Health Care: Wearable + Big Data

Engineering Leadership Professional Program

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The Affordable Care Act (ACA) expands health care coverage to 10s of millions of previously uninsured Americans by reforming the US health care system, creating unique challenges and opportunities for new and innovative businesses.

This technical brief explores the healthcare landscape, the emergence and adoption of cloud-connected wearable technologies, along with the application of “Big Data” technologies to harness the rich set of data from a wide population to improve the quality of preventive health care.

Keywords: Affordable Care Act, wearables, big data
I. INTRODUCTION

The total healthcare expenditure in the US is a whopping $3 trillion, accounting for close to 20% of the GDP of the US. The Affordable Care Act, commonly referred to as “ObamaCare,” was signed into law on March 23, 2010, with the goal of insuring 10s of millions of previously uninsured Americans.

Wearables are clothing and accessories incorporating computer and advanced electronic technologies with the vision of interweaving technology into the everyday life. While wearables have existed since the calculator watch in the 1980s, their applications are rapidly increasing in numbers in the 2010s, thanks to related technological trends around smartphones and ubiquitous internet connectivity for the Internet of Things.

Big data is a term applied to the storage, retrieval and analysis of huge sets of data, often unstructured, with the common characteristics of Volume, Variety, Velocity, Variability, Veracity and Complexity. Big data and the related analytics software is often hosted in cloud based infrastructure due to cost, agility and elasticity advantages offered by cloud computing.

This technical brief explores the opportunities created due to the expanding healthcare market and the application of internet-connected wearable technologies and cloud-based big-data storage and analytics, to offer better quality preventive health care by using the collective, crowd-sourced, anonymized data from a large population.

II. HEALTHCARE MARKET

The healthcare industry is one of the world's largest and fastest-growing industries [1]. Consuming over 10 percent of gross domestic product (GDP) of most developed nations, health care can form an enormous part of a country's economy.
In US, we have seen health care cost growing in last 50 years. In 2013, U.S. health care spending grew 3.6 percent in 2013, reaching $2.9 trillion or $9,255 per person. That accounted for 17.4 percent of US GDP, comparing with 13% in 1996.
Among the $2.9 trillion healthcare dollar, 32% is spent on hospital care, 20% on physicians and clinics, 9% on prescription drugs, and 8% on home/residential/personal care. 


From Figure 1 and Figure 2, we believe that healthcare market provides an outstanding business opportunity for disrupted business and technologies.

III. ECOSYSTEM

EXISTING PLAYERS

*Healthcare Provider* today work with the insurance agencies and regulatory agencies to provide health-care service to the customer. They include physicians, hospitals, dentists, nurses, surgeons, therapists etc. They also participate in clinical trials of new drugs and help get them to market.

*Regulatory Agencies* are agencies that are responsible to define and implement health-care policies. Examples like FDA, CLIA who approve drugs and methods of
Insurance Providers are companies like Cigna, Anthem, Aetna who provide insurance services to customers. They work directly with health-care providers and drug and device manufacturers to approve treatments and drugs covered under a specific insurance plan.

**POTENTIAL DISRUPTORS**

Wearable and Device manufacturers are the new entrants who are innovating on coming up with devices, sensors, patches which can be used by customers as a wearable device to collect, transmit and monitor key bio-metrics for an individual.

Diagnostic Labs provide services to perform diagnostic tests on bio samples. The process today has many steps and touchpoints. Something that is already getting disrupted by companies like Theranos. This is a $60bn market today.

Big Data Companies

**IV. GOVERNMENT AND REGULATION**

The US Federal Government and many of its sub-agencies have several laws and regulations in place related to healthcare.

**HITECH ACT**

The Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 provides the US Department of Health and Human Services (HHS) with the authority to establish programs to improve health care quality, safety, and efficiency through the promotion of health IT, including electronic health records and private and secure electronic health information exchange.

Under the HITECH Act, HHS is spending $25.9 billion to promote and expand the adoption of health information technology. The Washington Post reported the inclusion of "as much as $36.5 billion in spending to create a nationwide network of electronic health records." At the time it was enacted, it was considered "the most important piece of health care legislation to be passed in the last 20 to 30 years" and the "foundation for health care reform."

**FDASIA**
The Food and Drug Administration Safety and Innovation Act of 2012 (FDASIA) gives the United States Food and Drug Administration (FDA) the authority to collect user fees from the medical industry to fund reviews of innovator drugs, medical devices, generic drugs and biosimilar biologics.

Section 618 of FDASIA directed the Secretary of HHS, acting through the Commissioner of the U.S. Food and Drug Administration (FDA), and in consultation with ONC and the Chairman of the Federal Communications Commission (FCC), to develop a report that contains a proposed strategy and recommendations on an appropriate, risk-based regulatory framework for health IT, including medical mobile applications, that promotes innovation, protects patient safety, and avoids regulatory duplication.

**HIPAA**

The Health Insurance Portability and Accountability Act (HIPAA) of 1996 protects health insurance coverage for workers and their families when they change or lose their jobs, requires the establishment of national standards for electronic health care transactions, and requires establishment of national identifiers for providers, health insurance plans, and employers.

The HIPAA Privacy Rule describes what information is protected and how protected information can be used and disclosed. The HIPAA Security Rule describes who is covered by the HIPAA privacy protections and what safeguards must be in place to ensure appropriate protection of electronic protected health information.

**AFFORDABLE CARE ACT**

The Affordable Care Act of 2010, also known commonly as “ObamaCare,” establishes comprehensive health care insurance reforms that aim to increase access to health care, improve quality and lower health care costs, and provide new consumer protections.

As of May 2014, about 20 million Americans had gained health insurance coverage under the ACA, and the percentage of uninsured Americans dropped from 18% in 2013 to 13.4%.
Wearable market is expanding and growth, many new companies trying to get into this market. The market size is $10B revenue from 105M units today and forecasted $35B revenue from 250M units in 2018 [4].

There are several types of segmentation for health and medical wearable device. One is Location/Active monitor in home or hospital, Another is ECG for fitness use, ECG for medical use, EEG for medical and special sensing technology for Blood Glucose monitoring.

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<th>Solutions</th>
<th>Monitoring</th>
<th>Type</th>
<th>Business</th>
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<td>9Solutions</td>
<td>Location/Active</td>
<td>Medical</td>
<td>Device/Soft/DB</td>
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<td>AiQ, NUUBO</td>
<td>ECG</td>
<td>Fitness</td>
<td>Device/Soft</td>
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<td>Preventice</td>
<td>ECG</td>
<td>Medical(FDA)</td>
<td>Device/Soft/DB</td>
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UCSD medical team [5] developed wearable type pain-free Blood Glucose sensor, which called E-skin Tatoo. The micro-needles are on the backside of the pad devices and it can provide detailed diagnostics under the skin (ex. Blood Glucose level). The group is developing a compatible digital readout technology using Bluetooth. The data will be stored in the cloud or delivered to the person’s doctor directly.

Wearable devices are get into healthcare and medical market and have strong correlation with bid data and cloud technology.

VI. CASE STUDIES

CASE: OSCAR HEALTH INSURANCE

Oscar Insurance Corporation offers health insurance products. By Feb 2015, it covers parts of New York and New Jersey. The company expects to expand into California and Texas in late 2015.

The company was founded in 2013 and is headquartered in New York, New York. Since then it has raised $150M with the most recent round of $80M in May 2014 from Breyer, Formation, General Catalyst, Khosla, FF and Thrive.
The Oscar service includes three free physician visits, unlimited calls to a doctor at any time of the day or night, and unlimited generic drugs.

Oscar gives away Misfit for free and pays end user $1 when “you hit your daily goal”. One user can get up to $240 each year just for being active, and another $400 for going to gym. The money is given back in the form of Amazon gift card.

**CASE: KAISER PERMANENTE**

Kaiser Permanente, the largest integrated healthcare provider in the United States, wanted to increase patient engagement and convenience while enabling more efficient tools for clinicians by using mobile technologies to provide remote monitoring choices for patients in their homes. According to Dr. Yan Chow (Director, Innovation & Advanced Technology Group, Kaiser Permanente Information Technology), Kaiser [6] currently has 60+ telehealth pilots or implementations in multiple specialties for

- Live video teleconsultation
- Store-and-forward consultation
- Remote patient monitoring

<table>
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<tr>
<th>Description</th>
<th>Benefits</th>
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| Live video teleconsultation                       | • Saves travel time  
|                                                   | • Better access  
|                                                   | • Member convenience                                |
| Store-and-forward consultation                    | • Saves travel time  
|                                                   | • Better access  
|                                                   | • Member convenience                                |
| Remote patient monitoring                         | • Generates red flags for early intervention  
|                                                   | • reduce outpatient visits for routine checks and reporting of vital signs |

For example, Kaiser Permanente is piloting a way to give patients—such as expectant mothers, diabetics and people with Alzheimer’s disease—the choice to participate in remote monitoring in their homes. This could be a more comfortable way for patients to access care, and could enable clinicians to gain better insight into health conditions through real-time access to data. Kaiser Permanente could empower clinicians to provide adjustments to instructions based on alerts and updates in real time, for better, more proactive healthcare.
IMS Health is a healthcare big-data company, which specializes in analytics and services for drug makers, payers, and healthcare providers. As illustrated above, IMS Health has gathered 10+ petabytes of unique healthcare data:

- 55+ billion healthcare transactions
- 90% of prescription and over the counter drug sales in the U.S.
- ⅔ of all medical claims in US
- 33 million records for unique, de-identified patients from 85k physicians
- 3B billion prescription transactions a year from 1.4 million healthcare providers
- 200,000 interviews a year in 50+ countries

Over years, IMS has built an impressive network of data suppliers and clients in over 100 countries:

- 100,000 suppliers, including pharmaceutical manufacturer, pharmacy outlets, hospitals, physicians, health plans, laboratory companies, Electronic Medical Record Vendors, and national health systems’ databases.
- 5,000 clients, including pharmaceutical, medical device manufacturers and distributors, government, policymakers, financial community etc.
  - Including almost all top 100 global pharmaceutical and biotechnology companies

IMS currently has annual revenue about $2.6 billion. 57% revenue is generated from selling healthcare data, and 43% revenue is from analytics tools. These analytics tools deliver deliver scientific insights, commercial insights (clinical trial optimization, pharma commercial analytics, payer/provider business intelligence), healthcare marketing, sales, social and performance (ex. clinical trial optimization, Targeting & Segmentation). IMS raised $1.3 billion in its IPO in 2014.

No competitor provides the geographical reach or breadth of IMS Health’s services. OptumInsight (consulting division of United Health Group) is the only significant competitor, while there are several startups. OptumInsight provides business process outsourcing, advisory and data processing services to its clients, and has $5.2 billion revenue in 2014 and 80,000 employees.
CASE: THERANOS

Company. Theranos provides lab diagnostics on microsamples at a fraction of cost conventional diagnostic industry. Their costs are approximately 50%. Their results are available in a matter of hours vs days. They operate under complete regulatory approval and boast of very high accuracy on their tests as compared to traditional lab diagnostics. The results are available to be viewed on multiple devices by the patient and the doctor with charts, alerts etc.

Technology. Theranos’s strength is its Advanced diagnostic technology e.g, DNA vs cultures. The can perform multiple tests from same sample. They perform advanced analytics on the diagnostic data for alerts and notifications.

Ecosystem and Opportunity. The primary competitors like Quest and Labcorp each with a market cap of $7-8bn. The lab diagnostic market is $60bn. Optimizing this space and building efficiencies on the cost structure can save Medicare and Medicaid each $100bn over next decade.

VII. OPPORTUNITY - COMPANY X
Given the above changes in the healthcare ecosystem a company that can reduce the friction from the marketplace for other players stands to gain in multiple fronts. We believe the DNA of such a company would be to play in one or more areas listed below:

- offers software as a service (SaaS)
- cloud storage and access for patient data stored in a regulatory approved privacy compliant manner
- SDK for devices and wearable developers
- out-of-box advanced analytical capabilities in collaboration with medical experts
- tieup with health care providers for monitoring and alerting
- caters to individuals and healthcare providers

**VIII. CONCLUSION**

An era of preventive health-care will be ushered in by a combination of technology players in wearable devices, cheap and fast diagnostics and advances in big data analytics driving down healthcare costs. In this ecosystem a patient’s health-care data and actionable insights on this data would be available for the patient to act on. This has the potential to spur behavioral changes in the population leading to a healthy population thereby reducing the health care costs. Such a dynamic ecosystem provides some tremendous economic opportunities to a company which can make it easy for other players in the ecosystem to operate and grow.
REFERENCES

BIOGRAPHIES

**Andy Feng**, VP of Architecture, leads the architecture and design of Yahoo Big Data platforms and machine learning initiatives. He served as a track chair and program committee member at Hadoop Summit and Spark Summit in both 2013 and 2014. He is a PMC member and committer of the Apache Storm project. At Yahoo, he has also architected major platforms for personalization, ads serving, NoSQL, serving containers and messaging infrastructure. Prior to Yahoo, Andy served as Chief Architect at Netsape/AOL and Principal Scientist at Xerox.

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