Going beyond Digital Health: Driving Ubiquitous and Continuous Wellness through Connected Living and Smart Sensors
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Founder & CEO
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Technologist and Entrepreneur with over 20 years of hands-on, leadership and executive experience in building consumer facing and enterprise solutions, and leading high performance teams in multiple verticals. Worked as CTO for two startups prior to starting Kollabio.

Kollabio, Inc.

Kollabio is a Digital Solutions firm with a focus on building connected solutions using Wearables and IoT. Currently working on a Connected Digital Health platform called Health360.

Key Areas of Expertise
Digital Health & IoT
Digital Strategy & Transformation
Cloud Architecture & DevOps
Agile Systems Engineering & Delivery

Industries
Healthcare
Public Sector
Transportation
Agenda.

1. Challenges with Healthcare
2. Current Landscape of Digital Health
3. Market Forces Impacting Healthcare
4. Continuous Wellness w/ Smart Sensors
5. Closing Remarks
Challenges with Current Healthcare System
Lack of Holistic Context
Symptom Driven Reactive Care (Sick Care)
Factors Influencing Human Health

- Behavioral: 40%
- Genetics: 30%
- Social: 15%
- Medical Care: 10%
- Environmental: 5%

Source: McGinnis et al, Health Affairs, Vol 22(2)

Focus is on “symptoms” around a specific episode
Lack of Care Continuity
Institutionalized or Localized Care Delivery
Healthcare is Fragmented and Reactive

Health/Wellness is “continuous” and is an integral part of our lives!

Care is delivered at “Point of Care” – Gaps in Care Continuum!
Digital Health is starting to address these challenges...
Current State of Digital Health

Technologies
- Wearables
- Bio-Sensors
- Genomics
- Data Analytics
- Connected Devices
- AI/Machine Learning

Capabilities
- Wellness Management
- Telehealth
- Patient Experience & Engagement
- Care Coordination
- Remote Monitoring
- Population Health
Top 10 Most Active Markets of 2016

By StartUp Health

### The Top 10 Most Active Markets of 2016 YTD

Patient / consumer experience remains a dominant market in the first half of the year, leading significantly in both funding amount and deal count.

<table>
<thead>
<tr>
<th>Market</th>
<th>$ Invested</th>
<th># of Deals</th>
<th>Notable Deals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Patient / Consumer Experience</td>
<td>$958M</td>
<td>51</td>
<td>Livongo, DocPlanner</td>
</tr>
<tr>
<td>2. Wellness</td>
<td>$854M</td>
<td>25</td>
<td>Bloodbuy, Healthine</td>
</tr>
<tr>
<td>3. Personalized Health / Quantified-Self</td>
<td>$524M</td>
<td>19</td>
<td>Guardant Health, Prenaestes</td>
</tr>
<tr>
<td>4. Big Data / Analytics</td>
<td>$406M</td>
<td>19</td>
<td>Lumina, Acxio</td>
</tr>
<tr>
<td>5. Workflow</td>
<td>$328M</td>
<td>43</td>
<td>Maxwell Health, Captireity</td>
</tr>
<tr>
<td>6. Clinical Decision Support</td>
<td>$234M</td>
<td>13</td>
<td>ePatientFinder, RubiconMD</td>
</tr>
<tr>
<td>7. Medical Device</td>
<td>$227M</td>
<td>25</td>
<td>MindMaze, Halo Neuroscience</td>
</tr>
<tr>
<td>8. E-Commerce</td>
<td>$172M</td>
<td>9</td>
<td>Healthine, Bloodbuy</td>
</tr>
<tr>
<td>9. Research</td>
<td>$65M</td>
<td>7</td>
<td>Elemental Machines, Strata Oncology</td>
</tr>
<tr>
<td>10. Population Health</td>
<td>$55M</td>
<td>8</td>
<td>Virtual Health, Lightbeam Health Solutions</td>
</tr>
</tbody>
</table>
Active Digital Health Categories.

Rock Health, Q2, 2016.
What else is on the horizon?

Digital Health
in the context of
Other Emerging Technology Trends
Healthcare IoT Market Size

- # of “Things” connected by 2020
  (Source: Cisco, Gartner, McKinsey, Intel....)
  (Source: Mind Commerce Report by MarketResearch.com)
- Predicted global worth of IoT in Healthcare by 2025
  (Source: Intel, A guide to internet of things)
Innovations in IoT/Smart Sensors are gradually reshaping the places we work, live and play (Homes, buildings, workplaces and cities)…
Soon, ubiquitous deployment of Smart Sensors will sense a whole range of features about the world around us....

...and help us better understand, manage and monitor our own Health/wellness as an integral part of our life.
The Layered Smart Health Ecosystem.

- **Smart Communities & Cities**
- **Smart Workplaces**
- **Smart Mobility**
- **Smart Homes**
- **Smarter Self**

Sensors and Connected Devices:
- Motion, Presence, Temp, Humidity, Air Quality, Water Quality
- Wearables & Bio-sensors: Heart Rate, Blood Pressure, Activity, Sleep, Nutrition, Mood, Weight, etc.
- Lighting, Location Tracking, Weather Patterns, Geofencing, Traffic

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Smarter Self.

Features
- Wearable Fitness Devices
- Bio-sensors
- Connected Medical Devices

Usage Scenarios
- Continuous collection of bio-markers.
- Personal health checks at home.
- Remote condition monitoring and collaboration with providers.
- Real-time notifications to family members in emergencies.
- Assist with musculoskeletal and neurological disorders
- Become an extension of us – communicate with each other – augmented decision making
Emerging Wearables & Sensors.

Vital Signs Monitoring
Source: Scanadu Scout

Brain Monitoring & Cognitive Assessment
Source: Emotiv

Advanced Cardiac Care
Source: iRhythm

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Smart Homes.

Features

- Temperature and environment control.
- Water and Air quality monitoring.
- Motion and Presence detection.
- Automation of lights and appliances.

Usage Scenarios

- Monitor for deviations from normal patterns.
- Remote monitoring of elderly and chronic care.
- Real-time alerts on environmental quality.
- Security and safety for the occupants.
Emerging Smarter Home Devices.

Integrated Interfaces

- Track Medication Adherence
- Dispense Medications
- Order Refills
- Connect with Care providers
- Control Other Devices
- Control temperature and humidity

Personal Home Health Robot
(Source:Pilo)

Conversational Devices
(Source:Amazon Echo)
Smart Mobility/Connected Cars.

Features

- Embedded Biosensors.
- Condition Monitoring.
- Location Tracking.
- Autonomous driving and Driver-assist.
- Real-time Notifications.

Usage Scenarios

- Personalized recommendations based on location and Geo-fencing.
- Continuous monitoring of select bio-markers through embedded sensors
- Posture and alertness detection of drivers
- Traffic monitoring and driver assist to avoid accidents due to lack of driver attention
- Drive to the near-by healthcare facility in case of an emergency
Driverless Car Interface
(Source: wsj.com/Tesla)

Driverless Concept Car
(Source: The Guardian/Mercedes)
Smarter Workplaces.

**Features**
- Wearable Trackers.
- Smart Buildings.
- Embedded Smart Sensors.
- Real-time Notifications.
- Integrated with Employee Details.

**Usage Scenarios**
- Focus on Safety, Health and Wellness of Employees.
- Productivity optimization through Wellness initiatives (Wearables).
- Real-time Notifications on safety and conditions of work sites.
Smarter and Safer Workplaces.

- Wearables and Wellness programs with a focus on Health and Productivity.
- Automated monitoring of bad postures and safety risks (Desk Jobs).
- Real-time Notifications of employee and workplace safety (Factory/Mines).
- Monitoring of environmental conditions and safety hazards (Mines).
- Connectivity between workers and machines through Wearables and IoT.
- Heads-up display through augmented reality (Warehouses, Factories).
- Safer, more comfortable and productive workplaces/smart buildings.
Augmented Reality
(Source:Atheer AIR Glasses)

Smart Seating/Desk
(Source:HumanScale)

Connected Accessories
(Source:Smart Cap)
Smart Communities & Cities.

Smart Sensors for Traffic, Infrastructure, Streets, Buildings and Environment

- Smart Lighting
- Traffic Management
- Smart Mobility
- Location Intelligence
- Temperature Monitoring
- Connectivity
- Water Quality Monitoring
- Air Quality Monitoring
- Cameras

- Efficient, Safe and Productive Buildings
- Efficient, Smart, Safe Lighting.
- Real time alerts on Environmental quality.
- Community based health monitoring
- Personal Health integrated with Population Health
INTELLIGENT ASSETS
MAKING CITIES SMARTER BY...

- SUSTAINABLE DOMESTIC WATER USAGE
- LOCALISED SMART ENERGY NETWORKS
- OPTIMISED CITY MOBILITY USING APP
- IMPROVING TRAFFIC FLOW, REDUCING CONGESTION
- INTEGRATED DOMESTIC ENERGY
- EFFICIENT WASTE DISPOSAL & REUSE

- ASSET TRACKING
Precious metals "mined" from products accumulating in cities, and cascaded back into different use cycles

- DECREASED EMISSION AND POLLUTION LEVELS
Vibrant cities with more life, less stress and cleaner air

- MATERIALS TRACKING
Cheaper and more flexible built environment as components are modularised and tracked, enabling a local market for reused building materials.

- SAVING TIME AND RESOURCES
Personal health checks at home using a table-top device, transmitted straight to hospital for assessment - saving time, healthcare capacity, and energy

- ENERGY-SAVING STREET LIGHTS
Street lights connected to sensors and a real-time traffic management system


www.ellennmacarthurfoundation.org/publications/intelligent-assets
Continuous, Personalized Health Analytics

Integrated Health Context.

Clinical Data
Wearable Data
Sensor Data
Location Data
Genome Data
Environment Data
Social Data

The Smart Health Platform.
Challenges Remain.

**Privacy and Security**
- Information security
- De-identification where applicable
- Potential for unintentional inferences and economic decision making
- Consumers should have control over their data and decide who sees it

**Digital Adoption**
- Awareness of technology
- Training and education for both consumers and care providers
- Digital solutions that are designed for the target user base

**Interoperability**
- Need for standards to enable different “things” to work with each other seamlessly

**Payment Models**
- Reimbursements and reward models for digital health interventions are still in progress
- Industry needs to catch up with innovation

**The Data Deluge**
- Making sense of the raw data
- Provide the right level of detail for decision making
A Connected eco-system of Smart Sensors and Data sources will force us to rethink how Health is measured, managed and care is delivered.....
**Smart Sensors + Cloud + Mobile + Analytics**

- **Fragmented** → **Continuous**
- **Localized** → **Ubiquitous**
- **Symptom-Driven & Reactive** → **Holistic**
- **One-size Fits All** → **Personalized**

**Ubiquitous, Continuous, User-Driven Health & Wellness**
THANK YOU

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