JVVUB+SFuQSp0I&reflink=article_email_share

EMERGING TECHNOLOGIES TO SUPPORT AN AGING POPULATION

A Report by the

TASK FORCE ON RESEARCH AND DEVELOPMENT FOR TECHNOLOGY TO SUPPORT AGING ADULTS

COMMITTEE ON TECHNOLOGY

of the

NATIONAL SCIENCE & TECHNOLOGY COUNCIL

March 2019

TECHNOLOGY TARGETING THE SENIOR POPULATION

- IoT *(the Internet Of Things)*
- AI *(Artificial Intelligence)*
- Robotics
- Consumer Technology (stuff you find in BestBuy)
- Scooters, lift devices, etc.
- Tablets
- VR *(Virtual Reality)*
- Cloud things…Alexa based, etc.

SMART WATCHES (SAMSUNG, APPLE, FITBIT, OTHERS)

LET'S EXPLORE ONE EXAMPLE – THE APPLE WATCH (SERIES 6)

Apple Watch Series 5
The iWatch User Manual For
Dummies & Seniors
Tony
iPhone
FOR SENIORS
dummies
Dwight Spivey
APPLE WATCH
SERIES 3
FOR
Seniors
A RIDICULOUSLY SIMPLE GUIDE TO
APPLE WATCH SERIES 3 AND WATCHOS 6
SCOTT LA COUNTE

CURRENT APPLE MODELS

Apple Watch Series 6

From $399

44mm or 40mm case size

Always-On Retina display

—

GPS + Cellular[1]
GPS

Blood Oxygen app[2]

ECG app[3]

High and low heart rate notifications
Irregular heart rhythm notification[4]

Supports Family Setup[5]
(GPS + Cellular models)

Water resistant 50 meters[6]

Apple Watch SE

From $279

44mm or 40mm case size

—

Retina display

GPS + Cellular[1]
GPS

—

—

High and low heart rate notifications
Irregular heart rhythm notification[4]

Supports Family Setup[5]
(GPS + Cellular models)

Water resistant 50 meters[6]

Apple Watch Series 3

From $199

42mm or 38mm case size

—

Retina display

—
GPS

—

—

High and low heart rate notifications
Irregular heart rhythm notification[4]

—

Water resistant 50 meters[6]

A COLLECTION OF SENSORS ON YOUR WRIST

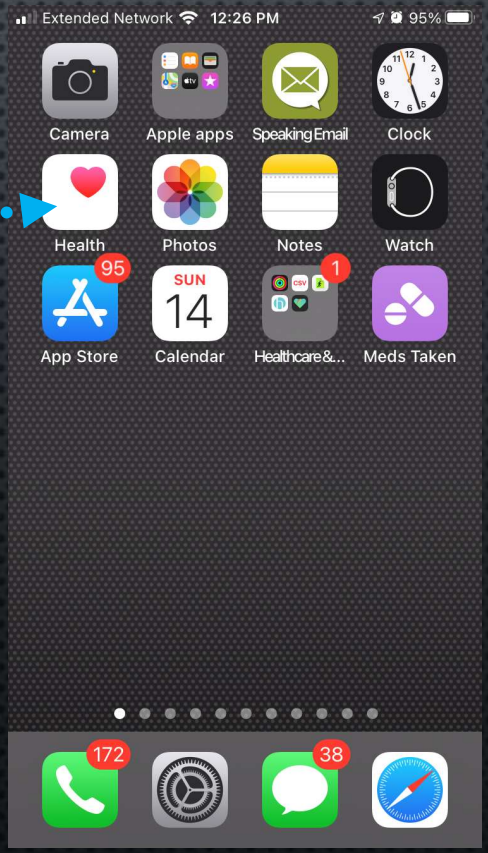
The Apple Watch is NOT a Medical Device

- Passive data collection
- Active data collection

PASSIVE METRICS

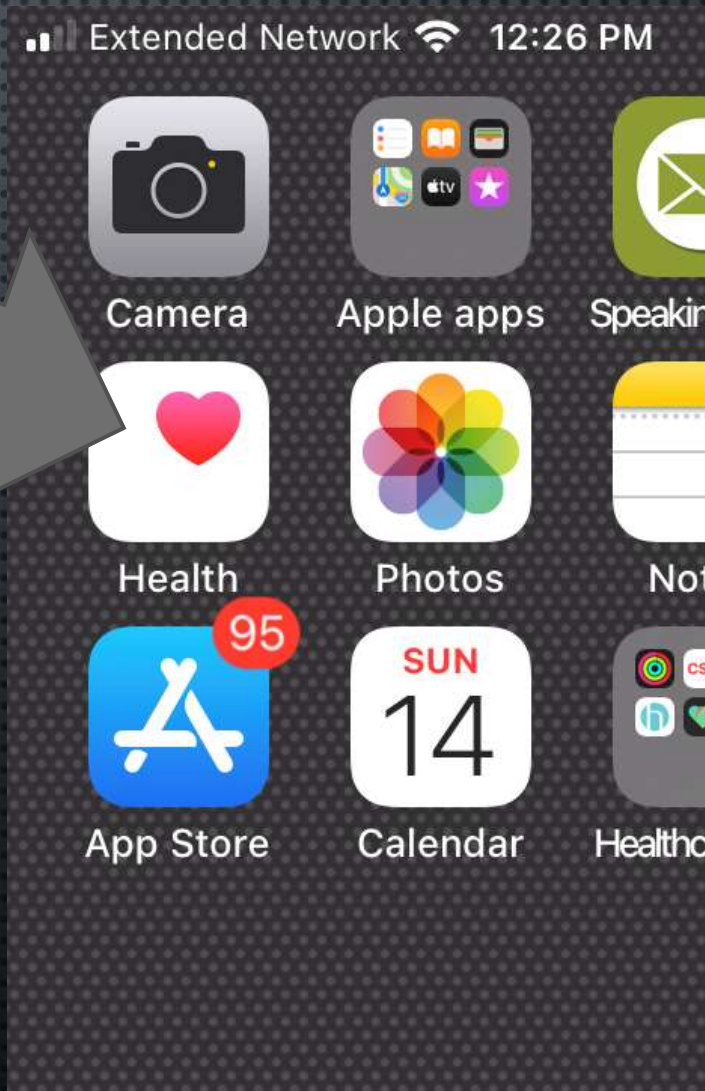
ON-GOING

REAL-TIME DATA COLLECTION

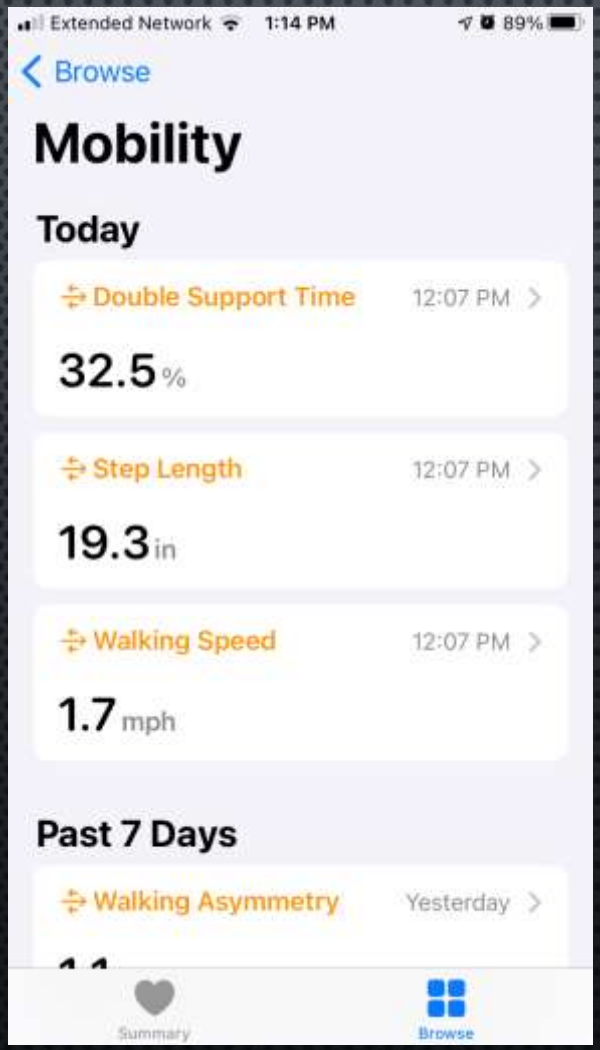


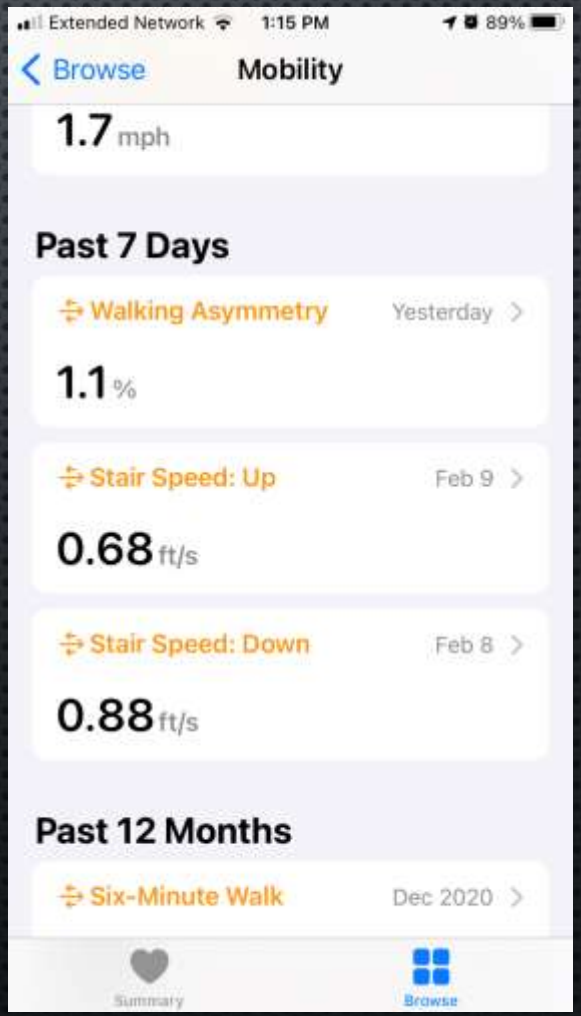
HEALTH APP ON THE PHONE

- REPOSITORY FOR ALL THE WATCH DATA
- DATA PRESENTATION FOR ALL SENSORS
- DASHBOARDS



MOBILITY – WALKING METRICS





WALKING METRICS – DOUBLE SUPPORT TIME

(THIS IS THE PERCENTAGE OF TIME DURING A WALK THAT BOTH FEET ARE ON THE GROUND.)

https://developer.apple.com/documentation/healthkit/hkquantitytypeidentifier/3552087-walkingdoublesupportpercentage

WALKING METRICS – WALKING ASYMMETRY

(WALKING ASYMMETRY IS THE PERCENT OF TIME THAT A USER'S STEPS WITH ONE FOOT ARE FASTER OR SLOWER THAN THE OTHER FOOT.)

https://developer.apple.com/documentation/healthkit/hkquantitytypeidentifier/3552086-walkingasymmetrypercentage

Regenerative and Technological Section / Original Paper

Gerontology

Gerontol
DOI: 10.1

Conclusions

We found that objective gait, balance, and PA parameters have the potential to provide clinically meaningful surveillance of older adults across frailty statuses. Particularly, our approach of monitoring frailty-specific PA pa- rameters may be incorporated into mHealth technologies (i.e., smartphone) and may serve as a 'frailty meter', similar to a

Wearable Sensor-Based
of Gait, Balance, and Phy

objective
cal frailty syndrome

Contents lists available at ScienceDirect

Gait & Posture

journal homepage: www.elsevier.com/locate/gaitpost

ELSEVIER

37

Research | Open Access | Published: 26 July 2019

Gait analysis with the Kinect v2: normative study with healthy individuals and comprehensive study of its sensitivity, validity, and reliability in individuals with stroke

Jorge Latorre, Carolina Colomer, Mariano Alcañiz & Roberto Llorens

Journal of NeuroEngineering and Rehabilitation **16**, Article number: 97 (2019) | Cite this article

d Estimation Using
s, Thermal Camera,
and Motion Tracking Suit Technologies

Gait Analysis

- Markers for several disease types
- Typically a Clinical Setting
- Traditionally done by fixed "in-place" technologies such as motion cameras
- Some attempt at using a smartphone's sensors to assess "fragility"

Now we have longitudinal "walking" metrics

- "Always on"
- Captures day to day activities / environment
- A new opportunity toward personal/precision medicine?

QUESTION SET 1

1. DO YOU SEE THE POTENTIAL FOR USING WALKING METRICS WITH YOUR CLIENTS/PATIENTS?
2. HOW?

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Older Adult Fall Prevention

Cost of Older Adult Falls

Falls among adults age 65 and older are very costly. Each year about $50 billion is spent on medical costs related to non-fatal fall injuries and $754 million is spent related to fatal falls.[1]

Non-fatal falls

- $29 billion is paid by Medicare
- $12 billion is paid by private or out-of-pocket payers
- $9 billion is paid by Medicaid

https://www.cdc.gov/homeandrecreationalsafety/falls/data/fallcost.html

What is not so obvious …

At Least to me…

"…those with slower walking speeds and a greater decline in speed over time were at greater risk of developing dementia independent of changes in cognition."

Walking Speed, Cognitive Function, and Dementia Risk in the English Longitudinal Study of Ageing

Ruth A. Hackett, PhD, Hilary Davies-Kershaw, PhD,*† Dorina Cadar, PhD,* Martin Orrell, PhD,‡ and Andrew Steptoe, DSc, DPhil**

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6127007/pdf/JGS-66-1670.pdf

ZIMMER IS USING WALKING METRICS…

https://www.zimmerbiomet.com/medical-professionals/zb-connect/mymobility.html

The "mymobility" platform's new **gait quality metrics** will use the Apple Watch and iPhone's sensors to measure hip and knee joint replacement patients' **walking speed** and the **period of time when both of their feet are in contact with the ground**. The platform will require patient permission and will not collect GPS data.*

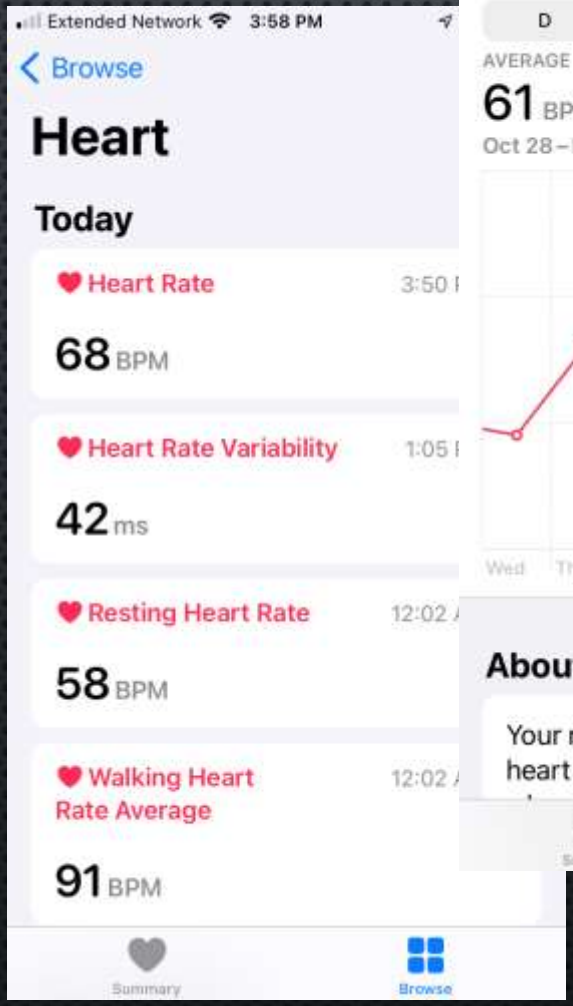
* https://www.beckershospitalreview.com/digital-transformation/apple-watch-to-release-new-gait-quality-metrics.html

QUICK REVIEW OF THE ANSWERS TO QUESTION SET 1 (USING WALKING METRICS)

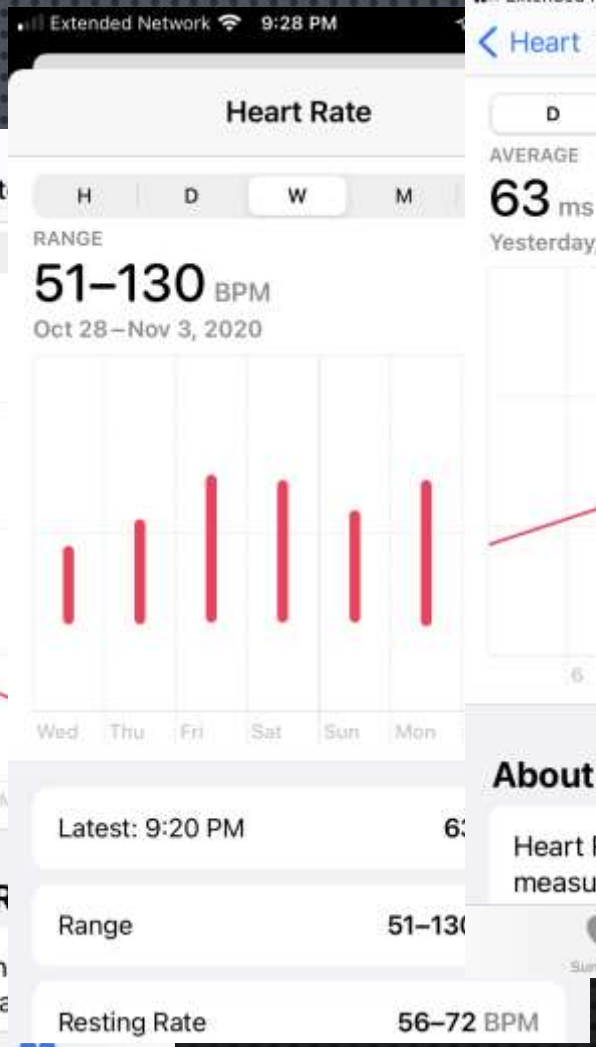
The watch is an "activity tracker"

- Every activity tracker measures …

HEART RATE


Extended Network 3:58 PM
Browse
Heart
Today
Heart Rate
68 BPM
Heart Rate Variability
42 ms
Resting Heart Rate
58 BPM
Walking Heart Rate Average
91 BPM
Summary
Browse

Extended Network 9:29 PM
Heart
D
W
M
AVERAGE
61 BPM
Oct 28 – Nov 3, 2020
Wed
Thu
Fri
Sat
Sun
About Resting Heart R
Your resting heart rate is th
heart beats per minute mea
Summary
Browse


Extended Network 9:28 PM
Heart Rate
H
D
W
M
RANGE
51–130 BPM
Oct 28 – Nov 3, 2020
Wed
Thu
Fri
Sat
Sun
Mon
Latest: 9:20 PM
Range
51–13
Resting Rate
56–72 BPM

Extended Network 4:15 PM 49%
Heart
Heart Rate Variability
Add Data
D
W
M
Y
AVERAGE
63 ms
Yesterday, 2 PM – Today, 2 PM
150
100
50
0
6
12 AM
6
12 PM
About Heart Rate Variability
Heart Rate Variability (HRV) is a measure of the variation in the time
Summary
Browse

HEART RATE NOTIFICATIONS

Using Heartrate Data

- Real-time heart rate measurement was my primary motivation to purchase my watch
- Provides a baseline / history to reference

ANOTHER REASON TO CONSIDER THE APPLE WATCH…

ARTICLES
https://doi.org/10.1038/s41551-020-00640-6
nature biomedical engineering
Check for updates

Pre-symptomatic detection of COVID-19 from smartwatch data

“consumer smartwatches can be used for the pre-symptomatic detection of coronavirus disease 2019 (COVID-19)”

“63% of the COVID-19 cases could have been detected before symptom onset“

“…consumer wearable devices may be used for the large-scale, real-time detection of respiratory infections, often pre-symptomatically”

NATuRE BIOMEDICAL ENGINEERING | VOL 4 | DeCeMBeR 2020 | 1208–1220 |
www.nature.com/natbiomedeng

Smartwatches can help detect COVID-19 days before symptoms appear

BY MEGAN CERULLO
JANUARY 15, 2021 / 7:26 AM / MONEYWATCH

CBS NEWS

- Can predict up to seven days before someone feels sick or infection is detected through testing.
- *Heart rate variability* markers change as inflammation develops
  (Individuals with COVID-19 experienced lower heart rate variability)
- 81% of coronavirus-positive participants experienced changes in their resting heart rates (up to nine and a half days prior to the onset of symptoms)
- An extremely elevated heart rate was indicative of symptom onset, another study reported.

https://www.cbsnews.com/news/covid-symptoms-smart-watch/

WHILE THE STANFORD RESEARCH IS THE MOST WIDELY REFERENCED, OTHER INSTITUTIONS HAVE REPORTED SIMILAR RESULTS

Stanford MEDICINE | News Center

FRONT PAGE ALL NEWS TOPICS MULT

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Smartwatch can detect early signs of illness

Stanford Medicine scientists have devised a smartwatch-based "alarm system that goes off when it detects signs of infection.

Biotech Innovations FREE

December 8, 2020

Using Smartwatch Data to Detect COVID-19 Cases Early

Jennifer Abbasi

JAMA. 2020;324(22):2247. doi:10.1001/jama.2020.23696

COVID-19 Resource Center

Early this year, investigators at the Scripps Research Translational Institute found that resting heart rate and sleep data from wearable sensors could predict population-level trends in influenza-like illness. Now, a new study from the same team suggests that wearable sensor data combined with self-reported symptoms might aid in the early detection of coronavirus disease 2019 (COVID-19).

Get the latest on COVID-19 Info, Vaccine Info and Vaccine Appointments.

Mount Sinai

Find a Doctor | Request an Appointment | Our Locations | Patient Care | About Us

Press Release

Mount Sinai Study Finds Wearable Devices Can Detect COVID-19 Symptoms and Predict Diagnosis

New York, NY (February 08, 2021) – Wearable devices can identify COVID-19 cases earlier than traditional diagnostic methods and can help track and improve management of the disease, Mount Sinai researchers report in one of the first studies on the topic. The findings were published in the Journal of Medical Internet Research on January 29.

The Warrior Watch Study found that subtle changes in a participant's heart rate variability (HRV) measured by an Apple Watch were able to signal the onset of COVID-19 up to seven days before the individual was diagnosed with the infection via nasal swab, and also to identify those who have symptoms.

Newsroom

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Aspen Ideas Festival

Mount Sinai Podcasts

In This Story

Early Detection of COVID-19: How Your Smartwatch Could Help

Wed, 08/12/2020 By Lillian Clark

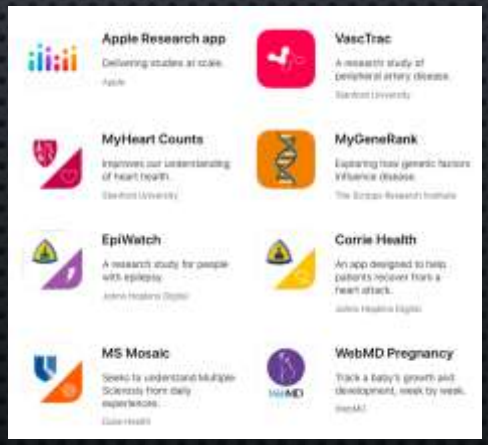
Duke researchers aim to detect coronavirus infections early in CovIdentify study

News of the first U.S. coronavirus case hit the American public on Tuesday, Jan. 21. For Jessilyn Dunn, PhD, assistant professor in the Departments of Biomedical Engineering and Biostatistics and Bioinformatics at Duke University and director of the Duke BIG IDEAs Lab, the infection in Washington State was a cue to launch a new study—CovIdentify.

GETTING THE DATA FROM THE CLIENT/PATIENT

NEED AN APP FOR THAT!

Analyze & Take Action



Question set 2

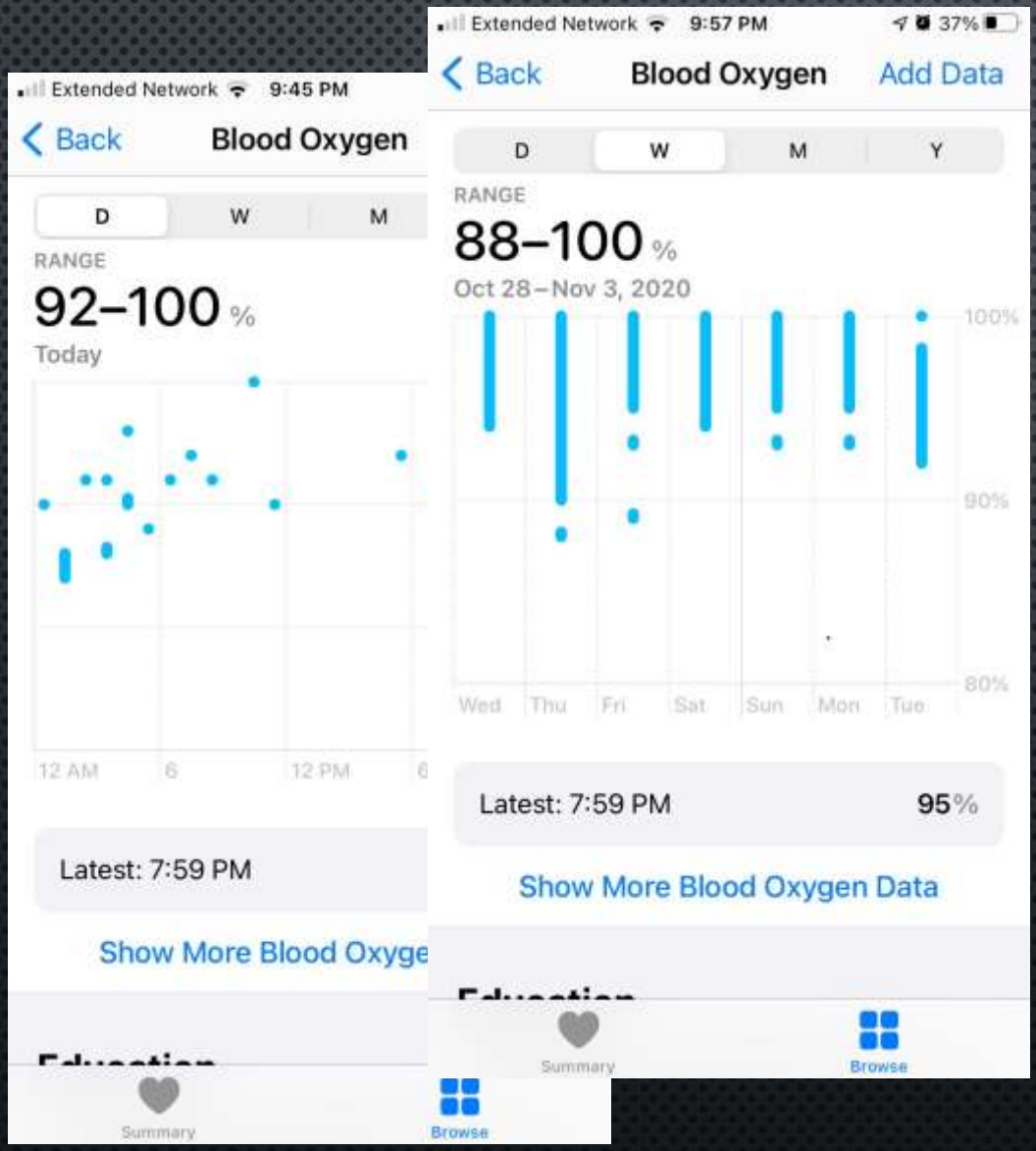
1. Does the fact that the watch has been used in trials for covid detection influence your view of the validity of a smartwatch?

2. Do you have some ideas on how a smartwatch can help you and your clients/patients?

BLOOD OXYGEN METRIC (SpO_2)

(New Apple Watch Feature in late 2020)

BLOOD OXYGEN SATURATION (SPO2)



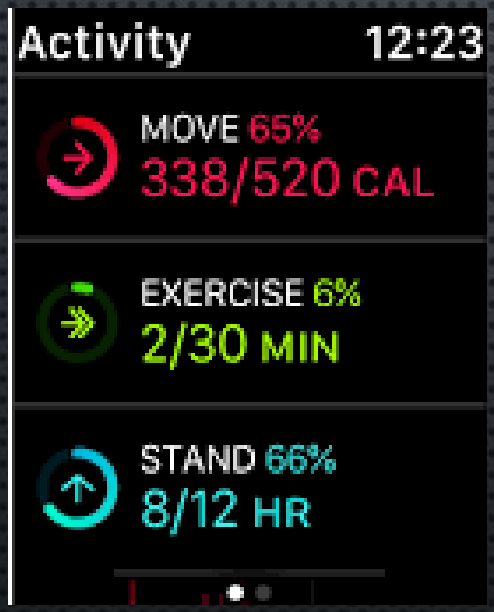
SpO2 Functional Status

- "Directional" data, not FDA sanctioned
- Considered a "general wellness" function

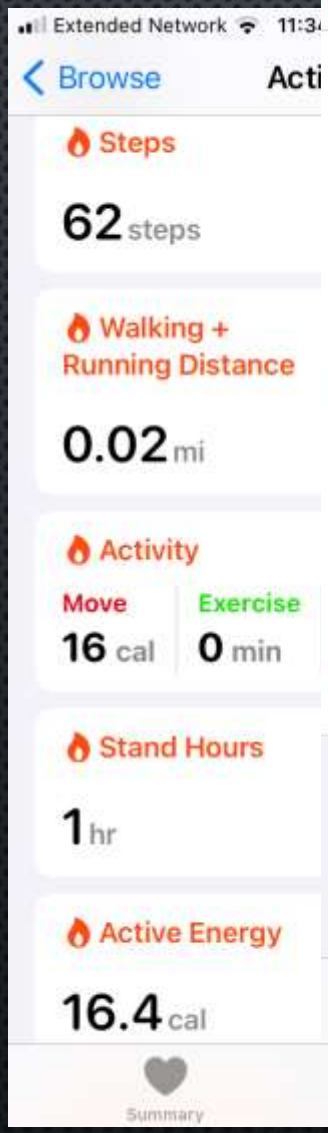
A useful metric?

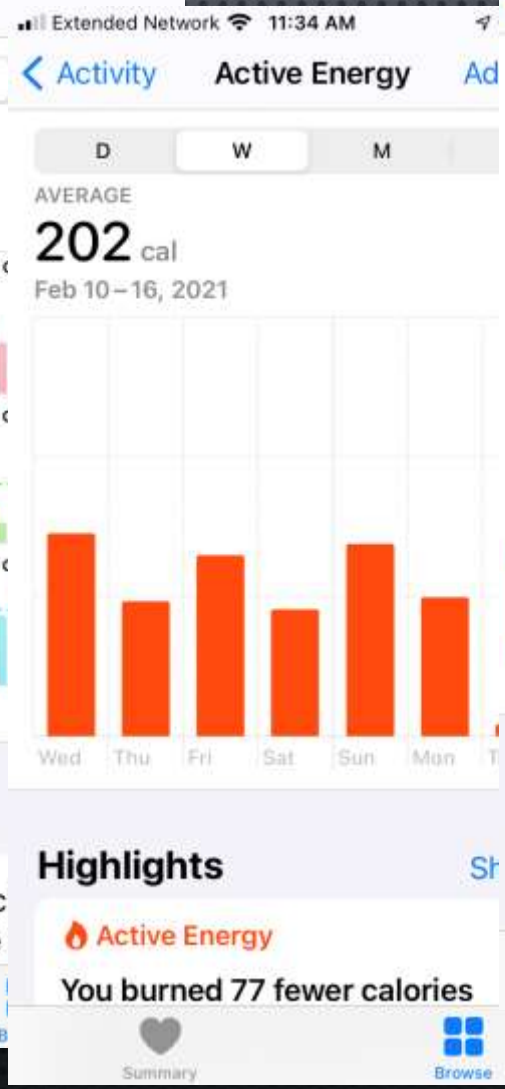
BACK TO THE "ACTIVITY TRACKER" ROLE

CURRENT DAY'S ACTIVITY DISPLAYED ON THE WATCH



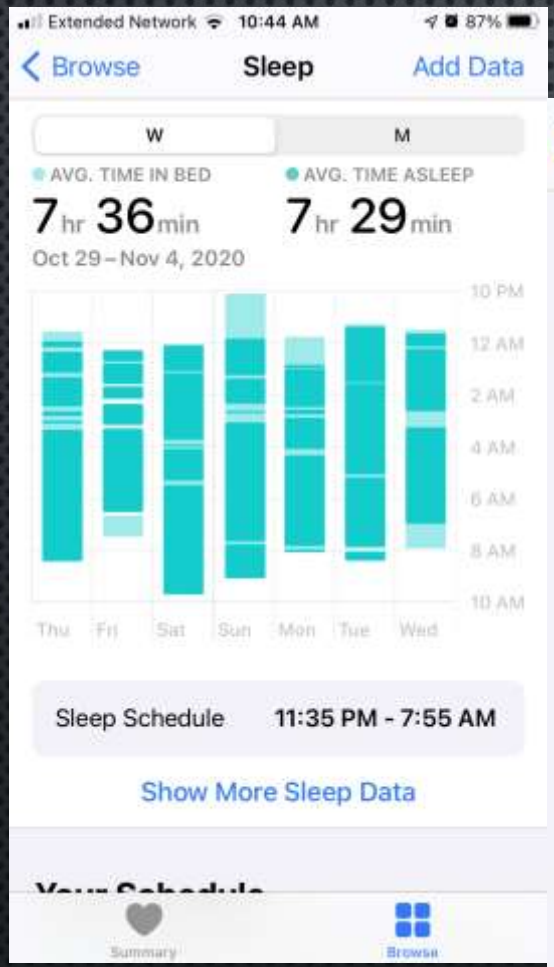
ACTIVITY & ENERGY TRACKING

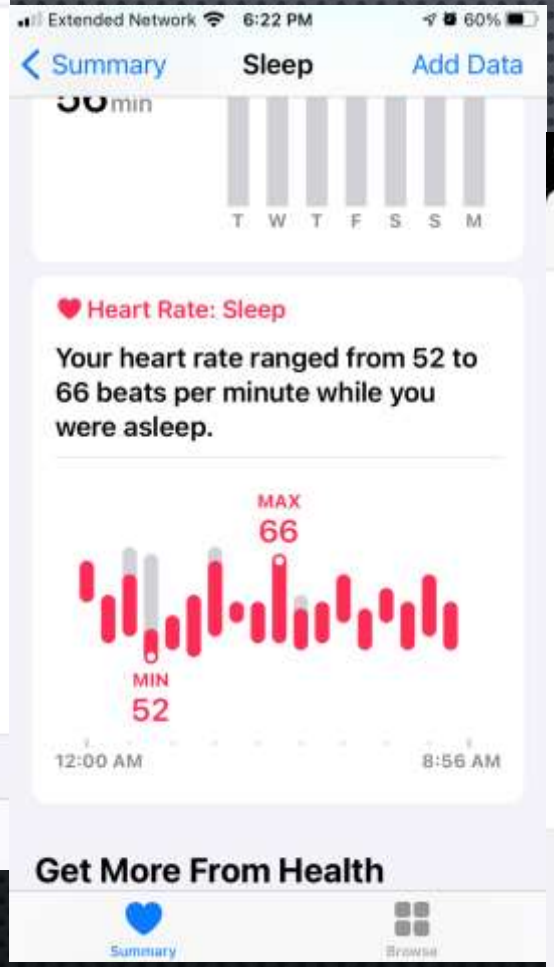




A CLASSIC "ACTIVITY TRACKER METRIC…"

SLEEP





The Stanford Covid study did identify changes in sleep patterns as a disease indicator

AT THE FOREFRONT
UChicagoMedicine

Patients & Visitors | Health Care Professionals | Research & Clinical Trials

April 28, 2019

Written By
John Easton

Learn more about our COVID-19 testing, vaccination program and visitor restrictions.

FOREFRONT | RESEARCH AND DISCOVERIES

Disrupted sleep linked to cognitive decline in older adults

Night Owl? Early Bird? Good Night's Sleep May Protect the Brain

Series - Alzheimer's Association International Conference 2012: Part 16 of 18

JAMA Network Open

Original Investigation | Neurology

Sleep Duration and Sleep Quality in Caregivers of Patients With Dementia

A Systematic Review and Meta-analysis

Chenlu Gao, MA; Nikita Y. Chapagain, BS; Michael K. Scullin, PhD

CONCLUSIONS AND RELEVANCE Sleep debt is known to have cumulative associations with physical, mental, and cognitive health; therefore, poor sleep quality in dementia caregivers should be recognized and addressed.

better sleep quality was observed in caregivers who received low-cost behavioral interventions

JAMA Network Open. 2019;2(8):e199891. doi:10.1001/jamanetworkopen.2019.9891

BODY WORK Haley Otman October 31, 2019 3:00 PM

A Consumer Sleep Tracker Researchers Can Actually Use

"We sent patients into the sleep laboratory for an overnight sleep study, wearing Apple watches, and used that data to develop our own algorithm to analyze acceleration and heart rate signal from the watch to estimate sleep,"

The design, when applied to **signals from the Apple Watch, exceeded** previously reported performance of **the more expensive, medical, wrist-worn sleep tracker** known as actigraphy.

https://academic.oup.com/sleep/article/42/12/zsz180/5549536

https://labblog.uofmhealth.org/body-work/a-consumer-sleep-tracker-researchers-can-actually-use

THE WATCH FEATURE MOST IDENTIFIED IN THE MEDIA FOR SENIORS

- Notifies 911 and Emergency contacts
- My experience …

After an emergency call ends, your Apple Watch alerts your emergency contacts with a text message, unless you choose to cancel. Your Apple Watch sends them your current location, and, for a period of time after you enter Emergency SOS mode, it sends your emergency contacts updates when your location changes.

Previous metrics all collected autonomously by the watch

- No User Input
- Data stored in the paired iPhone
- On-going data collection
- Records longitudinal data
- Event driven as well as periodic "schedule" driven

(Note: O2, heart rate can also be initiated by the user at any time)

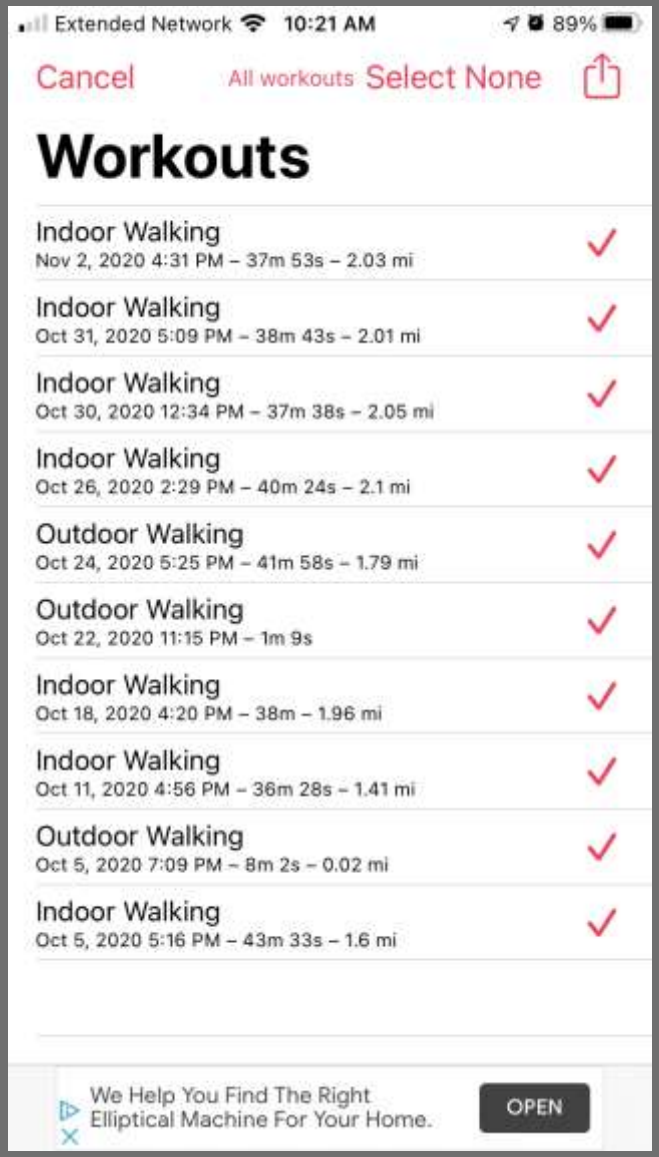
NOW LET'S LOOK AT USER INITIATED EVENTS

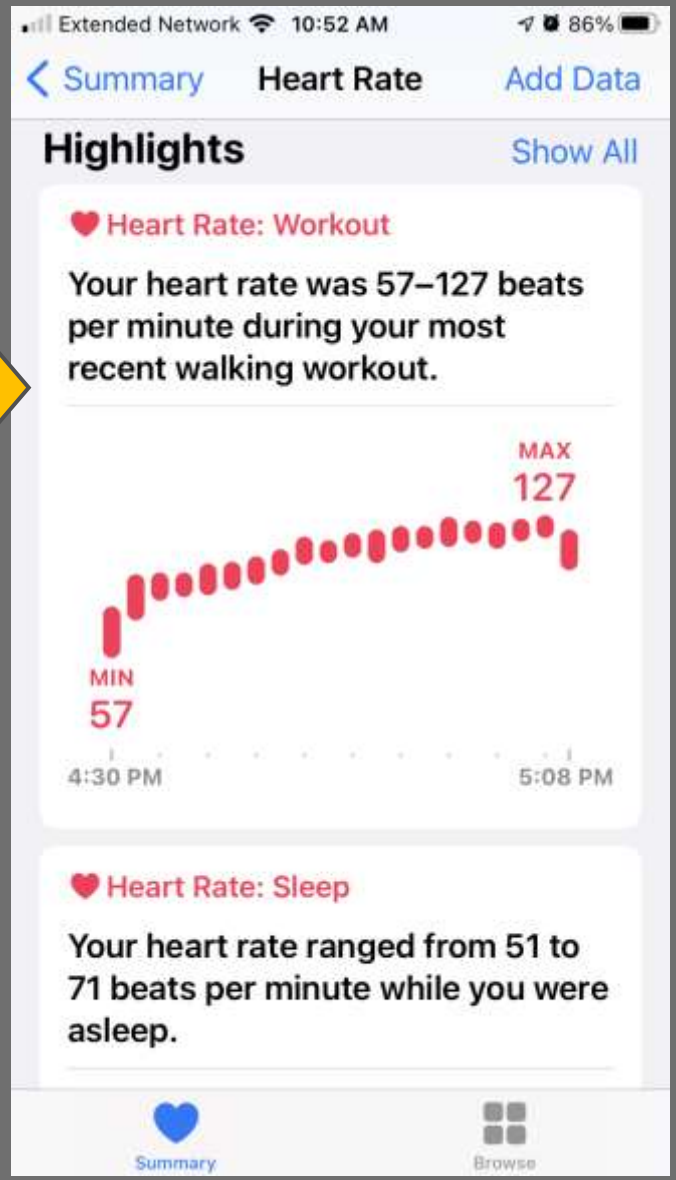
MANUAL ACTIVATION

FITNESS APP

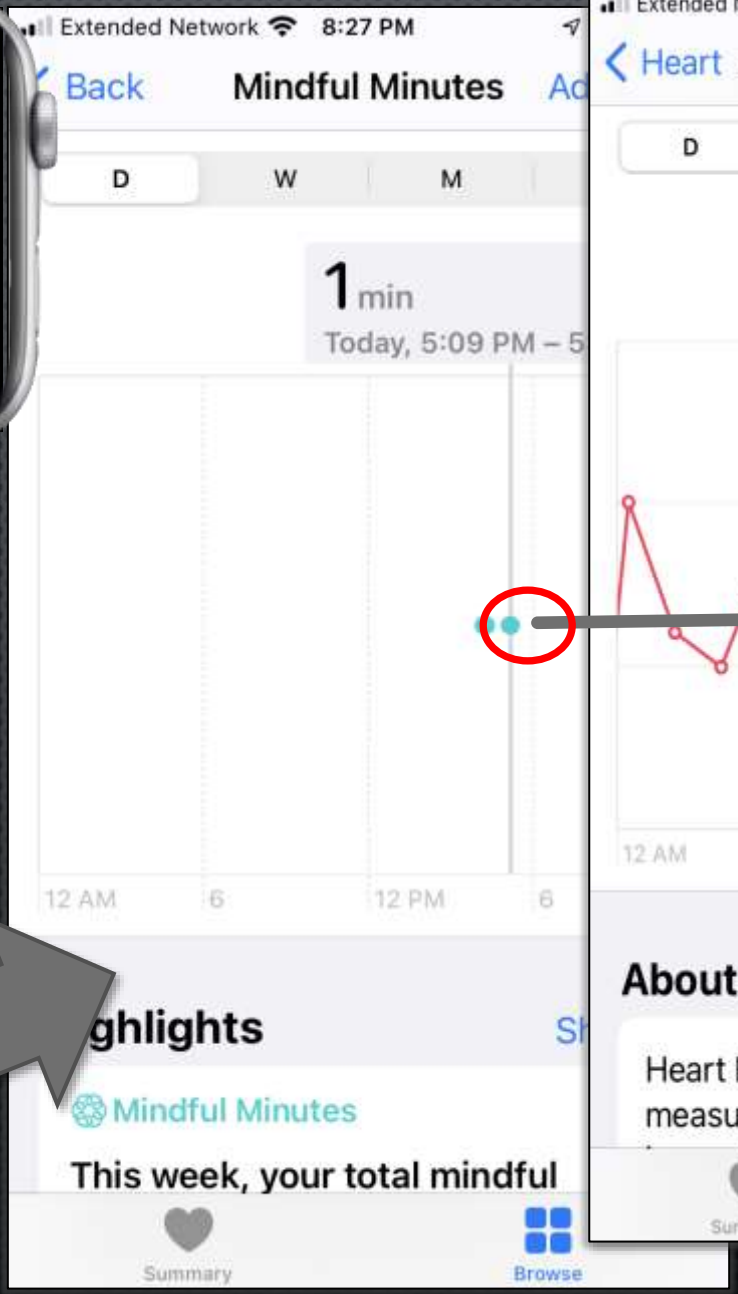
FITNESS APP VIEW ON THE PHONE

(HIGHLIGHTS FROM HEART RATE "SUB APP")

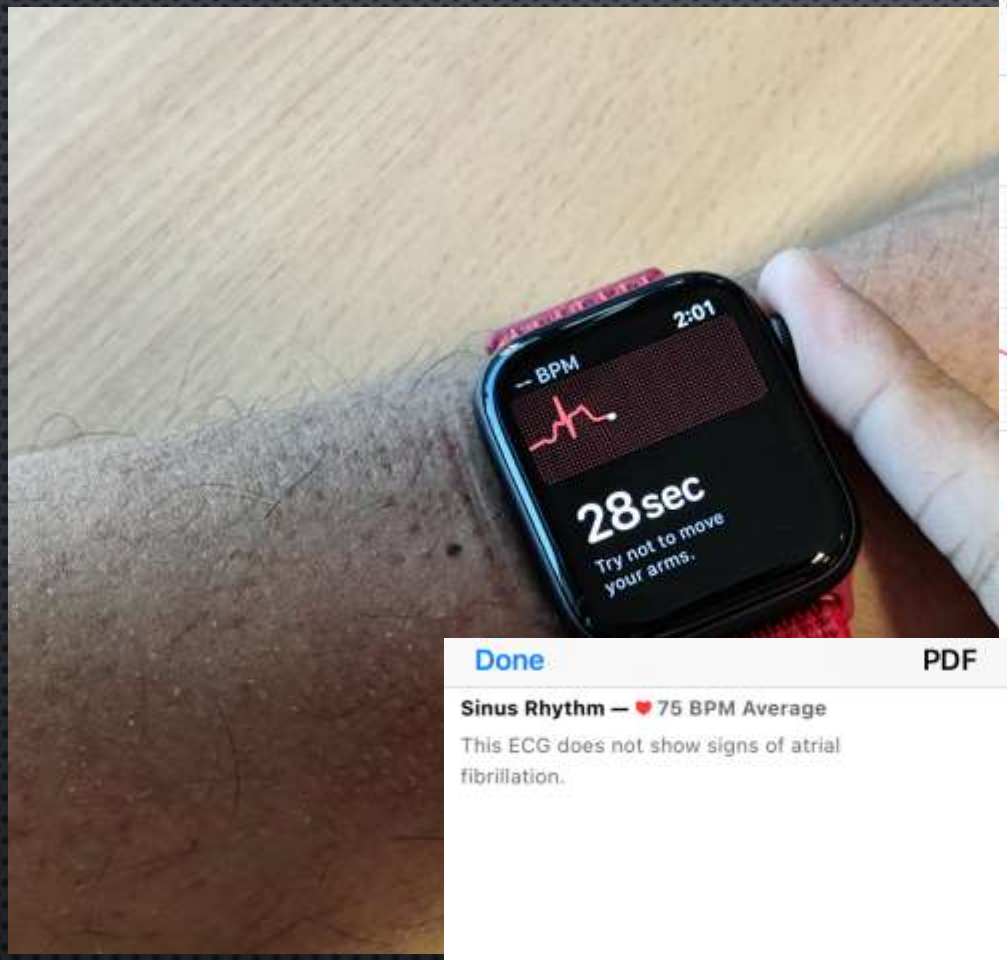




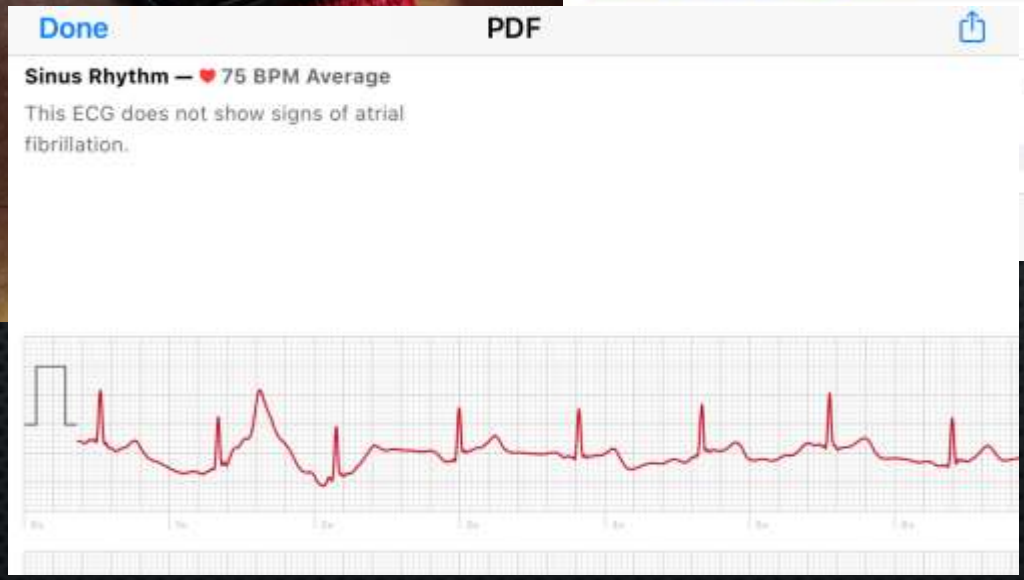
MINDFULNESS - PROMPTED BREATHING



ECG


2:01
— BPM
28 sec
Try not to move your arms.

Extended Network
10:21 PM
21%
Back
ECG Detail
Sinus Rhythm
Jan 26, 2021 at 6:35 PM
25s
26s
96 BPM Average
This ECG does not show signs of atrial fibrillation.


Done
PDF
Sinus Rhythm — 75 BPM Average
This ECG does not show signs of atrial fibrillation.

ECG

FDA clears Apple Watch ECG for remote patient visits during pandemic: 6 things to know

Laura Dyrda (Twitter) - Updated Wednesday, June 17th, 2020 Print | Email

Share Tweet Share 19

https://www.beckershospitalreview.com/cardiology/fda-clears-apple-watch-ecg-for-remote-patient-visits-during-pandemic-5-things-to-know.html

The FDA expanded the use of noninvasive patient-monitoring technologies, including the electrocardiogram app for the Apple Watch.

Six things to know:

1. The expanded indications allow clinicians to use the Apple Watch as a remote monitoring ECG device during public health emergencies such as the COVID-19 pandemic. Healthcare providers can access the expanded capability of Apple's ECG app for telemedicine services for the rest of the pandemic.

2. The Apple Watch now can serve as a substitute for in-clinic diagnostic testing, and healthcare providers can use it for clinical cases where the single-lead or lead 1 ECG tests can help diagnose some arrhythmias or conditions.

3. The app shouldn't be used for triaging emergency clinical situations, according to the report, which would include suspected heart attack or respiratory distress requiring immediate attention. Clinicians and patients also shouldn't rely on the app alone when making a diagnosis.

IN SUMMARY ECG

- Initiated by wearer/user
- PDF created and can be emailed to doc
- FDA sanctioned for limited use during pandemic
- Multi-lead capability *

Apple's new 'Family Setup' aims to make Apple Watch a kid tracker

Sarah Perez @sarahintampa / 12:51 PM CDT • September 15, 2020

Comment

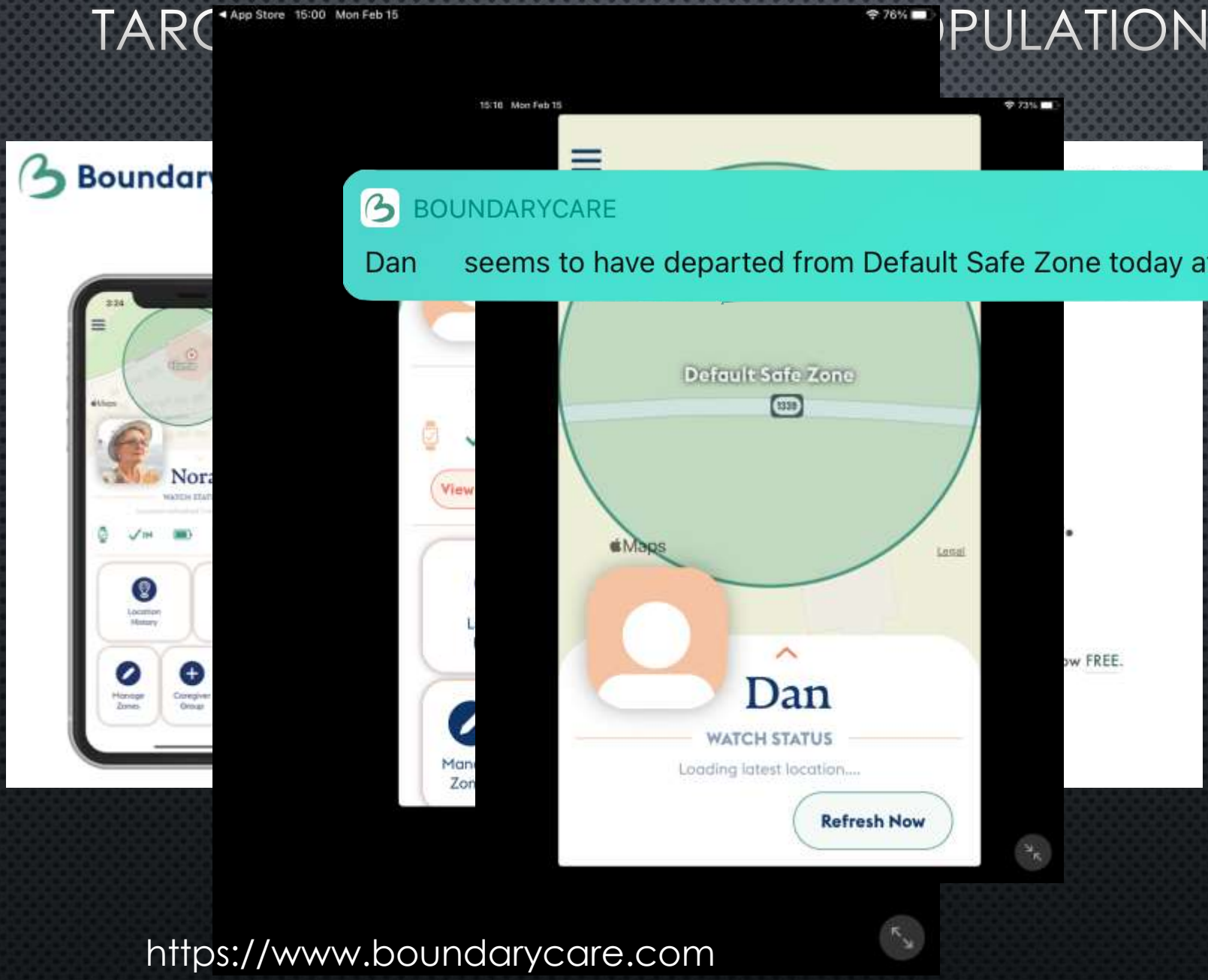
Image Credits: Apple

However, the watch has many of the health-related sensors disabled

"It also allows family members to receive location alerts so parents will know where the child is and if they have entered or exited a geofenced area"

https://techcrunch.com/2020/09/15/apples-new-family-setup-aims-to-make-apple-watch-a-kid-tracker/?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAANCFzrUdZOPo51WIQC80n29Y1uXfHcmfvUsI1LeDjX-AbC_FYtb42XkBccgRZbMaPzQBZTr-GvlEbNjJvaG4i_j7oj4ufNgbrDg5aoL5Yz4NWDgH3270iSlY060to-cUhEnqVU9aM-3NVi_0UtqX4vi2XTTw2w8YShDCfxik0UK1

TARG PULATION



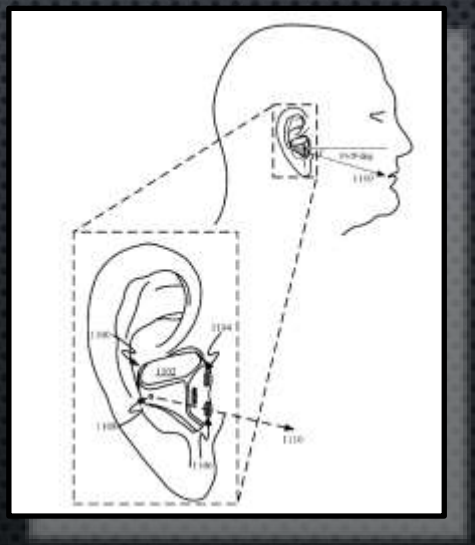
https://www.boundarycare.com

TRACKING/LOCATION OPTION

- Enables tracking Geofencing alerting
- Requires watch with cellular option
- $10/Mo typical fee
- Consider band type/option
- App alert when watch is removed

TEMPERATURE TRACKING

- FREQUENTLY ASKED / REQUESTED
- NOT AVAILABLE

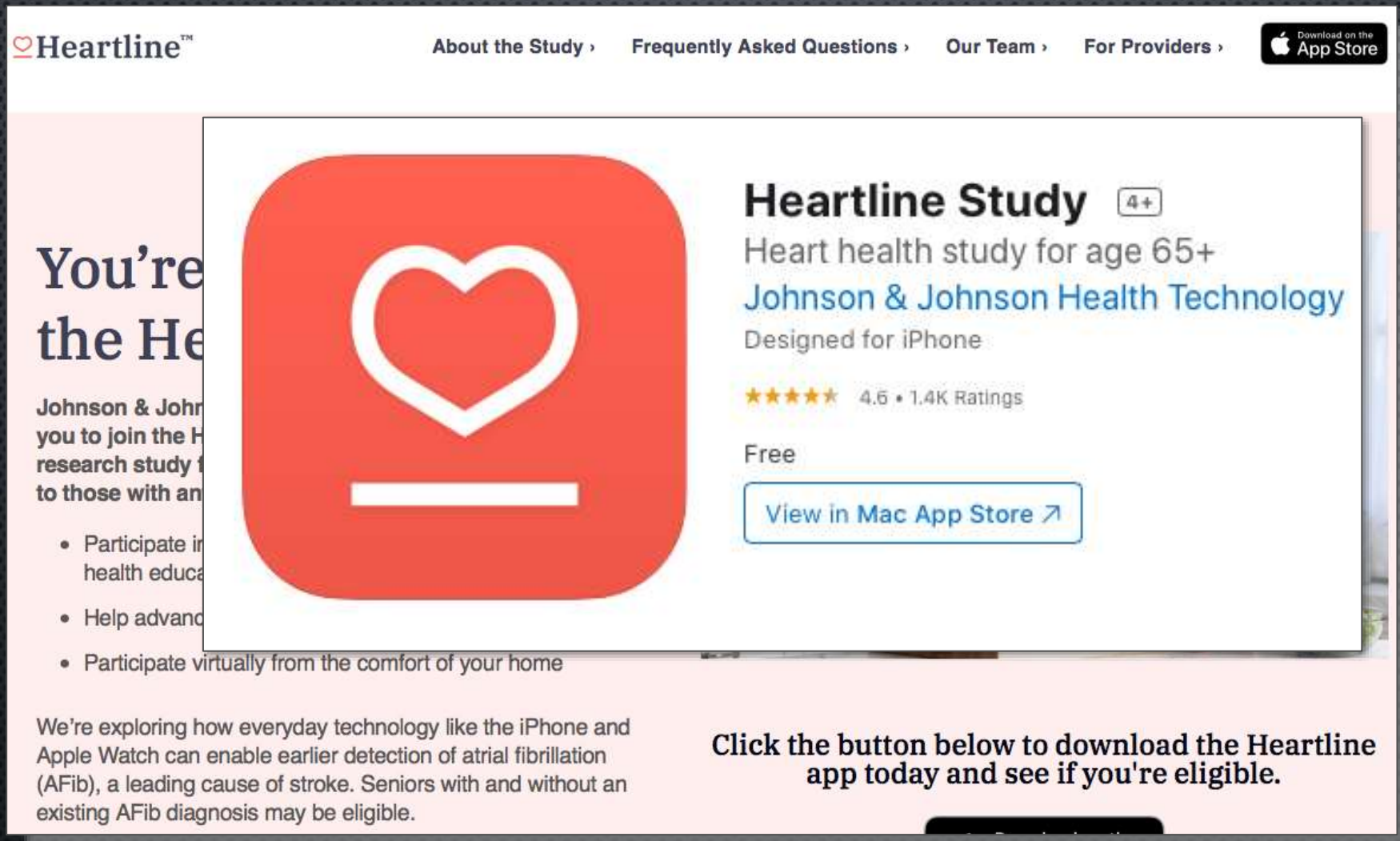


Checkpoint

- Reviewed the automatically triggered data events
- Explored the user-initiated events that create data
- Recognized that the watch enables long term data tracking (longitudinal data) useful in identifying trends and changes
- Identified some of the potential uses (use-cases) of this data
- Hopefully you have one or two use-cases that resonate?

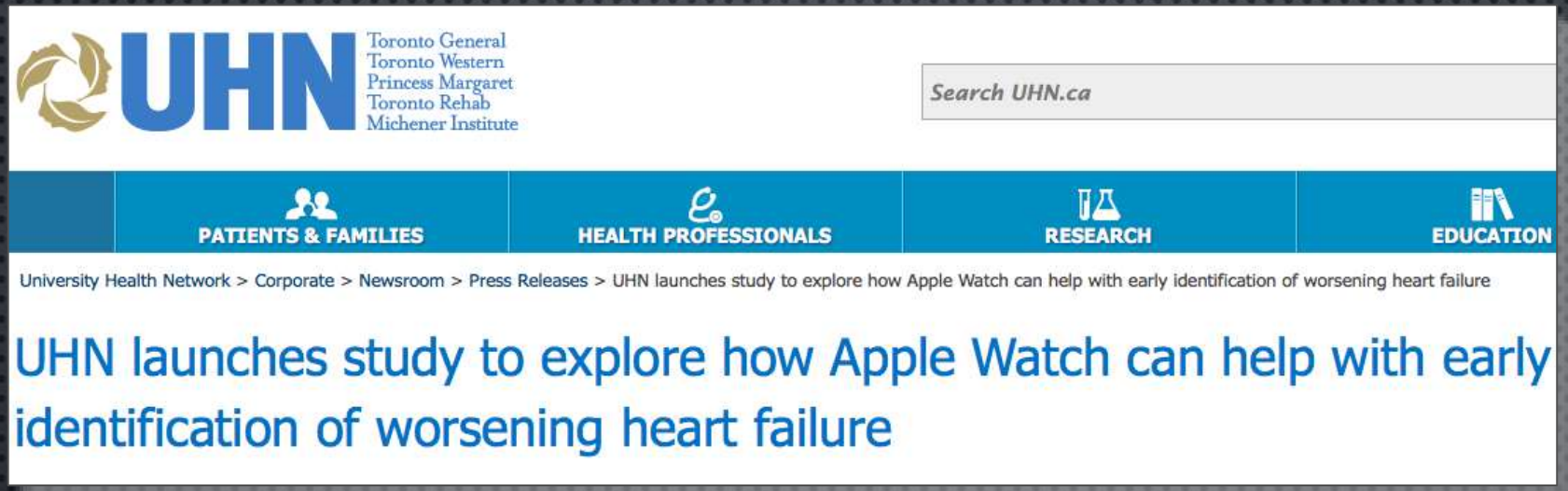
NOW LET'S LOOK AT EXAMPLES OF SOME OF THE CURRENT RESEARCH USING A SMARTWATCH

J&J STUDY



- Launched Feb,2020
- Goal: Enroll 150K

UNIVERSITY HOSPITAL NETWORK - TORONTO GENERAL… FEB 18, 2021



"…test if remote monitoring with Apple Watch can help with early identification of worsening heart failure. In this study, data collected using an Apple Watch will be compared to data routinely collected from the rigorous physical tests that patients normally undergo, to see **if Apple Watch health sensors and features, including the Blood Oxygen app and mobility metrics,** can provide early warning for worsening heart failure."

https://www.uhn.ca/corporate/News/PressReleases/Pages/UHN_launches_study_to_explore_how_Apple_Watch_can_help_with_early_identification_of_worsening_heart_failure.aspx

Biogen

BIOGEN TO LAUNCH PIONEERING STUDY TO DEVELOP DIGITAL BIOMARKERS OF COGNITIVE HEALTH USING APPLE WATCH AND IPHONE

January 11, 2021 at 7:30 AM EST

CAMBRIDGE, Mass., Jan. 11, 2021 (GLOBE NEWSWIRE) -- Biogen Inc. (Nasdaq: BIIB) today announced a new virtual research study, in collaboration with Apple, to investigate the *role Apple Watch* and iPhone could play in *monitoring cognitive performance and screening for decline in cognitive health including mild cognitive impairment (MCI).*

CONDUCTED BY APPLE MED STAFF

"An Apple Watch designed to remotely monitor fluctuations of resting tremor and dyskinesia in persons with Parkinson disease was shown to match in-clinic evaluations of these symptoms and capture symptom changes in response to treatment for 94% of participants."

"…the ability to use a commonly available device like an Apple Watch may provide clinicians with more transparency of patient symptoms throughout the day."

https://www.ajmc.com/view/apple-watch-effective-in-monitoring-symptoms-of-parkinson-disease

JOHNS HOPKINS
MEDICINE

ABOUT HEALTH PATIENT CARE RESEARCH

Johns Hopkins EpiWatch: App and Research Study

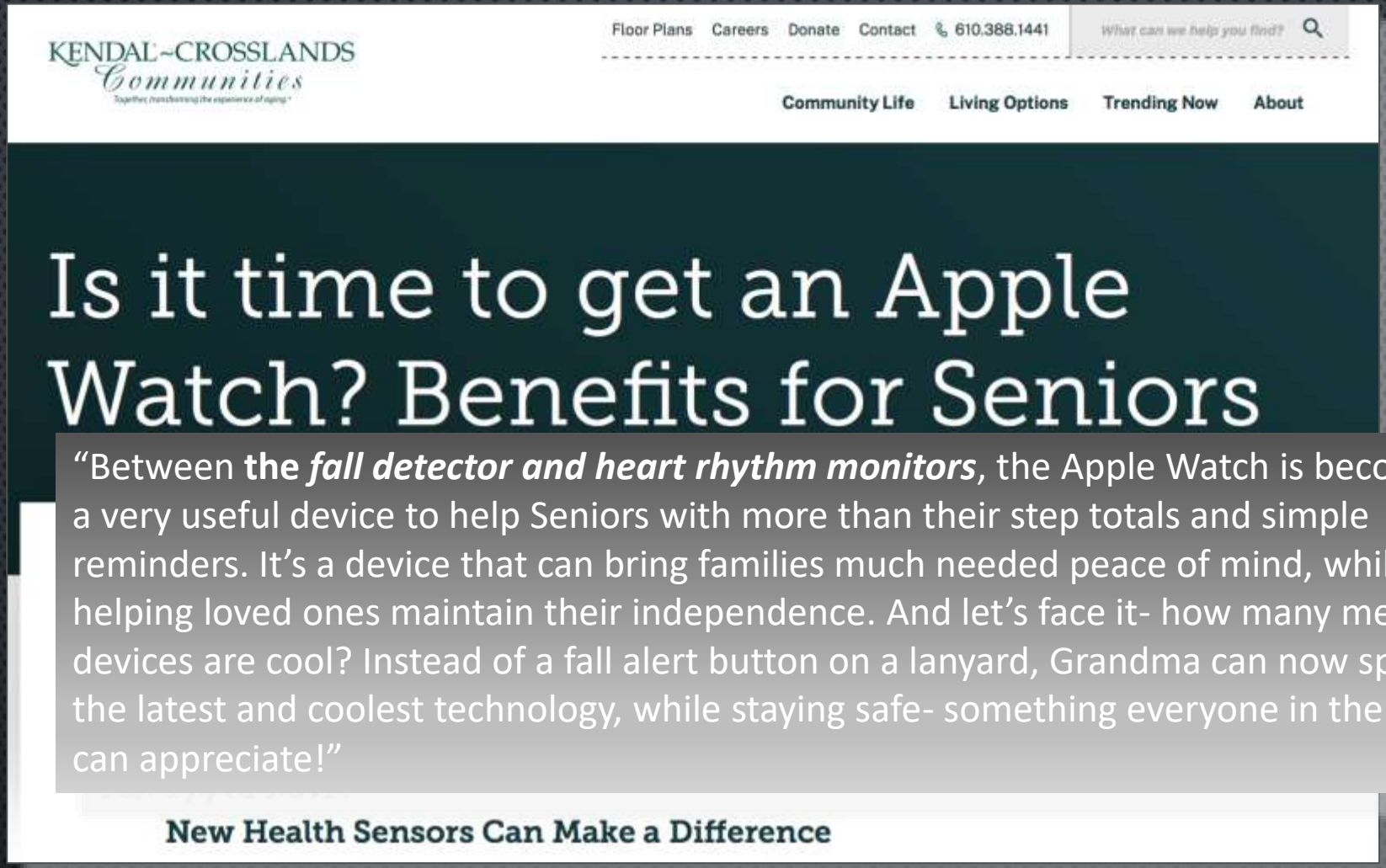
epiwatch

Track Your Seizures and Medications While Advancing Epilepsy Research

https://www.hopkinsmedicine.org/epiwatch#team

VALUE RECOGNITION BY PAYERS

https://www.cnbc.com/2019/10/07/devoted-medicare-advantage-plan-covering-apple-watch-as-a-benefit.html



https://kcc.kendal.org/news/time-get-apple-watch-benefits-seniors/

RUMOR…

Apple Watch blood sugar measurement coming in Series 7, claims report

Ben Lovejoy - Jan. 25th 2021 6:23 am PT @benlovejoy

…add reference….

FUTURES ?

US 20170281024A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2017/0281024 A1**

(43) **Pub. Date: Oct. 5, 2017**

Narasimhan et al.

(54) **WRIST WORN ACCELEROMETER FOR PULSE TRANSIT TIME (PTT) MEASUREMENTS OF BLOOD PRESSURE**

(71) Applicant: **Apple, Inc.**, Cupertino, CA (US)

(72) Inventors: **Ravi Narasimhan**, Sunnyvale, CA (US); **Richard C. Kimoto**, Cupertino, CA (US); **Thomas J. Sullivan**, Cupertino, CA (US); **Todd K. Whitehurst**, Cupertino, CA (US); **Derek Park-shing Young**, Cupertino, CA (US); **Zijing Zeng**, Cupertino, CA (US); **Erno Klaassen**, Cupertino, CA (US)

(21) Appl. No.: **15/507,607**

(22) PCT Filed: **Sep. 8, 2015**

(86) PCT No.: **PCT/US2015/048848**

§ 371 (c)(1),
(2) Date: **Feb. 28, 2017**

Related U.S. Application Data

(60) Provisional application No. 62/047,472, filed on Sep. 8, 2014.

Publication Classification

(51) **Int. Cl.**
A61B 5/021 (2006.01)
A61B 5/00 (2006.01)

(52) **U.S. Cl.**
CPC ***A61B 5/02125*** (2013.01); ***A61B 5/6824*** (2013.01); *A61B 5/024* (2013.01)

(57) **ABSTRACT**

Wrist-worn devices and related methods measure a pulse transit time non-invasively and calculate a blood pressure value using the pulse transit time. A wrist-worn device includes an accelerometer, a photo-plethysmogram (PPG) or a pulse pressure sensor, and a controller. The PPG or the pulse pressure sensor coupled to the wrist-worn device for detecting an arrival of a blood pressure pulse at the user's wrist. The controller is configured to process output signals from the accelerometer to detect when the blood pressure pulse is propagated from the left ventricle of the user's heart, process a signal from the PPG or the pulse pressure sensor to detect when the blood pressure pulse arrives at the wrist, calculate a pulse transit time (PTT) for propagation of the blood pressure pulse from the left ventricle to the wrist, and generate one or more blood pressure values for the user based on the PTT.

EARBUDS WITH BIOMETRIC SENSORS

(19) **United States**
(12) **Patent Application Publication**
Qian et al.
(10) **Pub. No.: US 2018/0063621 A1**
(43) **Pub. Date: Mar. 1, 2018**

(54) **EARBUDS WITH COMPLIANT MEMBER**

(71) Applicant: **Apple Inc.**, Cupertino, CA (US)

(72) Inventors: **Phillip Qian**, San Jose, CA (US); **Edward Siahaan**, San Francisco, CA (US); **Erik L. Wang**, Redwood City, CA (US); **Christopher J. Stringer**

Publication Classification

(51) **Int. Cl.**
H04R 1/10 (2006.01)
H04R 1/40 (2006.01)

(52) **U.S. Cl.**
CPC ***H04R 1/105*** (2013.01); ***H04R 1/406*** (2013.01); ***H04R 1/1091*** (2013.01); ***H04R***

(73) Assignee

(21) Appl. No.

(22) Filed:

(63) Continuation of Sep. 16,

BACKGROUND

[0003] Portable electronic device users have shown increasing interest in biometric tracking. Biometric sensors often need to be in close or even direct contact with the skin to properly measure and track biometric parameters along the lines of heart rate, VO_2, and core temperature. Requiring a user to place a sensor in direct contact with the skin to track these types of biometric data can be overly burdensome, making adoption of the biometric tracking more difficult. Consequently, mechanisms for unobtrusively measuring biometric parameters are highly desirable.

Observations

1. Watch must be removed and recharged every day
2. An iPhone is required
3. Supplied strap can be somewhat difficult to put on
4. The side button is small
5. Haptic is a nice touch
6. You can "speed dial" from your watch
7. You can wear it in the shower / swimming
8. The watch interface icons are small and dynamic
9. The Fitness app is very useful / motivating for me
10. I do launch the heartrate and o2 measurements from time to time

Supporting our well-being

- Out of the Box
  - Motivating - Activity, Mindfulness, Fitness
  - Afib Detection
  - Min/Max heartrate notification
  - Fall Detection
  - Emergency Alert Activation
  - Other metrics include o2,Walking Metrics, heart rate
- Personal / Family Engagement / Action
  - Personal awareness
  - Improved Activity Level
  - Family / caregiver "engagement"
  - Geofencing
  - Participate in Studies
- Additional Action / Development Steps Required
  - Fall prevention
  - Intervention / Mitigation / Early Detection
  - Medication Adherence

Additions to the list?

SO WE HAVE SEEN A NUMBER OF WAYS THE WATCH CAN BE USED, NOW IT'S YOUR TURN

Your to do…

- Identify one or two potential uses (use-cases) for the watch that have value to you and/or your clients/patients

REMEMBER OUR OBJECTIVES?

- **IDENTIFY** SMARTWATCH **FEATURES AND CAPABILITIES** THAT MAY BE BENEFICIAL IN SUPPORTING THE WELLBEING OF AGING ADULTS
- **BECOME AWARE** OF **CHALLENGES AND LIMITATIONS** IDENTIFIED BY THE PRESENTER'S EXPERIENCE USING A SMARTWATCH
- **UTILIZE** THE INFORMATION PRESENTED TO EVALUATE THE POTENTIAL FOR THE USE OF **SMARTWATCH TECHNOLOGY** WITHIN YOUR ORGANIZATION AND CLIENT BASE **TO ADDRESS SPECIFIC MONITORING AND BEHAVIORAL METRICS**

I wish the Apple Watch was available in 2011 for my Mom

Wearing a Smart-Watch can be a positive contributor to one's well being

THANK YOU

DAN ABELL