Role of IOT and Wearables in Healthcare

Jan 19th, 2018
A Global Healthcare Crisis

- **40 of the 56 million annual deaths** globally occur from preventable chronic conditions such as cardiovascular disease, cancer, and chronic respiratory conditions.

- **80% of all heart disease, diabetes, and stroke**, and 40% of cancers can be prevented by optimizing risk factors including obesity, hypertension, sedentary activities, poor nutrition, and tobacco and alcohol use.

- In the US, more than **3.5 million seniors** are turning **65 every year**, with **90%** having at least one chronic condition.

- **80%** of Medicare costs result from **20% of the patients**, who are elderly, with **multiple comorbidities** such as diabetes, COPD, or congestive heart failure.

---

**US Healthcare Costs**

Changing the Cost Curve: People want Health, not Healthcare

Shift of Focus—and Investments—from Acute Care to Prevention

Healthcare Spending by Type of Activity, Global, 2007–2025

Source: Frost & Sullivan
He realizes that his primary care physician is not available now—it is a Saturday evening. Besides, he first needs to make an appointment on Monday.

John has light fever with a sore throat; he suspects it is strep throat.

He needs to attend an important meeting on Monday. Reluctantly, with no other option, he heads for the ER.

<table>
<thead>
<tr>
<th>7.45 p.m.</th>
<th>5 miles</th>
<th>2 hours</th>
<th>$350</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctor’s Office Closed</td>
<td>Distance from Home</td>
<td>Time in ER + 20 min for prescription</td>
<td>Cost incurred</td>
</tr>
</tbody>
</table>

Note: Illustrative distance, time, and costs. Representative example for the US region. Source: Frost & Sullivan
What it Could be—Anytime, Anywhere, and Cheaper

**INSTANT HEALTHCARE**
Virtual office visits reduce wait time

**CONTINUOUS HEALTHCARE**
Information is transmitted and shared in real-time between individuals and caregivers

**ERROR FREE HEALTHCARE**
Sensors, real-time analytics improve diagnoses, reduce procedural errors, and errors in medication administration

**MY HEALTHCARE**
Care will increasingly be customized to fine-tune the approach to the individual and their family

**COST-EFFECTIVE HEALTHCARE**
The most innovative companies improve quality while collapsing extraneous outdated processes and cost

Source: Frost & Sullivan
Cost, quality, and access issues continue to plague the current care system, with the most recently enacted initiatives (reimbursement cuts, PPAC, etc.) failing to significantly reverse trend lines.
The Internet of Things (IoT) entails any ecosystem of connected medical/consumer technologies supporting targeted health and wellbeing services.

Applications are often developed in coordination with multiple stakeholders specializing in specific aspects of solution development and deployment.

Solutions may be tailored to one use case, or bridge across various layers of the care continuum.
Role of Wearables in Healthcare
What do we Track? When, Where, and How?
The human body is a tremendous source for a variety of vital signs—a biological data generating System.

Harnessing Human Body Data/Biometrics

- EEG
- Cortical Stimulator
- Sleep
- Stress
- Eye Tracking
- Body Posture
- Fall Deduction
- Ear/Audio
- BP (Blood Pressure)
- ECG/EKG, Heart Rate (HR), Heart Rate Variability (HRV)
- Insulin Level
- Blood Glucose
- Respiratory Rate
- Muscle Tension
- Body Motion
- Body Weight
- SpO2
- Blood pH
- Body Temperature
- Total Activity
- Calorie Meter
- EMG

Value to Health

- Critical/High Value
- Nice to Have
- General/Wellness

Major Therapeutic Focus

Heart and Cardio Monitors

- ECG/EKG, HR, HRV
- Temperature
- Fall Deduction
- Respiratory Rate
- BP

Diabetes and Obesity Monitors

- Blood Glucose
- Insulin
- Body Pressure
- HR, Vision
- Body Weight
- Respiratory Rate, BP

Respiratory & COPD Monitors

- ECG, HR, SpO2, Respiratory Rate
- Temperature
- Fall Deduction
- Activity
- Body Posture

Chronic Pain Management

- Body Pressure
- Muscle Tension
- Body Posture
- Fall Deduction
- Body Motion
- Body Weight
- Total Activity
- Sleep

Critical/High Value

Nice to Have

General/Wellness

Source: Frost & Sullivan Analysis
Wearables—Shifting Focus to Clinical Over Consumer Health

**Consumer Health Applications**
- Intended for maintaining or encouraging a general state of wellness or healthy activity
- Considerably large market with a large number of players
- Less regulated market, facilitating easier entry; but very competitive
- Due to a large variety of solutions, it is very tough to make consumers stick to a particular device
- Newer technologies with consumer-centric and secure interfaces expected to easily overtake existing players in the ecosystem

**Medical or Clinical Use Applications**
- Useful for a medical professional to diagnose or influence course of care decisions
- The market is new and slow moving with a limited number of players
- Considerable regulations and stringent norms; difficult to enter
- Once entered with apps providing accurate medical information, secure user interfaces, and private health data securities, players can gain significant market share in a shorter period of time
- Fees can be paid by insurers and thus expected to be more regularly used by users

Source: Frost & Sullivan
Wearables Targeting Specific Health Needs

Brain Health and Neuro Monitoring
- Halo
- Thync
- Muse
- Evena
- Force Impact Technologies
- Cerora

Respiratory/Sleep Monitoring
- KOKOON
- SleepMango
- Airng
- SunSprite

Mother and Infant Care
- iSono Health
- PregSense
- Ultra Stan
- Modoo
- Bloom Technologies
- OWLET
- SMART DIAPER
- Pixie Scientific
- Cyrcadia Health
- Mimo
- Sensible Baby
- Sproutling

Cardio and Multi-Parameter Monitoring
- Vitaliti
- HealthPatch MD
- ViSi Mobile
- Sotera Wireless
- B.O.L.T
- BioVotion
- Withings
- Echolabs
- SCANADU
- VitalConnect
- Biotex
- Infra

Pain Management & Wound Care
- Quell
- ViMove
dorsaVi
- valedo
- PulseRelief
- SurroSense
- ORPyX
- Ulcer Sensor Leaf Healthcare

Aging in Place (Elderly Care)
- Balansens
- GoSafe
- UnaliWear
- Tempo
- activeprotective
- ENVIRO-TRACKER
- Vega

Sources: Company Web sites and press kits; Frost & Sullivan
Top 10 Segments for Medical-Grade Wearables

- Multi-Parameter RPM
- Heart & CVD
- Diabetes and Obesity
- Respiratory & COPD
- Aging in Place
- Pediatric Health
- Women’s Health
- Neurological & Mental Health
- Sleep Disorders
- Chronic Pain Management

Source: Frost & Sullivan
Consumer Perception—Wearables for Health and Wellness

Increasing millennial adoption of digital health will shift the value proposition of wearables from complex products to simple consumer-centric information services, empowering individuals for self-health management.

Healthcare Wearables Segment: Consumer Adoption by Age and Gender, US, 2016

- Overall, 16% of the consumers report using wearable sensors to track health, with the highest use (28%) among consumers aged 18–35.
- Interest in using wearable sensors in the future is strong among both men and women. The younger age groups report the highest use and future interest in wearable sensors.

Source: Frost & Sullivan
Value Creation for Wearables to be Driven by ‘Intelligence’

Differentiation solely through product innovation

- Medical Products

Differentiation by providing services to key stakeholders such as physicians, patients, and payers

- Services

Intelligence

Differentiation via product efficiency and evidence/outcome-based health benefits to demonstrate product value to end users

- Services

Medical Products

Apple–HealthKit has a Higher Impact than Apple Watch on Healthcare

Source: Roland Berger, Frost & Sullivan Analysis
Partnering to Innovate—Beyond Conventional Boundaries

Next-generation wireless technologies to power device connectivity in remote patient monitoring, transitional care support, and chronic care management

Use cloud-based 2net platform to collect device data during home-based clinical trials

Collaborated to develop a series of next-generation CGM products designed to be smaller and less expensive than existing technologies

Smart contact lens technology that monitors health vitals, measures blood glucose level non-invasively, and offers early detection of chronic health conditions

Retail
Walgreens

Pharma
Novartis

CGM Device Company
dexcom

Google
Technology & Data Science

Technology & Connectivity
Qualcomm®

Health Insurance
Oscar

Consumer Technology
Samsung

Clinical Trail Cloud Tech
medidata

Cosmetics & Beauty
L’Oreal

Wearable Technology
Fitbit

Medtronic
Medical Device

Collaborated to use mHealth wristband vivofit in clinical studies

L’Oreal is funding MIT’s research on a wearable skin patch that monitors blood flow 24/7, expected to be used to study skin health

Source: Frost & Sullivan

Health Insurance
Insured people submit their Fitbit data, and if they reach the daily fitness goals, they get $1 every day.

Clinical Trail Cloud Tech
Connecting patients implanted with neuromodulation therapies via consumer electronics and allowing physicians to more quickly make informed, data-driven treatment decisions

Medtronic
Collaborated to develop a series of next-generation CGM products designed to be smaller and less expensive than existing technologies

Source: Frost & Sullivan
### Wearables Potential to Transform Healthcare

Wearables are poised to play a critical role in broader transformations in healthcare delivery.

#### Technology-driven Paradigm Shift in Future Healthcare System

<table>
<thead>
<tr>
<th>Factors Transforming Healthcare</th>
<th>From Today As-is-State (2015)</th>
<th>Shift</th>
<th>Future To-be-State (2025)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Process/provider-centric</td>
<td></td>
<td>Patient-centric and participatory</td>
</tr>
<tr>
<td>Objective</td>
<td>Symptomatic, curative</td>
<td></td>
<td>Predictive and preventive</td>
</tr>
<tr>
<td>Access/Location</td>
<td>Limited in-hospital care (centralized)</td>
<td></td>
<td>Any time, any place-homecare (decentralized)</td>
</tr>
<tr>
<td>Technology</td>
<td>Isolated systems</td>
<td></td>
<td>Integrated systems (digital medicine)</td>
</tr>
<tr>
<td>Treatment Methods</td>
<td>Episodic care (invasive)</td>
<td></td>
<td>Holistic care (minimum/non-invasive)</td>
</tr>
<tr>
<td>Medication</td>
<td>Blockbuster medication</td>
<td></td>
<td>Personalized medication</td>
</tr>
</tbody>
</table>

Decentralization of Care Delivery Model  
*(Home & Virtual Care; eVisits)*

Cost Containment  
*(Promoting ACO and value-based care)*

Customer Centric Care  
*(Data-driven, engaging, Social, Outcome-based Care)*

Preventive & Wellness Focused  
*(Personalized Medication/Care)*

Source: Frost & Sullivan
Wearables—Enabling Care Decentralization

Benefits to Different Stakeholders

- **Hospital**
  - Reduces readmission, patient process time, and test duplication

- **Physician**
  - Can access comprehensive patient data and history for improved decision making and diagnosis

- **Patient**
  - Can stay more informed about personal health and wellness, and benefit from reduced treatment time

- **Payer**
  - Reduced treatment cost and hospital stay, and overall process efficiency

Wearable-enabled Decentralized Care Model

- **Patient**
  - Reimbursement
  - Self Monitoring
  - Insurance
  - Analytics

- **Physician**
  - Population health benchmarking
  - Regular feedback, reinforcement, appropriate level of intervention

- **Insurance**
  - Report
  - Reinforcement, appropriate level of intervention

Wearables Care Modules

- Health Awareness & Training
- Wellness Program
- Medication Adjustments
- Home Monitoring
- Service while Travelling
- PoC Labs and Diagnostic

Sources: AJM; Frost & Sullivan
# Wearable-enabled Business Models to Promote Preventive Care

<table>
<thead>
<tr>
<th>Business Model</th>
<th>Sub-type</th>
<th>Target Use Case</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service-based Models</td>
<td>Subscription, Pay-as-you-go, Transaction Fees, Renting, Leasing, Licensing,</td>
<td>Clinical Trials, Rehabilitation Program, Wellness and Fitness Programs</td>
<td>Research and Clinical Trials, Corporate-Wellness Programs, Incentivized by Insurance Payers</td>
</tr>
<tr>
<td>Fee-based Models</td>
<td>Direct Sales</td>
<td>Most General Purposes Consumer and Infotainment Wearable Devices</td>
<td>Xiaomi, Samsung, Sony, Supported by Consumers</td>
</tr>
</tbody>
</table>

**Business Model Evolution**
- **Product-to-Service-Oriented Business Model**
Challenges for this Vision

Technical

Physical Security, Cybersecurity

Lack of Interoperability

Data Source Verification

Standardized Data Capture, Accuracy

Unique Identifiers

Debatable

Data Ownership

Privacy

High Costs
### Wearable and Data-driven Healthcare Models 2020

#### Benefits to Stakeholders

- **Medical billing entities:** Increase compliance with the ACA outcome measurements
- **Policy makers and insurance companies:** Opportunity to integrate wearable technologies into practice to improve patient outcomes and patient compliance

#### Analytics and data service providers:

- New business opportunities and providing data-based value-added solution to all users

#### Sources:

Roland Berger; Frost & Sullivan

---

**Traditional Model**

- **Physician**
  - Decides on treatment based on real-life experience provided by advisors and increased networks

- **Lab**
  - Providing reactive based diagnostics where required

- **Patient**
  - Receiving diagnosis from automated tools, actively participating in treatment decisions

- **Pharma**
  - Developing and providing innovative drugs

- **Traditional Diagnostics**
  - Providing instruments and tools to diagnose conditions
  - Providing companion diagnostics as instrumented by data interpretation

- **New Diagnostics**
  - Offering new PoC tests directly to patients
  - Referencing real-time data sets to population benchmarks

- **B2B Advisory**
  - Giving individual treatment advice based on real-life data and diagnostic results
  - Real-time and actionable decision support

- **B2C Health Advisory**
  - Advice on wellbeing
  - Collecting real-time data sets

---

**Future Model**

- **Physician**
  - Decides on treatment based on real-life experience provided by advisors and increased networks

- **Lab**
  - Providing reactive based diagnostics where required

- **Patient**
  - Receiving diagnosis from automated tools, actively participating in treatment decisions

- **Pharma**
  - Developing and providing innovative drugs

- **B2B Advisory**
  - Giving individual treatment advice based on real-life data and diagnostic results
  - Real-time and actionable decision support

- **B2C Health Advisory**
  - Advice on wellbeing
  - Collecting real-time data sets

- **New Diagnostics**
  - Offering new PoC tests directly to patients
  - Referencing real-time data sets to population benchmarks

- **Understanding and improving individual performance**
Envision: Connected Health Ecosystem 2025

IoT Ecosystem (Smart Medical Objects)

- Network Infrastructure
- Encryption & Digital Sign

Data Lakes

- Indexing Device Registries
- Decryption & Authenticate Digital Sign

Blockchain

Converging Technologies

- Cybersecurity
- Machine Learning
- Analytics/Informatics
- Decision Support
- Interoperability

Trusted Applications (by Segment)

- On Body
- In Home
- Community
- In Clinic
- In Hospital
5 Competitive Keys for Success in Wearables

1. Identify the Right Segment
   - More than a land grab for customers, it is critical for market participants to identify and establish partnerships with the right stakeholders.

2. Targeted Impact
   - Entrants witnessing the highest rates of adoption targeted applications where ROI was easy to recognize, measure, and translate into savings.

3. Clean User Interface
   - Many available solutions suffer from over-engineering. An overwhelming number of features and advanced functionalities lead to user confusion and can delay or restrict usage.

4. Platform Flexibility
   - As new entrants continue to enter the marketplace, solutions with the ability to adapt to various use cases and function as a platform or plug-and-play mitigate risk.

5. Under-served Population
   - While a number of underserved customer segments are in need of solutions, very few services are designed to meet their needs.

Source: Frost & Sullivan
Related Research and Thought Leadership

• Recent Research Study:
  ➢ Internet of Medical Things, Forecast to 2021
  ➢ Wearable Technologies in Clinical and Consumer Health, Forecast to 2020

• Complimentary Frost Prospective:
  ➢ 10 Ways The Internet of Medical Things Is Revolutionizing Senior Care
  ➢ The Future of Wearables: Can Companies Avoid The Pitfalls Threatening Healthcare Wearables?