SINI 2017 — 27th Summer Institute in Nursing Informatics

Clinical Practice, Health, and the Internet of Things

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Big Data/Data Analytics and Quality of Care

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Clearsense
ANIA — When caring and technology meet
Stony Brook University

"The doctor of the future will give no medicine, but instead will interest his patients in the care of human frame, in diet, and in the cause and prevention of disease".

Thomas Edison (1847 – 1931)

Be Original Already

- Keep an open mind
- Don't work alone
- Ask lots of questions
- Explore
- Learn then rebel

https://youtu.be/Uq-FOOQ1TpE

Thinking Differently

"Look for patterns and ask why those patterns exist."

"Embrace curiosity, be open, playful, and persistent."

Debra Kaye

Red Thread Thinking

Weaving Together Connections for Brilliant Ideas and Profitable Innovation
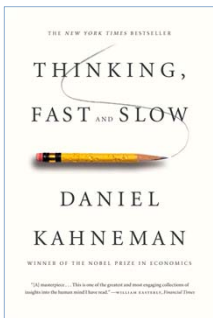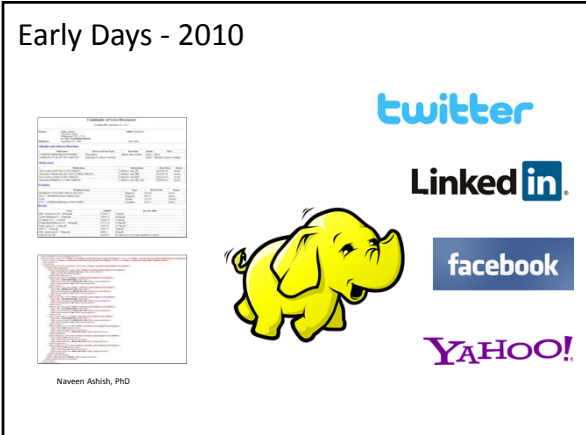
Debra Kaye with Karen Kelly

Design Thinking

"Design is the action of bringing something new and desired into existence—a proactive stance that resolves or dissolves problematic situations by design. It is a compound of routine, adaptive and design expertise brought to bear on complex dynamic situations."

Harold Nelson

DesignThinking

Integrating Innovation, Customer Experience, and Brand Value

Edited by Thomas Lockwood

Understanding Cognition

"The best we can do is a compromise: learn to recognize situations in which mistakes are likely and try harder to avoid significant mistakes when the stakes are high."
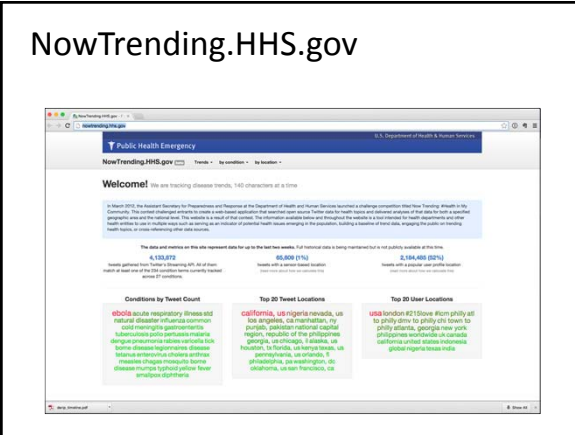
Daniel Kahneman

Evolution of Healthcare Analytics
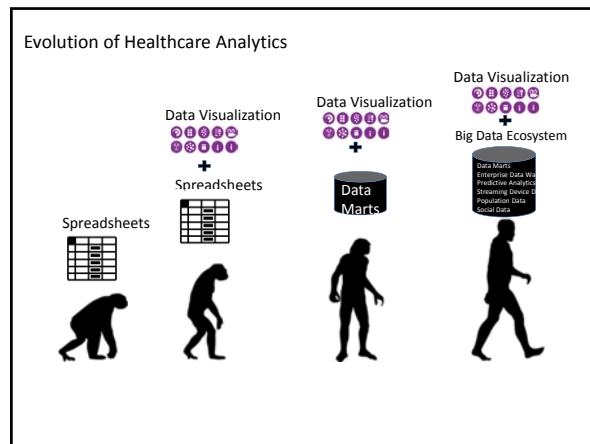
Early Days - 2010

Naveen Ashish, PhD

NowTrending.HHS.gov

The Case for Big Data in Healthcare

- New sources of health data are emerging that are not handled well by traditional BI/data storage
- The volume, complexity, diversity, & timeliness of healthcare data is rapidly increasing
- *Patients are gaining much more insight and interest in managing their own health*
- Need for Predictive/Prescriptive Analytics to support pro-active healthcare paradigm

From: "The 'Big Data' Revolution in Healthcare", Center for US Health System Reform, 2013

Current Environment

Electronic Medical Record
– Not designed to process high volume/velocity data
– Not intended to handle complex operations
  - Such as:
    – Anomaly detection
    – Machine learning
    – Building complex algorithms
    – Pattern set recognition

Enterprise Data Warehouse
– Suffer from a latency factor of up to 24 hours
– The EDW serves all of the following retrospectively as opposed to in real time
– Clinicians
– Operations
– Quality and research

Big Data = Complete Data

- The Electronic Medical Record is primarily transactional taking feeds from source systems via an interface engine

- The Enterprise Data Warehouse is a collection of data from the EMR and various source systems in the enterprise

- In both cases decisions are made concerning data acquisition

- A Big Data system is capable of ingesting and storing healthcare data in total and in real time

Modern Healthcare Data Ecosystem

A healthcare information ecosystem built on "Big Data" technologies should:

Be capable of serving the needs of clinicians, operations, quality and research

And should do so in real time and in one environment

Should be:

Able to ingest all healthcare generated data both internal and external in native format
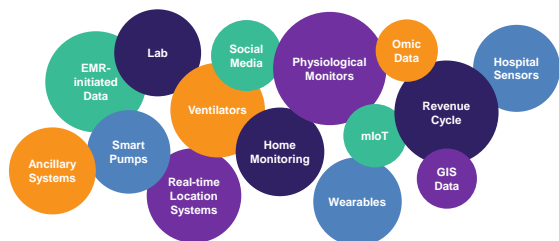
Should be:

A platform for advanced analytics such as early detection of sepsis & hospital acquired conditions
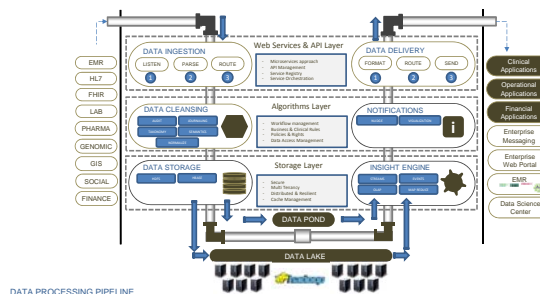
Be enabled to predict potential readmissions

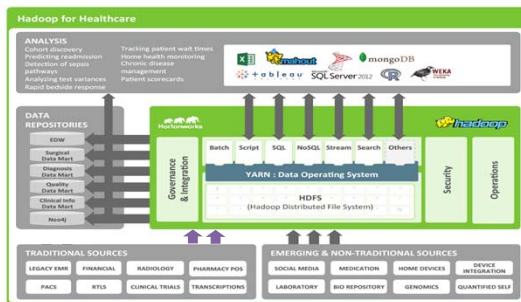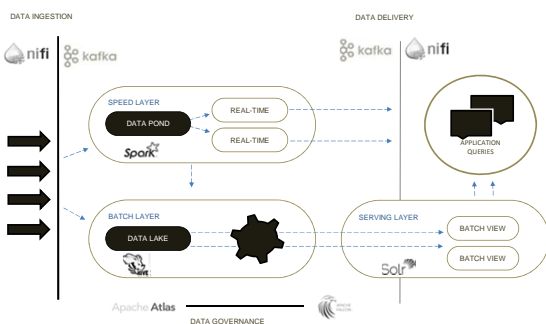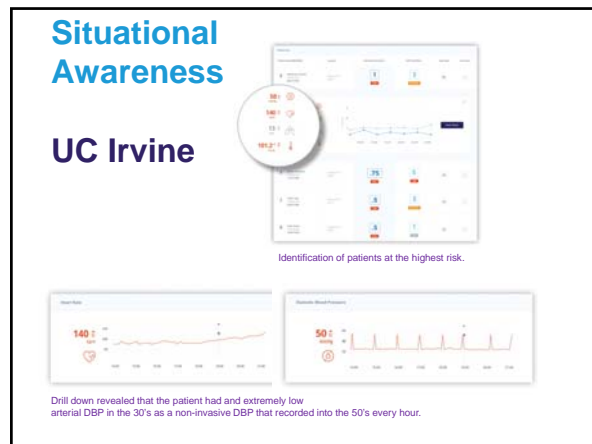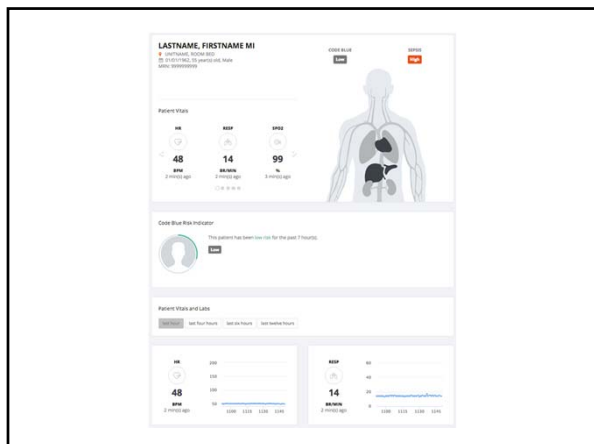Leverage complex algorithms and be a machine learning platform

Data Types

Modern Healthcare Data Ecosystem

Modern Healthcare Data Ecosystem

Ecosystem components

- HDFS
- NiFi
- Spark
- Kafka
- Ooozie
- Ranger
- Atlas
- HIVE
- R

- HUE
- PostgreSQL
- Neo4j
- Data Governance
- Splice Machine

Situational Awareness Defined

Situation Awareness (SA) is the perception of environmental elements with respect to time or space, the comprehension of their meaning, and the projection of their status after some variable has changed, such as time, or some other variable, such as a predetermined event. It is also a field of study concerned with understanding of the environment critical to decision-makers in complex, dynamic areas from aviation, air traffic control, navigation, military operations, healthcare to more ordinary but nevertheless complex tasks such as driving an automobile or riding a bicycle.

Situational Awareness Defined (cont.)

Situation awareness involves being aware of what is happening in the vicinity, in order to understand how information, events, and one's own actions will impact goals and objectives, both immediately and in the near future. One with an adept sense of situation awareness generally has a high degree of knowledge with respect to inputs and outputs of a system, i.e. an innate "feel" for situations, people, and events that play out due to variables the subject can control. Lacking or inadequate situation awareness has been identified as one of the primary factors in accidents attributed to human error. Thus, situation awareness is especially important in work domains where the information flow can be quite high and poor decisions may lead to serious consequences.

Endsley's model of SA. This is a synthesis of versions she has given in several sources, notably Endsley (1995a) and Endsley et al (2000). Drawn by Dr. Peter Lankton, May 2007.

SA Environments by Level of Care

- Monitored Inpatient Environments
  - ER
  - OR
  - ICU
  - Step Down
- Inpatient Environments
  - Med/Surg
  - OB
  - Oncology
- Outpatient Environments
  - Clinic
  - Urgent Care
  - Home

Situational Awareness

UC Irvine

Identification of patients at the highest risk.

Drill down revealed that the patient had and extremely low
arterial DBP in the 30's as a non-invasive DBP that recorded into the 50's every hour.

Use Cases

- Legacy System Retirement
- *Patient Condition Changes*
  - *RRT*
- *Early Sepsis Detection*
- *Environmental Response*
- Real Time Nursing Unit Utilization
  - Staffing and Resource Allocation
- Social Media Sentiment Analysis
- Research
  - Cohort Discovery
  - Data Science

- Clinician Aware Applications
- Patient Monitoring External to Traditional Healthcare Setting
- *Event Driven Care & Real Time Quality Monitoring*
- *Personal Health Record*

Future Use Cases

- Ventilator Management
  - Vent dashboard in EMR
- Hospital Acquired Infections (HAI)
- VTE Surveillance
- Sensium Vitals Digital Patch
- Patient-Generated Data
  - Home Devices (Scale, Vital Signs, Glucose)
  - Exercise & Diet (Fit Bit,)

- *Combining Phenotype Data with Genotype Data*
- Patient Threat Analysis
- Edge and Vertices Analysis
  - Patient caregivers and outcomes

Real-Time Monitoring Med/Surg Population & Home

Colleague Aware Applications

- Preparing for the Emerging Real-time Healthcare System
  - Where is my patients patients RD?
  - Connect me now

RFID & Patient Throughput

Sedation Utilization in SICU
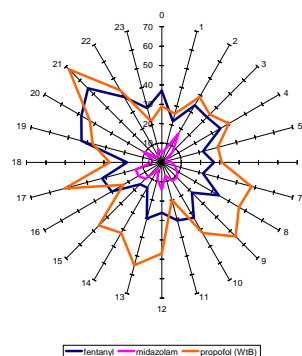
Imaging Analytics

- NIH Funded U24 Grant
- Joel Saltz, PhD
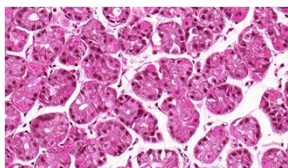
  – This project is to develop, deploy, and disseminate a suite of open source tools and integrated informatics platform that will facilitate multi-scale, correlative analyses of high resolution whole slide tissue image data, spatially mapped genetics and molecular data for cancer research.

Healthcare Sentiment Analysis

- The application of natural language processing, computational linguistics and text analytics to identify and extract subjective information.
- What is being said about a person or about an organization. Sentiment can be positive or negative.
- Early identification of negative sentiment allows an organization to respond immediately and avoid being blindsided. Positive sentiment allows for marketing opportunities.

Social Media Engagement/Surveillance Dashboard

- Sentiment Analysis
- Healthcare: Patients & UCI
- CS 191 Students
- MedStream

Tweets from the bedside

"Prom is overrated. #Name of Healthcare Organization @Name of Healthcare Organization"
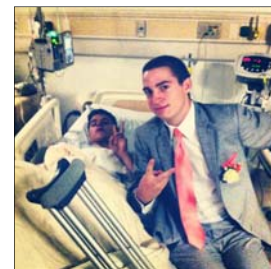
Food & Nutrition

It's Not all Negative

cdunlay
Our view from XXX, Labor and Delivery #baby #newborn #babyboy #boy #life #babydelivery… http://t.co/gCBCFZZYJm

karenkaren478
Driving past XXXX hospital brings back so many bad memories ☺

nursebeth72
I can't get enough of these sunsets #nofilter #sunset @ Hoag Memorial Hospital http://t.co/LiPRLgNlx1

m_fullbright
Florida health employee caught photographing patient data, gets fired http://t.co/tdEGaoMafZ

jf3lix
@TaylorMazzone1 @InMyZzone83 Big Props! You're in good hands at UCLA Medical Center.

ddpearson1
Bike accident resulting in 6 broken ribs & collapsed lung. Virginia Hospital Center is NOT Trauma 1 facility. BEG to be taken anywhere else.

chull62068carol
Lobby of Long Island Jewish Hospital. Still here. No relief in sight. Not stuck yet! http://t.co/wEl0uO5q7S

Moving Beyond Clinical & Billing Data
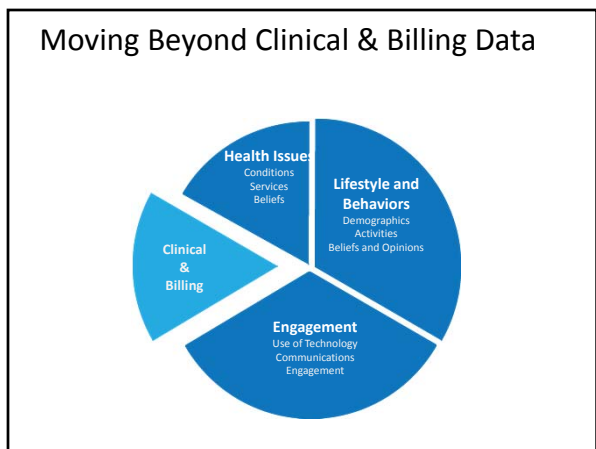
Taking the Lead from Retail

Health Issues
Chronic Diseases
Cancer
Conditions Have
Conditions Treated
Conditions Not Treated
Mental Health

Care Access and Utilization
Care Utilization
Medications
Health Insurance
Insurance Purchasing
Discussed with Provider

Demographics
Gender, Age, Education
Household Composition
Life Changes and Housing
Language and Ethnicity
Employment
Income and Assets
Financial
Transportation

Communications
Social Isolation
Patient Education
Digital Engagement
Health Marketing
Activities and Destinations

Health Activities and Beliefs
Smoking
Alcohol
Diet and Weight Loss
Exercise
Health Attitudes
Perception of Wellness

What is the medication utilization of the Medicaid/Uninsured Population?

Paradox of Population Health

- Understanding the Patient as a Person
  - Social Determinates
  - Demographic Issues

- A Person's Personal "Big Data"
  - Medical IoT
  - Omics

- High Quality and Value Care at the Personal Level
  - Quality Measures for the Masses

- Making it Personal
  - Access to and Understanding the Longitudinal Record

Miller, B. 2016 https://blog.caradigm.com/2016/01/the-paradox-of-population-health/

The difference between a vision and a hallucination is that other people can see the vision.

Life is short,
Build Stuff
that
Matters