



MDEXPO

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Wearable Medical Technology

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What is Wearable Technology?

Technology that is designed to be used while worn.

Such as smartwatches, smartglasses, smartrings, clothing, and attachable or implantable medical devices.

Wearable electronic devices connected to the wearer that detect, analyze, and transmit information such as vital signs, and/or ambient data

Can allow in some cases immediate biofeedback to the wearer.



What is Wearable Medical Technology?

- Type 1- Non- FDA Approved
 - Most wearable Over The Counter- “Smart” products
- Type 2- FDA Approved
 - Class 1- Lowest risk to patients – stethoscope
 - Class 2- If used incorrectly pose a risk to operator and patient- ECG
 - Class 3- Can harm patients and users if they fail or are used incorrectly – Defib

Some wearable medical devices fall into this category- such as Holter Monitor, and Insulin Pump. These are devices that are prescribed.

History of wearable medical devices

- 1800s:
- Hearing aids
- Eyeglasses
- 1900s
- Wearable wristwatch
- 1930s- Pacemaker
- 1940s- Holter monitor- “radio telemetry”
- 1970s
- Temperature detection- on watches
- Calculator watches

History of Wearable Medical Devices

- 2000s
- Wearable cameras on watches
- Bluetooth- key development
- 2010
- FitBit- movement tracker
- 2013
- Near Field Communication Ring (NFC Ring)
“Smartring”
- Samsung Galaxy
- 2015- Apple Watch

Apple WATCH



Insulin Pump History

- Insulin Pump
- 1974- Biostator – Closed-loop insulin delivery system
- FDA Approved
- 60Kg bedside unit
- \$50K/month to rent
- Type 1 Diabetes

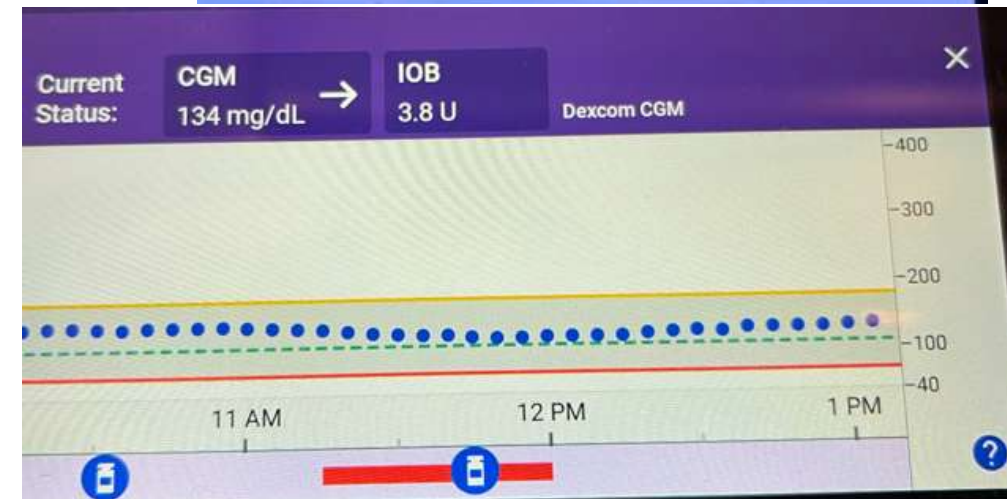
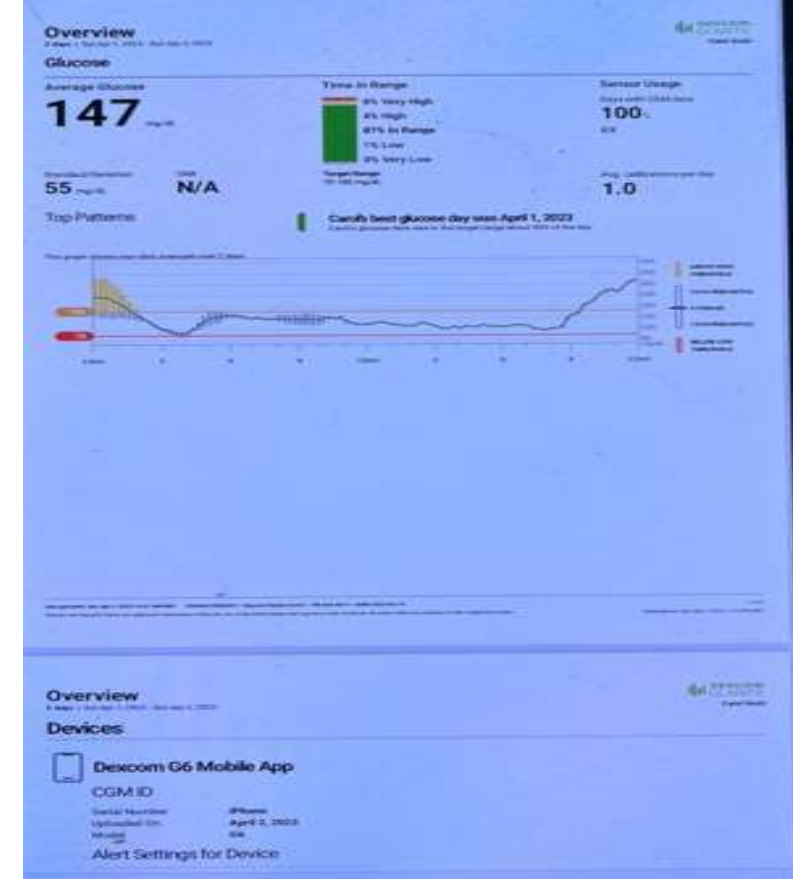


Insulin Pump History

- 2000s
- Wearable Glucometer
- Wearable Insulin Pump
- App for pump and glucometer
- Closed Loop
- Bluetooth
- Better A1C for patients
- Reports and alerts
- Type 1 diabetes



Insulin Pump Data



Vital Signs

NORMAL VITAL SIGNS IN ADULTS

CORE TEMPERATURE

98.6°F (37°C)

HEART RATE

60–100 beats per minute

RESPIRATORY RATE

12–18 breaths per minute

BLOOD OXYGEN

95–100%

BLOOD PRESSURE

120/80 mm Hg

NFC Rings

- Heart rate
- SpO2 (blood oxygen)
- Respiration
- Blood Pressure
- Body temperature tracking
- Tracks steps
- Track sleep
- Heart Rate Variability (HRV)



Smart Watch

- Step Counter
- Heart Rate
- Respiratory Rate
- Blood Pressure
- Calorie Counter
- Pulse Ox (blood oxygen)
- Temperature
- ECG – Electrocardiograph
- Fall Detection
- Connectivity- to phone or “home base”



Is it Comparable to Hospital Equipment?



What do you think?



Have any of you done any
comparing or thought about it?



Do you know of any interaction
with hospital equipment?



Accuracy

- Can these devices be trusted?
- How can accuracy be tested?

Creating a Healthier Patient Population

Patients with chronic diseases,
wearable devices can reduce
the number of hospitalizations

Patients can adjust routines and
diets according to the display of
the wearable device data

This can save expensive
treatment costs or
hospitalization

Creating a Healthier Patient Population

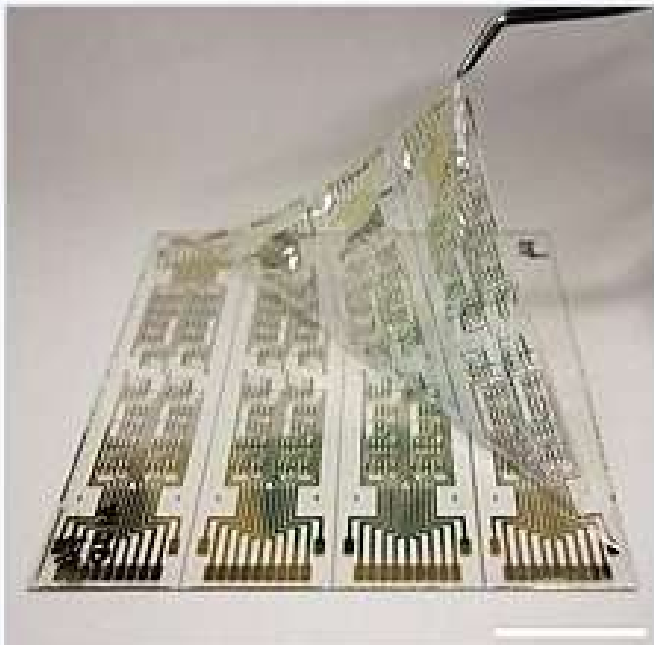
- Monitoring Sleep:
 - Heart Rate Variability- Spacing between R waves. Why is this important?
 - Blood Oxygen- This can tell if the wearer stops breathing or if O2 is lowered
 - Motion while sleeping
 - Can help detect early Sleep Apnea
 - Sleep Apnea can lead to other problems if untreated

Wearable Sensors in Clothing

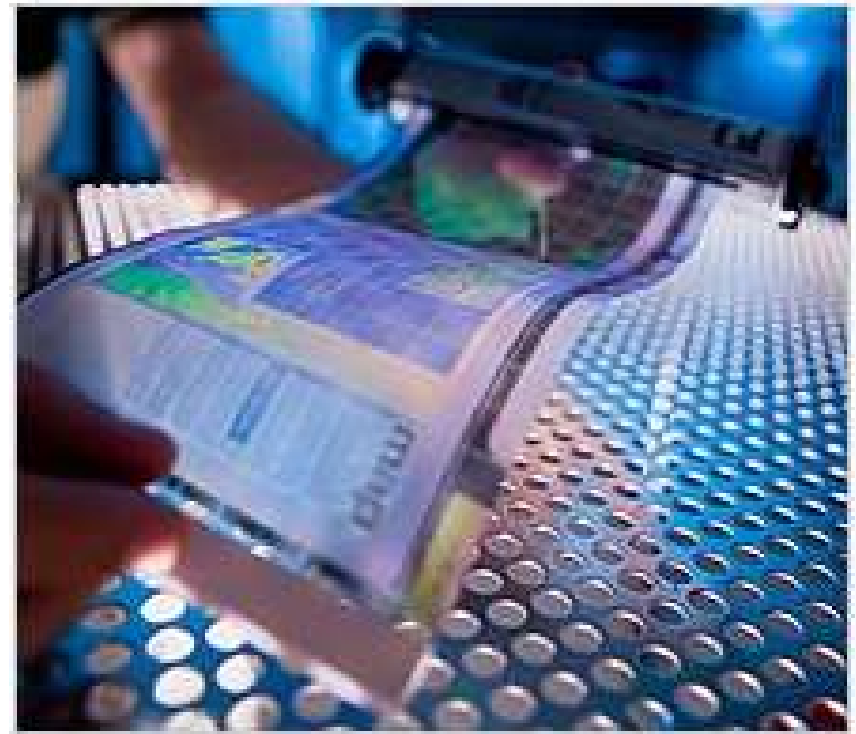
- Hexoskin- Brand Name
 - 3 lead ECG
 - Respiration
 - Pulse Ox
 - Blood Pressure
 - Skin Temperature
 - 3 Axis Accelerometer
 - Non-invasive
 - Machine washable
 - 36+ hour battery
 - Bluetooth to phones
 - Clinically validated by by research labs

Wearable Sensors- Astroskin





Organic CMOS logic circuit. Total thickness is less than 3 μm . Scale bar: 25 mm



Organics-based flexible display

Miniaturization and Organic Electronics

ECG



Atrial Fibrillation — ❤️ 129 BPM Average

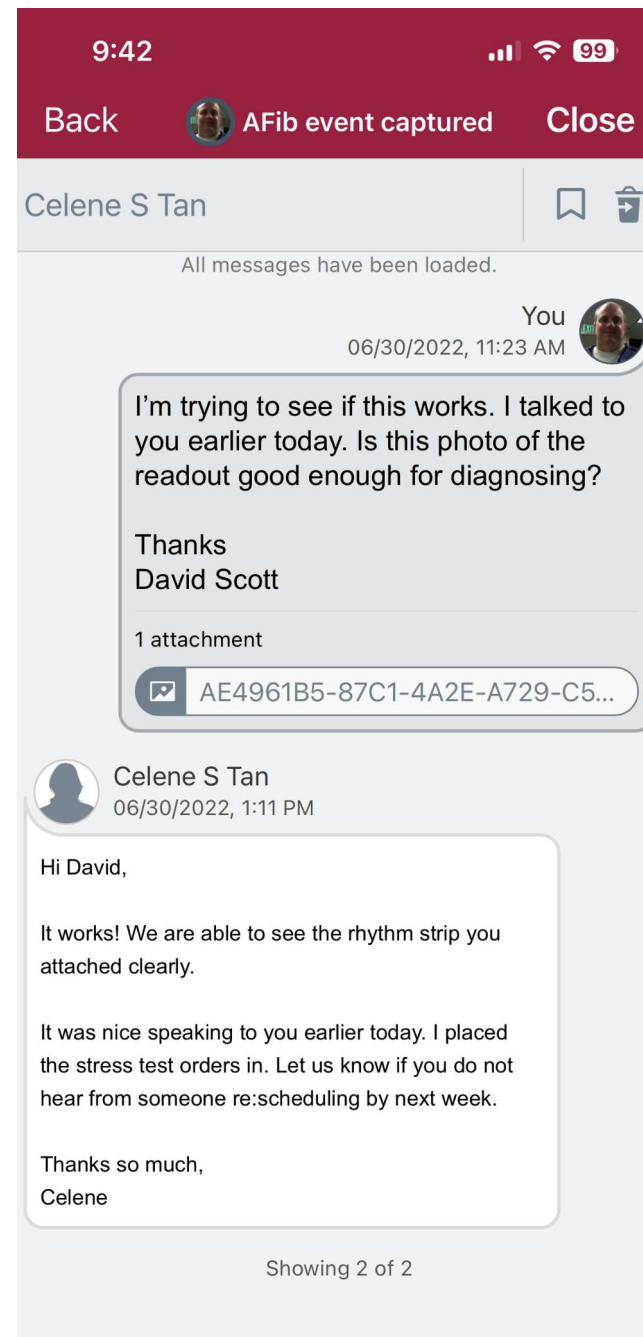
This ECG shows signs of AFib and a high heart rate.

If this is an unexpected result, or your heart rate stays high, you should talk to your doctor soon.



25 mm/s, 10 mm/mV, Lead I, 512Hz, iOS 16.3.1, watchOS 8.6, Watch6,7, Algorithm Version 2 — The waveform is similar to a Lead I ECG. For more information, see Instructions for Use.

Healthcare App on phone



Future

- Biosensors can measure skin conductance, heart rate, and body temperature, as well as detect changes in pH, glucose, and salt in the human body through sweat and tears
- Tattoo-based epidermal biosensors
- Clothing- metal woven fabric
- Sweat glucose monitoring systems that combine pH, humidity, and temperature sensors have led to improvements in the therapeutic application of diabetes care.

Future

- Power- battery technology – solid cell technology, advancements in electric cars. Solar on wearables.
- More sensors in development- cancer detection, early detection for other health issues
- More sensors could lead to more/different technology in hospitals
- Better/more connectivity
- More data
- More miniaturization
- AI interpretation- even “smarter”

Conclusions

- Need- Secure data transmission- maybe a medical Wi-Fi?
- Earlier detection of possible health issues- better outcomes
- Healthier patient population
- More and better healthcare at home
- Hospitals- will have higher acuity patients
- Doctors or “AI Doctors” will be more in touch with patients, more “data crunching”
- BMETs will be involved with technology and advancements

References:

- [Hexoskin Smart Shirts - Cardiac, Respiratory, Sleep & Activity Metrics](#)
- [The best smart clothing: From biometric shirts to contactless payment jackets –
Wareable](#)
- [E-textiles – Wikipedia](#)
- [Organic electronics – Wikipedia](#)
- [Smartwatch – Wikipedia](#)
- [Smart ring – Wikipedia](#)
- [Reshaping healthcare with wearable biosensors | Scientific Reports \(nature.com\)](#)

3 Easy Steps to Win \$100!

1. Take a picture
2. Post on social media using #MDEXpo
3. The attendee who uses the hashtag the most throughout the conference will win a \$100 giftcard!!

