Wireless Health: Remaking of Medicine by Pervasive Technologies

THE WIRELESS HEALTH MARKET IS PROJECTED TO MORE THAN TRIPLE FROM $2.7B IN 2007 TO $9.8B IN 2012

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Director, Wireless Health Program
Director, Case School of Engineering San Diego Programs
Enabling diagnosis, therapy and monitoring of health-related conditions by tracking relevant biomarkers, managing treatment regimen and monitoring progress...while the patient goes about his/her daily life.
Digital health is mostly a concept at this time, but a remarkably powerful and rich one that enables effective and efficient ways to collect, forward and process medical data and information within the health care ecosystem.
Convergence of Pervasive Technologies

- Ubiquitous sensing
- Wireless connectivity
- Cloud computing
- Social networks
The market for wearable wireless sensors is predicted to grow to 400 million devices by 2014.

Graphic from Don Jones (Qualcomm Life)
Individualized, preventative medicine that is time and place independent.
Ubiquitous connectivity and computing are bringing about unprecedented mobility...working, entertainment, shopping, socializing, gaming, etc., anytime, anywhere.

This trend is also infiltrating health care, promising significant improvements in quality, convenience, reach and cost of care through “wireless health” solutions.
National Health Expenditures, $2.6 Trillion in 2010

Centers for Medicare & Medicaid Services, Office of the Actuary.

How big is it?
National Health Expenditures

Centers for Medicare & Medicaid Services, Office of the Actuary.

Other: Nursing facilities & continuing care retirement communities (5.5%), medical devices & hospital supplies (3.2%), home health care (2.7%), government administration (1.7%), net cost of health insurance (5.6%), residential & personal care (5.0%), government public health activities (3.2%), investment (5.7%).
# Chronic Diseases 75% of the Cost

<table>
<thead>
<tr>
<th>Disease</th>
<th># in U.S.</th>
<th>Wireless Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alzheimer’s</td>
<td>5 M</td>
<td>Vital signs, location, activity, balance</td>
</tr>
<tr>
<td>Asthma</td>
<td>23 M</td>
<td>RR, FEV1, Air quality, oximetry, pollen count</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>3 M</td>
<td>Ultrasound self-exam</td>
</tr>
<tr>
<td>COPD</td>
<td>10 M</td>
<td>RR, FEV1, air quality, oximetry</td>
</tr>
<tr>
<td>Depression/Mood Disorders</td>
<td>21 M</td>
<td>Med compliance, activity, communication</td>
</tr>
<tr>
<td>Diabetes</td>
<td>24 M</td>
<td>Glucose, hemoglobin A1C</td>
</tr>
<tr>
<td>Heart Failure</td>
<td>5 M</td>
<td>Cardiac pressures, weight, BP, fluid status</td>
</tr>
<tr>
<td>Hypertension</td>
<td>74 M</td>
<td>Continuous BP, med compliance</td>
</tr>
<tr>
<td>Obesity</td>
<td>80 M</td>
<td>Smart scales, caloric in/out, activity</td>
</tr>
<tr>
<td>Sleep Disorders</td>
<td>40 M</td>
<td>Sleep phases, quality, apnea, vital signs</td>
</tr>
</tbody>
</table>

*Table from Eric Topol, M.D.*
Enhancing quality

Targeted care, at the right time, based on collection and/or communication of relevant health data and information. New care possibilities that are enabled through continuous monitoring, wireless communication and/or rich new databases of disease conditions.

Improving convenience

By the mobility afforded the patients and the care providers.

Extending reach

Possibilities in diagnosis, therapy and monitoring at a distance and/or in places otherwise difficult to reach.

Reducing cost

Keeping patients out of care facilities through preventative care solutions and timely diagnosis. Reducing errors and amplifying the productivity of the health care providers.
The world's first cellular-enabled Blood Glucose Meter.

The Telcare BGM® automatically uploads readings to your online portal and to the family members and healthcare providers of your choice.
Heart Failure

Heart Rate
Fluid Status
Activity Level
Posture
Respiratory Rate
Arrhythmia Detection
Temperature
ECG
Energy Intake and Expenditure

Calorie-counting smart patch measures energy intake and expenditure

Counting calories? Technology is available to help you, led by software like DietPower, and sophisticated websites such as the excellent and free FitDay. But those will soon be obsolete, because now there's a smart patch by PhiloMetron that measures how many calories you've eaten and burned. Then you can read 'em and weep on your cell phone, because those numbers are transmitted to it via Bluetooth.
Meet Zeo, your personal sleep coach.
Zeo Sleep Data

Waking up in the middle of the night?

- Partner came to bed
- Dog barking again
- Partner was snoring
- Partner stole the covers
- Paper delivered
- Up with the sun

(Sleep graph from myZeo website. Lifetime use of myZeo included with purchase of Zeo.)

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A Cheap, Portable Way to Monitor Unborn Babies

A nonprofit creates a new heart monitoring machine employing wireless technology.

Wednesday, April 20, 2011 | By Emily Singer

An inexpensive portable device could make it easy to monitor fetal health in remote locations, and it might also provide an alternative more expensive machines currently used in doctors' offices in the developed world.

Maternal monitoring: A device designed by the West Wireless Health Institute measures fetal heart rate via an ultrasound monitor (lower belt) and maternal contractions via another sensor (higher belt), and then transmits the data via Bluetooth to a tablet (left).

Credit: West Wireless Health Institute
Unobtrusive
- Measurement devices must be small

Power and data rate
- Ultra low power for battery to last
- High rate for real-time, data-intensive applications

Security
- Data must remain private

Smart nodes
- IP transport and protocols from sensor to servers

Flexible deployment topologies
- Star or mesh
- Scalability
The **ingestible sensor** is technology you swallow. Integrated into the medications you take and the products you use, it’s made entirely of ingredients found in food and activated upon ingestion. Today, the sensor aids in capturing the time, identity and characteristics of what you swallow. Tomorrow, the sensor will bring critical bodily measurements from the inside, out.

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Pharmacy–connected GlowCaps improve medication adherence through reminders, social feedback, financial incentives and automatic refills.

VITALITY™

GlowCaps™ light and sound remind you to take your prescriptions every day

Vitality addresses the billion-dollar adherence problem for pharmaceutical brands, retail pharmacies and healthcare providers with a simple device — a cellular-connected pill cap.

Vitality GlowCaps illuminate, play a melody, and even ring a home phone so patients don't forget. They can send weekly emails to remote caregivers, create accountability with doctors through an adherence report, and automatically refill prescriptions. Vitality improves medication adherence, health, and peace of mind.
Seamless Data Transfer

Connecting medical device data to patients and clinicians wirelessly.

Launch the next generation of medical devices with the 2net Platform, a unique technology-agnostic, cloud-based service designed to enable medical device connectivity. The 2net Platform offers reliable sharing and management of biometric data that can empower users to better care for themselves and others. Remotely and accurately. Around the clock— wherever you are.

Connecting the wireless health network.
In-Patient Data Directly to the Doc

AirStrip Technologies is a medical software development company focused on enabling mobility in healthcare. We have built and deployed an FDA-cleared platform which allows patient information - including waveforms and other critical data from EMRs, bedside monitors and devices, pharmacy, lab, and other clinical information systems - to be securely and natively accessed by physicians and nurses on their smart phones or tablets...anytime, and anywhere.

Healthcare ANYWHERE

Securely delivering critical patient information, including virtual real-time waveform data, directly from a patient’s location to a doctor’s mobile device.
THE DEVICE

As a first offering, AliveCor has developed a clinical-quality, low-cost mobile ECG heart monitor. The device is compatible with the iPhone 4 / 4S and enables patients to monitor their heart health anywhere, at any time, and provides physicians with an additional heart health assessment tool.
Obstacles

Technology availability

The extent and richness of solutions possible to a wide range of health problems.

Acquisition and ownership cost

Costs associated with purchasing the solutions and operating/maintaining them, respectively.

Regulatory efficiency

The time and cost associated with obtaining approval for specific solutions to particular health problems.

Reimbursement policy

Covering the cost of utilizing wireless health solutions, including when used for prevention, which is a great application opportunity for wireless health but not reimbursable for the most part today.
Clinical and health education

The need for the health providers to adopt wireless health solutions and know when/how to deploy them. Teaching patients about preventative and self-management practices.

Demonstrated outcomes

Clinical or field studies that show the efficacy of wireless health solutions.

Patient awareness

Visibility of patients into wireless health solutions in order to promote their own interests.

Interstate medical practice

Ability to practice medicine across state lines.
Graduate Study in Wireless Health

Master of Science and Graduate Certificate

Setting the standard for wireless health education
First ever curriculum designed specifically for wireless health and comprised of entirely new courses tuned accordingly

Based in San Diego because of the city’s wireless health leadership

Supported by the main campus in Cleveland

Designed for online/distance effectiveness
Master of Science (MS in EE or BME): Gives you the Knowledge and training to enter and advance the field

- 6 required and 3 electives courses
- Full-time students can finish in 9–12 months
- Part-time students can use up to 3 years

Graduate Certificate (joint EE and BME): Gives you the knowledge and training to enter the field

- A prescribed subset of 3 required courses of the MS
- Can finish in 9 months or use up to 21 months
- Successful graduates may matriculate into the MS, counting the courses toward the MS requirements
# Wireless Health Curriculum

<table>
<thead>
<tr>
<th>Course Type</th>
<th>#</th>
<th>Course Title <em>(prerequisite)</em></th>
<th>Format Option</th>
<th>Semester Offered</th>
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<tbody>
<tr>
<td>Required</td>
<td>R1</td>
<td>Introduction to Wireless Health</td>
<td>LEC/ITN</td>
<td>Fall &amp; Spring</td>
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<tr>
<td></td>
<td>R2</td>
<td>The Human Body</td>
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<td>R3</td>
<td>Health Care Delivery Ecosystem</td>
<td>LEC/ITN</td>
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<td>R4</td>
<td>Wireless Communications</td>
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<td></td>
<td>R5</td>
<td>Biomedical Sensing Instrumentation <em>(R1, R2)</em></td>
<td>LEC/ITN</td>
<td>Spring &amp; Fall</td>
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<td></td>
<td>R6</td>
<td>Life in a Hospital, Clinic or Care Center <em>(R1, R2, R3)</em></td>
<td>Rotation</td>
<td>Summer</td>
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<tr>
<td>Elective</td>
<td>E1</td>
<td>Principles of Health Care Management <em>(R3)</em></td>
<td>ITN</td>
<td>Fall &amp; Spring</td>
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<td></td>
<td>E2</td>
<td>Introduction to Medical Informatics</td>
<td>ITN</td>
<td>Fall &amp; Spring</td>
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<td>E3</td>
<td>Clinical Decision Support Systems</td>
<td>ITN</td>
<td>Fall &amp; Spring</td>
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<td>E4</td>
<td>Advanced Biomedical Instrumentation <em>(R5)</em></td>
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<td>E5</td>
<td>Mobile Persuasion &amp; User Experience Engineering</td>
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<td>E6</td>
<td>New Health Product Development</td>
<td>LEC/ITN</td>
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<td>E7</td>
<td>RF Engineering for Medical Devices <em>(R4)</em></td>
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<td>E8</td>
<td>FDA Medical Device Regulations</td>
<td>LEC/ITN</td>
<td>Spring &amp; Fall</td>
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<td>E9</td>
<td>New Health Technology Ventures <em>(E6)</em></td>
<td>LEC/ITN</td>
<td>Spring &amp; Fall</td>
</tr>
</tbody>
</table>

LEC: Onsite in San Diego  
ITN: Distance Learning - Online format  
1Only ITN in the flagged semester

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**Online option available!**
2012 Class of Certificate Students

http://engineering.case.edu/wireless_health
Thank You!

Our Wireless Health Program is San Diego Based, Cleveland Connected

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