Big Data

Well Care Health

Fall 2017 Healthcare Group

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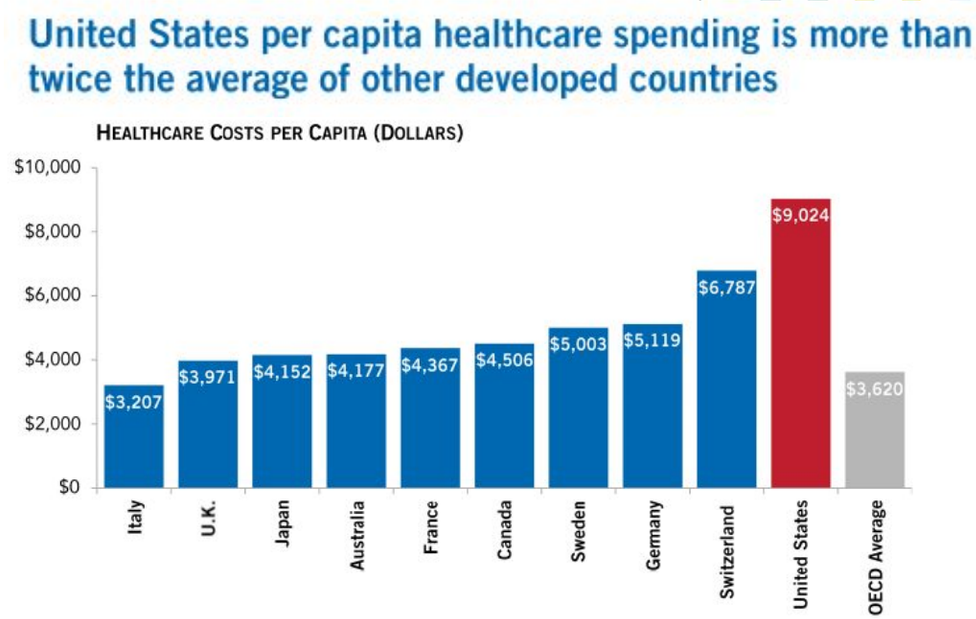
Problem Highlights

Gross domestic product and national health expenditures	*1960*	*1970*	*1975*	*1980*	*1990*	*2000*	*2009*	*2014*	*2015*
					Per capita amount, in dollars				
National health expenditures	$146	$355	$605	$1,108	$2,843	$4,857	$8,141	$9,515	$9,990
Health consumption expenditures	133	319	550	1,022	2,657	4,562	7,687	9,041	9,508
Personal health care	125	300	514	942	2,425	4,121	6,899	8,050	8,468
Administration and net cost of private health insurance	6	13	22	52	153	288	546	743	787
Public health	2	6	13	28	79	153	242	248	252
Investment[2]	13	36	55	86	187	295	453	474	482
					Amount, in billions				
National health expenditures	$27.2	$74.6	$133.3	$255.3	$721.4	$1,369.7	$2,494.7	$3,029.3	$3,205.6
Health consumption expenditures	24.7	67.0	121.1	235.5	674.1	1,286.4	2,355.7	2,878.4	3,050.8
Personal health care	23.3	63.1	113.2	217.0	615.3	1,162.0	2,114.2	2,562.8	2,717.2
Administration and net cost of private health insurance	1.1	2.6	4.9	12.1	38.7	81.3	167.4	236.6	252.7
Public health	0.4	1.4	3.0	6.4	20.0	43.0	74.1	79.0	80.9
Investment[2]	2.5	7.5	12.2	19.9	47.3	83.3	139.0	150.9	154.7
					Percent				
National health expenditures as percent of GDP	5.0	6.9	7.9	8.9	12.1	13.3	17.3	17.4	17.8

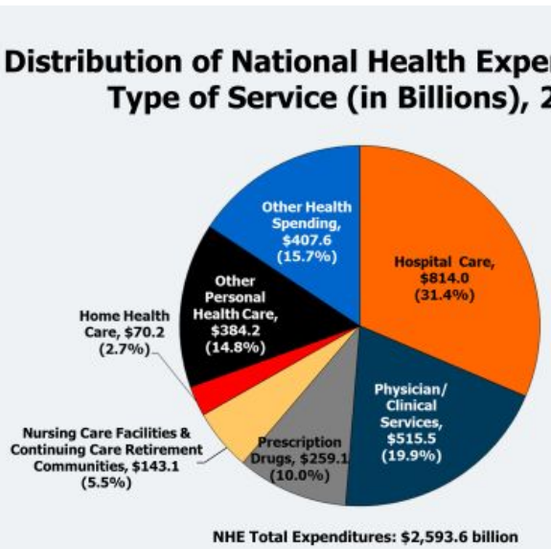
Health, United States, 2016, table 93

- *It is not that we are not spending enough money on healthcare, the problem is that **we are not spending the money wisely**.*
- *The goal of our healthcare solution is to **offer access at a sensible price**.*



In 2015, U.S. health care spending increased 5.8 percent to reach $3.2 trillion, or$9,990 per person

PGPF.ORG



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Problem Highlights of WellCare

1. High Re admission Rates

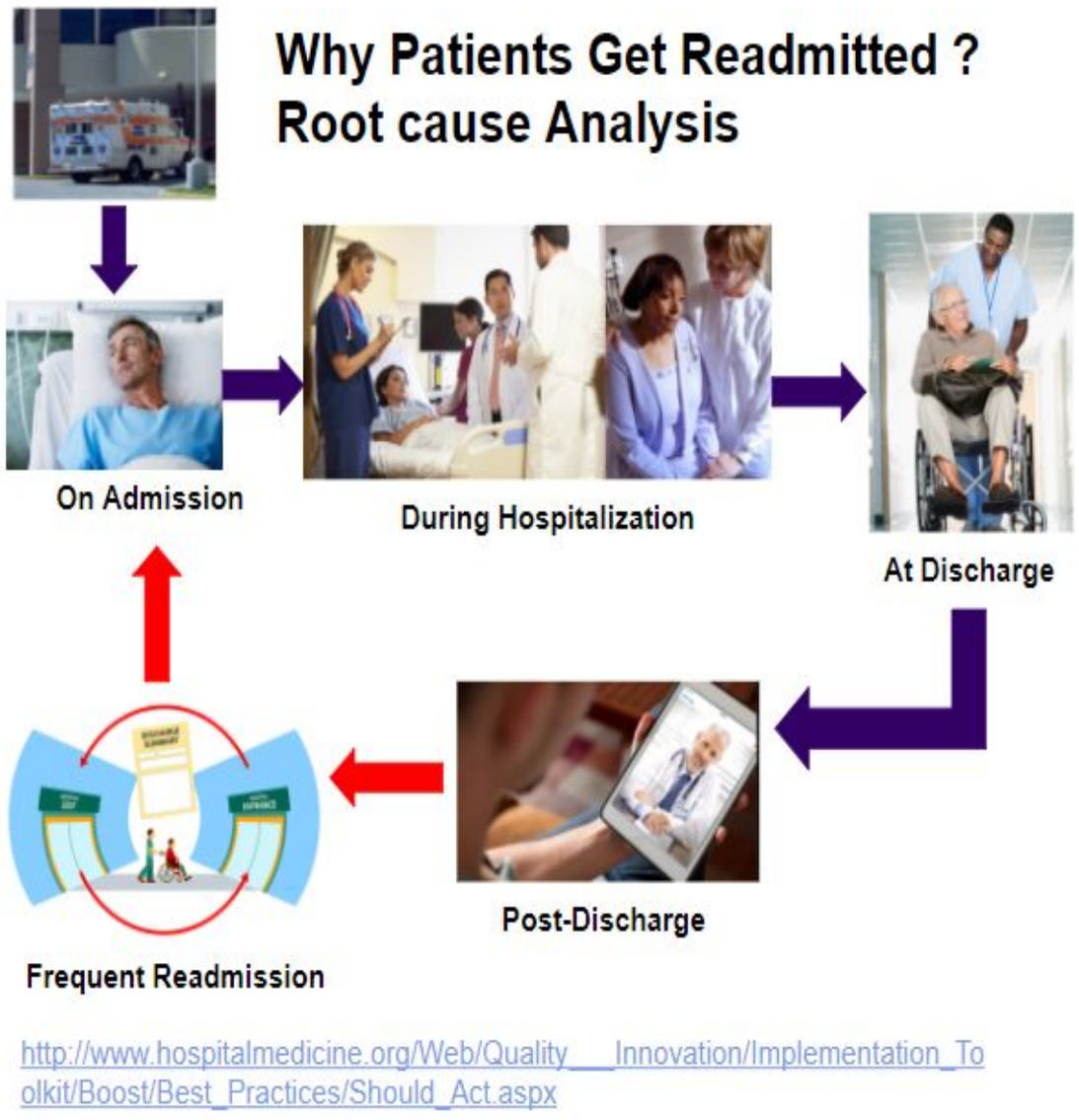
- < 30 days of being discharged
- Pain and suffering for the patient
- Sends bills skyrocketing

2. High cost of health insurance

- Patient unaware of care plan and medications
- Poor coordinated care

3. 80% of data is unstructured

- Physician's dictation - electronically transcribed - one time use-dig through patient pages
- EMR Data / Claims
- Pharmaceutical R&D: Clinical Trials Data, Genomic Data
- Patient behavior and sentiment data



http://www.hospitalmedicine.org/Web/Quality___Innovation/Implementation_Toolkit/Boost/Best_Practices/Should_Act.aspx

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Key Trends in Healthcare

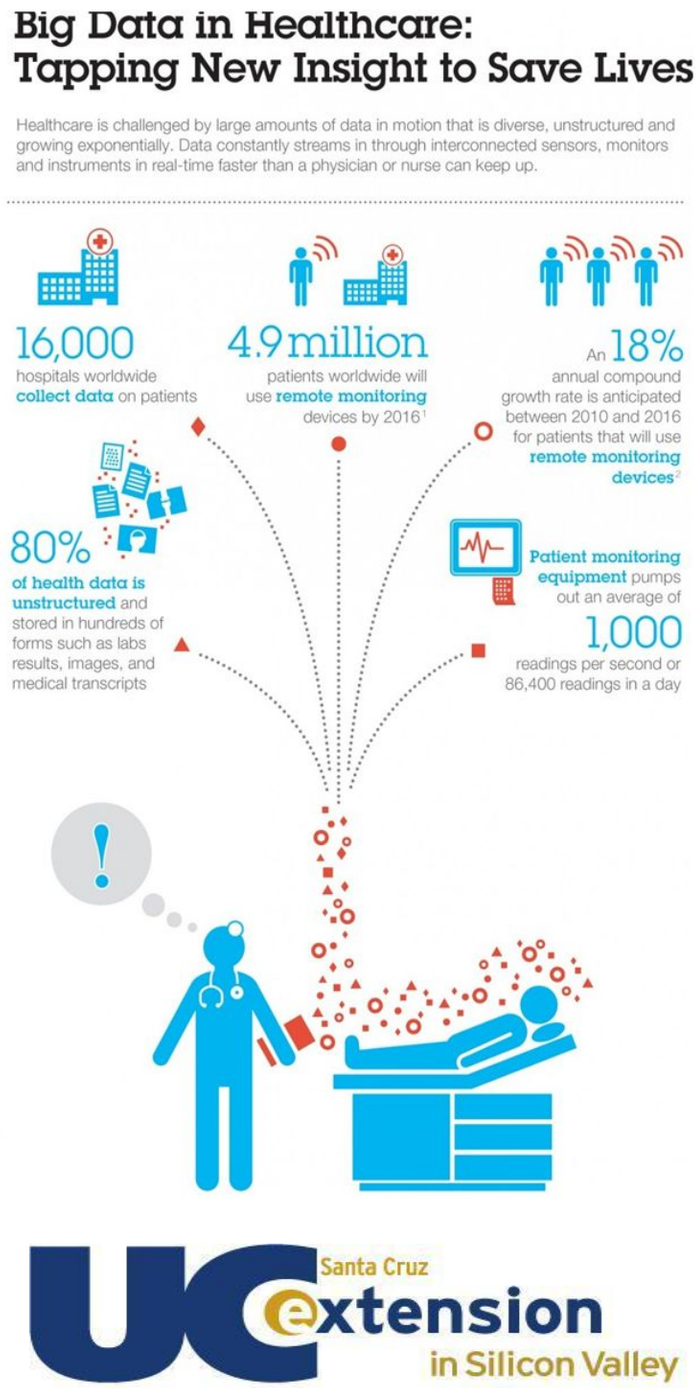
Value-based patient-centric care

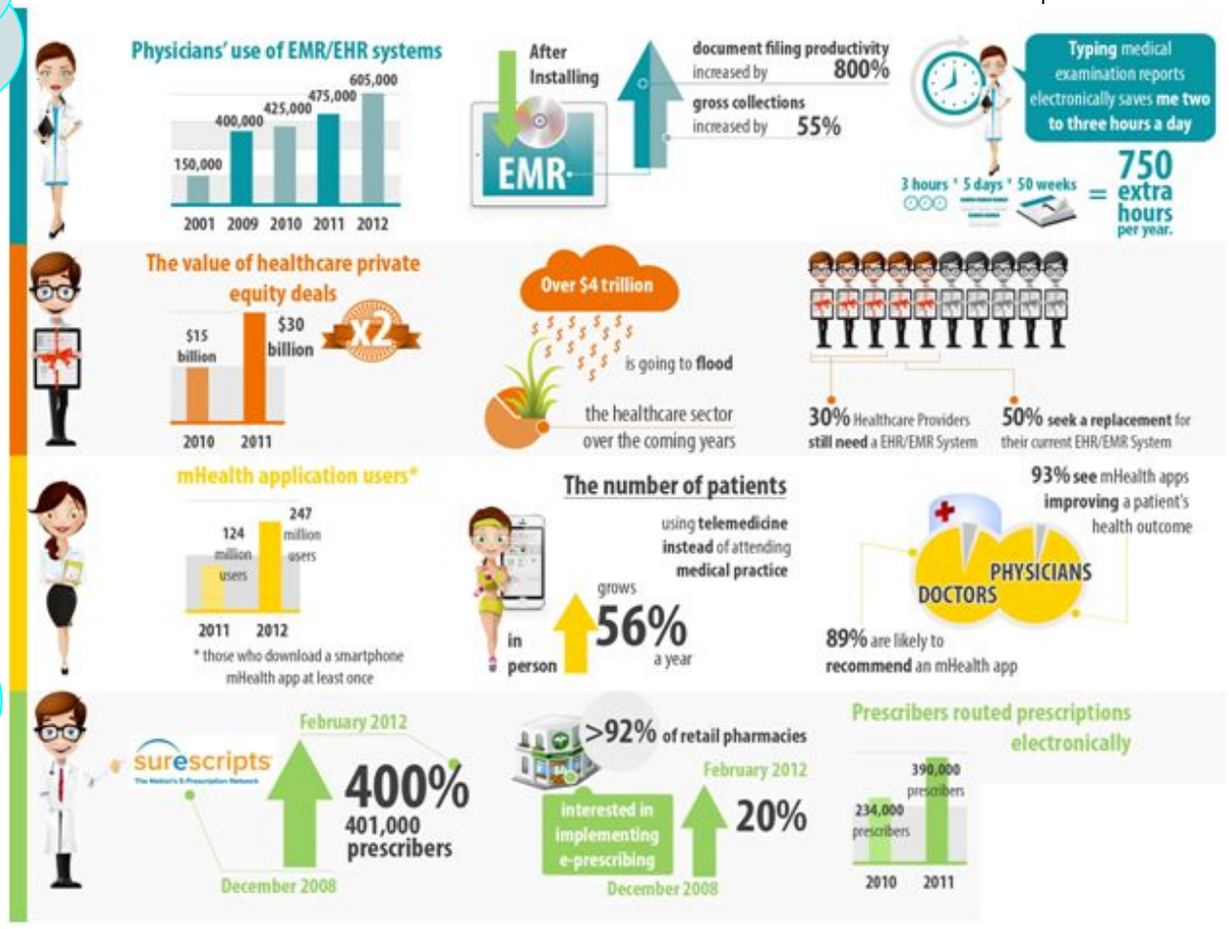
Healthcare Internet of Things (IoT) & real-time monitoring

Predictive analytics to improve outcomes

Reducing fraud, waste, and abuse

Kaiser Telehealth /IBM Watson Health





Proposed Solution

- Deploy a system to fully utilize patient's data, unstructured (80%), semi-structured, and structured, with Lambda architecture, which handles both NRT data processing and batch data processing.
- Develop a user friendly patient portal to promptly collect discharged patient's health data and provide better patient care.
  - Proactively follow up with patients if needed
  - Have patient to visit his/her primary doctor before the situation getting deteriorated.
- Provide sensor/monitor etc. IoT technology to discharged patients for real time monitoring
  - Proactive detection and alert
  - Call and communicate with patients if needed
- Implement data analysis, pattern recognition, machine learning to predict the readmission
- Create a 360 degree view with patient's consolidated data - EHR, CDR, sensor data, patient portal log, etc.

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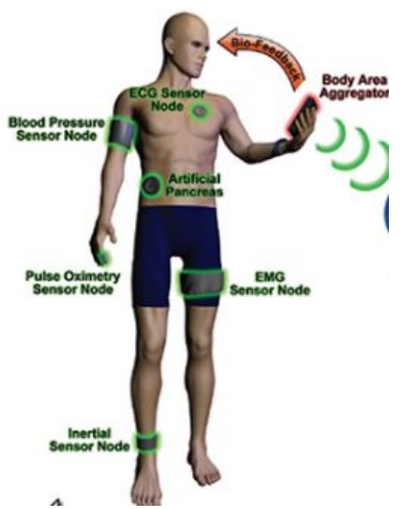
Proposed Solution

Semi-constructed Data (EMR, sensor, log)

Unconstructed data (EMR, sensor, log)

Structured Data

Lambda Architecture With Hadoop / Spark



Proposed Solution Architecture

Semi-Structured Data

HEALTH DEVICES / SENSORS

Unstructured Data

CDR (HEALTH CASE)

WELLCARE HEALTH © PATIENT PORTAL APP (CLICKSTREAM DATA)

Unstructured Data

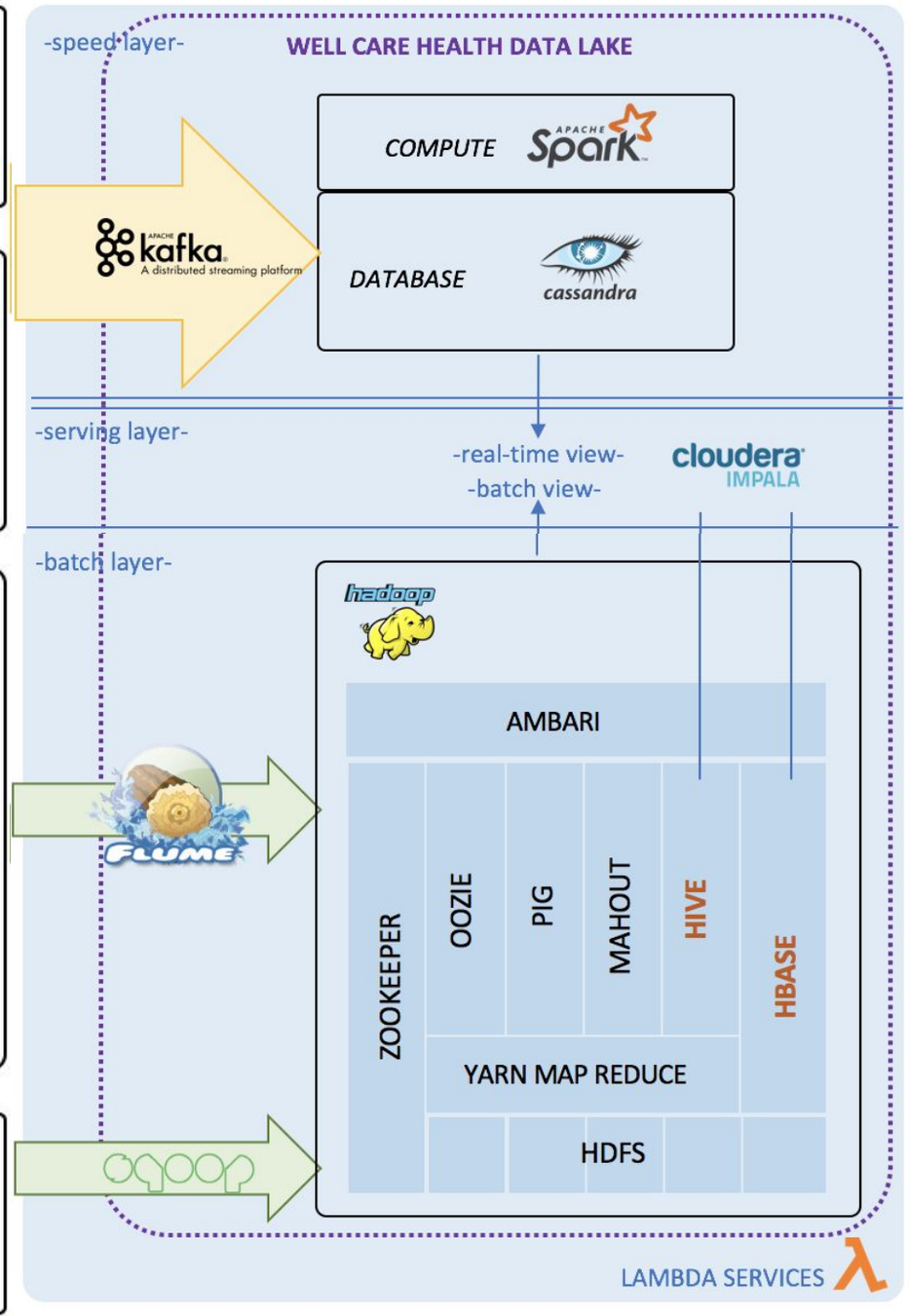
CDR (FEEDBACK)

DISCHARGE INTERACTION NOTES AFTER-CARE PATIENT INTERACTION LOGS

DICTATED PHYSICIAN'S NOTES

Structured Data

EMR / PATIENT RECORDS



WELLCARE HEALTH ©
PATIENT PORTAL APP
PATIENT CARE: INTERVENTION
(USING RECOMMENDATION ENGINE)

PREDICTING READMISSION

- PATIENT FOLLOW-UP (Outgoing)
- PATIENT CARE (Incoming)

DATA ANALYSIS (R)

BI (TABLEAU):
* Cost
* Readmission Stats
* Other KPIs

Recommended Tech Stacks

- **Flume** is a distributed, reliable and available service for efficiently collecting, aggregating, and moving large amount of log data from different sources to Hbase.

- **Kafka** is used to build real-time data pipeline and streaming apps. It is horizontally scalable, fault-tolerant and very fast.

- **Sqoop:** to transfer data from relational database to Hadoop

- **Ambari** enables system admin to provision, manage, and monitor a Hadoop cluster.
- **HDFS and YARN MapReduce** form the data management layer of Hadoop.
  - YARN MapReduce provides the resource management
  - HDFS provides the scalable, fault-tolerant, cost-efficient storage for big data.

- **HBase:** stores Hadoop output files into a big table for random access

Recommended Tech Stacks

Apache Spark is a fast and general engine for big data processing, with build-in modules for streaming, SQL, machine learning and graph processing.

Cassandra is a database with linear scalability and high availability without compromising performance. It is the perfect platform for NRT data.

Cloudera Impala is the open source, analytic massively parallel processing (MPP) database for Apache Hadoop that provides the fastest time-to-insight.

Apache Mahout is used to create scalable performance machine learning applications.

Tableau is an integrated Business Intelligence (BI) and analytics solution that helps to analyze key business data and generate meaningful insights.

Deployment strategy

POC → Design → Build → Test → Deploy + Post Implementation

|----- 1 month-----||---------- 4-5 months---------- ||------- 1 month -----|

	POC	Design / Build / Test	Deploy + Post Implementation
Lambda Services (incl Hadoop)	• Min # of clusters • Tech stack POC	• Increase cluster size for build / test • Dev't and test of tech stack	
Intervention / Recomm. Engine, Prediction	• Sample patient data across all data sources	• Design, build, test recommendation engine, intervention feature, and prediction-based features	
Patient management system		• Design, build, test features to support patient care using Agile	• Scale out for production size • Monitor/adjust • CI / CD
Monitoring devices / IoT	• Test devices with sample high-risk patients	• Integration of devices with patient management system and WellCare Health Patient Portal App	
WellCare Health© Patient Portal App		• Design, build, test features to support patient care; MVP / Agile methodology	
Business Intelligence	• Sample data	• Gap analysis of data • Design, build, test BI dashboards using Agile	

Deployment strategy

Stakeholders

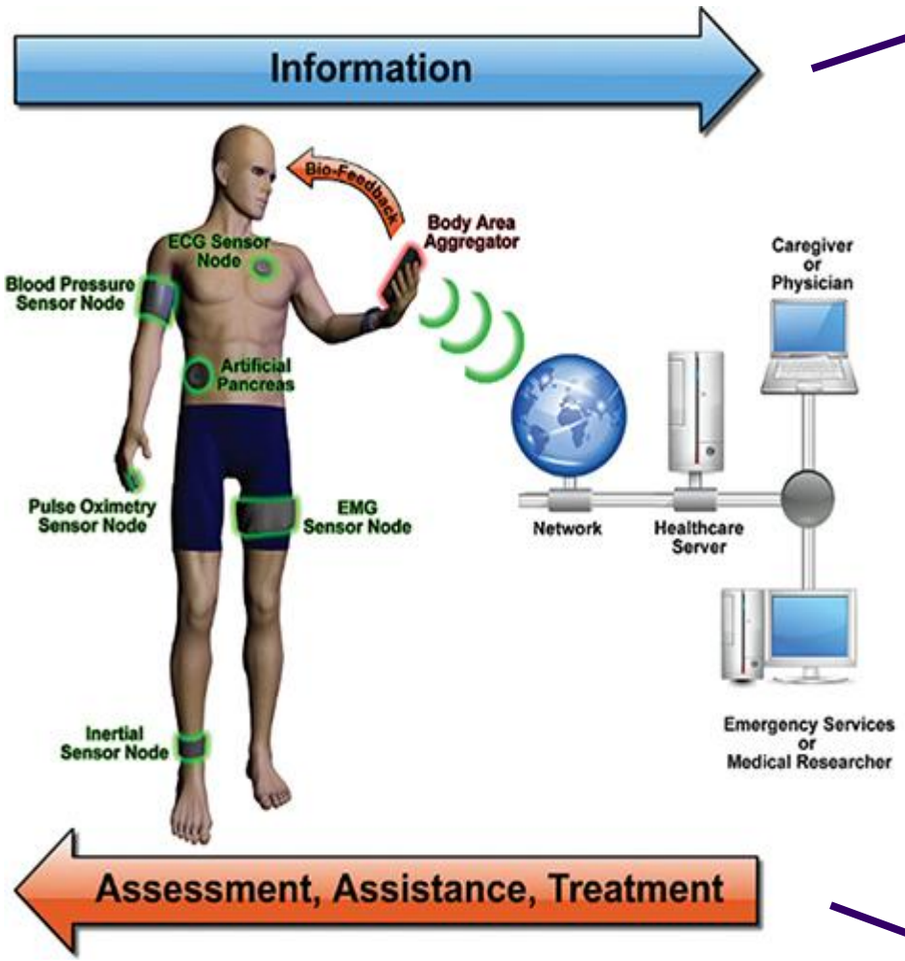
WellCare Health Team (Customers / End Users)	External Parties	Solution Providers
• Management • IT • Patient Care Team • SMEs (Doctors, Practitioners)	• Patients • Software Vendors	• Solutions / Technical Architect • Software Engineers • Data Scientists • Business Analysts • Project Managers

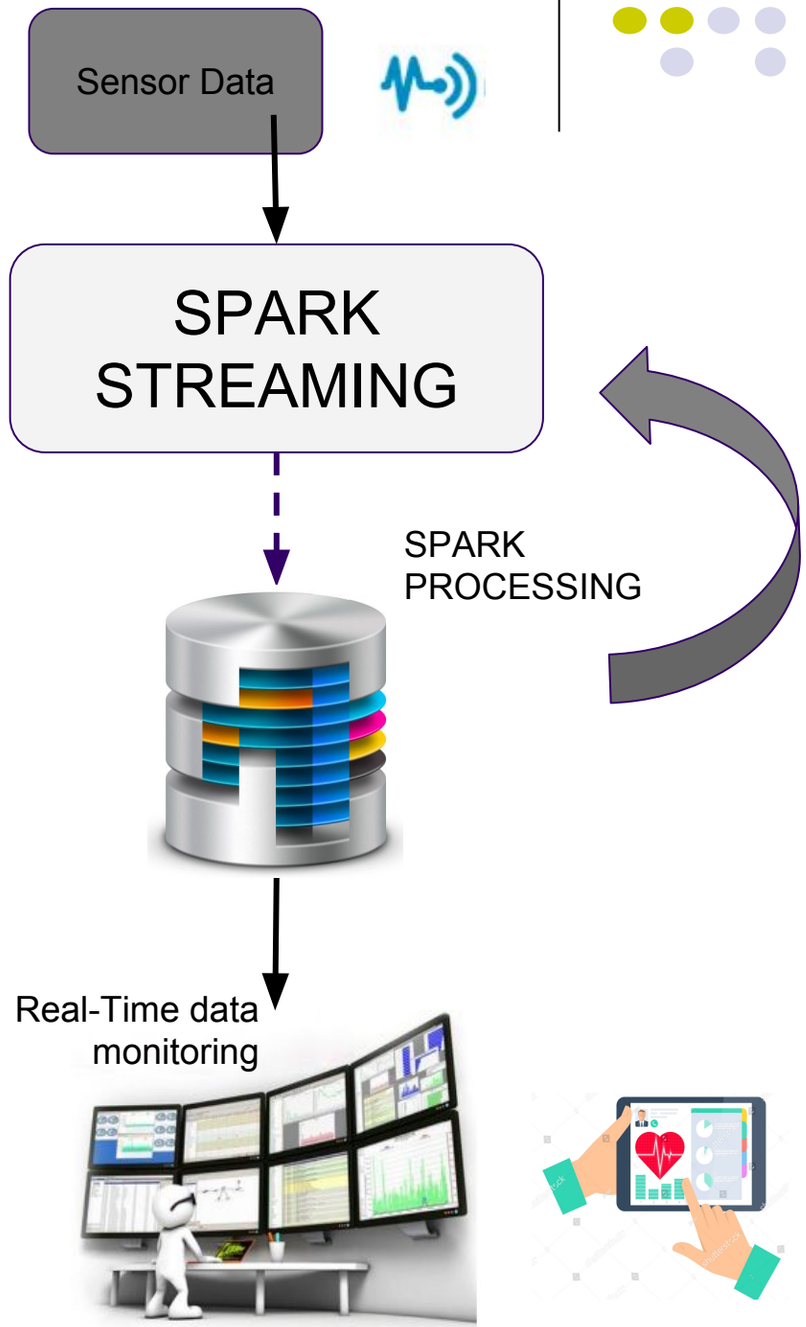
Deployment Strategy

High Level Cost Table

Items	Unit price	Subtotal
Amazon EC2 with Kafka/Cassandra supported	$15,000/month (enterprise)	$180k/yr
AWS Lambda Services	$40/month	$480/yr
Sqoop/Flume	Open source (free)	0
Cloudera	$2800 for basic	$2800
Tableau	$1000/user yr + $1600 one-time-license	$7600
Mahout	$60/month	$720/yr
Health App development (Software)	$55,600.00	$55600
Resources		
3 patient system management staff	$60K/yr * 3 = $180k/yr	$180k/yr
4 data analysis/scientist	$80k/yr * 4 = $320k/yr	$320k/yr
Business intelligence	$70k/yr	$70k/yr
Total		**$817,200/yr**

Solution design mockup - NRT





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Solution design mockup - Batch

Unstructured Data

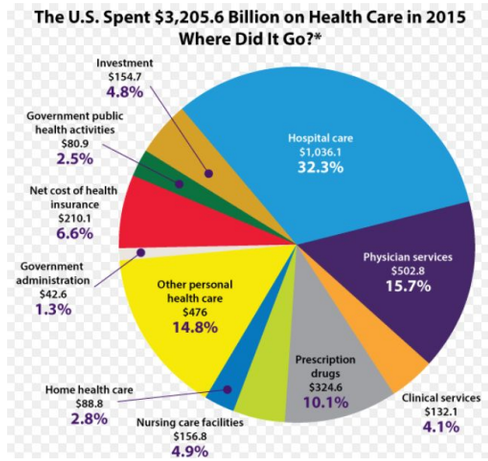
Call Data Records(Patient Feedback/Logs)

Discharge Interaction Notes /After care patient Follow-up

Physician's notes/Voice->Text

Structured Data

Patient information



Tableau

Health App

Data Sources

Platform

Data Analysis

Deliver/Decision Makers

Solution design mock up

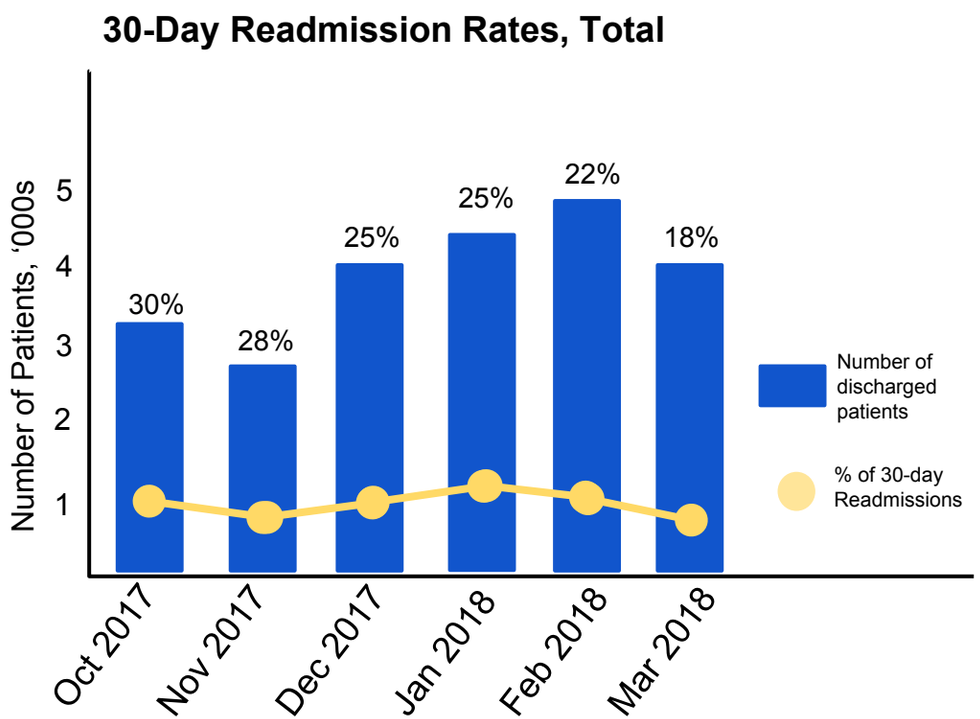
Metrics Dashboard Examples

Admission & Readmission | NRT Monitoring | Patient Satisfaction | Financials

Admission Rates

Readmission Rates
30-Day Readmissions
- Total
- By Procedure
- By Diagnosis
- By Payer Type

60-Day Readmissions
90-Day Readmissions



Admission Rates

NRT Monitoring

Patient Satisfaction
- Patient Satisfaction Rating, Quarterly

Financials
- Cost of Readmission by Payer Type
- Cost Avoidance Through Intervention Readmissions

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Proposed Solution Benefits

Benefits:

- Reduction of readmission rates
- Reduction of overall healthcare costs through decrease in avoidable readmissions and reduction of waste
- Increase in effectiveness of patient care and patient satisfaction
- Contribution of data to the healthcare industry

Proposed Solution Themes

- *Data-driven holistic patient care using big data*
- *Individualized proactive patient care and use of IoT for real-time health monitoring*
- *Key metrics for prediction, recommendation and decision making*

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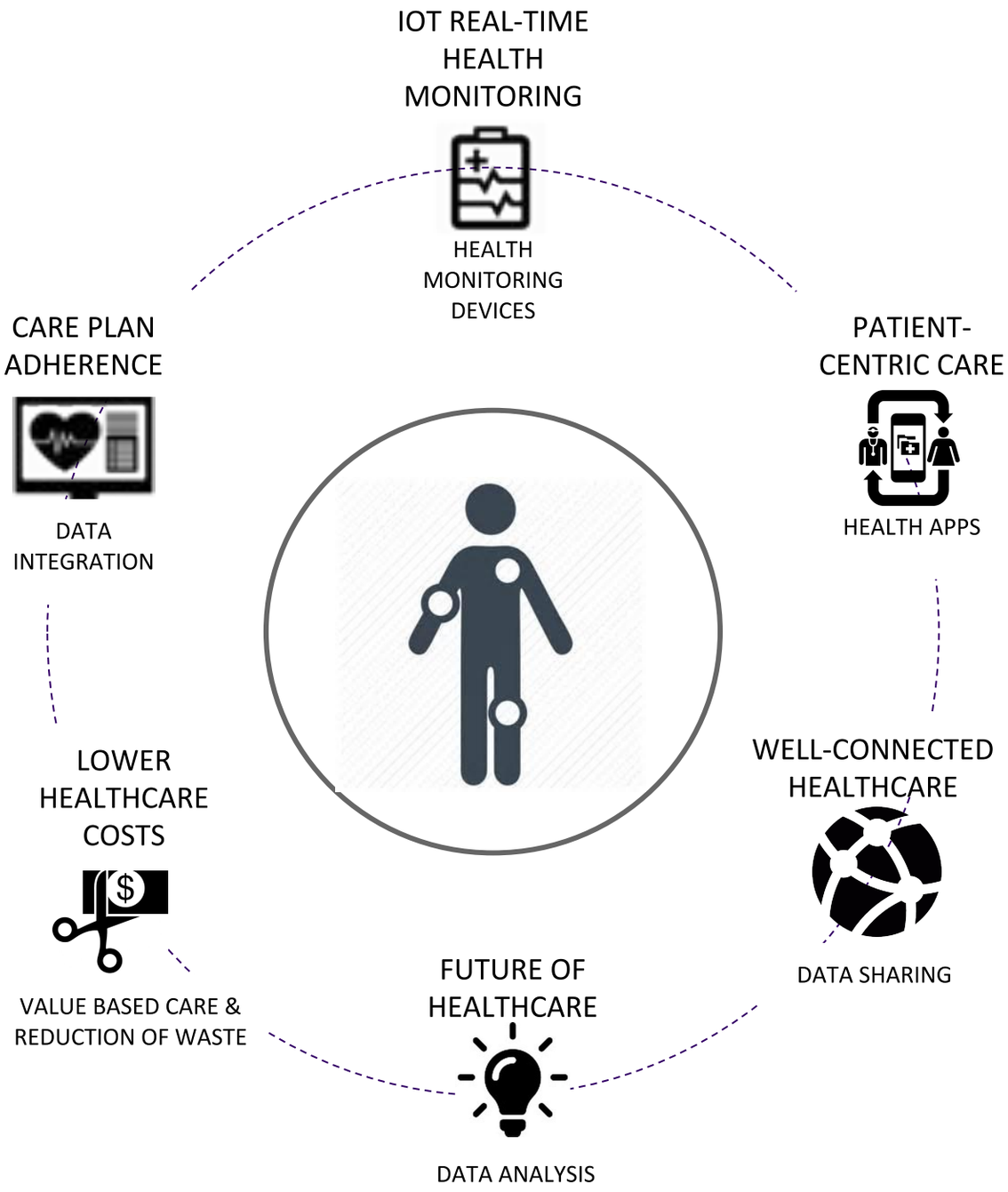
Summary

"The world is one big data problem."-
Andrew McAfee, MIT scientist



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