The main challenges of m-Health: the most promising directions for research and development

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Phase 1.

Wearable contact monitors with radio channel (5 KHz, ZigBee, Ant+, BlueTooth, BT LE, WiFi, GSM). No analysis on the monitor.

Data transmitted to the “cloud” DB (EHR). No analysis In the “cloud”
Remote Patient Monitoring

<table>
<thead>
<tr>
<th>Modality</th>
<th>Pros</th>
<th>Cons</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemonitoring</td>
<td>Better access</td>
<td>Data issues</td>
<td>Multimodal by population</td>
</tr>
<tr>
<td></td>
<td>‘Personalization’</td>
<td>Integration issues</td>
<td>Team-based care</td>
</tr>
<tr>
<td></td>
<td>Early detection</td>
<td>Rules engine issues</td>
<td>Requires initial in-person visit</td>
</tr>
<tr>
<td></td>
<td>Fewer visits and hospitalizations</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Members love it</td>
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</tbody>
</table>
Wearable Tech as Jewelry
Nearest hot-point in m-health - Google Glass

Sergey Brin, Google
Sergey Brin helps the designer Diane von Furstenberg with a pair of Project Glass glasses before a fashion event in New York.
Both attired in Google Glass, Diane von Furstenberg watches her models rehearse during New York Fashion Week last September with Sergey Brin, a Google founder.

By CLAIRE CAIN MILLER
Published: August 23, 2013
Google Glass Moves into the OR:
http://www.youtube.com/watch?v=sslTdTFWBv3E
There is an ECG analysis service that is offered at varying tiers. A “Preliminary finding by a US based cardiac technician” for $2 (24 hr turnaround) or $5 (30 min turnaround). For $12 one can receive “Clinical Analysis & Report by a US Board Certified Cardiologist,” which includes a doctor recommended course of action.
GlucoTrack. It uses three independent technologies: ultrasonic, electromagnetic and thermal, to painlessly obtain blood glucose levels.
Withings Pulse O2 Fitness Tracker with Blood Oxygen Saturation Monitoring

by EDITORS on Apr 22, 2014

Withings is releasing a new fitness tracker with both heart rate and blood oxygenation (SpO2) monitoring in a futuristic watch-like package. The Pulse O2, of course, also counts steps, calories burned, and watches how much you move during sleep.

It features a touchscreen which allows user to swipe through different readouts and can be worn like a watch or clipped onto a piece of clothing. The device is priced at $120 and is available in either black or blue.

Read More »
A Physically Transient Form of Silicon Electronics
Soft Microfluidic Assemblers of Sensors, Circuits, and radios for the Skin

4 April, vol. 344, 2014, Science
Soft Microfluidic Assembliers of Sensors, Circuits, and radios for the Skin
«Умные» ложка и вилка компании Hapilabs
Power in your back pocket with new 'phone charging shorts'
Бесплатная программа Moves для оценки уровня двигательной активности на смартфоне iPhone и на базе Android OS.
Часы фирмы Basis (США) для мониторинга ЧСС, двигательной активности, потоотделения, температуры кожи

www.mybasis.com
Activity Details

- **HEART RATE**
  - 65 avg bpm/min

- **STEPS**
  - 8227
  - 6 avg steps/min

- **CALORIES**

- **SKIN TEMP**

- **PERSPIRATION**

**ACTIVITY**

- **WALKING**
  - 5382 steps
  - 84 avg steps/min
  - 1 hr 1 min total

- **RUNNING**
  - 0 steps
  - 0 avg steps/min
  - 0 min total

- **BIKING**
  - 0 calories
  - 0 avg calories/min
  - 0 min total
**Activity Details**

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HEALTH DEVICES
at a glance

WHICH HEALTH MONITORING DEVICE
WOULD YOU WEAR?

- HANDHELD DEVICE
- STRAP
- SHIRT
- HEADBAND
- CUP
- BRACELET
- KEYCHAIN
- SHOE SENSOR

INSTRUMENTED
Automatic real-time monitoring of pressure, calories burned, motion, or temperature.

INTERCONNECTED
Connects personal health record services, PCs, smart phones, and secure information with caregivers and doctors.

INTELLIGENT
Analyzes data, tracks progress, and provides recommendations.

HOWEVER,
More than 10% consumers do not know if their device have these capabilities.

WHAT SHOULD HEALTH DEVICES MONITOR?

88% physicians want patients to monitor health parameters AT HOME
Their top priorities:

- WEIGHT
- BLOOD SUGAR
- BLOOD PRESSURE
- EXERCISE
- CALORIES
- PAIN
- SLEEP PATTERN

HAVE YOU EVER USED A HEALTH DEVICE?

- NO
- YES
15%

6% use devices for monitoring FITNESS
9% use devices for monitoring HEALTH CONDITIONS

WHAT HOLDS CONSUMERS BACK FROM HEALTH DEVICE PURCHASES?

30% consumers reported PRICE as their most concern

- $100
- $200
72% willing to pay for a device less than $100
12% willing to pay in $100 to $200 range
10% willing to pay more than $200
A Look Into the Future of Health Care

How Passive Sensors Will Support Patient Care Outside the Hospital

Meet Ann R. She is 65 and has congestive heart failure and diabetes. Ann is able to live safely at home thanks to sensors that monitor changes in her health without the need for frequent visits to the doctor. The data from the sensors signal her care team (clinicians and family members) when support is needed.

Let's take a look at how these sensors assist Ann without her needing to do anything.

As Ann steps out of bed, her weight is recorded by a Wi-Fi-enabled sensor under her floorboards.

As she brushes her teeth, sensors in the bathroom floor mat monitor pressure points in her feet to detect early signs of ulcers.

A patch on her arm monitors important signals such as:
- Heart rate
- Blood-oxygen level
- Blood pressure
- Glucose level
Sensors in the floor and along the wall register her gait to assess risk of falling.

Her diuretic medication contains a tiny sensor that signals her arm patch that she has ingested the pill.

The signals detected by all sensors are automatically transmitted via a secure wireless connection and stored in Ann's personal health record. She can see the data and allow others to access it.

If any of the health measurement signals fall outside of a pre-determined normal range for Ann, the data are transmitted to her doctor and her daughter.

This scenario will be achievable in the near future. Patients will be able to receive more personalized support from their care teams and live healthier lives on their own.

For more information, see Making Sense of Sensors: How New Technologies Can Change Patient Care, www.chcf.org/MakingSenseSensors
SpiroSmart using iPhone

Using SpiroSmart

Caption: This shows the SpiroSmart phone.
Credit: S. Patel, Univ. of Washington
Some Ideas:

Cough Analysis

Tremor Analysis in Parkinson Disease

Pupil Reaction to Light Analysis

Eye Tracing

Face Assymetry Analysis (early stroke symptom)

Comparison of the typical words pronunciation (one-two-three-four)

Phonocardiography and Lung Sounds with multiplication of the original low frequencies
<table>
<thead>
<tr>
<th>Name</th>
<th>Continuous/discontinuous</th>
<th>Frequency/Pitch</th>
<th>Inspiratory/Expiratory</th>
<th>Quality</th>
<th>Associated conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheeze or rhonchi</td>
<td>continuous</td>
<td>high (wheeze) or lower (ronchi)</td>
<td>expiratory or inspiratory</td>
<td>whistling/sibilant, musical</td>
<td>asthma, many others</td>
</tr>
<tr>
<td>Stridor</td>
<td>continuous</td>
<td>high</td>
<td>either, mostly inspiratory</td>
<td>whistling/sibilant, musical</td>
<td>epiglottitis, foreign body, laryngeal oedema, croup</td>
</tr>
<tr>
<td>Inspiratory gasp</td>
<td>continuous</td>
<td>high</td>
<td>inspiratory</td>
<td>whoop</td>
<td>pertussis (whooping cough)</td>
</tr>
<tr>
<td>Crackles (aka crepitations or rales)</td>
<td>discontinuous</td>
<td>high (fine) or low (coarse), nonmusical</td>
<td>inspiratory</td>
<td>cracking/clicking/rattling</td>
<td>pneumonia, congestive heart failure</td>
</tr>
<tr>
<td>Hamman's sign (or Mediastinal crunch)</td>
<td>discontinuous</td>
<td>neither (heartbeat)</td>
<td>crunching, rasping</td>
<td></td>
<td>pneumomediastinum, pneumopericardium</td>
</tr>
</tbody>
</table>
Phonocardiograms from normal and abnormal heart sounds.

Auscultogram from normal and abnormal heart sounds.