IBM Watson Health

The Impact of Cognitive Computing on Healthcare

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IBM

IBM Watson Health

Watson: The Next Grand Challenge

JEOPARDY! The IBM Challenge

IBM

Session Description

The Impact of Cognitive Computing on Healthcare

Complex care coordination requires significant time and can tax the resources of even the most versatile organizations. IBM's Watson computer can rapidly, intelligently parse through disparate data to help coordinate care. Learn how this new evolution of computers featuring natural language processing, hypothesis generation and evaluation, and dynamic learning can augment efforts to improve health information sharing for better patient outcomes.

"Have You Started Your Data Expedition Yet?"

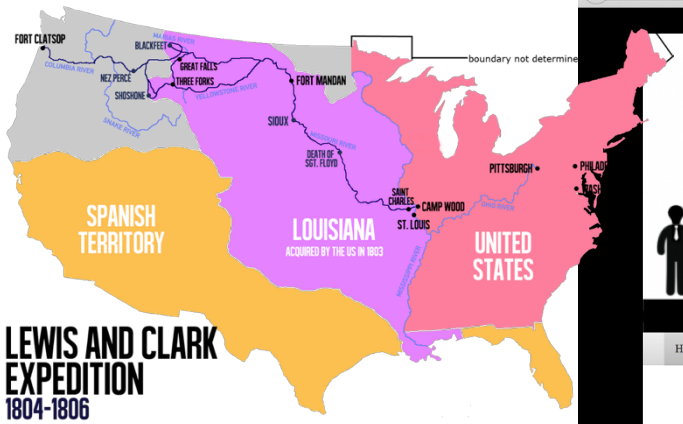
- **Blog:** http://craigrhinehart.wordpress.com/

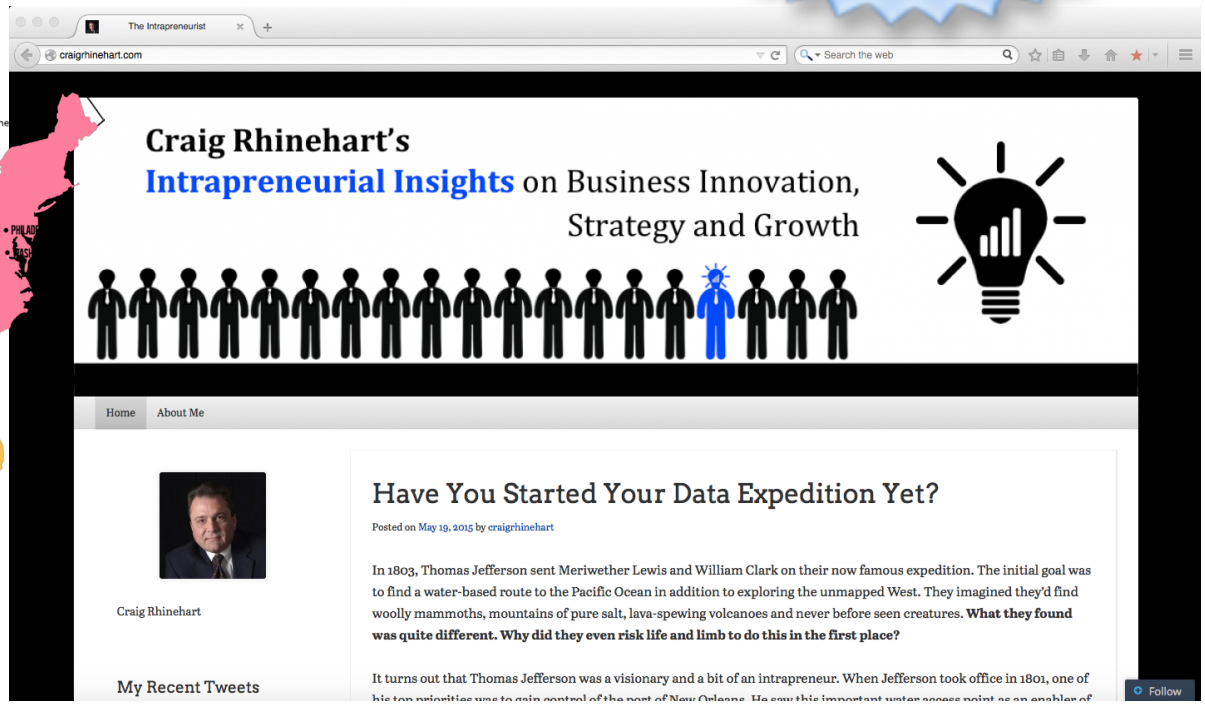
  Craig Rhinehart's Intrapreneurial Insights on Business Innovation, Strategy and Growth

- **Twitter:** @CraigRhinehart

- **Email:** craigrhinehart@us.ibm.com

New Post





#WatsonHealth
#MiHIN

Topics

- Introduce Cognitive Computing
- Why Cognitive Computing in Healthcare?
- An Explosion of Data and Costs
- IBM's Approach and Role in Healthcare
- How Customers Are Transforming With Cognitive Computing

Topics

- **Introduce Cognitive Computing**
- Why Cognitive Computing in Healthcare?
- An Explosion of Data and Costs
- IBM's Approach and Role in Healthcare
- How Customers Are Transforming With Cognitive Computing

The Era of Cognitive Computing Will Transform Our Future

Tabulating Systems Era

Programmable Systems Era

Cognitive Systems Era

What is Cognitive Computing?

- Cognitive computing is the simulation of human thought processes in a computerized model.
- Cognitive computing involves self-learning systems that use data mining, pattern recognition and natural language processing to mimic the way the human brain works. The goal of cognitive computing is to create automated IT systems that are capable of solving problems without requiring human assistance.
- Cognitive computing systems use machine learning algorithms. Such systems continually acquire knowledge from the data fed into them by mining data for information. The systems refine the way they look for patterns and as well as the way they process data so they become capable of anticipating new problems and modeling possible solutions.
- Cognitive computing is used in numerous artificial intelligence (AI) applications, including expert systems, natural language programming, neural networks, robotics and virtual reality. The term cognitive computing is closely associated with IBM's cognitive computer system, Watson.

http://whatis.techtarget.com/definition/cognitive-computing

Medical Transcription Discharge Summary Sample # 2:

DATE OF ADMISSION: MM/DD/YYYY

DATE OF DISCHARGE: MM/DD/YYYY

ADMITTING DIAGNOSIS: Syncope.

CHIEF COMPLAINT: Vertigo or dizziness.

HISTORY OF PRESENT ILLNESS: This is an (XX)-year-old
years ago, atrial fibrillation, peripheral arterial disease,
patient came to the ER for an episode of vertigo while reaching for some books. The patient was able to reach the books, to support self, but did not have any syncope. No nausea or vomiting. No chest pain. No shortness of breath. Came to ER and had a CT head, which was within normal limits. The impression was atrophy with old ischemic changes but no acute intracranial findings. No focal weakness, headache, vision changes or speech changes. The patient has had similar episodes since one year. Peripheral neuropathy since one year and not relieved with multiple medications. The patient also complains of weight loss of 25 pounds in the last 6 months. No colonoscopy done. Recent history of hematochezia but believes it was secondary to proctitis and secondary to decreased appetite. No nausea, vomiting, no abdominal pain.

PROCEDURES PERFORMED: The patient had a chest x-ray,
thickening and small pleural effusion, a left costophrenic an
pattern. The patient also had a head CT which showed atro

CONSULTS OBTAINED: A rehab consult was done.

PAST ME
hyperten

FAMILY H

SOCIAL H

ALLERGIE

REVIEW
hemorrh
and feet.

PHYSICA
Appearar
is central
nontende
EXTREMI
No nysta

LABORAT
percenta

The patie
effusion,
head CT,

Echocardiogram Sample Report:

DATE OF STUDY: MM/DD/YYYY

DATE OF INTERPRETATION OF STUDY:

Echocardiogram was obtained for assessn
The patient has been admitted with diagn
study was suboptimal due to poor sonic w

FINDINGS:

1. Aortic root appears normal.
2. Left atrium is mildly dilated. No gross i
recognized, although subtle abnormalities
atrium is of normal dimension.
3. There is echo dropout of the interatria
could not be excluded.
4. Right and left ventricles are normal in i
ventricular systolic function appears to be
fraction is around 55%. Again, due to poo
abnormalities in the distribution of lateral
excluded.
5. Aortic valve is sclerotic with normal ex
Doppler study demonstrates trace aortic
6. Mitral valve leaflets are also sclerotic
imaging and Doppler study demonstrates trace to mild degree of mitral regurgitation.
7. Tricuspid valve is delicate and opens normally. Pulmonic valve is not clearly seen. No evidence of pericardial effusion.

l thickening and small pleural
D pattern. The patient also had a

Cardiology Consultation Transcribed Medical Transcription Sample Reports
DATE OF CONSULTATION: MM/DD/YYYY
REFERRING PHYSICIAN: John Doe, MD
CONSULTING PHYSICIAN: Jane Doe, MD
REASON FOR CONSULTATION: Surgical evaluation for coronary artery disease.
HISTORY OF PRESENT ILLNESS: The patient is a (XX)-year-old female who has a known history of coronary artery disease. She underwent previous PTCA and stenting procedures in December and most recently in August. Since that time, she has been relatively stable with medical management. However, in the past several weeks, she started to notice some exertional dyspnea with chest pain. For the most part, the pain subsides with rest. For this reason, she was re-evaluated with a cardiac catheterization. This demonstrated 3-vessel coronary artery disease with a 70% lesion to the right coronary artery; this was a proximal lesion. The left main had a 70% stenosis. The circumflex also had a 99% stenosis. Overall left ventricular function was mildly reduced with an ejection fraction of about 45%. The left ventriculogram did note some apical hypokinesis. In view of these findings, surgical consultation was requested and the patient was seen and evaluated by Dr. Doe.
PAST MEDICAL HISTORY:
1. Coronary artery disease as described above with previous PTCA and stenting procedures.
2. Dyslipidemia.
3. Hypertension.
4. Status post breast lumpectomy for cancer with followup radiation therapy to the chest.

ALLERGIES: None.
MEDICATIONS: Aspirin 81 mg daily, Plavix 75 mg daily, Altace 2.5 mg daily, metoprolol 50 mg b.i.d. and Lipitor 10 mg q.h.s.
SOCIAL HISTORY: She quit smoking approximately 8 months ago. Prior to that time, she had about a 35- to 40-pack-year history. She does not abuse alcohol.
FAMILY MEDICAL HISTORY: Mother d
REVIEW OF SYMPTOMS: There is no
hemoptysis or productive cough. Ther
palpitations. She notes no nausea, vor
some diffuse abdominal discomfort. S
no depression or psychiatric problems.
problems or blood dyscrasias. No blee
lumpectomy procedures for this with fo
mammography shows no evidence of a
changes in weight.
PHYSICAL EXAMINATION: Her bloo
Respirations are 18 and unlabored. Ter
In general, this was an elderly-appear
good. Pupils were equal and reactive t
Neck veins not distended at 90 degree
appreciated. Chest had a normal AP diameter. The lungs were clear in the apices and bases, no wheezing or egophony appreciated. The heart had a normal S1, S2. No murmurs, clicks or gallops. The abdomen was soft, nontender, nondistended. Good bowel sounds present. No hepatosplenomegaly was appreciated. No pulsatile masses were felt. No abdominal bruits were heard. Her pulses are 2+ and equal bilaterally in the upper and lower extremities. No clubbing is appreciated. She is oriented x3. Demonstrated a good amount of strength in the upper and lower extremities. Face was symmetrical. She had a normal gait.
IMPRESSION: This is a (XX)-year-old female with significant multivessel coronary artery disease. The patient also has a left main lesion. She has undergone several PTCA and stenting procedures within the last year to year and a half. At this point, in order to reduce the risk of any possible ischemia in the future, surgical myocardial revascularization is recommended.
PLAN: We will plan to proceed with surgical myocardial revascularization. The risks and benefits of this procedure were explained to the patient. All questions pertaining to this procedure were answered.

Cardiology Consultation Transcribed Medical Transcription Sample Reports
REFERRING PHYSICIAN: John Doe, MD
CONSULTING PHYSICIAN: Jane Doe, MD

ear-old lady is seen in consultation for Dr. John
ral hernia repair and has a background of aortic
isease. The patient was admitted with complaints
underwent a CT scan of the abdomen and pelvis
transverse colon, but without strangulation. There
enal cysts. The hepatic flexure wall was thickened.
culitis. It has been recommended to her that she
ason, cardiology consult is obtained to assess
dpoint.
he underwent echocardiography and cardiac catheterization prior to the operation. Echocardiography showed an ejection fraction of 50%. There was marked left ventricular hypertrophy with septal wall 1.60 cm and posterior wall 1.55 cm. Coronary arteriography showed 90% stenosis in the anterior descending artery, situated distally just before the apex of the left ventricle. Only mild to moderate narrowing was seen elsewhere in the coronary circulation.
CORONARY RISK FACTORS: Her father had an irregular heartbeat and her brother had a fatal heart attack. She herself has had high blood pressure for 20 years. She has elevated cholesterol and takes Lipitor. She has had diabetes for 20 years. She is not a cigarette smoker. She does little physical exercise.

DIOVASCULAR AND RESPIRATORY: She has no chest pain. She
eath if she walks too far. No cough. She has occasional swelling of
mildly lightheaded. Has not lost consciousness. She tends to be
e is tired. She has no history of heart murmur or rheumatic fever.
I symptoms as noted above, but she does not usually have such
atemesis. She has no history of ulcer or jaundice. She sometimes
n and no blood in the stool. GENITOURINARY: She tends to have
once at night to pass urine. No dysuria, incontinence. She has had
stones noted. NEUROLOGIC: She has occasional headaches. No
hearing, or speech. No limb weakness. MUSCULOSKELETAL: She
pains and has a history of gout. HEMATOLOGIC: No anemia,
blood transfusion. GYNECOLOGIC: No gynecologic or breast

e has had shoulder and hand injuries and has had carpal tunnel
and has been on insulin. She has chronic renal insufficiency with
had hypothyroidism. She has had morbid obesity. She has chronic
s BiPAP. She has had hysterectomy and oophorectomy in the past.

al, she was taking glipizide XL 2.5 mg daily, metoprolol 50 mg
vastatin 40 mg daily, Synthroid 75 mcg daily, aspirin 81 mg daily,
ntly, she is taking Lipitor 40 mg daily, Lantus 10 units at bedtime,
olol 50 mg b.i.d. and Zosyn 2.25 grams q.6h.

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ions are noted.
TIC DATA: Electrolytes are normal. BUN and creatinine 18/2.2.
7.6, hemoglobin 11.7 with hematocrit 34.9, platelets 187,000.
A1c 7.7. TSH 1.82. Troponin I was normal on three occasions.
heart with postoperative changes, but no evidence of acute
left atrial enlargement. Low voltage QRS, probable inferior wall
or wall infarction, age undetermined.

h bioprosthetic valve. Residual systolic murmur.
with severe stenosis in anterior descending artery, but this is situated distally and subtends only a small mass of myocardium.
3. Well preserved left ventricular systolic function. The EKG appearance of previous myocardial infarction is probably serious, indicating multiple other medical problems as listed above and also documented in the chart.
RECOMMENDATIONS: It appears that she does not wish to proceed with the surgery at this time, and if such surgery is not

Unstructured data is messy but filled with key medical facts

Medications, diseases, symptoms, non-symptoms, lab measurements, social history, family history … and much more

Real Language is Real Hard

Chess (Traditional Computing)

- Finite, precise and mathematically well-defined
- Limited number of moves and states
- Grounded in **explicit**, **unambiguous** mathematical **rules**

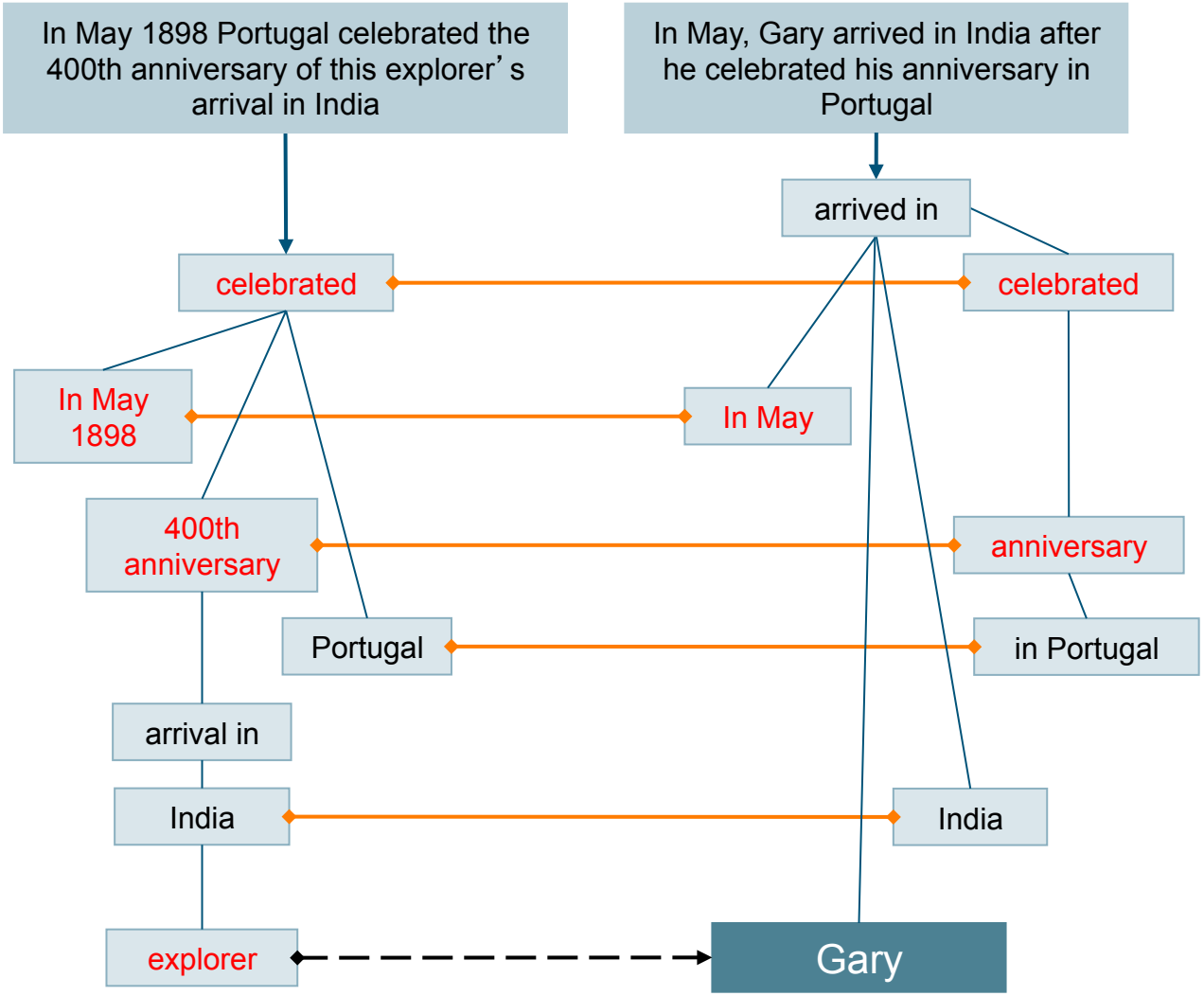
Human Language

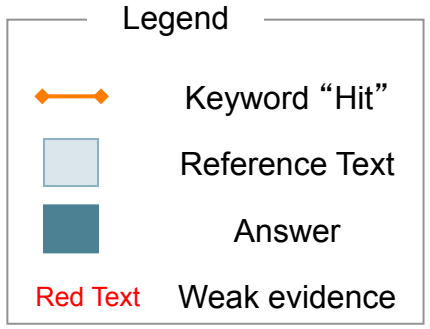
- Ambiguous, **contextual** and implicit
- Contains slang, riddles, idioms, abbreviations, acronyms, negation and more
- Grounded only in **human cognition**
- Seemingly infinite number of ways to express the same concepts and meaning

Remember to Answer in the Form of a Question …

In May 1898 Portugal celebrated the 400th anniversary of this explorer's arrival in India

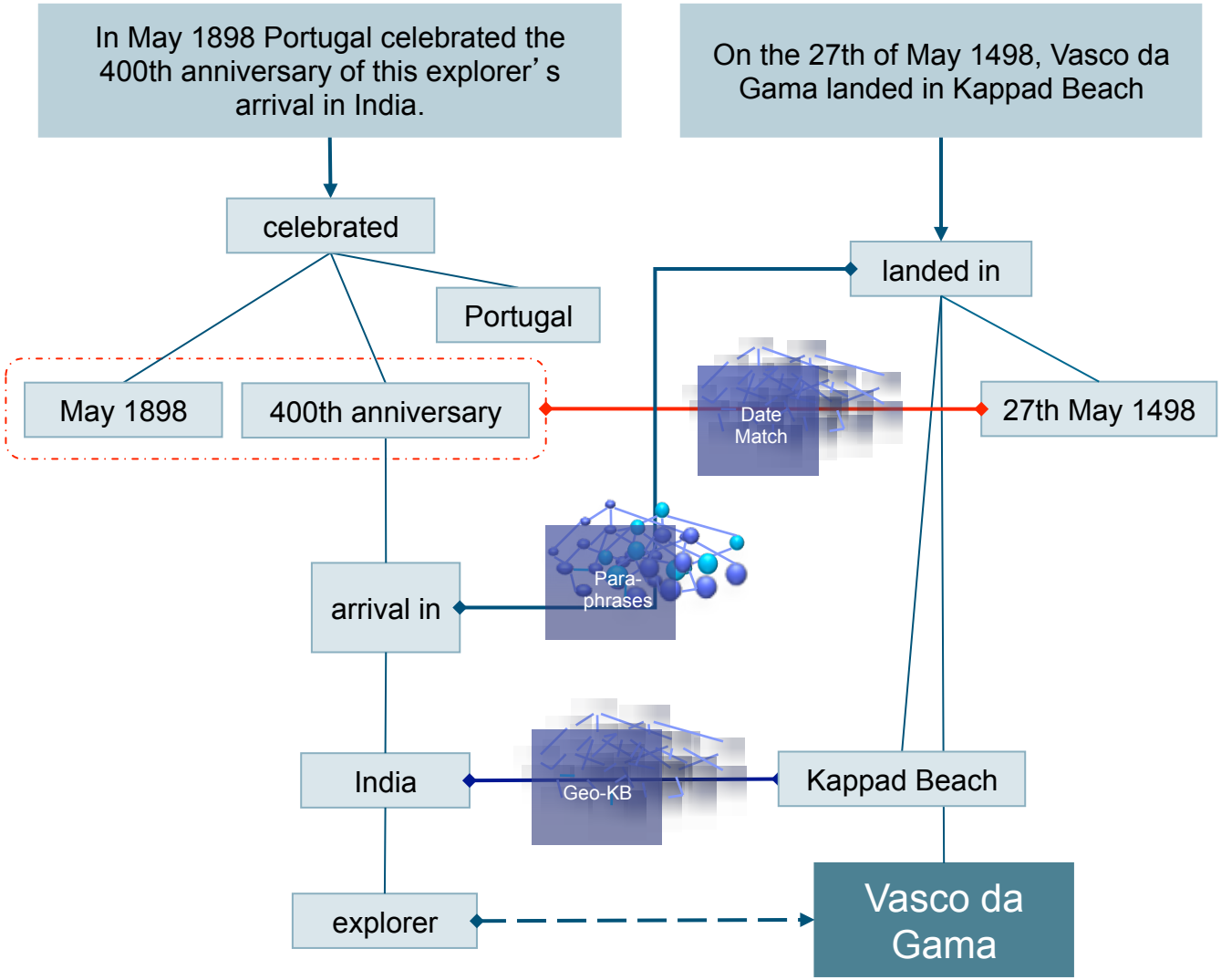
Answering Complex Natural Language Questions Requires More Than Keyword Based Evidence

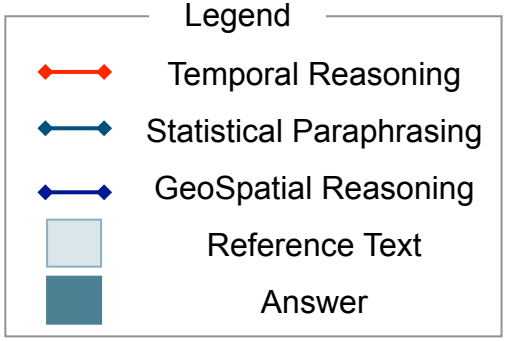




This evidence suggests "Gary" is the answer BUT the system must learn that keyword matching may be weak relative to other types of evidence

Just Like The Human Brain … Watson Leverages Multiple Algorithms to Gather Deeper Evidence





Stronger evidence can be much harder to find and score …

- Search far and wide
- Explore many hypotheses
- Find judge evidence
- Many inference algorithms

… and the evidence is still not 100% certain

Topics

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- **An Explosion of Data and Costs**
- IBM's Approach and Role in Healthcare
- How Customers Are Transforming With Cognitive Computing

IBM Watson Health

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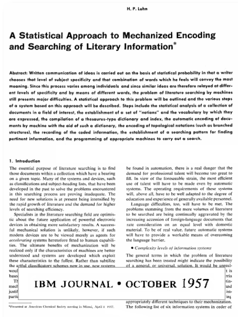
Numerous Innovations in Healthcare for 100+ Years

- First Related Research Published in 1957



H. P. Luhn

A Statistical Approach to Mechanized Encoding and Searching of Literary Information*

Abstract: Written communication of ideas is carried out on the basis of statistical probability in that a writer chooses that level of subject specificity and that combination of words which he feels will convey the most meaning. Since this process varies among individuals and since similar ideas are therefore relayed at different levels of specificity and by means of different words, the problem of literature searching by machines still presents major difficulties. A statistical approach to this problem will be outlined and the various steps of a system based on this approach will be described. Steps include the statistical analysis of a collection of documents in a field of interest, the establishment of a set of "notions" and the vocabulary by which they are expressed, the compilation of a thesaurus-type dictionary and index, the automatic encoding of documents by machine with the aid of such a dictionary, the encoding of topological notations (such as branched structures), the recording of the coded information, the establishment of a searching pattern for finding pertinent information, and the programming of appropriate machines to carry out a search.

1. Introduction

The essential purpose of literature searching is to find those documents within a collection which have a bearing on a given topic. Many of the systems and devices, such as classifications and subject-heading lists, that have been developed in the past to solve the problems encountered in this searching process are proving inadequate. The need for new solutions is at present being intensified by the rapid growth of literature and the demand for higher levels of searching efficiency.

Specialists in the literature searching field are optimistic about the future application of powerful electronic devices in obtaining more satisfactory results. A successful mechanical solution is unlikely, however, if such modern devices are to be viewed merely as agents for *accelerating* systems heretofore fitted to human capabilities. The ultimate benefits of mechanization will be realized only if the characteristics of machines are better understood and systems are developed which exploit these characteristics to the fullest. Rather than subtilize the artful classificatory schemes now in use, new systems ...

be found in automation, there is a real danger that the demand for professional talent will become too great to fill. In view of the foreseeable strain, the most efficient use of talent will have to be made even by automatic systems. The operating requirements of these systems will, above all, have to be well adapted to the degree of education and experience of generally available personnel.

Language difficulties, too, will have to be met. The problems stemming from the mere volumes of literature to be searched are being continually aggravated by the increasing accession of foreign-language documents that rate consideration on an equal level with domestic material. To be of real value, future automatic systems will have to provide a workable means of overcoming the language barrier.

• *Complexity levels of information systems*

The general terms in which the problem of literature searching has been treated might indicate the possibility of a general, or universal, solution. It would be unreal- ...

appropriately different techniques to their mechanization. The following list of six information systems in order of

*Presented at American Chemical Society meeting in Miami, April 8, 1957.

IBM JOURNAL • OCTOBER 1957

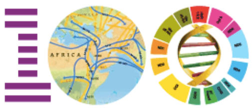
- First NLP Solution in Healthcare in 1997

TAKMI

Bringing Order to Unstructured Data

Before 1997, the process of analytics dealt only with structured information. Most of the world's information, however, is chaotic, unstructured data and text. In response, IBM developed TAKMI, which provides businesses with detailed information, trend identification and otherwise-undetectable insights—helping inform problem-solving and context-based decision-making. Although TAKMI was created to analyze call center logs, IBM quickly realized its potential for broader applications. A medical version of the TAKMI system is analyzing medical publications, taking inventory, and mapping unstructured medical data to identify patterns and enable intelligent clinical decisions.

- Mapping the Human Genome in 2005



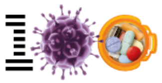
The Mapping of Humanity's Family Tree

Who am I? How did we get here? Launched in 2005, National Geographic's Genographic Project aims to answer these questions. IBM and the Genographic Project began gathering human DNA from across the world and analyzing it for genetic markers that signal a deviation—or branch—in our family tree. By examining our ancestral roots, researchers can draw a more complete picture of humanity's migratory history. IBM is providing the analytics to read the more than 400,000 samples collected so far. Through this project, IBM has gained tremendous knowledge of genetic variation and has become the world's first company with a genetic non-discrimination policy.

- Watson Wins on Jeopardy! in 2011

A Computer Called Watson

IBM's computer, code-named "Watson" leverages leading-edge Question-Answering technology, allowing the computer to process and understand natural language. It incorporates massively parallel analytical capabilities to emulate the human mind's ability to understand the actual meaning behind words, distinguish between relevant and irrelevant content, and ultimately, demonstrate confidence to deliver precise final answers. In February of 2011, Watson made history by not only being the first computer to compete against humans on television's venerable quiz show, Jeopardy!, but by achieving a landslide win over prior champions Ken Jennings and Brad Rutter.



Information-Based Medicine

In 2006, IBM helped create EuResist, a project that would help doctors prescribe more effective, tailored drug "cocktails" to HIV patients, using a database of more than 33,000 previous treatment cases. Through healthcare innovations such as EuResist, the World Community Grid and the Watson computer, IBM is leading the world in using data analysis and information technology to build smarter systems to more effectively fight illnesses such as AIDS, HIV and cancer.

Smarter Healthcare Management

Guang Dong Hospital in southern China treats more than 10,000 patients daily and is known for integrating traditional Chinese medicine with contemporary Western medical practices. IBM is helping the hospital deploy an electronic, patient-centered records system that offers access to a patient's medical data from any location. Electronic medical records have the potential to save the healthcare industry billions of dollars and prevent billions more misdiagnoses. IBM is working with a variety of industry stakeholders to drive the digitization of records, a critical step in improving patient care. In addition to working with hospitals, IBM is partnering with Google and Continua Health Alliance to allow individuals to create personal health profiles that capture key medical information.

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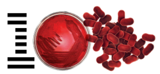
Medicine On Demand

Malaria kills about 800,000 people each year, the vast majority of whom live in Sub-Saharan Africa. But stock-outs of malaria treatments in many Sub-Saharan African countries continue to be a problem. Launched in 2009, "SMS for Life" aims to reduce out-of-stock incidents for five key malaria medicines in the region. As Tanzanian health workers send weekly stock count text messages to a centralized database, district managers and the National Malaria Control Programme can use any Internet browser to access supply levels and provide regions with adequate medicine. Inexpensive IBM solutions like this increase inventory visibility throughout the supply chain and help detect signs of an epidemic—increasing public safety and reducing needless deaths.



Tracking Infectious Diseases

In 1976, the World Health Organization utilized the IBM System/370 at the United Nations' International Computing Center in Geneva to precisely map trends and outbreaks of smallpox so that it could best allocate its limited personnel and resources to the most urgent locations. The system became a global model for demographic tracking. Since then, IBM has worked to understand the spread of many epidemics and pandemics. It partnered with the Centers for Disease Control to model the spread of H1N1—the "swine flu"—and developed the Spatiotemporal Epidemiological Modeler for use in tracking bird flu, dengue fever, and other infectious diseases that threaten human wellbeing.

Excimer Laser Surgery

In 1981, three IBM scientists—Rangaswamy Srinivasan, James Wynne and Samuel Blum—discovered how the newly invented excimer laser could remove specific human tissue without harming the surrounding area and do so on an extremely minute scale—a process that became the foundation for LASIK and PRK surgery. The painless procedure, which changes the shape of the cornea, has improved the vision and quality of life for millions of people around the world.

Scanning Tunneling Microscope

The scanning tunneling microscope (STM) revolutionized our ability to manipulate solid surfaces the size of atoms. Gerd Binnig and Heinrich Rohrer of IBM's Zurich Research Center were awarded the 1986 Nobel Prize in Physics for discovering the STM. And the STM, in turn, has led to other discoveries on a "nano" scale, playing an essential role in the blossoming of nanotechnology. It was vital in the 1990s discovery of fullerenes, which led to the development of the carbon nanotube. The Nobel committee said the invention opened up "entirely new fields... for the study of the structure of matter."

IBM Watson Health

TED: Cognitive Computing Video

IBM

Leading Institutions Recognize The Promise and Value of Watson ...

Ongoing Training Partner

Memorial Sloan Kettering Cancer Center

Watson for Oncology, trained by Memorial Sloan Kettering

available in clinical use in lung, breast, colon and rectal cancer

Bumrungrad International HOSPITAL

Bumrungrad International Hospital

5 year agreement for Watson for Oncology

THE UNIVERSITY OF TEXAS MD Anderson Cancer Center

Making Cancer History®

MD Anderson

Introduced proprietary solution with Watson for clinical use for Leukemia and Molecular Targeted Therapies

MAYO CLINIC

Mayo Clinic

Completed testing with Clinical Trial Matching for lung, breast, colon and rectal cancer

BCM® Baylor College of Medicine

Baylor College of Medicine

Published results of use with Watson Discovery Advisor – identified 7 targets for P53 activation within weeks

NEW YORK GENOME CENTER

Watson Genomics Advisor

Secured 13 Cancer and Academic medical centers for beta testing

Department of Veterans Affairs

Selected Watson to analyze EMRs in a demo project

MAYO CLINIC

Mayo Clinic

Selected Watson to analyze EMRs for Clinical Efficiency and Effectiveness Program

IBM Watson Solutions for Healthcare and Life Sciences

"Imagine having the ability within three seconds to look through all of that (medical) information … at the moment you're caring for that patient."

Dr. Sam Nussbaum, WellPoint's Chief Medical Officer, Anthem (formerly WellPoint)

R&D Productivity

Discovery Advisor
to enable researchers to uncover new insights into relationships between genes, proteins, pathways, phenotypes and diseases

Clinical Trial Matching
to optimize patient selection and recruitment for clinical trials

IBM Watson Content Analytics
Core NLP solution platform for extracting and leverage medical facts from unstructured data

Improve Outcomes

Oncology
to assist in the creation of individualized treatment plans and enhance patient / physician experience

EMR Advisor
to identify critical attributes of a patient case and provide easy-to-consume summaries

Paths
Clinical reasoning for Medical Education & top of license care delivery

Improve Engagement

Engagement Advisor
to transform interactions and experiences with patients and physicians

Utilization Management
to streamline and automate authorizations and ensure adherence to guidelines

Healthcare Transformation: A Work in Progress

1st

US rank in Healthcare spending [1]

37th

US rank in quality of care delivered [2]

<5

Hours or less per month spent reading medical journals by 81% of reporting physicians

21.7

Hours required to meet the patient care guidelines each day [3]

$585B

(Billion) Wasted on missed opportunities, unnecessary, error-prone and inefficiently delivered services [3]

$7T+

The cost for health and social programs worldwide … and it is rising

73

… the number of days it will take for medical data to double by 2020 [4]

80%

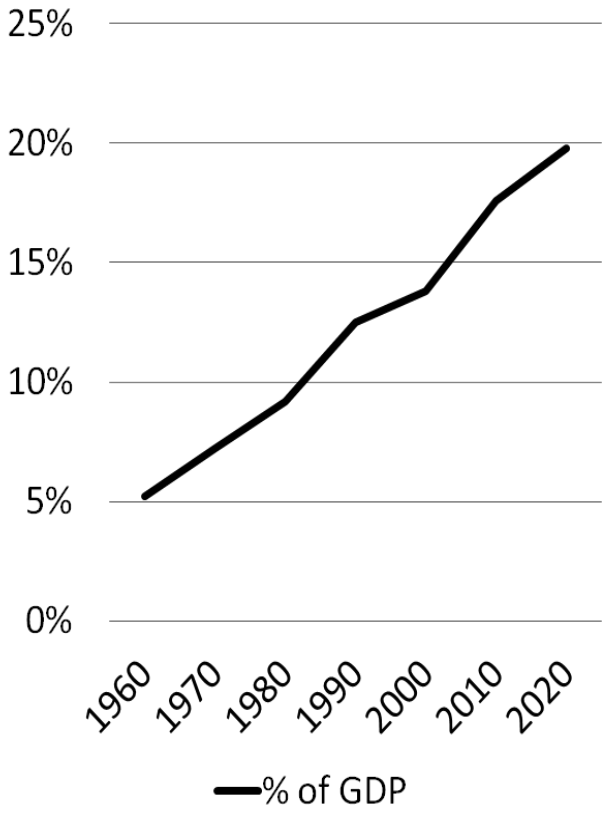
of the world's healthcare data is unstructured

An Ocean of Unused Data

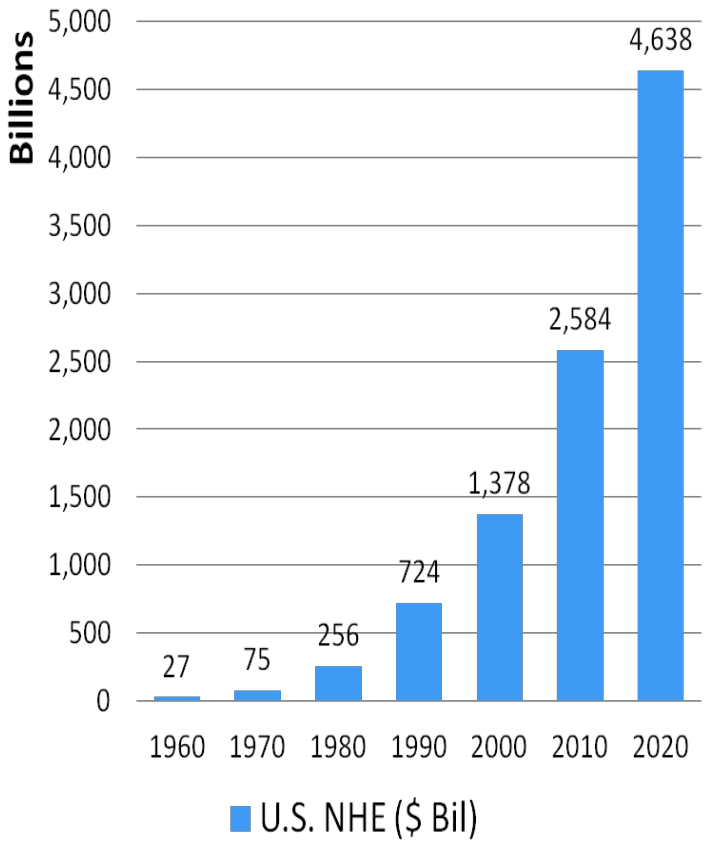
1 *World Health Statistics 2011* from World Health Organization
2 *The World Health Report 2000 – Health Systems: Improving Performance* from World Health Organization
3 *Best Care at Lower Cost: The Path to Continuously Learning Health Care in America* from Institute of Medicine / National Academy of Sciences
4 University of Iowa, Carver College of Medicine 2014

The Current Spending Projections Are Not Sustainable

Healthcare as % of US GDP

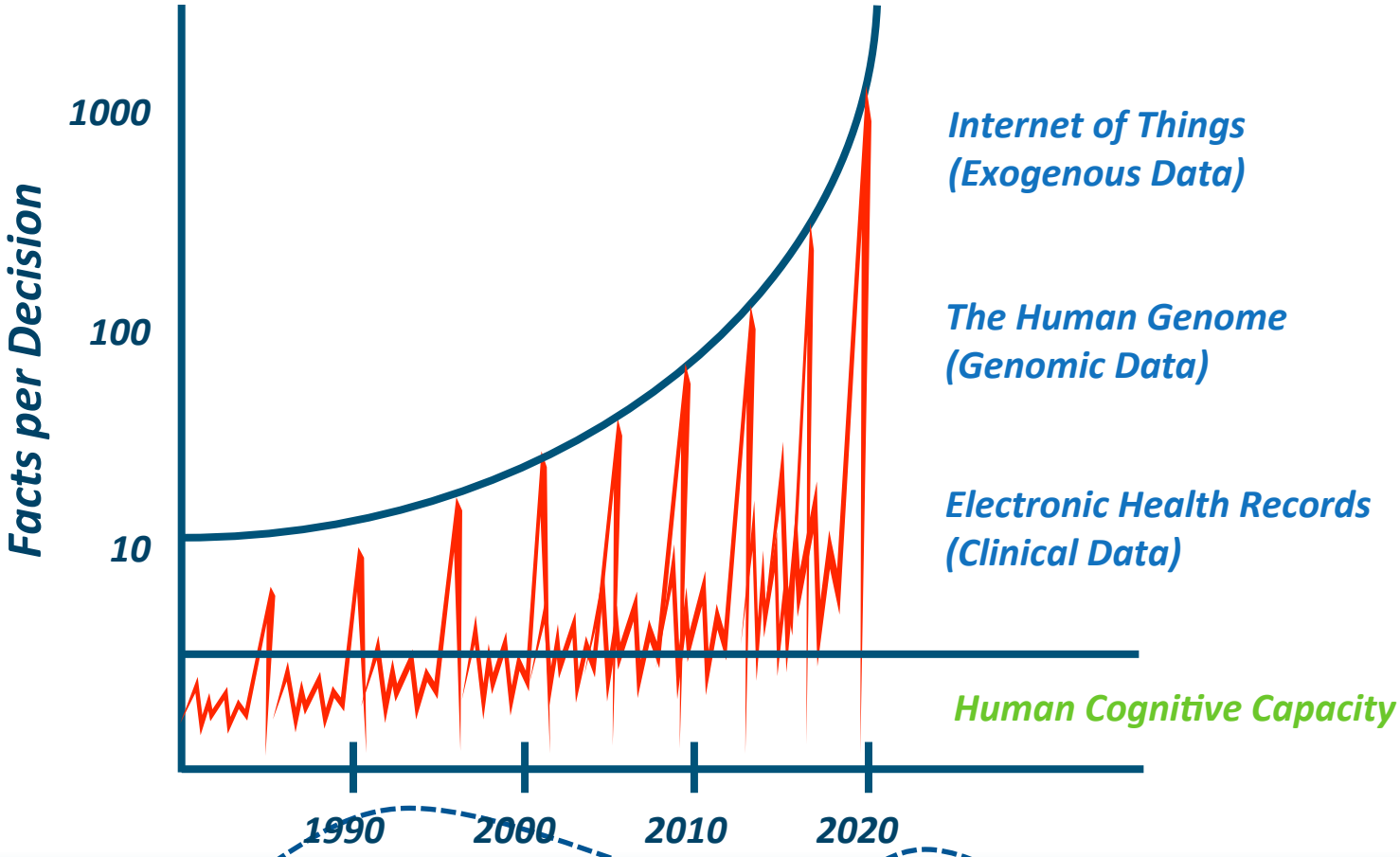


US National Health Expenditure



Source: Centers for Medicare and Medicaid Services

Leveraging Big Data – The Impossible Task Without Analytics and New Computing Models



Personal Data is Exploding

Impact on a person's health status

Exogenous Factors

60%

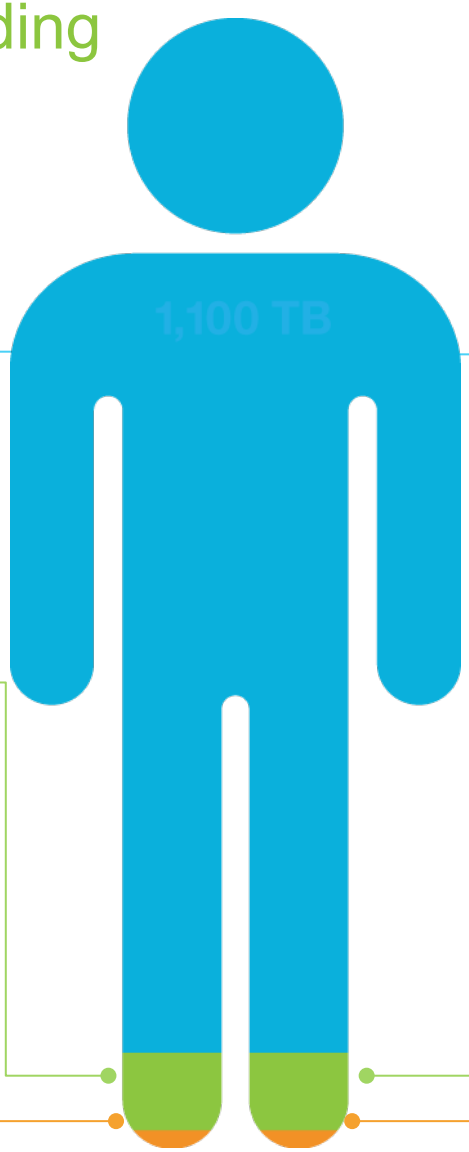
Environment & Social Context, Behavior

Genomic Factors

30%

Clinical Factors

10%



In their lifetime, the data an average person will generate

1,100 TB

Volume, Variety, Velocity, Veracity

Educational records, Employment Status, Social Security Accounts, Mental Health Records, Caseworker Files, Fitbits, Home Monitoring Systems, and more…

6 TB

Volume

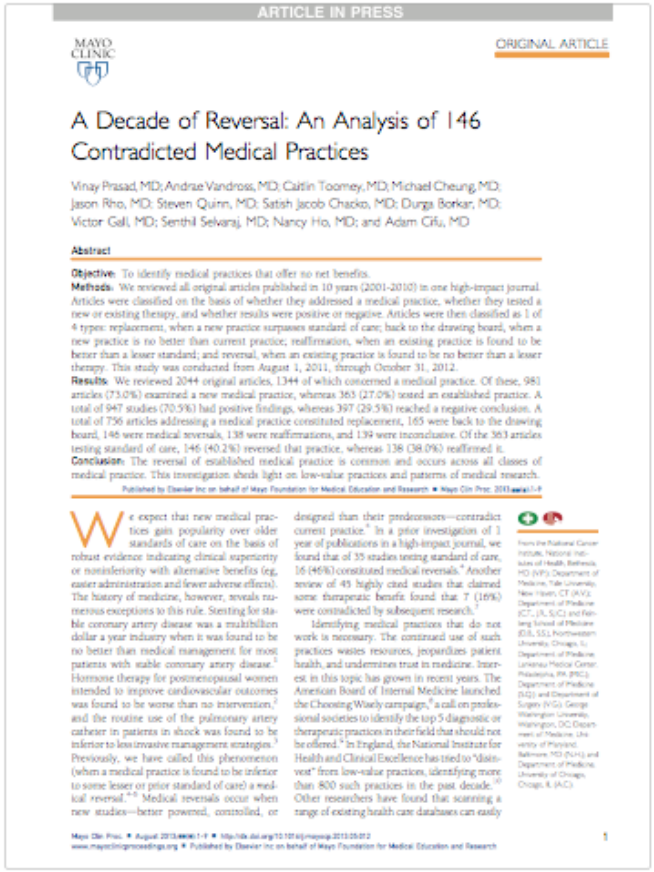
0.4 TB

Variety

Electronic Medical / Health Records, Physician Management Systems, Claims Systems and more…

Enormous Opportunity to Leverage Big Data

A Decade of Reversal:
An Analysis of 146
Contradicted Medical Practices



ARTICLE IN PRESS

MAYO CLINIC

ORIGINAL ARTICLE

A Decade of Reversal: An Analysis of 146 Contradicted Medical Practices

Vinay Prasad, MD; Andrae Vandross, MD; Caitlin Toomey, MD; Michael Cheung, MD; Jason Rho, MD; Steven Quinn, MD; Satish Jacob Chacko, MD; Durga Borkar, MD; Victor Gall, MD; Senthil Selvaraj, MD; Nancy Ho, MD; and Adam Cifu, MD

Abstract

Objective: To identify medical practices that offer no net benefits.

Methods: We reviewed all original articles published in 10 years (2001-2010) in one high-impact journal. Articles were classified on the basis of whether they addressed a medical practice, whether they tested a new or existing therapy, and whether results were positive or negative. Articles were then classified as 1 of 4 types: replacement, when a new practice surpasses standard of care; back to the drawing board, when a new practice is no better than current practice; reaffirmation, when an existing practice is found to be better than a lesser standard; and reversal, when an existing practice is found to be no better than a lesser therapy. This study was conducted from August 1, 2011, through October 31, 2012.

Results: We reviewed 2044 original articles, 1344 of which concerned a medical practice. Of these, 981 articles (73.0%) examined a new medical practice, whereas 363 (27.0%) tested an established practice. A total of 947 studies (70.5%) had positive findings, whereas 397 (29.5%) reached a negative conclusion. A total of 756 articles addressing a medical practice constituted replacement, 165 were back to the drawing board, 146 were medical reversals, 138 were reaffirmations, and 139 were inconclusive. Of the 363 articles testing standard of care, 146 (40.2%) reversed that practice, whereas 138 (38.0%) reaffirmed it.

Conclusion: The reversal of established medical practice is common and occurs across all classes of medical practice. This investigation sheds light on low-value practices and patterns of medical research.

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We expect that new medical practices gain popularity over older standards of care on the basis of robust evidence indicating clinical superiority or noninferiority with alternative benefits (eg, easier administration and fewer adverse effects). The history of medicine, however, reveals numerous exceptions to this rule. Stenting for stable coronary artery disease was a multibillion dollar a year industry when it was found to be no better than medical management for most patients with stable coronary artery disease.[1] Hormone therapy for postmenopausal women intended to improve cardiovascular outcomes was found to be worse than no intervention,[2] and the routine use of the pulmonary artery catheter in patients in shock was found to be inferior to less invasive management strategies.[3] Previously, we have called this phenomenon (when a medical practice is found to be inferior to some lesser or prior standard of care) a medical reversal.[4-6] Medical reversals occur when new studies—better powered, controlled, or designed than their predecessors—contradict current practice.[7] In a prior investigation of 1 year of publications in a high-impact journal, we found that of 35 studies testing standard of care, 16 (46%) constituted medical reversals.[4] Another review of 45 highly cited studies that claimed some therapeutic benefit found that 7 (16%) were contradicted by subsequent research.[7]

Identifying medical practices that do not work is necessary. The continued use of such practices wastes resources, jeopardizes patient health, and undermines trust in medicine. Interest in this topic has grown in recent years. The American Board of Internal Medicine launched the Choosing Wisely campaign,[8] a call on professional societies to identify the top 5 diagnostic or therapeutic practices in their field that should not be offered.[9] In England, the National Institute for Health and Clinical Excellence has tried to "disinvest" from low-value practices, identifying more than 800 such practices in the past decade.[10] Other researchers have found that scanning a range of existing health care databases can easily

From the National Cancer Institute, National Institutes of Health, Bethesda, MD (VP); Department of Medicine, Yale University, New Haven, CT (AV); Department of Medicine (CT, JR, SJC) and Feinberg School of Medicine (DB, SS), Northwestern University, Chicago, IL; Department of Medicine, Lankenau Medical Center, Philadelphia, PA (MC); Department of Medicine (VG), George Washington University, Washington, DC; Department of Medicine, University of Maryland, Baltimore, MD (NH); and Department of Medicine, University of Chicago, Chicago, IL (AC).

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"40.2% reversed the original standard of care … and only 38.0% reaffirmed the original standard of care"

"Medicine has become too complex (and only) about 20% of the knowledge clinicians use today is evidence-based."

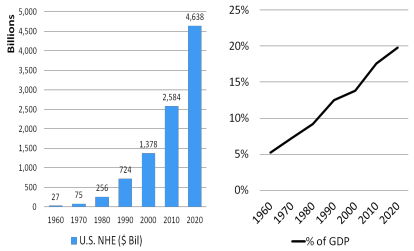
Steven Shapiro, Chief Medical and Scientific Officer, UPMC

Is This Really an Opportunity?

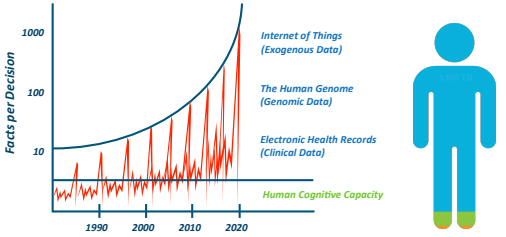
"Before The Beginning of Great Brilliance …
There Must Be Chaos"

Wellness → Diagnosis and Early Intervention → Disease Maintenance → Late Stage Co-Morbidity

Unsustainable Operating Models



Unfathomable Information Volumes



The Need for Better Outcomes

An Ocean of Unused Data

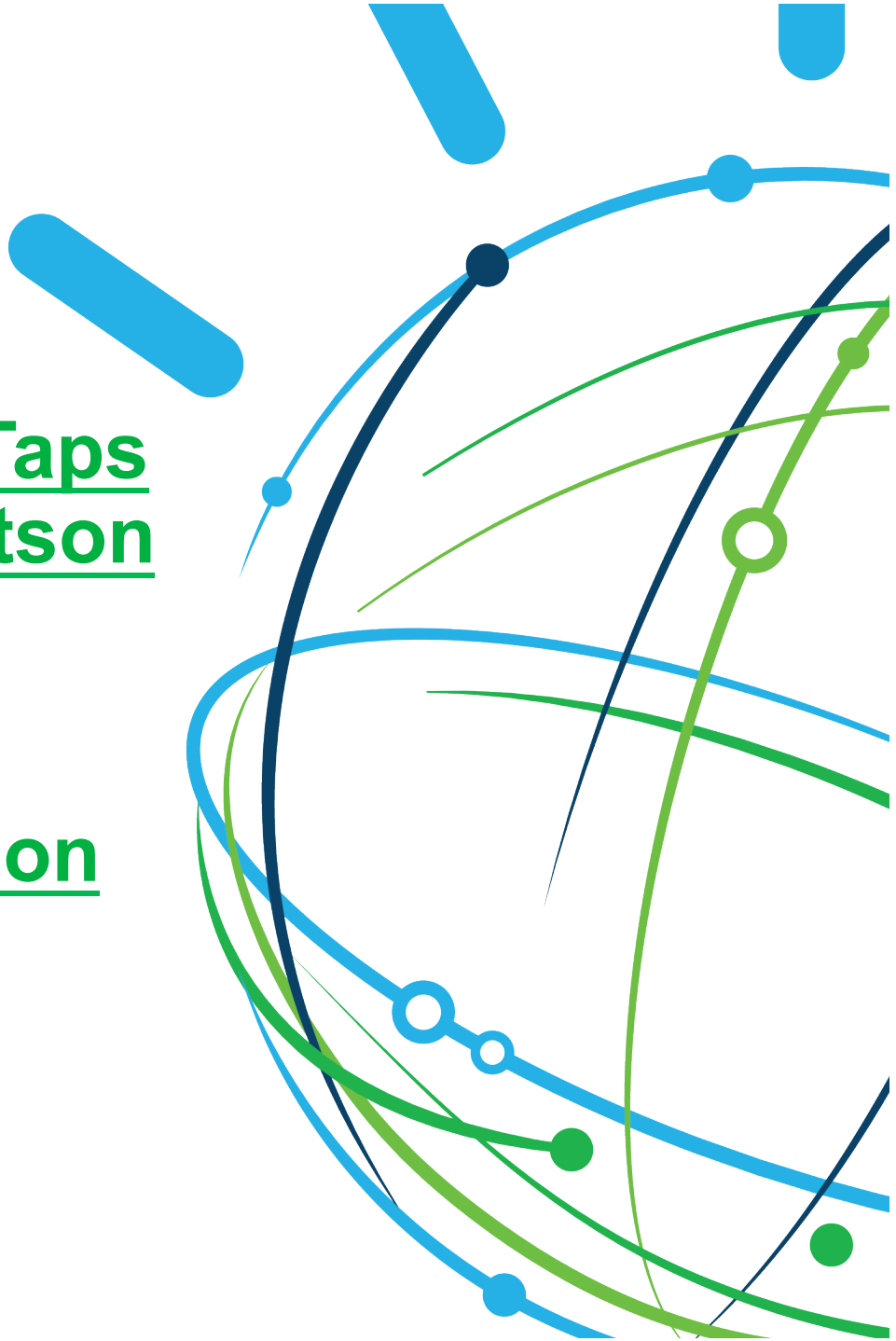
Topics

- Introduce Cognitive Computing
- Why Cognitive Computing in Healthcare?
- An Explosion of Data and Costs
- **IBM's Approach and Role in Healthcare**
- **How Customers Are Transforming With Cognitive Computing**

IBM Watson Health

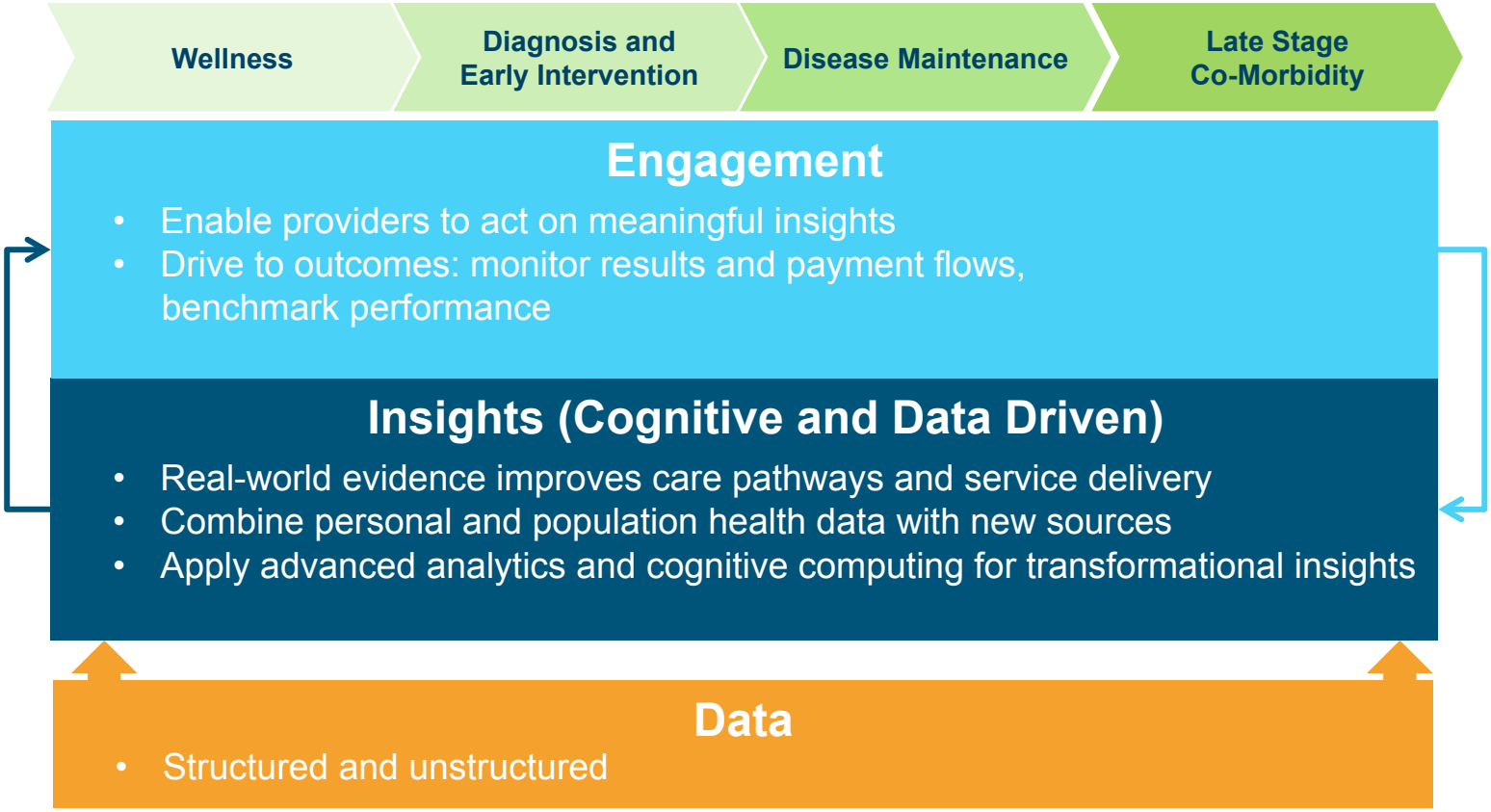
Healthcare Industry Taps Into the Power of Watson

New York Genomics Center and IBM Watson



IBM

Big Data Analytics and Cognitive Computing Enable New Insights and Engagement

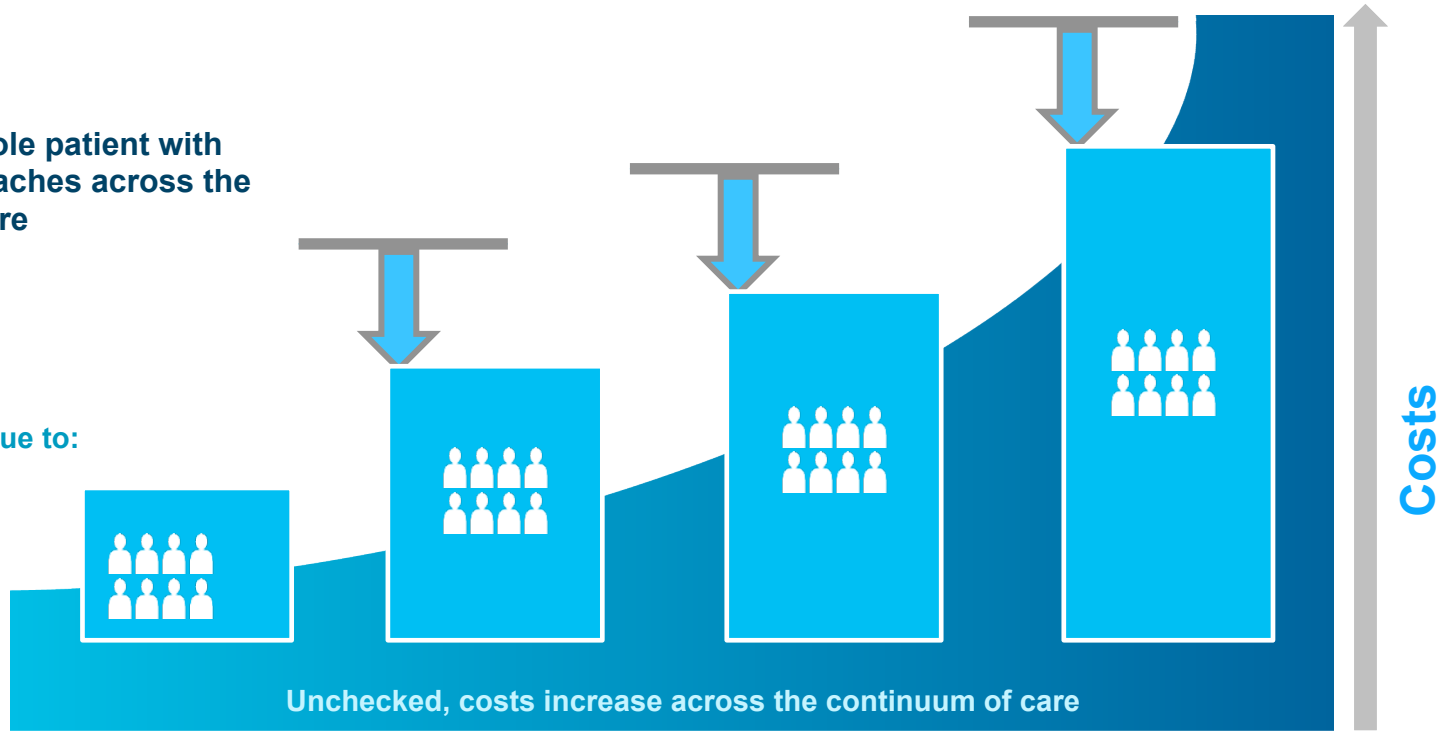


Integrated Care Approaches Improve Health and Reduce Costs

Address the whole patient with proactive approaches across the continuum of care

Costs increase due to:

- **Aging populations**
- **Chronic disease**
- **Complex conditions**



	Wellness	Diagnosis and Early Intervention	Disease Maintenance	Late Stage, Co-morbidity
Proactive, evidence-based approaches	**Promote healthy behaviors**	**Proactive early detection**	**Best practice care protocols**	**Out patient support**	**Care management for complex conditions**

What Is IBM Doing in Healthcare?

- Long history of selling to Information Technology infrastructure (systems, software and service) to Healthcare, Life Sciences and Government customers
- IBM Research focuses on “Healthcare Informatics” (2010) to develop next generation healthcare analytics such as “Patient Similarity Analytics”
- IBM forms IBM Watson Group (post-Jeopardy 2011) to commercialize Watson – Healthcare is first industry chosen to focus on for suite of new solutions
- IBM makes acquisitions (2011) specific to support specific Healthcare and Government solutions

Initiate Master Patient Index

CÚRAM SOFTWARE Social Program and Care Management

- IBM forms Watson Health Group with multiple acquisitions, partnerships and new health cloud capabilities and offerings:

PHYTEL

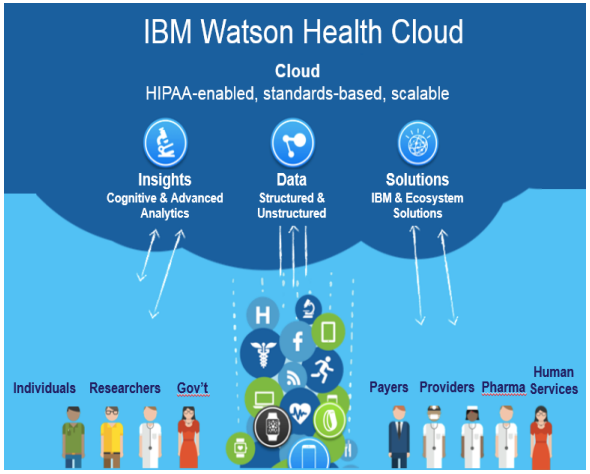
Patient Engagement
PCMH Focus, 40M Lives

explorys

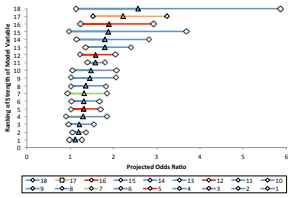
Big Data Analytics,
Applications, 50M Lives

Medtronic

Johnson & Johnson



Value of Unstructured Data and Social Determinants



Seton Healthcare Family

The Data We Thought Would Be Useful … Wasn't

- Structured data not available, not accurate, without the unstructured data - which was more trustworthy

What We Thought Was Causing 30 Day Readmissions … Wasn't

- 113 possible candidate predictors expanded and changed after mining the data for hidden insights

New Hidden Indicators Emerged … Social Determinants Were Essential

- Social indicators were important to identifying patients most at risk (most came from unstructured data)

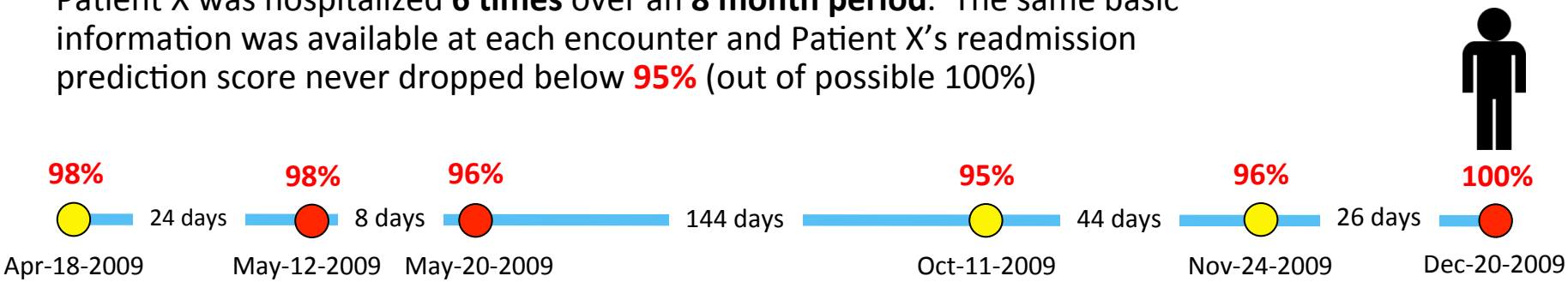
1. Jugular Venous Distention Indicator
2. **Paid by Medicaid Indicator**
3. Immunity Disorder Disease Indicator
4. Cardiac Rehab Admit Diagnosis with CHF Indicator
5. **Lack of Emotion Support Indicator**
6. Self COPD Moderate Limit Health History Indicator
7. With Genitourinary System and Endocrine Disorders
8. Heart Failure History
9. High BNP Indicator
10. Low Hemoglobin Indicator
11. Low Sodium Level Indicator
12. **Assisted Living**
13. High Cholesterol History
14. Presence of Blood Diseases in Diagnosis History
15. High Blood Pressure Health History
16. **Self Alcohol / Drug Use Indicator**
17. Heart Attack History
18. Heart Disease History

Predictor Analysis	% Encounters Structured Data	% Encounters Unstructured Data
Ejection Fraction (LVEF)	2%	74%
Smoking Indicator	35% (65% Accurate)	81% (95% Accurate)
Living Arrangements	<1%	73% (100% Accurate)
Drug and Alcohol Abuse	16%	81%
Assisted Living	0%	13%

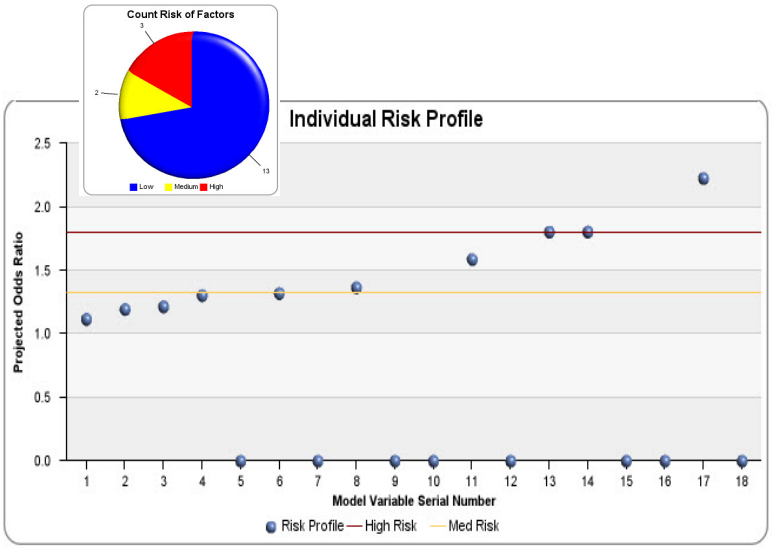
The Impact – What Happened to Patient X?

Seton Healthcare Family

Patient X was hospitalized **6 times** over an **8 month period**. The same basic information was available at each encounter and Patient X's readmission prediction score never dropped below **95%** (out of possible 100%)



Individual Patient Data at Each Encounter (Patient X @ Dec 20, 2009)



Description of Model Serial Number

18. Jugular Venous Distention Indicator
17. Paid by Medicaid Indicator
16. Immunity Disorder Disease Indicator
15. Cardiac Rehab Admit Diagnosis with CHF Indicator
14. Lack of Emotion Support Indicator
13. Self COPD Moderate Limit Health History Indicator
12. With genitourinary system & Endocrine disorders
11. Heart Failure History
10. High BNP Indicator
9. Low Hemoglobin Indicator
8. Low Sodium Level Indicator
7. Assisted Living from ICA Extract
6. High Cholesterol History
5. Presence of diseases of the blood in diagnosis history
4. High Blood Pressure Health History
3. Self Alcohol/Drug Use Indicator (Cerner + ICA)
2. Heart Attack History
1. Heart Disease History

Patient Population Monitoring
Clinical and Operational Data

Admit / Readmission

30-Day Readmission

IBM Watson Health

MD Anderson Cancer Moonshot

IBM

Thank You

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Find out more about IBM Watson Health

http://www.ibm.com/smarterplanet/us/en/ibmwatson/health/

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