Healthcare Application of Digital Health Devices: Valuable Data or Information Overload?

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• Equity
  • iRhythm
• Lecture honoraria
  • Zoll
Device Features
- Activity monitoring
- Heart rate monitoring
- Sleep tracking
- GPS
- Waterproof
- Skin conductance
- Temperature
- Swimming metrics
- Calorie burn
- Inactivity alarms
- Mobile application
- Food Diary
- Water Intake Log
- Oxygen Saturation
- EKG

Device Types
- Wrist bands
- Smart watches
- Pendants
- Handheld EKG Monitor
- Clips
Smart-watches: a potential challenger to the implantable loop recorder?

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Real-word Healthcare Applications

• Cedars-Sinai Samuel Oschin Comprehensive Cancer Institute (Los Angeles, CA)\(^1\)
  - Activity level has a strong correlation to whether or not an oncology patient can physically make it through chemotherapy
  - Rolled out a test across 30 adult cancer patients
  - Provided each one with a Fitbit Charge HR device
  - Assess patient activity levels over a fixed period of time, and then correlate that data with patients’ outcomes from cancer treatment

• Dartmouth-Hitchcock (Lebanon, NH)\(^2, 3, 4\)
  - Developed a new health technology and service solution "ImagineCare"
  - Helps people to stay healthy and helps patients to ‘get well’ faster
  - Provides people with the information and tools they need to make good decisions and become engaged in their own health
  - Creates an ongoing dialogue between patients and their care team, using remote sensing technologies to gather real-time health data, based on the needs and goals of each patient
Accuracy of Activity Trackers

• Philips health watch (FDA approved)
  • It can track heart rate (HR), heart rate zones, resting HR, HR recovery, and resting respiration rate. Sends insights and advice based on medical guidelines via the Philips HealthSuite health app

• Accuracy varies between different commercially available devices

<table>
<thead>
<tr>
<th>Device</th>
<th>Overall Accuracy</th>
<th>Heart Rate Monitor</th>
<th>Sleep Tracking</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple Watch</td>
<td>99.06%</td>
<td>Yes</td>
<td>No</td>
<td>$349-$999+</td>
</tr>
<tr>
<td>Garmin VivoFit</td>
<td>97.01%</td>
<td>No</td>
<td>Yes</td>
<td>$99</td>
</tr>
<tr>
<td>Jawbone UP</td>
<td>82.51%</td>
<td>No</td>
<td>Yes</td>
<td>$99</td>
</tr>
<tr>
<td>Samsung Gear 2</td>
<td>79.76%</td>
<td>Yes</td>
<td>No</td>
<td>$299</td>
</tr>
</tbody>
</table>
Wearables are accurate for non-exercise HR

### Table. Concordance Correlation Coefficients for Each Heart Rate Monitor

<table>
<thead>
<tr>
<th>Device</th>
<th>Agreement With Electrocardiogram</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Concordance Correlation Coefficients (95% CI)</td>
</tr>
<tr>
<td>Polar H7</td>
<td>.99 (.987-.991)</td>
</tr>
<tr>
<td>Apple Watch</td>
<td>.91 (.884-.929)</td>
</tr>
<tr>
<td>Mio Fuse</td>
<td>.91 (.882-.929)</td>
</tr>
<tr>
<td>Fitbit Charge HR</td>
<td>.84 (.791-.872)</td>
</tr>
<tr>
<td>Basis Peak</td>
<td>.83 (.779-.865)</td>
</tr>
</tbody>
</table>

Wang et al. JAMA Cardiology, 2016
Heart Rhythm Monitoring

### ILR
- Invasive
- Carry Patient Assistant® at all times
- Travel
- Must take transmitter
- Metal detector interference
- Device ID card
- Trust your doc

### Handheld EKG Monitors
- No implant; remove at will
- Travel
- Take your phone
- Wear your watch (maybe), or...
- BYO ECG sensor
- Smartphone or card limb lead ECG
- ECG watchband
- No transmitter or extra stuff
- See your data

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**Device $4000-5500 up front**

**3-year recurring cost**
- Cost of procedure + explant: $7,400
- Monitoring: $22-45 per encounter

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Source: Mintu Turakhia MD, MAS "Future of ECG Monitoring in Patients with Known AF is Wearable Sensors and Digital Health". Stanford University, December 2016
Difficulty of connecting data to EHR

• Data integration and interoperability
  • Currently there is no real integration of fitness related data with health data stored in EHR systems\(^6\) enabling collection, compilation and streaming of data in a meaningful way\(^7\)

• Standardization of data exchange
  • Proprietary fitness trackers are non-compliant with HL7 specification for accurate interpretation of data within EHR\(^6\) and vendors are reluctant to offer connectivity due to difficulty of mapping the data\(^8\).

• Data security and privacy
  • Data transmission must be secured using encryption and patient authorization for secondary sharing of Patient Generated Health Data (PGHD) in EHR may be needed\(^8\)

• Clear separation of data source
  • More consistency in the standards for data provenance is needed for receiving health IT systems to better track where information in a patient’s record came from\(^8\)
Information Overload for Providers

• Healthcare providers are concerned because:
  
  • The "...influx of information...might interfere with their ability to delivery quality care."\(^8\)
  • They may have to review "large amounts of data, leading to increased liability and unrealistic patient expectations."\(^8\)
  • They could be "held accountable for information that was not received or reviewed in a timely manner and information that may require an urgent response."\(^8\)

• Time is money, and it takes time to review, process and analyze the PGHD to then enter valuable data into the EHR.\(^8\)
Patients Want mHealth

- **4.3 million** mobile health application downloads daily
- **66%** of people would use a mobile app to manage a heart condition
- **$26 billion** predicted 2017 worldwide mHealth market revenue for associated services and hardware
- **72%** of patients want to refill prescriptions on their phone
The clinician experience

- Care pathway of ILRs does not fit the disease
  - LINQ is about heart rate and rhythm
  - Device clinic must still manage: lots of patient calls
  - **Burden of actionability is on the doctor**

- Wearables and mHealth
  - Data first in the hands of the patient
  - **Burden of actionability on the patient**
    - Health coaches can be the intermediary
    - Precedence: blood glucose, blood pressure, insulin titration
Final points for mHealth

• Inexpensive
• Can pull in comprehensive, **contextual data** (med adherence, activity, health status, patient-reported outcomes)
• Can **vary the “dose”**
• Can **integrate with self-management** and low-coast health coaching
  • **Frees up the doctor**; proven in diabetes
  • Challenges still exist with data intergration
References


7. Levine, B. A. (2016). The big healthcare disappointment of 2016: health apps are interesting, but they won't be truly useful until they flow data into patients' EHRs. Contemporary OB/GYN, 61(7), 36-38.