Big Data: How data can guide the scientific decision-making process

Professor Heiko Spallek
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Slides
http://bit.ly/AIDPH-Spallek

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DMD (1993)

PhD (1993)


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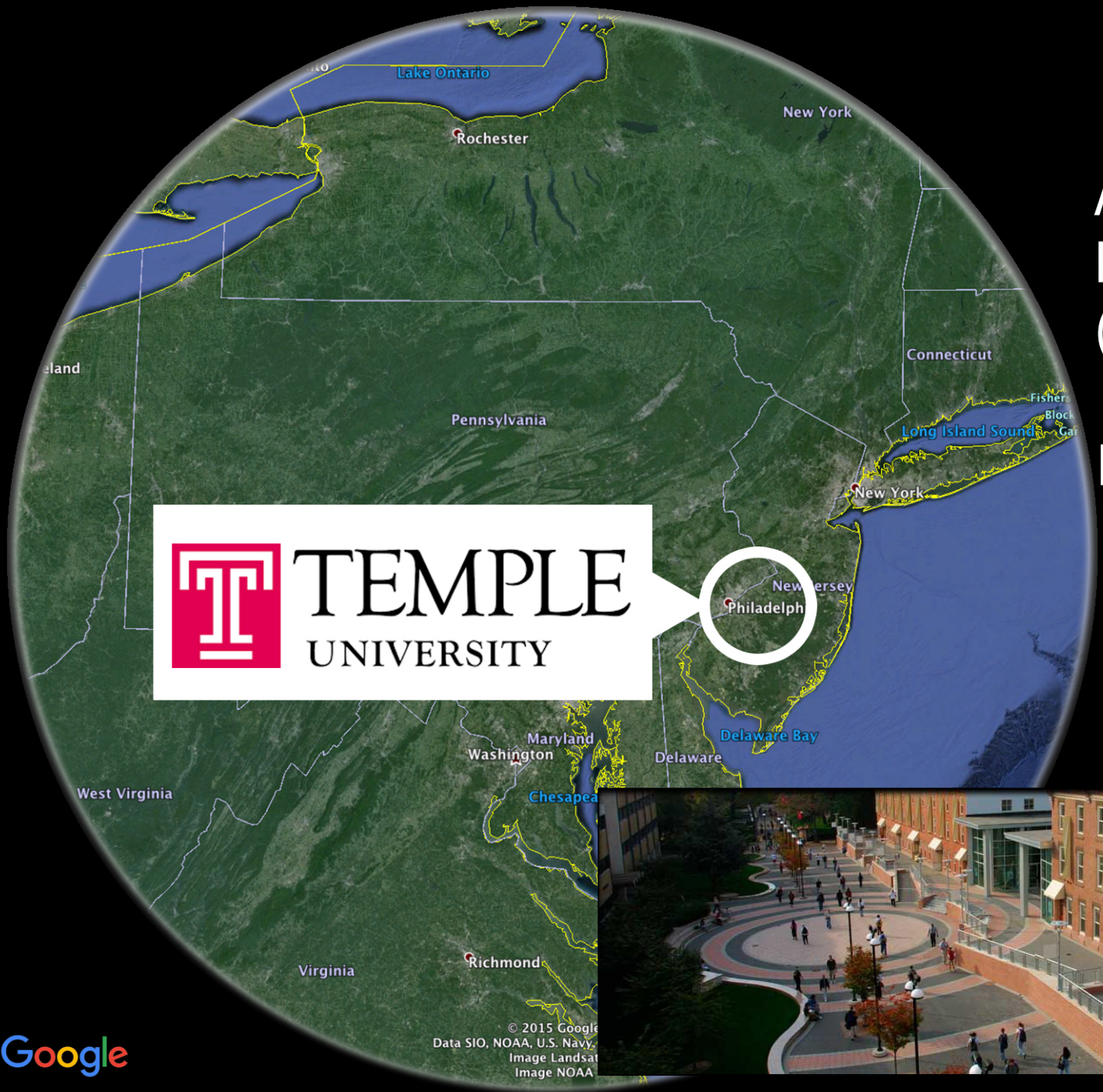

TEMPLE UNIVERSITY

Assistant Professor (1996)

MSBA (2000)

Assistant Professor (2002)

Associate Professor (2010)

Associate Dean (2010)


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Professor & Pro-Dean (2016)

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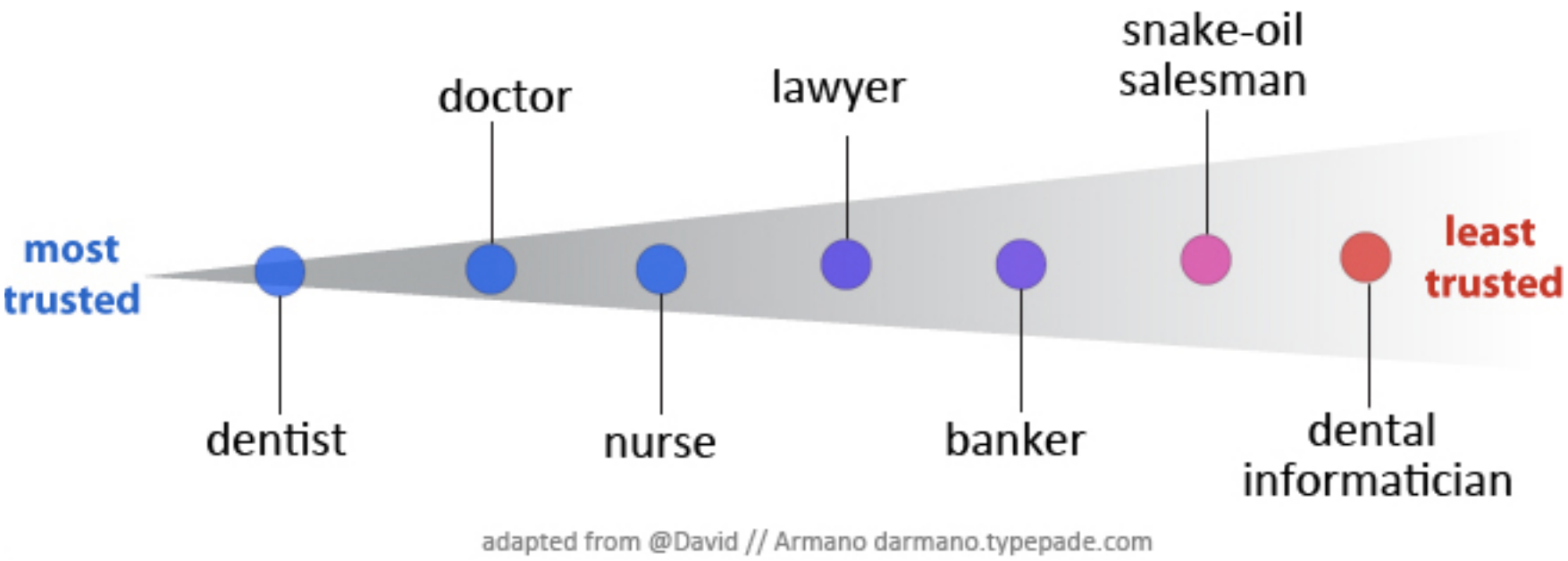
Dentists Trust Dentists



adapted from @David // Armano darmano.typepade.com

Disclosures

I am

- the representative of the American Association for Dental Research to serve on the American Dental Association's Standards Committee on Dental Informatics (SCDI),
- chair of the ADA SCDI Working Group 13.1 on Educational Software Used in Electronic Media and Working Group 13.4 Use of Computer-Based Resources for Access to Information Supporting Oral Healthcare,
- until recently, Board of Directors of the Consortium for Oral Health Research and Informatics (COHRI),
- member of the Advisory Council, Institute for Oral and Systemic Health (IOSH) at the Marshfield Clinic,
- until recently, member of the Board of Directors for German startup company Everbase,
- inventor of the cloud-based software products CredentialKeeper and Curriculum Management Tool with financial interest in the commercialization of these products,
- member of the Advisory Board of the Collaboration on Oral Health Technology with representatives from the Universities of Michigan, Buffalo, North Carolina Chapel Hill and Pittsburgh,
- funded by NIH as principal investigator (MPI) with $2,488,348 for *"A Clinic-Randomized Trial of a Clinical Decision Support System to Improve Dental Provider Delivery of Brief Tobacco Interventions and Quitline Referrals"*

Big Data: How data can guide the scientific decision-making process

Ideas

Why record keeping?

Comparison: paper vs electronic

What do we collect?

What can we learn from it?

Data Cemeteries → Sources of Knowledge

Learning Health System

Barriers

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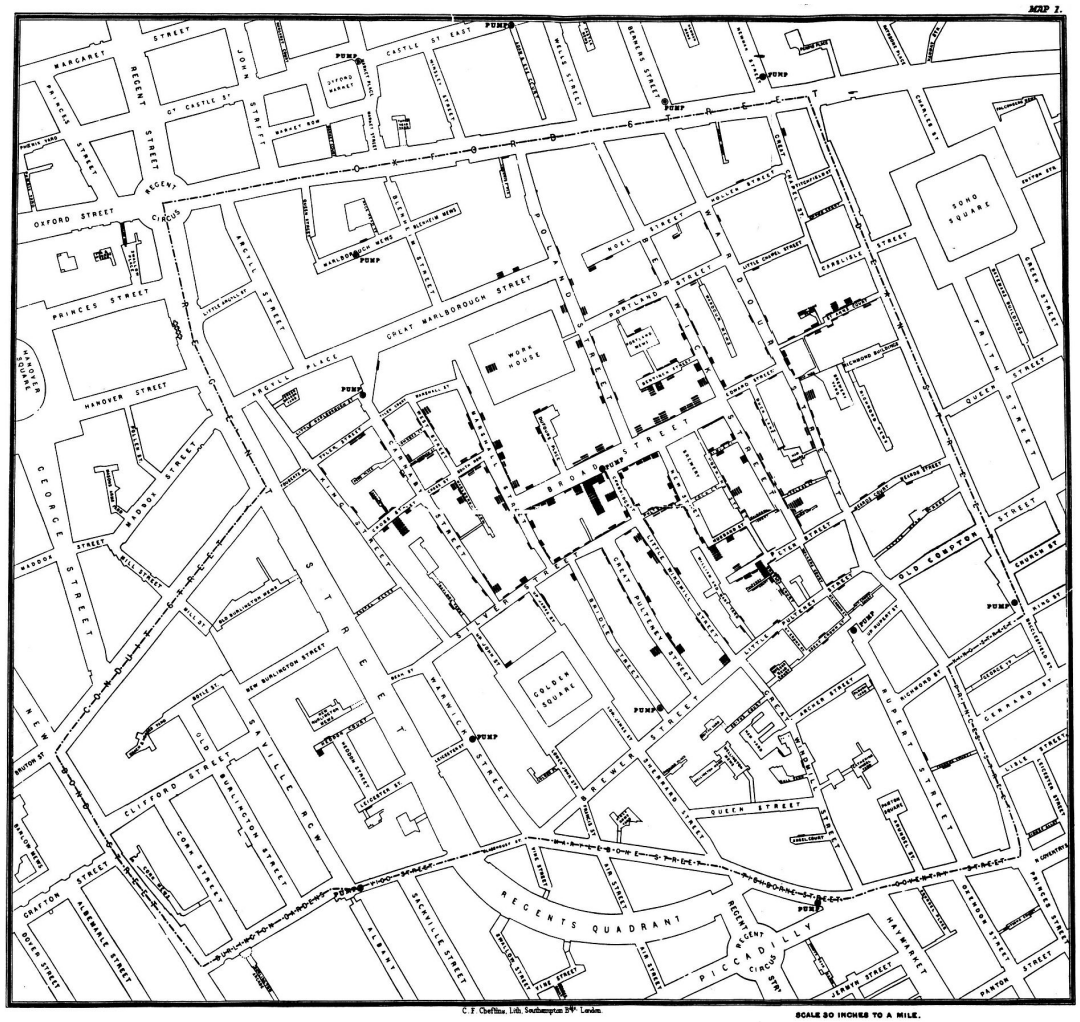
Why do we keep records?



"1854 Broad Street Cholera Outbreak"

What do we collect?

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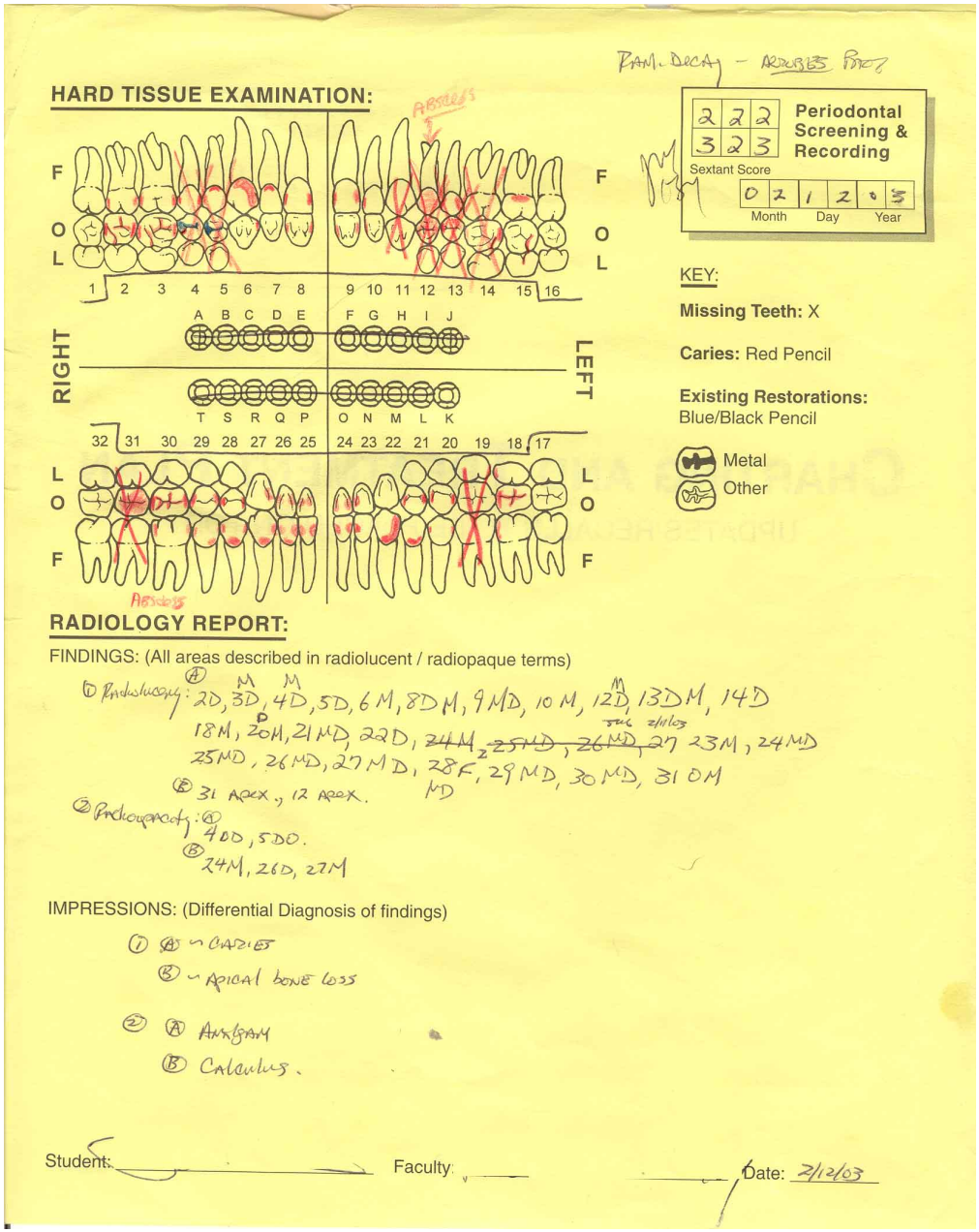


HARD TISSUE EXAMINATION:

RAM. DECAY – ABSCESS #7

Periodontal Screening & Recording

2	2	2
3	2	3

Sextant Score

0	2	1	2	0	3

Month Day Year

F O L

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

A B C D E F G H I J

RIGHT LEFT

T S R Q P O N M L K

32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17

L O F

KEY:

Missing Teeth: X

Caries: Red Pencil

Existing Restorations: Blue/Black Pencil

Metal

Other

RADIOLOGY REPORT:

FINDINGS: (All areas described in radiolucent / radiopaque terms)

① Radiography: Ⓐ 2D, 3MD, 4MD, 5D, 6M, 8DM, 9MD, 10M, 12MD, 13DM, 14D 18M, 20M, 21MD, 22D, 24M, ~~25MD, 26MD,~~ 27 23M, 24MD 25MD, 26MD, 27MD, 28F, 29MD, 30MD, 31DM

Ⓑ 31 APEX, 12 APEX.

② Radiography: Ⓐ 4DD, 5DD.

Ⓑ 24M, 26D, 27M

IMPRESSIONS: (Differential Diagnosis of findings)

① Ⓐ ~ CARIES

Ⓑ ~ APICAL BONE LOSS

② Ⓐ AMALGAM

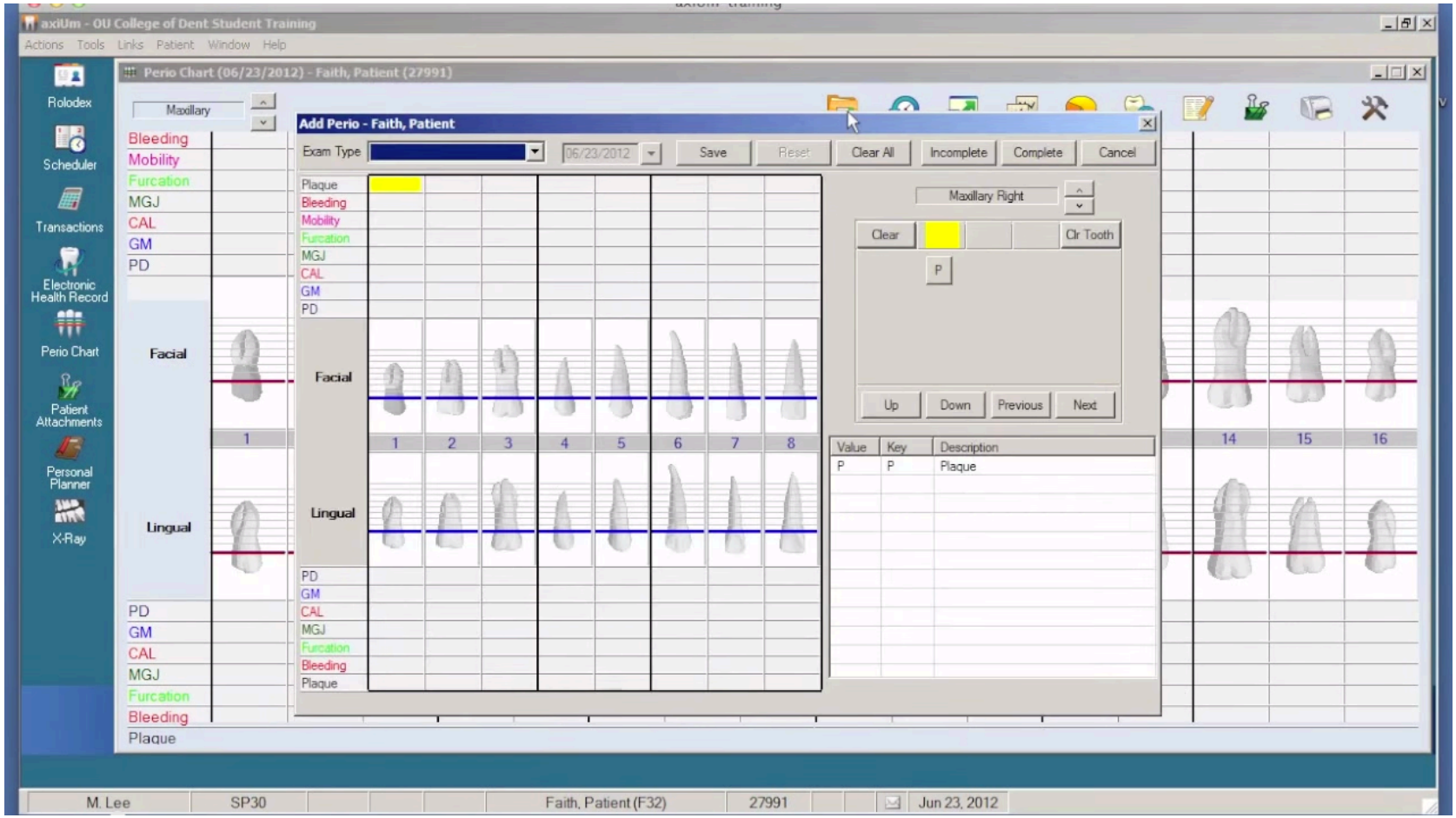
Ⓑ CALCULUS.

Student: _____ Faculty: _____ Date: 2/12/03

Hard tissue exam and radiology report

What data do we collect?

Dental Records: WORN—write once read never



Did it help?

Well…

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Song et al. BMC Medical Informatics and Decision Making 2010, 10:7
http://www.biomedcentral.com/1472-6947/10/7

BMC
Medical Informatics & Decision Making

RESEARCH ARTICLE Open Access

How information systems should support the information needs of general dentists in clinical settings: suggestions from a qualitative study

Mei Song[1*], Heiko Spallek[1], Deborah Polk[2], Titus Schleyer[1], Teena Wali[1]

Abstract

Background: A major challenge in designing useful clinical information systems in dentistry is to incorporate clinical evidence based on dentists' information needs and then integrate the system seamlessly into the complex clinical workf... However, little is known about the actual information needs of dentists during treatment sessions. The ... general dentists' information needs and the information sources they use to m... needs in clinical settings ... to inform the design of dental information systems.

Methods: A ... semi-structured interview was conducted with a convenience sample of 18 general dentists in the Pittsburgh ar... dentists. Interview tra... scripts were coded and analyzed using thematic analysis with a constant comparative method to identify categ... and themes regarding information needs and information source use patterns.

Results: Two ... dentists used four types of information sources: clinical information/tasks, administrative tasks, patient education and professional development. Major themes of dentists' unmet information needs includ... (1) timely access to information on various subjects; (2) better visual representations of dental problems; (3) access to patient-specific evidence-based information; and (4) accurate, complete and consistent

Unmet information

- timely access to information on various subjects
- better visual representations of dental problems
- access to patient-specific evidence-based information
- accurate, complete and consistent documentation of patient records

Why did we want to have computers in the operatory?

Let's ask the dentists.

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Research Paper ■

Clinical Computing in General Dentistry

TITUS K. L. SCHLE
HEIKO SPALLEK, D
PEDRO HERNANDEZ,

Abstract

computing among

Design: Telephone

Measurements: A
structure; clinical i
(features of practic
Internet use; and a

Results: The autho
(89.6% response ra
for this study. The
administration and
other information,
1.8% of all general
entered most data.
agnosis and treatm
reliability, program

Conclusion: Clinic
address usefulness and ease of use, workflow support, infection control, integration, and implementation issues.

■ **J Am Med Inform Assoc.** 2006;13:344–352. DOI 10.1197/jamia.M1990.

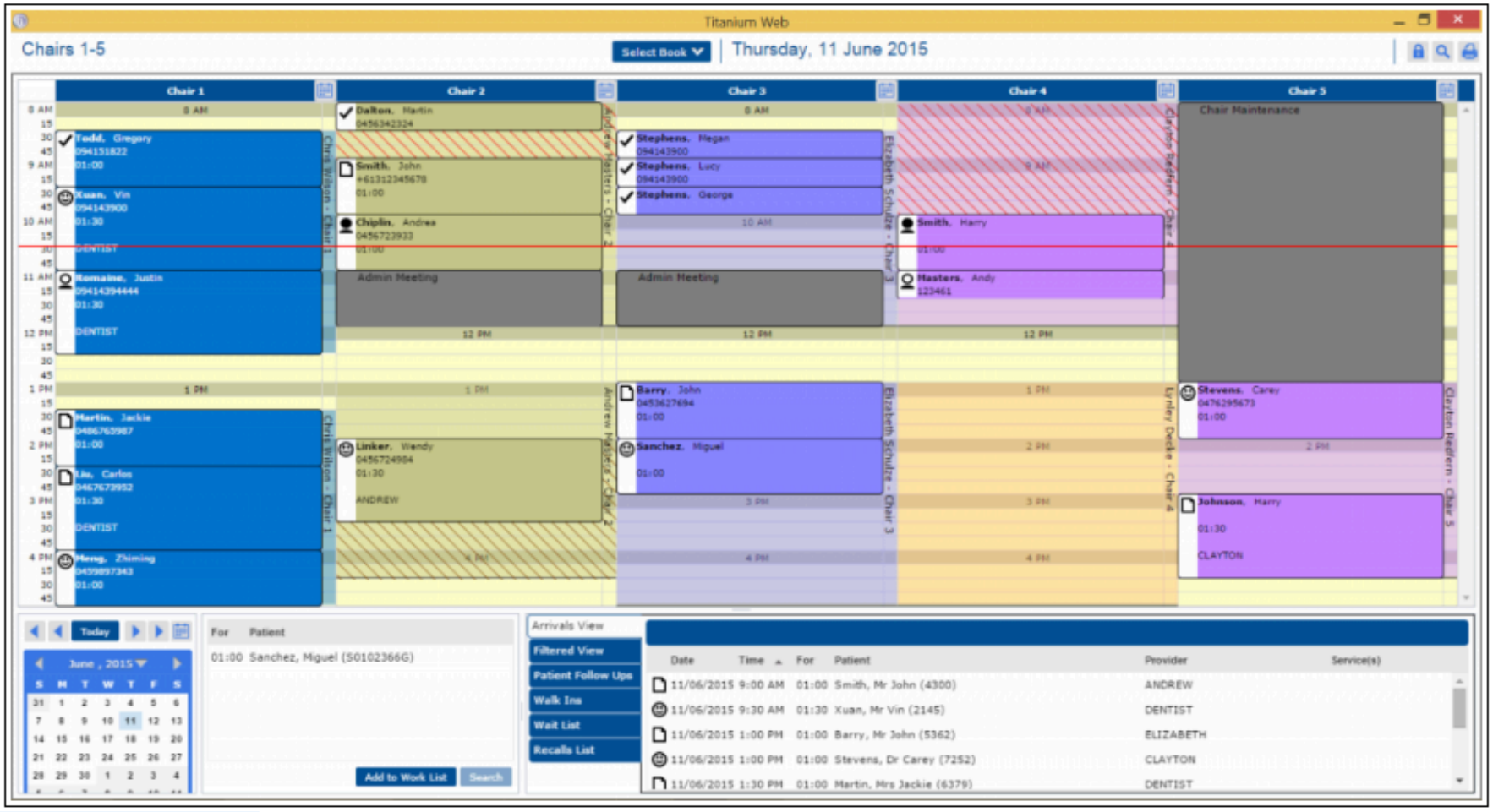
Data management		27%
	Scheduling 11%	
	Retrieval 6%	
	Treatment planning 5%	
	Direct data entry 5%	
Digital imaging		17%
Efficiency		12%
Current technology		9%
Minimize front desk congestion		6%
Intraoral charting		6%
Patient education		6%
Other		5%
Convenience		3%
Better communication		2%
Error reduction		1%

Chrome File Edit View History Bookmarks People Window Help

Titanium « Titanium Solutions

https://www.titanium.solutions/solutions/titanium-2/

Scheduling



Titanium Appointment Book

What data do we collect?

WORN—write once read never

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Research Paper ■

A Qualitative Investigation of the Content of Dental Paper-based and Computer-based Patient Record Formats

TITUS SCHLEYER, DMD, PHD, HEIKO SPALLEK, DMD, PHD, PEDRO HERNÁNDEZ, DMD

- **developed a base-line dental record (BDR) from several paper records and textbooks**
- **mapped data fields to ANSI/ADA Spec. 1000: Specification for electronic health record**
- **compared BDR with information content of each PMS**

Measurements: We calculated frequency counts of BDR categories and data fields for all paper-based and computer-based record formats, and cross-mapped information coverage at both the category and the data field level.

Results: The BDR had 20 categories and 363 data fields. On average, paper records and CPRs contained 14 categories, and 210 and 174 fields, respectively. Only 72, or 20%, of the BDR fields occurred in five or more paper records. Categories related to diagnosis were missing from most paper-based and computer-based record formats. The CPRs rarely used the category names and groupings of data fields common in paper formats.

Conclusion: Existing paper records exhibit limited agreement on what information dental records should contain. The CPRs only cover this information partially, and may thus impede the adoption of electronic patient records.

■ **J Am Med Inform Assoc.** 2007;14:515–526. DOI 10.1197/jamia.M2335.

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Dentist

MEDICAL HISTORY

PHYSICIAN'S NAME _____ DATE OF LAST PHYSICAL EXAM. _____ AGE_____

DO YOU HAVE OR HAVE YOU HAD ANY OF THE FOLLOWING - INDICATE WITH A (✔)

- ☐ Allergies to drugs
- ☐ Allergies to anesthetics
- ☐ Any heart ailments
- ☐ High blood pressure
- ☐ Neurological problems
- ☐ Radiation treatments
- ☐ Excessive bleeding from cut or extraction
- ☐ Anemia or blood problems
- ☐ Arthritis
- ☐ Chronic Fatigue Syndrome
- ☐ Asthma
- ☐ Hay fever or allergies in general
- ☐ Diabetes
- ☐ Kidney problems
- ☐ Latex sensitivity
- ☐ Liver problems or hepatitis
- ☐ Malignancies
- ☐ Psychiatric care/emotional problems
- ☐ Rheumatic fever
- ☐ Sinus problems
- ☐ Immune System Disorders (AIDS, HIV, ARC)
- ☐ Stroke
- ☐ Thyroid
- ☐ Eye disorders
- ☐ Tonsilitis
- ☐ Tuberculosis
- ☐ Ulcer or colitis
- ☐ Pregnancy If so, what month _____
- ☐ Venereal disease
- ☐ Other _____

Describe any current medical treatment including drugs taken, even though not listed above _____

Vendor

MEDICAL DOCTOR: _____

MD ADDRESS: _____

_____

MD PHONE NO: _____

Patients: Please fill out health history down to dashed line.

1. What is your general state of health? Excellent ☐ Good ☐ Fair ☐ Poor ☐

Yes / No

2. ☐ ☐ Have you been in the hospital in the past two years for any reason? Reason: _____
3. ☐ ☐ Are you under the care of a physician? For what? _____
4. ☐ ☐ Are you taking medications? (please list) _____
5. ☐ ☐ Do you have any allergies? (please list) _____
6. ☐ ☐ Have you used cocaine or heroin? _____
7. ☐ ☐ Are you an alcoholic or recovering alcoholic? _____
8. ☐ ☐ Do you smoke or chew tobacco? How often? How much? _____

Do you or have you had any of the following (please check yes or no at the right for each item):

CHECK EACH ITEM	Yes	No		Yes	No		Yes	No
Epilepsy or seizures	☐	☐	Irregular heartbeat	☐	☐	Kidney problems	☐	☐
Fainting or dizziness	☐	☐	Bruise/bleed easily	☐	☐	Venereal disease	☐	☐
Stroke	☐	☐	High blood pressure	☐	☐	Diabetes	☐	☐
Persistent cough	☐	☐	Rheumatic fever	☐	☐	Thyroid disease	☐	☐
Emphysema/Bronchitis	☐	☐	Heart murmur	☐	☐	AIDS/HIV+	☐	☐
Tuberculosis/PPD+	☐	☐				Arthritis	☐	☐
			Mitral valve prolapse	☐	☐	Prosthetic joints	☐	☐
Asthma	☐	☐				Cancer/radiation therapy	☐	☐
			Congenital heart lesions	☐	☐			
Sinus problems	☐	☐	Heart surgery	☐	☐			
Anemia/Sickle Cell	☐	☐	Artificial heart valves	☐	☐	Do you have any other	☐	☐
Hepatitis- A, B, or C	☐	☐	Females: are you	☐	☐	disease, condition, or		
Liver disease	☐	☐	Pregnant?			illness not listed above?		
Pneumonia	☐	☐	(due date)_____			List:_____		

Dental School

Do you have or have you ever had any of the following?

RESPIRATORY (LUNGS)	Y	N
Tuberculosis	☐	☐
Emphysema / Bronchitis	☐	☐
Asthma / Wheezing	☐	☐
Persistent Cough	☐	☐
Other: _____		

HEART / BLOOD VESSELS	Y	N
Rheumatic Fever	☐	☐
Heart Murmur	☐	☐
Chest Pain	☐	☐
Heart Attack	☐	☐
Shortness of Breath	☐	☐
Swelling of Ankles	☐	☐
High / Low Blood Pressure	☐	☐
Congenital Heart Disease	☐	☐
Prosthetic Valves	☐	☐
Heart Surgery	☐	☐
Pacemaker	☐	☐
Other: _____		

GENITOURINARY	Y	N
Kidney Disease	☐	☐
Kidney Transplant / Dialysis	☐	☐
Difficulty / Pain on Urination	☐	☐
Blood in Urine	☐	☐
Frequent Urination	☐	☐
Sexually Transmitted Disease	☐	☐
Syphilis	☐	☐
Gonorrhea	☐	☐
Herpes	☐	☐

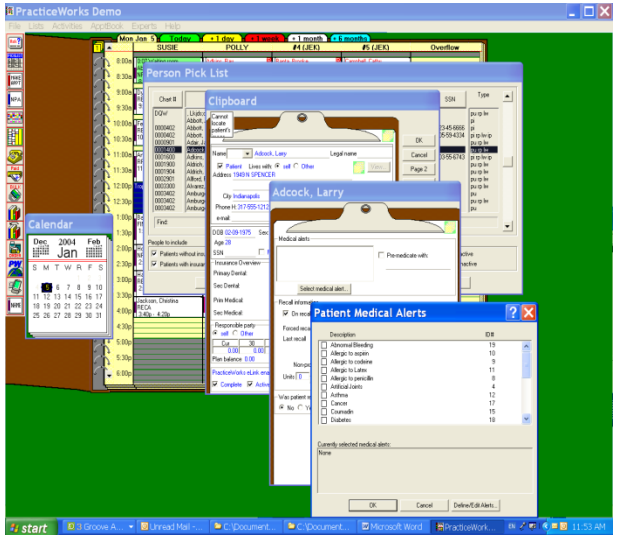
BLOOD / LYMPH / IMMUNE	Y	N
Easy Bruising / Excessive Bleeding	☐	☐
Persistent Swollen Glands	☐	☐
Blood Transfusion	☐	☐
Hemophilia	☐	☐
Anemia / Sickle Cell	☐	☐
HIV Positive	☐	☐
A'DS	☐	☐
Leukemia	☐	☐
Spleen Problems	☐	☐
Other _____		

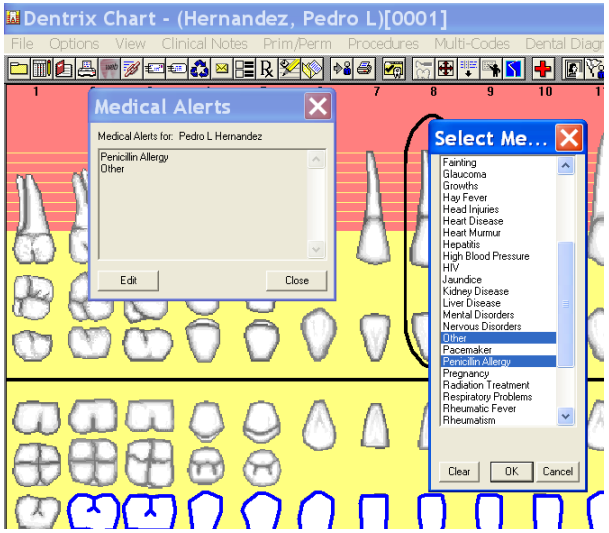
ENDOCRINE (GLANDS)	Y	N
Diabetes	☐	☐
Thyroid Trouble / Goiter	☐	☐
Weight Change	☐	☐
Excessive Thirst	☐	☐
Other _____		

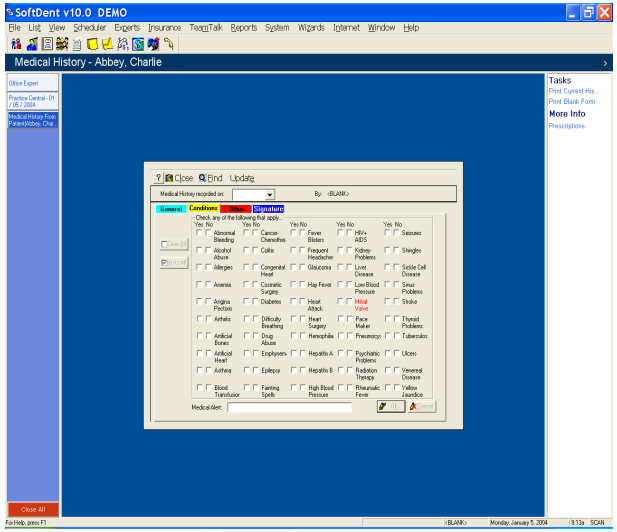
GENERAL	Y	N
Tires Easily	☐	☐
Weakness	☐	☐
Night Sweats	☐	☐
Persistent Fever	☐	☐

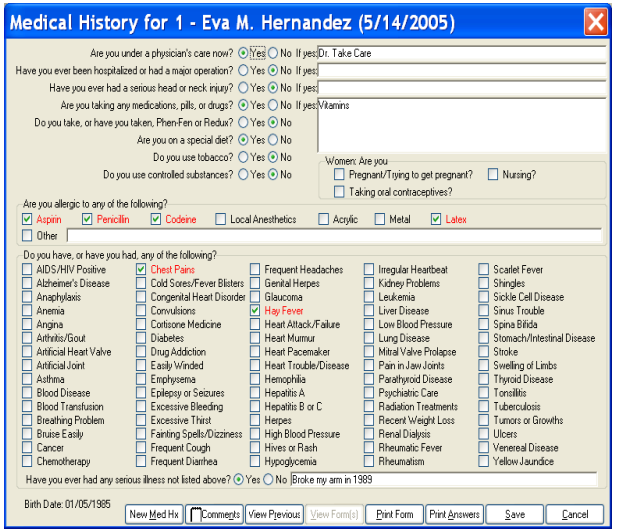
OTHER	Y	N
Radiation Therapy	☐	☐
Chemotherapy	☐	☐
Tumors or Growth	☐	☐
Cancer	☐	☐
Alcohol Use	☐	☐
Tobacco Use	☐	☐

Dental School


PracticeWorks Demo
Person Pick List
Clipboard
Adcock, Larry
Patient Medical Alerts
Calendar


Dentrix Chart - (Hernandez, Pedro L)[0001]
Medical Alerts
Medical Alerts for: Pedro L Hernandez
Penicillin Allergy
Other
Edit
Close
Select Me...
Fainting
Glaucoma
Growths
Hay Fever
Head Injuries
Heart Disease
Heart Murmur
Hepatitis
High Blood Pressure
HIV
Jaundice
Kidney Disease
Liver Disease
Mental Disorders
Nervous Disorders
Other
Pacemaker
Penicillin Allergy
Pregnancy
Radiation Treatment
Respiratory Problems
Rheumatic Fever
Rheumatism
Clear
OK
Cancel


SoftDent v10.0 DEMO
Medical History - Abbey, Charlie
Tasks
More Info


Medical History for 1 - Eva M. Hernandez (5/14/2005)
Are you under a physician's care now? Yes No If yes: Dr. Take Care
Have you ever been hospitalized or had a major operation? Yes No If yes:
Have you ever had a serious head or neck injury? Yes No If yes:
Are you taking any medications, pills, or drugs? Yes No If yes: Vitamins
Do you take, or have you taken, Phen-Fen or Redux? Yes No
Are you on a special diet? Yes No
Do you use tobacco? Yes No
Do you use controlled substances? Yes No
Women: Are you
Pregnant/Trying to get pregnant? Nursing?
Taking oral contraceptives?
Are you allergic to any of the following?
Aspirin Penicillin Codeine Local Anesthetics Acrylic Metal Latex
Other
Do you have, or have you had, any of the following?
AIDS/HIV Positive
Alzheimer's Disease
Anaphylaxis
Anemia
Angina
Arthritis/Gout
Artificial Heart Valve
Artificial Joint
Asthma
Blood Disease
Blood Transfusion
Breathing Problem
Bruise Easily
Cancer
Chemotherapy
Chest Pains
Cold Sores/Fever Blisters
Congenital Heart Disorder
Convulsions
Cortisone Medicine
Diabetes
Drug Addiction
Easily Winded
Emphysema
Epilepsy or Seizures
Excessive Bleeding
Excessive Thirst
Fainting Spells/Dizziness
Frequent Cough
Frequent Diarrhea
Frequent Headaches
Genital Herpes
Glaucoma
Hay Fever
Heart Attack/Failure
Heart Murmur
Heart Pacemaker
Heart Trouble/Disease
Hemophilia
Hepatitis A
Hepatitis B or C
Herpes
High Blood Pressure
Hives or Rash
Hypoglycemia
Irregular Heartbeat
Kidney Problems
Leukemia
Liver Disease
Low Blood Pressure
Lung Disease
Mitral Valve Prolapse
Pain in Jaw Joints
Parathyroid Disease
Psychiatric Care
Radiation Treatments
Recent Weight Loss
Renal Dialysis
Rheumatic Fever
Rheumatism
Scarlet Fever
Shingles
Sickle Cell Disease
Sinus Trouble
Spina Bifida
Stomach/Intestinal Disease
Stroke
Swelling of Limbs
Thyroid Disease
Tonsillitis
Tuberculosis
Tumors or Growths
Ulcers
Venereal Disease
Yellow Jaundice
Have you ever had any serious illness not listed above? Yes No Broke my arm in 1989
Birth Date: 01/05/1985
New Med Hx
Comments
View Previous
View Form(s)
Print Form
Print Answers
Save
Cancel

Mapping of paper records, textbooks and CPRs to the BDR

BDR Categories	BDR	Baseline Dental Record (BDR) source: Paper records: Dentists D1	D2	D3	D4	School DS1	DS2	Vendors V1	V2	V3	V4	Text Books* Stefanac	Clark's	Jaroski	CPRs Dentrix	Eaglesoft	PW	SoftDent
Chief complaint	3	1	2	2	1	2	1	1	1	2	1	n/a	n/a		0	0	0	0
Medication history	8	5	1	1	1	6	3	2	1	2	2	n/a	n/a		0	2	1	3
Medical history	120	25	28	50	36	54	35	70	33	61	33	n/a	n/a	n/a	36	70	19	52
Dental/social history	78	6	25	24	9	3	14	28	28	20	30	n/a	n/a		2	14	4	6
Hard tissue and periodontal chart	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Intraoral soft tissue examination	26	0	14	0	11	13	6	8	8	4	10	n/a	n/a		9	11	7	9
Extraoral head and neck examination	7	0	1	0	2	6	4	1	1	1	2	n/a	n/a		1	1	1	2
Temporomandibular joint/occlusion	32	0	20	0	8	1	5	12	9	8	8	n/a	n/a		9	9	3	11
Radiographic history and findings	18	0	4	0	2	1	15	1	1	2	3	n/a	n/a	n/a	1	1	0	2
Physician information	6	2	2	4	2	4	0	3	1	5	5	n/a	n/a	n/a	0	2	0	2
Alert/Summary box	2	0	1	0	1	1	1	0	1	0	1	n/a		n/a	1	1	1	1
Medical history update	6	0	1	0	5	0	4	2	0	0	1	n/a			0	0	0	2
Consultations	7	0	0	0	0	5	5	3	0	1	0	n/a	n/a		3	6	0	4
Subtotal	313	39	99	81	78	96	93	131	84	106	96				62	117	36	94
Systemic diagnoses	3	0	0	0	0	1	2	0	0	0	0	n/a	n/a		0	0	0	0
Dental diagnoses	9	0	1	0	4	2	2	0	0	2	3	n/a		n/a	2	1	0	2
Problem list	7	0	1	0	0	1	0	0	0	0	7	n/a	n/a		0	0	0	0
Prognosis, risk assessment and etiology	3	0	0	0	0	1	2	0	0	0	0	n/a		n/a	1	0	0	0
Subtotal	22	0	2	0	4	5	6	0	0	2	10				3	1	0	2
Treatment plan	21	3	7	3	6	8	3	8	0	5	6	n/a	n/a		6	8	8	7
Progress notes	10	2	4	6	3	3	2	5	3	6	6	n/a			6	4	4	5
Prescriptions	1	0	0	0	0	0	1	0	0	0	0	n/a	n/a		1	1	1	1
Subtotal	11	2	4	6	3	3	3	5	3	6	6				7	5	5	6
Total fields	367	85	217	177	176	216	207	280	174	233	230				150	254	90	211
Total categories		7	16	7	15	18	18	13	11	14	16				14	15	10	16

*No numbers of data elements are reported for textbooks because they individually only cover a portion of the dental record.

BDR Category	Data Element	Data Type	D1
Medication History	List any prescribed (or OTC) drugs.	text	1
	Tranquilizers	yes/no	1
	Cortisone	yes/no	1
	Anticoagulants	yes/no	1
	Aspirin	yes/no	1
	Steroids	yes/no	0
	Sedatives	yes/no	0
	Fen-Phen/Redux	yes/no	0
# of Data Elements:	8	**Total**	5

BDR Categories											
Chief complaint											
Medication history											
Medical history											
Dental/social history											
Hard tissue and periodontal chart											
Intraoral soft tissue examination											
Extraoral head and neck examination											
Temporomandibular joint/occlusion											
Radiographic history and findings	18	0	4	0	1	1	15	1	1	2	2
Physician information	6	2	2	4	2	4	0	3	1	5	5
Alert/Summary box	2	0	1	0	1	1	1	0	1	0	1
Medical history update	6	0	1	0	5	0	4	2	0	0	1
Consultations	7	0	0	0	0	5	5	3	0	1	0
Subtotal	313	39	98	80	77	96	93	131	84	106	95

BDR Categories	BDR	Baseline Dental Record (BDR) Source										CPRs			
		Dentists				Schools		Vendors							
		D1	D2	D3	D4	DS1	DS2	V1	V2	V3	V4	Dentrix	Eaglesoft	PracticeWorks	SoftDent
Chief complaint	3	1	2	2	1	2	1	1	1	2	1	0	0	0	0
Medication history	8	5	1	1	1	6	3	2	1	2	2	0	2	1	3
Medical history	120	25	27	49	36	54	35	70	33	61	33	36	70	19	52
Dental/social history	78	6	25	24	9	3	14	28	28	20	30	2	14	4	6
Hard tissue and periodontal chart	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Intraoral soft tissue examination	26	0	14	0	11	13	6	8	8	4	10	9	11	7	9
Extraoral head and neck examination	7	0	1	0	2	6	4	1	1	1	2	1	1	1	2
Temporomandibular joint/occlusion	32	0	20	0	8	1	5	12	9	8	8	9	9	3	11
Radiographic history and findings	18	0	4	0	1	1	15	1	1	2	2	1	1	0	1
Physician information	6	2	2	4	2	4	0	3	1	5	5	0	2	0	2
Alert/Summary box	2	0	1	0	1	1	1	0	1	0	1	1	1	1	1
Medical history update	6	0	1	0	5	0	4	2	0	0	1	0	0	0	2
Consultations	7	0	0	0	0	5	5	3	0	1	0	3	6	0	4
Subtotal	313	39	98	80	77	96	93	131	84	106	95	62	117	36	93

Was it cheap?

cost of health information technology

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Costs of Health IT: Beginning to Understand the Financial Impact of a Dental School EHR

Heiko Spallek, D.M.D., Ph.D., M.S.B.A. (CIS); Lynn Johnson, Ph.D.; Joseph Kerr, M.B.A., P.M.P.; David Rankin, M.S., PGCertIA, CGCIO, ITIL, CCNA, MCSE, CNE

Abstract: Health Information Technology (Health IT) constitutes an integral component of the operations of most academic dental institutions nowadays. However, the expenses associated with the acquisition and the ongoing maintenance of these compl... including unmeasured central campus support, covered centrally and therefore difficult to quantify, and spread over years, center... denyin... ...ding of the resources that have been dedicated to Health IT. The aim of this study was to understand the financial impact of Health IT at four similar U.S. dental schools: two schools using a purchased Electronic Health Record (EHR), and two schools that developed their own EHR. For these schools, the costs of creating ($2.5 million) and sustaining ($174,000) custom EHR software were significantly higher than acquiring ($500,000) and sustaining ($121,000) purchased software. The results should be interpreted with caution and should not be regarded as a gold standard for what a complete Health IT suite should cost. The presented data are intended to inform school administrators about the myriad of costs associated with Health IT and ... ...king estimates for implementation projects.

100 DMD + 30 DH students; 100,000 patient visits/a dental school

- **Initial acquisition:**
  - **between US$ 524,523 and US$ 2,503,971**
- **Ongoing operations/a:**
  - **between US$ 631,816 and US$ 848,105**

Watch video: https://vimeo.com/fdim/spallek-cost-of-health-it

Dr. Spallek is Associate Professor, Dental Public Health, Center for Informatics in Oral Health Translational Research and Associate Dean ... ...is Professor of Dentistry, School of Dentistry, Associate Dean for Faculty Affairs and Institutional Effectiveness, and Clinical Professor, School of Information, University of Michigan; Mr. Kerr is Associate Dean for Administration, School of Dental Medicine, University at Buffalo; and Mr. Rankin is Director, Office of Computing and Information Systems, School of Dentistry, University of North Carolina at Chapel Hill. Direct correspondence and requests for reprints to Dr. Heiko Spallek, School of Dental Medicine, University of Pittsburgh, 427 Salk Hall, 3501 Terrace Street, Pittsburgh, PA 15261; 412-648-8882; hspallek@pitt.edu.

What Data Can We Collect?

some more optimistic remarks

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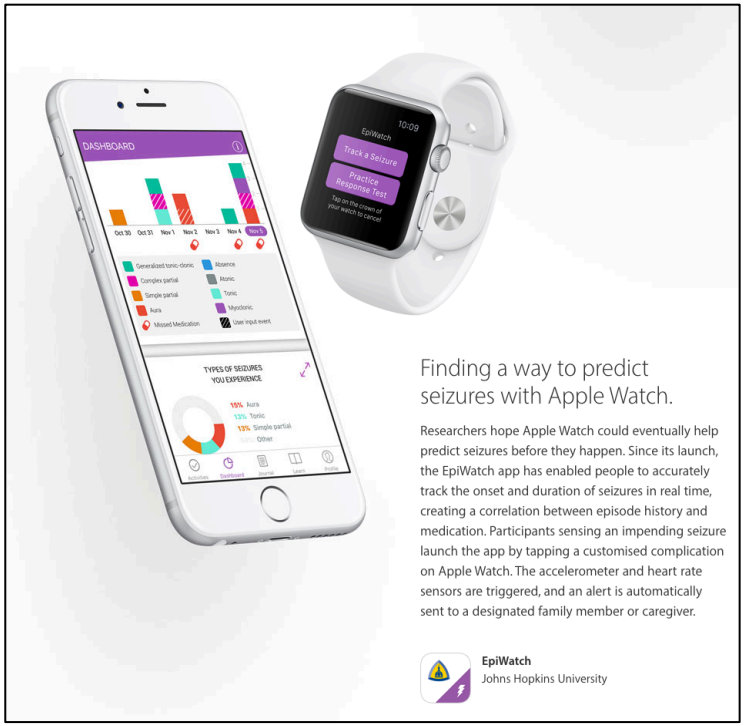
What data can we collect?

Classes of data

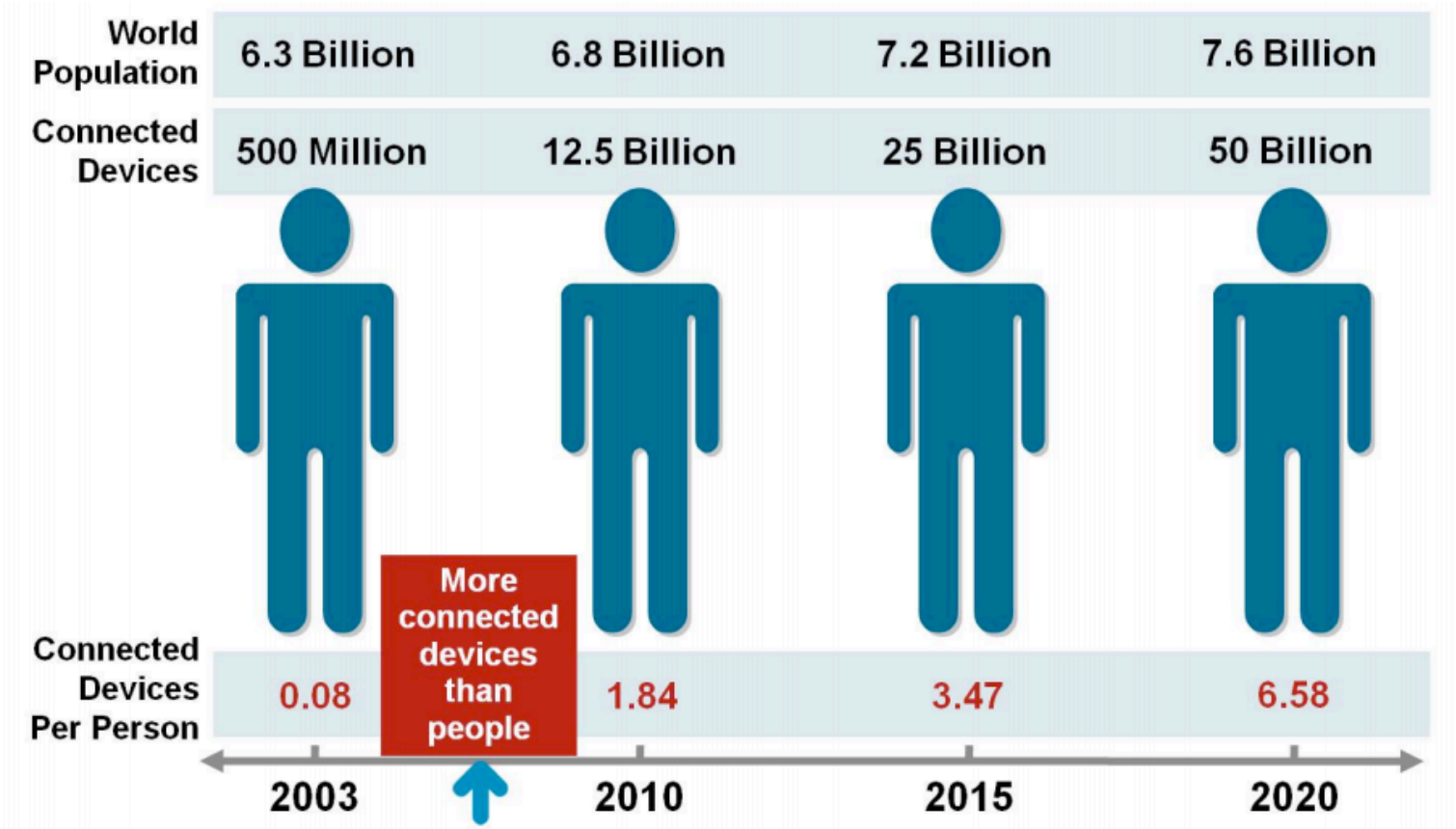
1. structured in traditional databases
2. unstructured, e.g. images, video, voice, GIS
3. Internet of Things (IoT)



http://www.apple.com/au/researchkit/

Internet of Things (IoT)

Figure 1. The Internet of Things Was "Born" Between 2008 and 2009

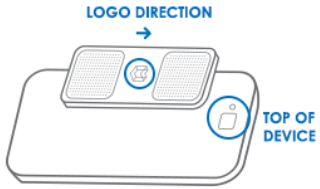


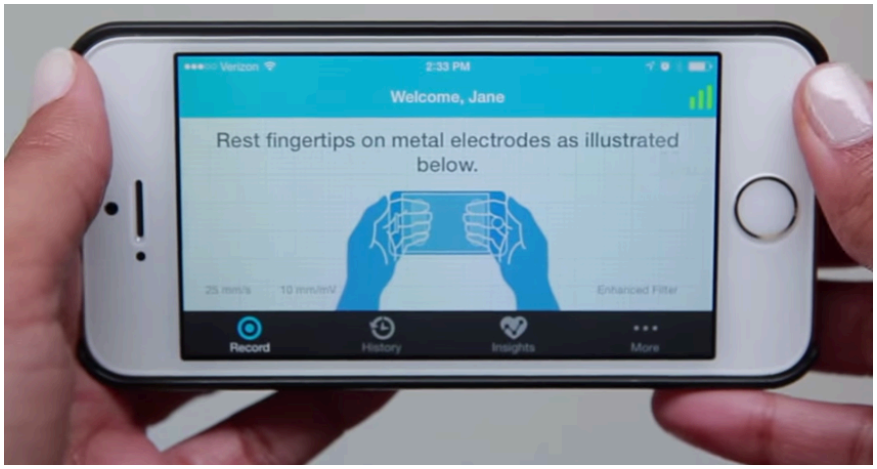
Source: Cisco IBSG, April 2011

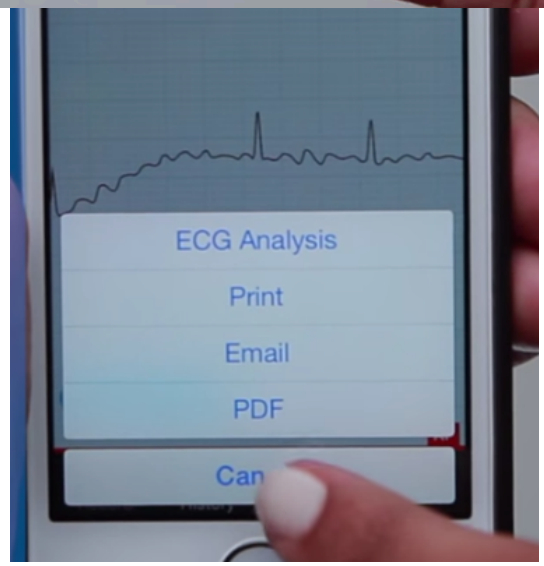
D. Evans, "The Internet of Things: How the Next Evolution of the Internet is Changing Everything," Cisco Internet Business Solutions Group, April 2011, http:// www.cisco.com/ web/ about/ ac79/ docs/ innov/ IoT_IBSG_0411FINAL.pdf .

Internet of Medical Things (IoMT)

1 **Attach the AliveCor Heart Monitor**







Internet of Dental Things (IoDT)

Internet of Dental Things (IoDT)

Onvi says it has created the first smart video toothbrush

http://www.bizjournals.com/chicago/news/2016/12/06/chicago-startup-onvi-smart-video-toothbrush.html#i1

What can we learn from aggregated data?

Big Data – just hype?

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Data Cemeteries ➔ Sources of Knowledge

"ensuring that electronic repositories become valuable resources rather than expensive investments that are quickly ignored"

Van Knippenberg, D., Dahlander, L., Haas, M., & George, G. (2015). Information, Attention, and Decision Making. Academy of Management Journal, 58(3), 649–657.

Steps

- interoperability = connectedness
- standardization
- data stewardship

We need to educate decision makers about this!

Atul Gawande on the potential of information for health

kinds of information that matter to your health and well-being over time, information about the state of ...

- your internal systems, e.g. imaging, lab-test results
- your living conditions, e.g. housing, environment
- the care you receive, e.g. medications, treatments
- your behaviors, e.g. sleep, exercise

"The potential of this information is so enormous it is almost scary."

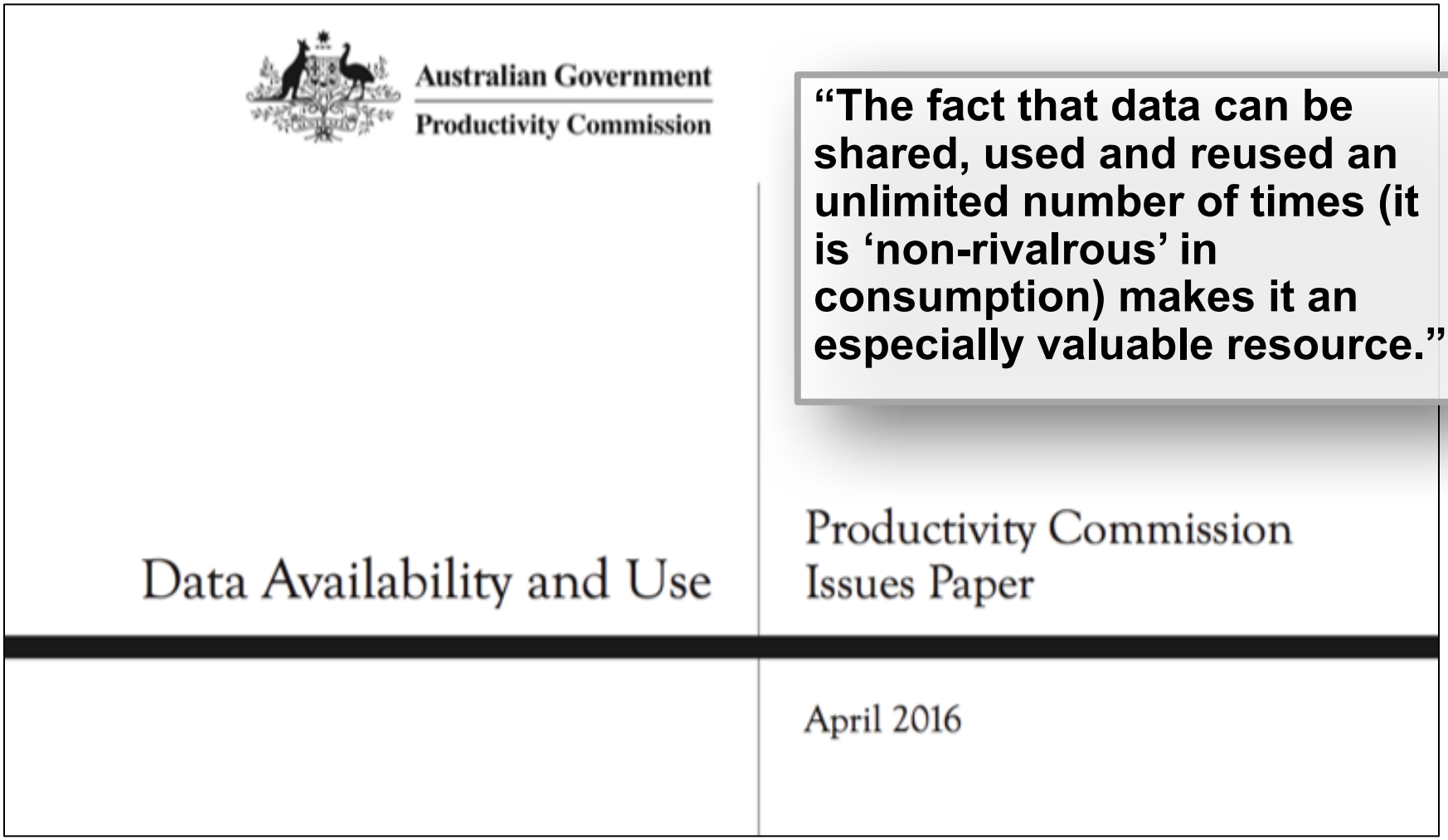
Atul Gawande: The Heroism of Incremental Care, The New Yorker, 2017, http://www.newyorker.com/magazine/2017/01/23/the-heroism-of-incremental-care

What can be done with Big Data?

Mayo Clinic (59,000 employees) + UnitedHealth Group ($122 billion corporation) + Optum Labs:

$300m research study over 5 years:
repeated in hours, same result

Why data is a key economic resource



"The fact that data can be shared, used and reused an unlimited number of times (it is 'non-rivalrous' in consumption) makes it an especially valuable resource."

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University of Sydney submission to the Productivity Commission's inquiry into Data Availability and Use, July 2016

.. the value of publicly funded datasets is maximised where (de-identified) data are freely available to researchers, where data is updated regularly and where investment in good data management and curation practices ensure that data is FAIR (**Findable, Accessible, Interoperable, Reusable**). Conversely, their value is greatly diminished if access is difficult or denied, or if the data are not curated well.

For example, oral (dental) and medical clinicians are unable to share crucial healthcare information about mutual patients in their care, resulting in sub-optimal patient outcomes[13,14]

Vision of a Dental Education Data Warehouse

Credit: Marc Triola, MD
Associate Dean for Educational Informatics
NYU School of Medicine

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The Big Data Context: Dental Education

North America alone

- 60+ dental schools
- 20,000 dental students
- 500 residents
- 167,000 dentists
- 50,000+ patient visits/typical dental school/year

“big-data science for education”

“learning informatics”

The Patient Will See You Now: The Future of Medicine is in Your Hands
Eric Topol

The Big Data Context: Dental Education

Australia alone

- 9 dental schools
- 20,000 dentists

Sydney (WCOH)

- 500 dental students
- 371 residents, VDO & clinical educators
- 150,000 dental visits/yr

"big-data science for education"

"learning informatics"

The Patient Will See You Now: The Future of Medicine is in Your Hands

Eric Topol

We collect a LOT of Data in Dental Education

- Big Data and analytics can help us produce better dentists.
- Learning analytics methods to derive actionable knowledge from a sea of data.
- Patient health outcomes are the ultimate indicator of the effectiveness of dental education.

"There's an entire industry devoted to measuring how important my research is, with impact factors of papers and so on. Yet, we don't even collect data on how I am teaching."

Carl Wieman, Nobel Prize winning physicist (Science Vol 340 April 19, 2013)

Examples: Professionalism, Admissions, Simulation

Does unprofessional behavior in medical school predict disciplinary actions by the state licensing boards?

M Papadakis et al NEJM 2005

Are DAT and GPA predictors for clinical performance?

Do virtual case simulations improve the quality of patient history taking by dental students?

Does simulation clinic performance correlate with the survival time of restorations?

Data Cemeteries → Sources of Knowledge

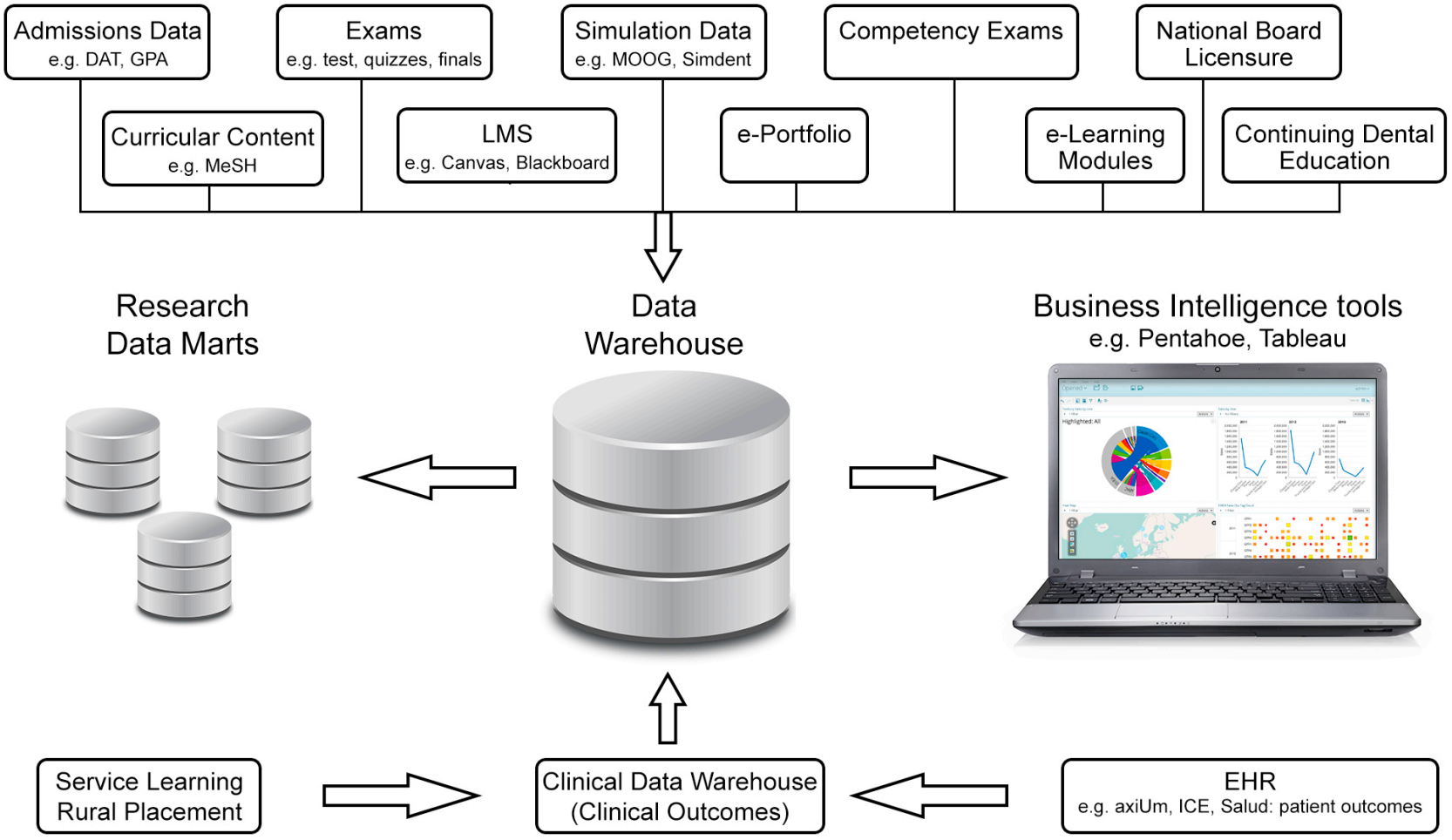
'Education Data Warehouse'

- comprehensive picture of all learners
- detailed information on the content of our curricula, assessments
- information about a person's performance, strengths, weaknesses, interests, experiences
- model a student's 'educational genome'

→ guide future learning

Marc Triola

Dental Education Data Warehouse for "personalized learning"



Continuous Improvements

Vision of a Learning Health System

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Learning Health System (LHS)

Health systems--at any level of scale--become learning systems when they can, continuously and routinely, study and improve themselves

The NEW ENGLAND JOURNAL of MEDICINE

Perspective: Jan 3, 2013

"Code Red and Blue — Safely Limiting Health Care's GDP Footprint"

Arnold Milstein, M.D., M.P.H.

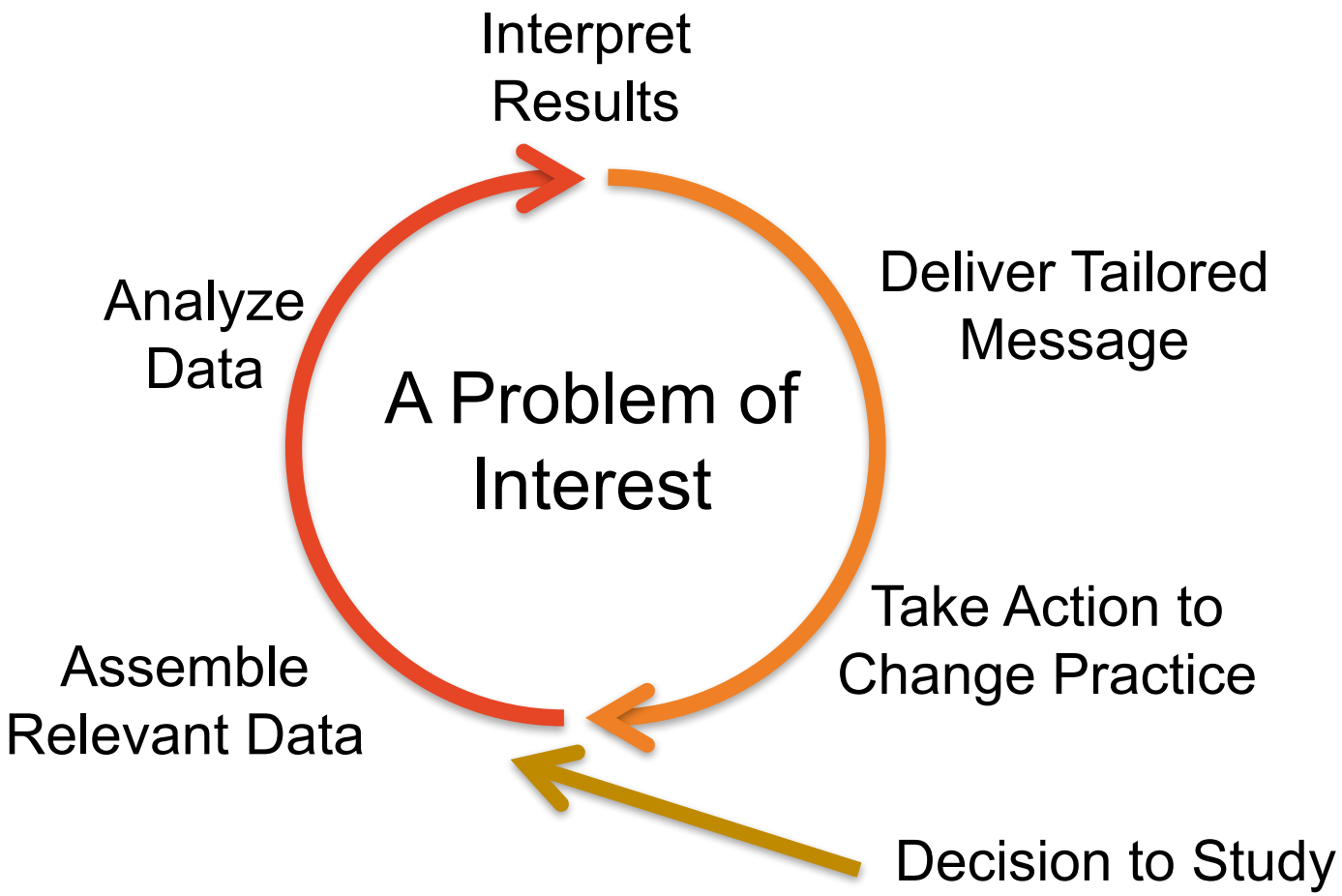
…U.S. health care needs to adopt new work methods, outlined in the Institute of Medicine's vision for a learning health system…

A Health System That Can Learn

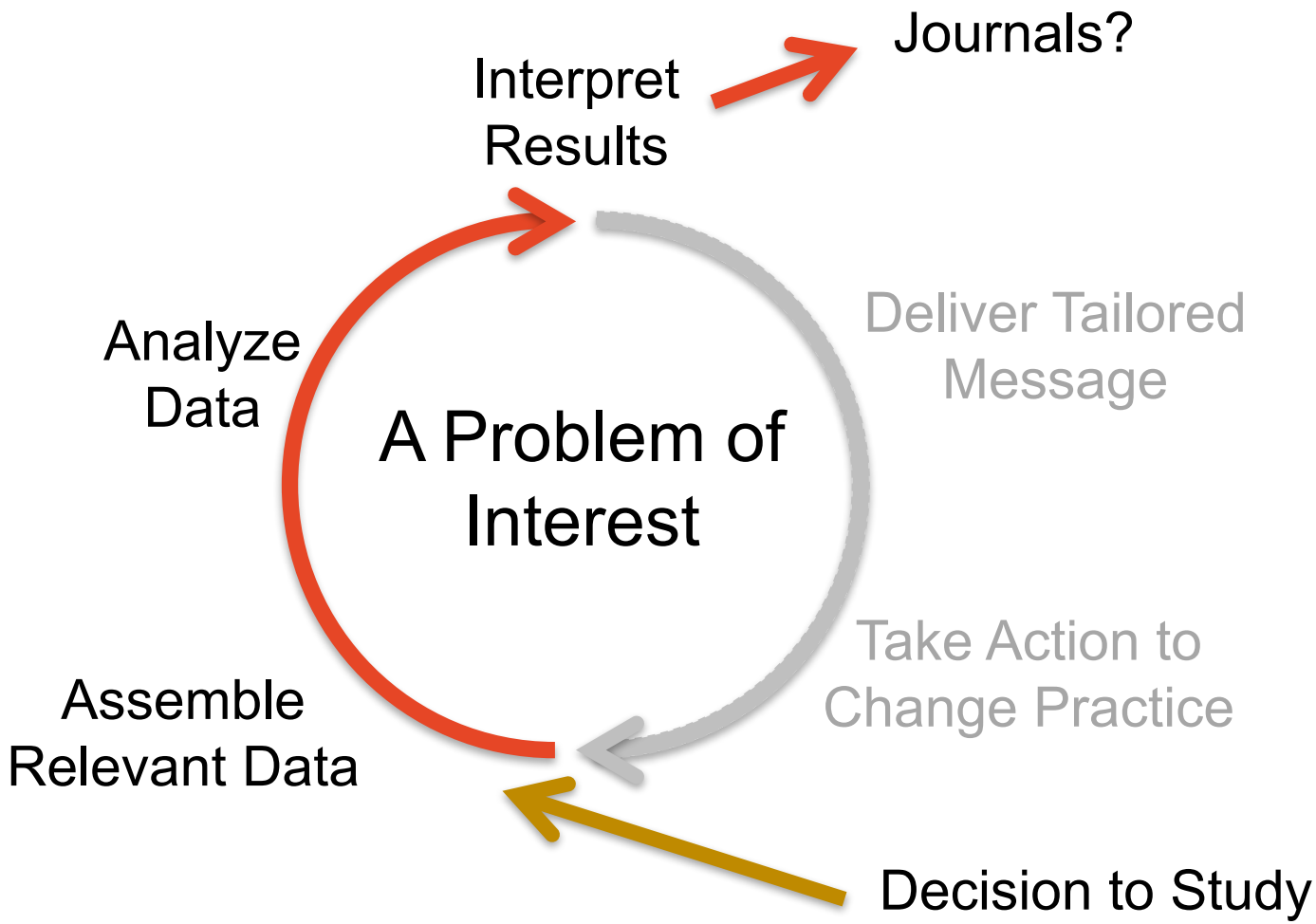
- Every patient's characteristics and experience are available for study
- Best practice knowledge is immediately available to support decisions
- Improvement is continuous through ongoing study
- This happens routinely, economically and almost invisibly
- All of this is part of the culture

Charles P. Friedman, PhD
Josiah Macy, Jr. Professor of Medical Education
Chair, Department of Learning Health Sciences
Professor of Information and Public Health
University of Michigan

The LHS Must Do This

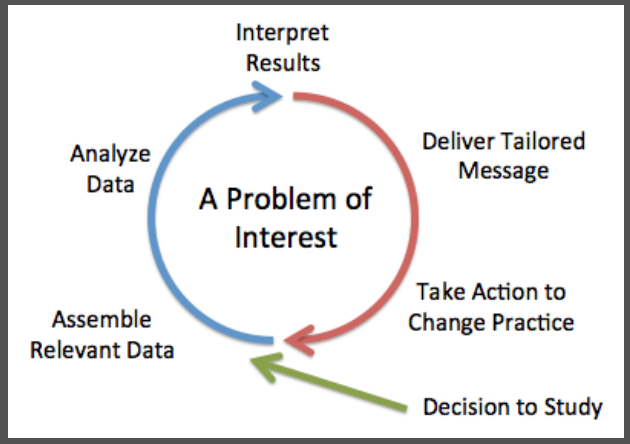


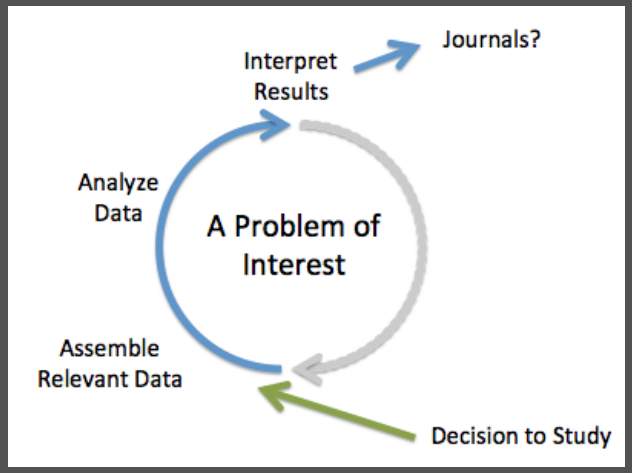
Not This

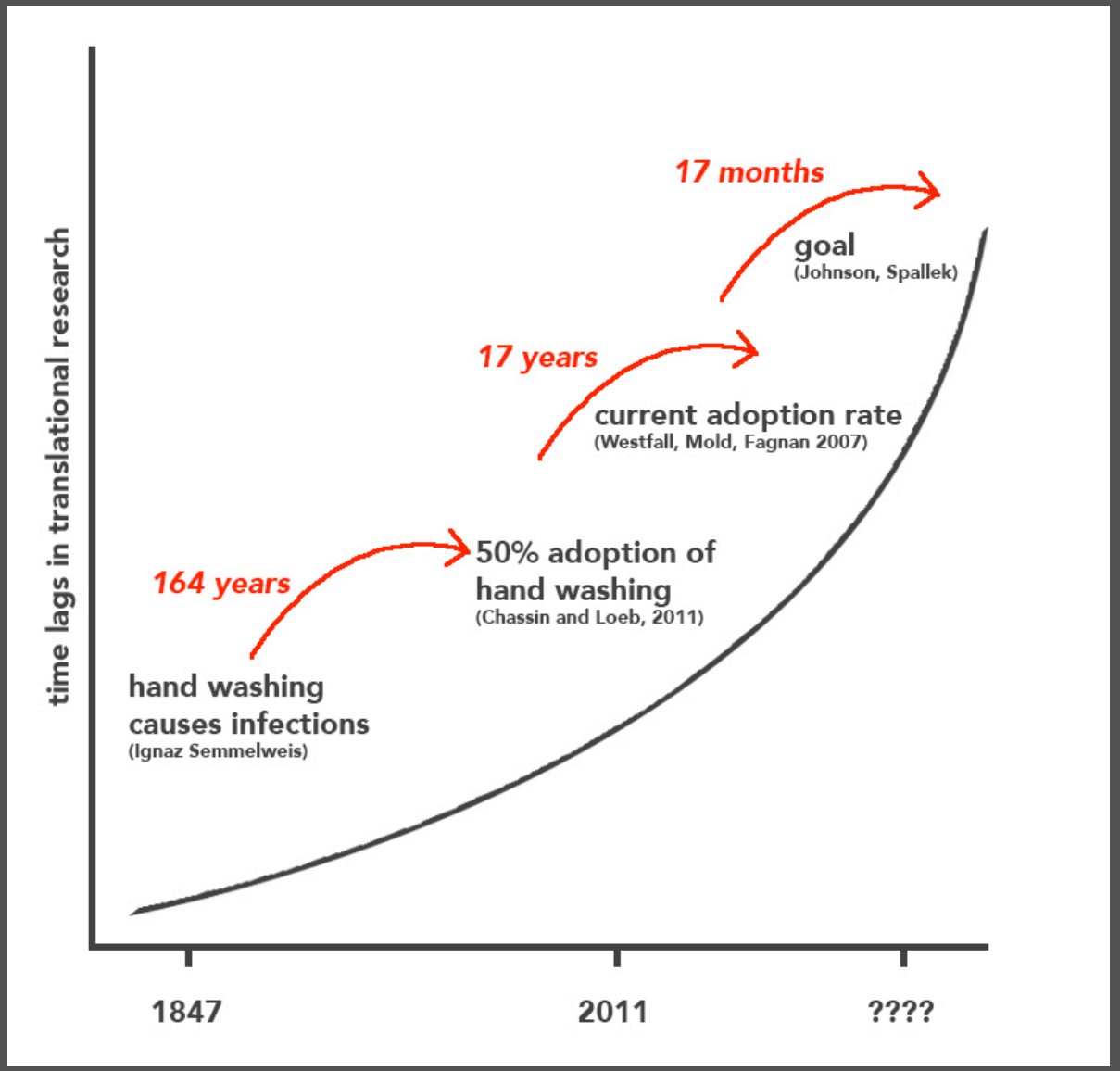

Journals?
Interpret Results
Deliver Tailored Message
Analyze Data
A Problem of Interest
Take Action to Change Practice
Assemble Relevant Data
Decision to Study

How can we accelerate 17 years to 17 months?

Converting data cemeteries to sources of knowledge







What are the barriers?

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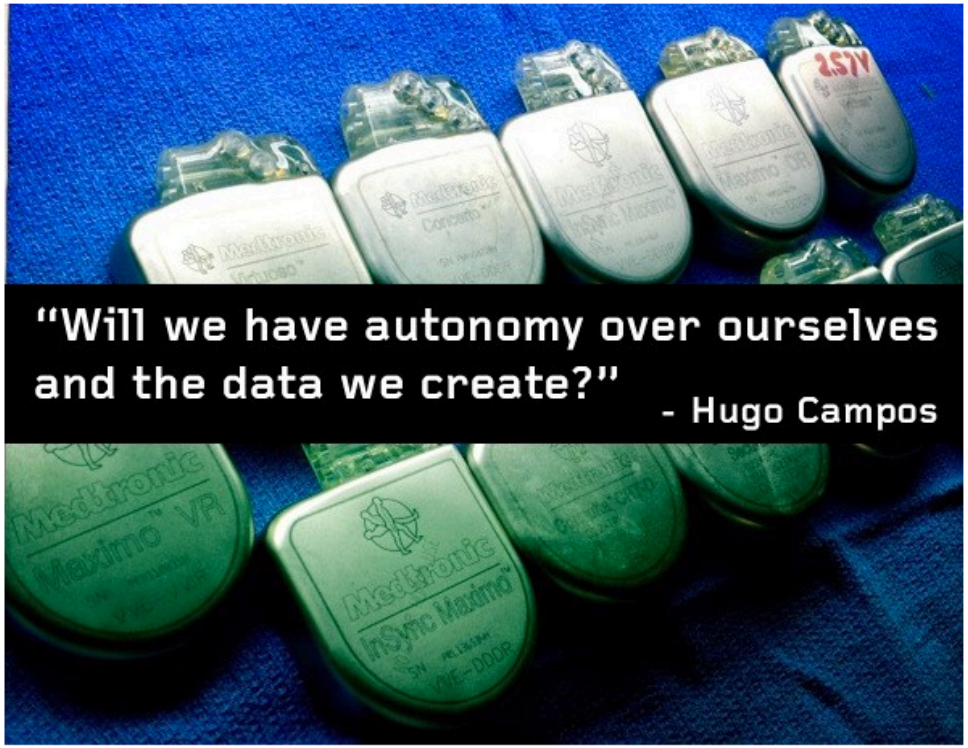
Ownership of Data



My Device, My Body, My Data

An Access Conversation with Hugo Campos

The Patient Will See You Now: The Future of Medicine is in Your Hands by Eric Topol

https://medium.com/access-matters/my-device-my-body-my-data-4e158f8dfcec

Data Stewardship

You are here: The NHS in England / The NHS / Records / Your health records / The care data system

Your health and care records

About health records | Accessing records | NHS Number | Care.data programme

The care data system

The care.data programme - collecting information for the health of the nation

The care.data programme will bring together securely, health and social care inform
different settings in order to see what's working really well in the NHS and what cou
better. Using data in this way is known as data sharing for purposes beyond direct c
information will only be shared if it will benefit patient care.

Nearly 1million patients could be havir shared against their wishes

Calls for an official investigation as it is disclosed th patients opted out to having their GP data shared w have their demands ignored.

429 0 115 544

Failure to Heed Patients' Privacy Requests Raises 'Big Data' Concerns in England: Offers Lessons for How Clinical Pathology Lab Test Data Should Be Protected in U.S.

Category: Compliance, Legal, and Malpractice, dark daily home page, Laboratory Management and Operations, Laboratory News, Laboratory Operations, Management & Operations

Like 0 Tweet G+1 2 Share 4

Published: August 14 2015

National Health Service agency admits to releasing information on 700,000 patients who opted out of nation's new centralized medical-information database

In the United States, the debate is ongoing about how healthcare data is used while at the same time protecting patient privacy. The outcome of this debate will be increasingly important for medical laboratories because—in order to deliver more value—labs will want to combine lab test data with other sources of clinical information.

Daily Mail AUSTRALIA

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Latest Headlines | News | World News | Sydney | Melbourne | Brisbane | Malcolm Turnbull | Headlines | Wires |

NHS to carry on selling patients' medical data to insurance firms despite history of blunders over illegal use of the information

- **NHS will continue to sell patients' medical records to insurance firms**
- **Data includes personal details of diagnoses, dates of birth and postcodes**
- **Expert said proper checks were now in place to prevent misuse of records**

By BEN WILKINSON FOR THE DAILY MAIL

PUBLISHED: 13:42 EST, 27 November 2014 | **UPDATED:** 21:23 EST, 27 November 2014

Share 17 shares 66 View comments

The NHS will continue to sell patients' medical records despite its woeful history of blunders over the illegal use of private data.

The Mail revealed in June that files had been sold to insurance firms and other companies without proper checks and balances.

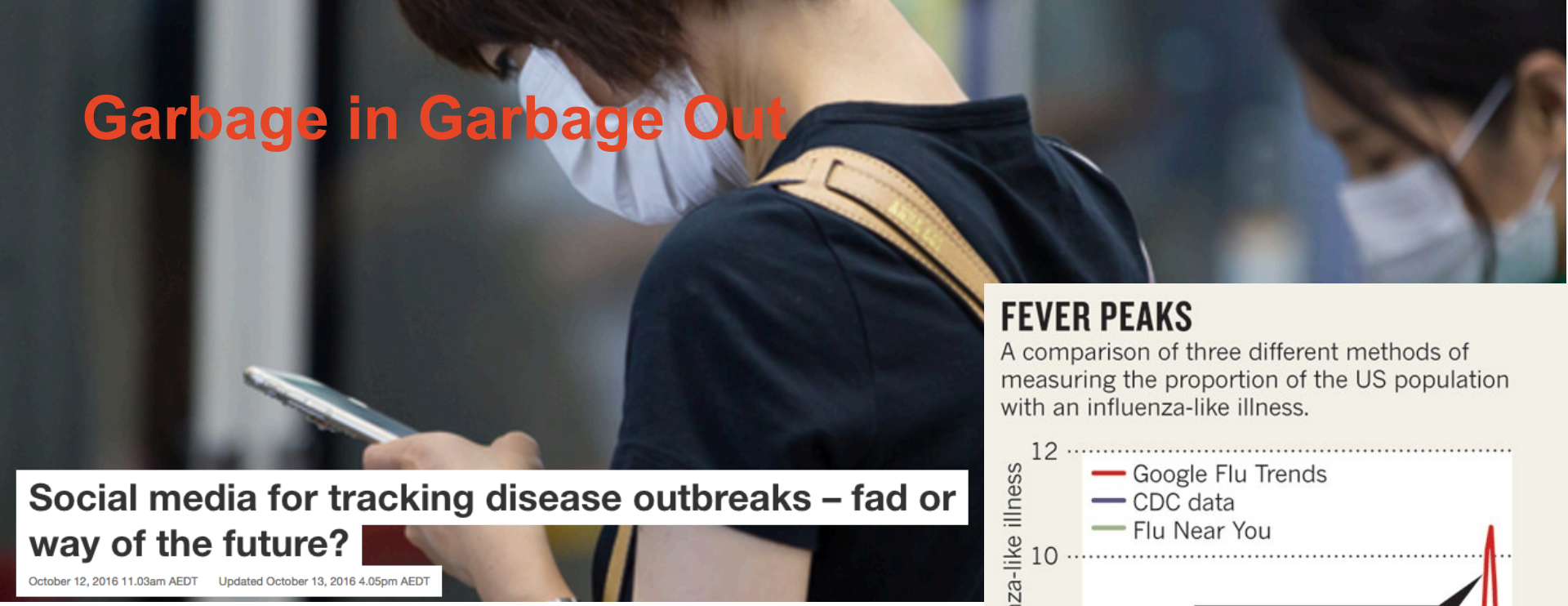
The data – including highly personal details of patient diagnoses, dates of birth and postcodes – was used to help calculate insurance premiums.

Re-identification

We randomly sampled 5,000 numbers from our crowdsourced MetaPhone dataset and queried the Yelp, Google Places, and Facebook directories. With little marginal effort and just those three sources—all free and public—we matched 1,356 (27.1%) of the numbers. Specifically, there were 378 hits (7.6%) on Yelp, 684 (13.7%) on Google Places, and 618 (12.3%) on Facebook.

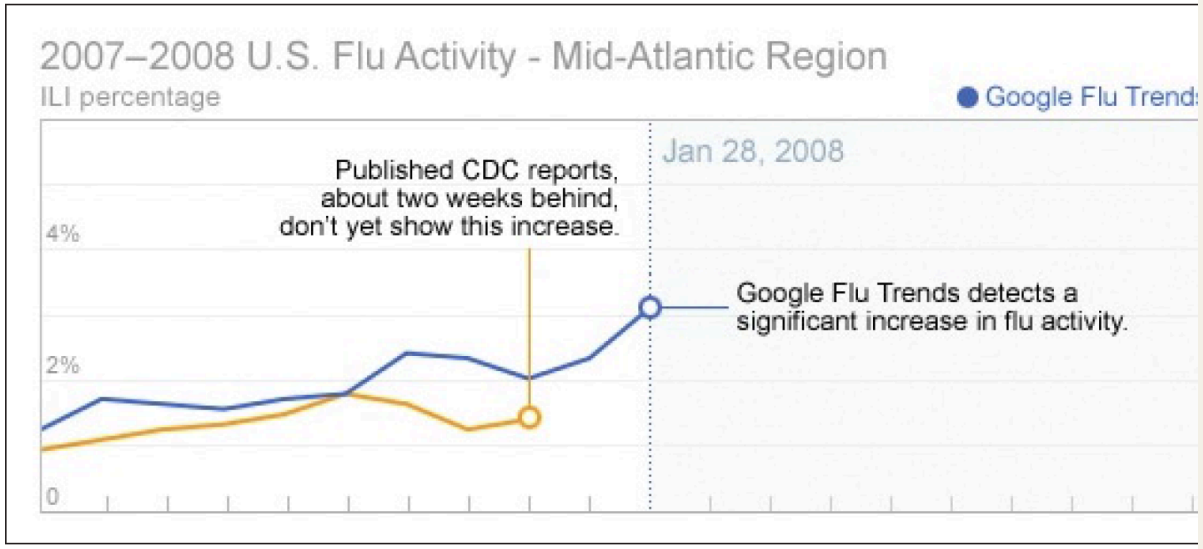
http://www.theatlantic.com/technology/archive/2013/12/stanford-researchers-it-is-trivially-easy-to-match-metadata-to-real-people/282642/

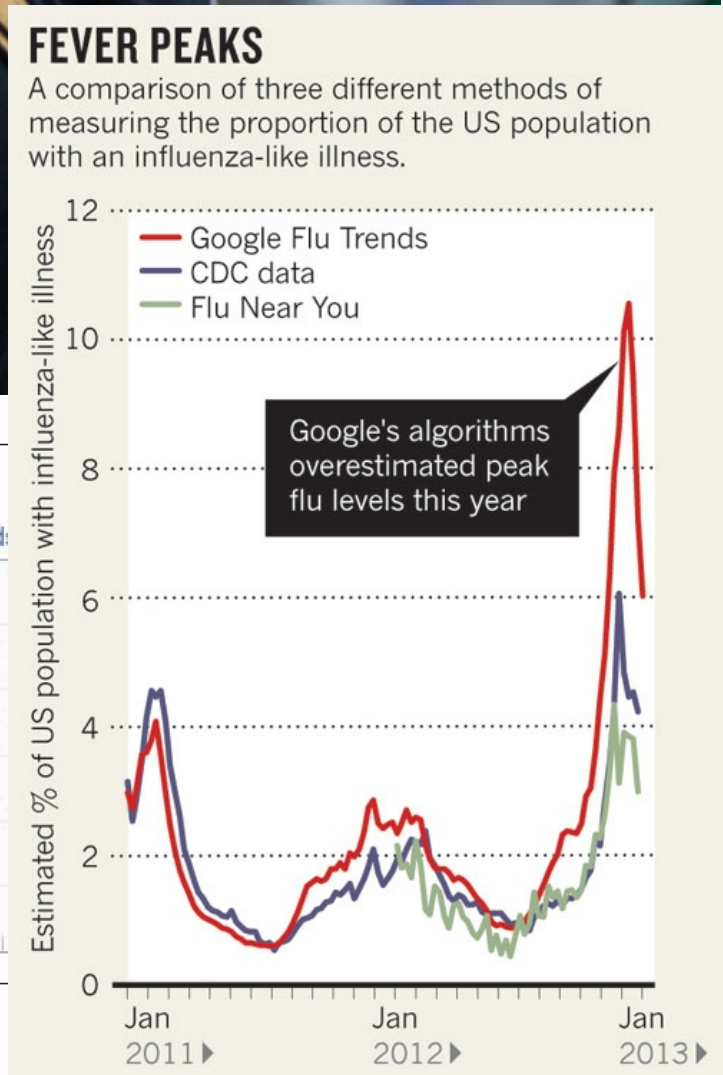
Garbage in Garbage Out



Social media for tracking disease outbreaks – fad or way of the future?

October 12, 2016 11.03am AEDT Updated October 13, 2016 4.05pm AEDT





FT Magazine: http://www.ft.com/intl/cms/s/2/21a6e7d8-b479-11e3-a09a-00144feabdc0.html
Nature: http://www.nature.com/news/when-google-got-flu-wrong-1.12413#/fever
The Conversation: https://theconversation.com/social-media-for-tracking-disease-outbreaks-fad-or-way-of-the-future-66401

Analyzing qualitative data

qualitative data = hows & whys

transform qualitative → quantitative: shallow shadow of original form
e.g. toothache

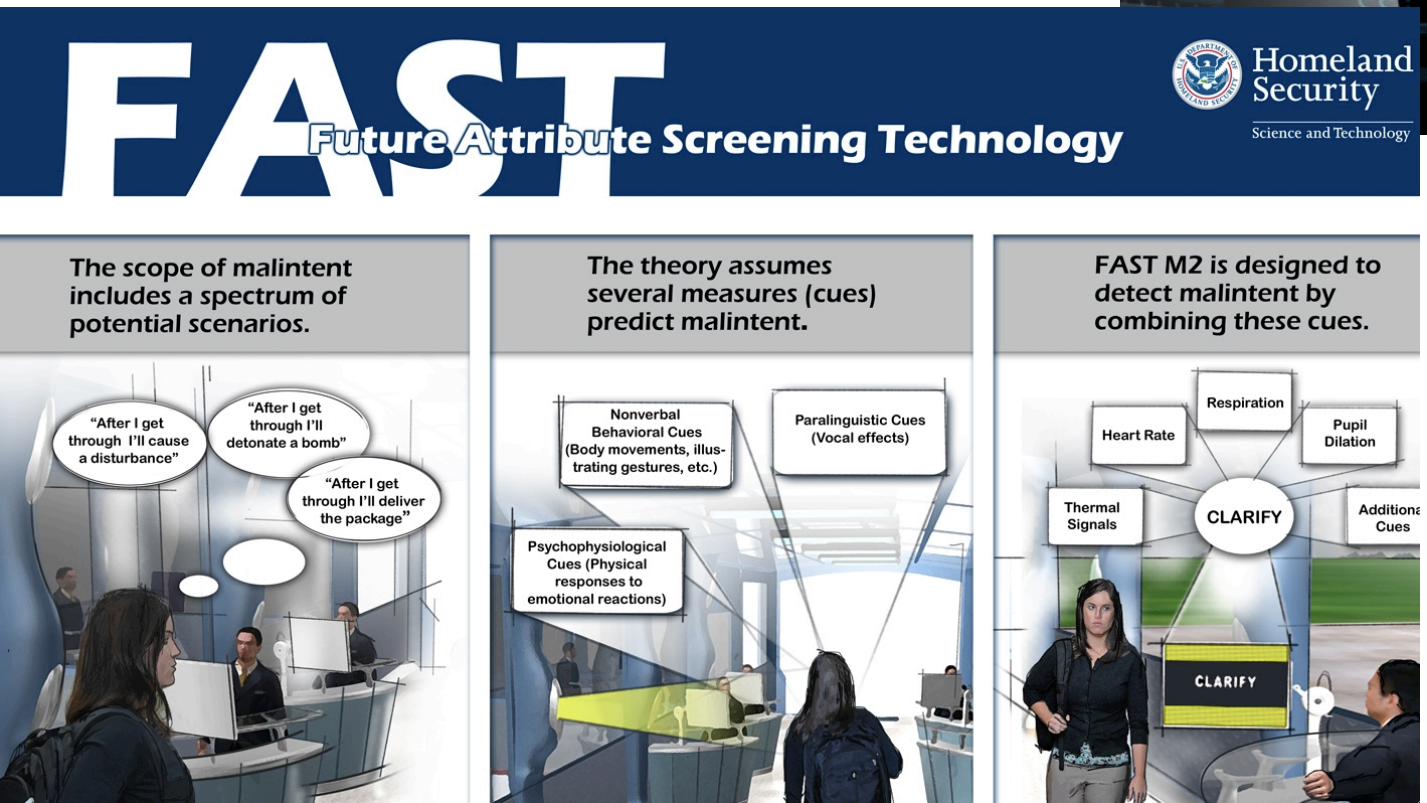
humans explain context when communicating

computers get context during design from engineers

Stephen Cohen on Big Data: Full talk from Wired 2012
https://www.youtube.com/watch?v=VVw2RMun-ss

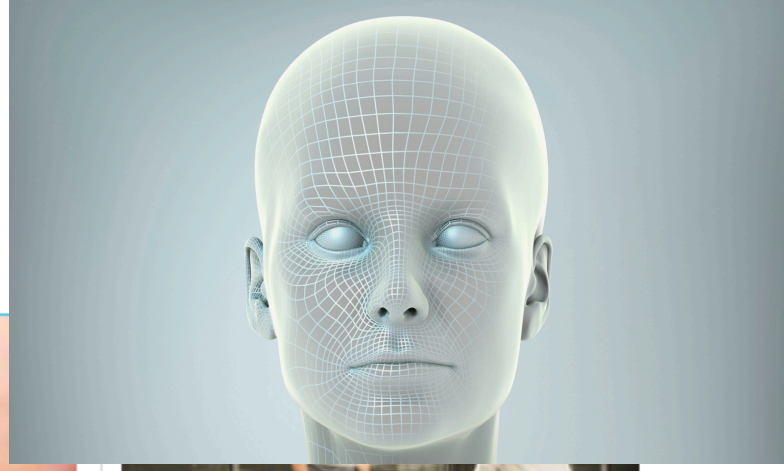
Privacy "big-data authoritarianism"

http://en.wikipedia.org/wiki/Future_Attribute_Screening_Technology



Super AI

Bostrom, Nick: Superintelligence: Paths, Dangers, Strategies

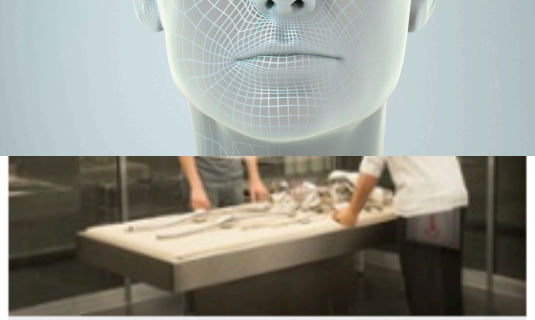


Artificial intelligence and nanotechnology 'threaten civilisation'

4d 54

Artificial intelligence will become strong enough to be a concern, says Bill Gates

29 Jan 2015



Artificial intelligence might be a threat to humans but not for the reasons you think

Nigel Shadbolt

22 Jan 2015

Experts including Elon Musk call for research to avoid AI 'pitfalls'

12 Jan 2015

When fridges attack: the new ethics of the Internet of Things

8 Sep 2014 4

Elon Musk: artificial intelligence is our biggest existential threat

27 Oct 2014 673

Current and Future Work

What would an EHR system look like that dentists suddenly can't live without?

Paraphrased from:
When lead engineer of I.B.M.'s Watson's health team, Eric Brown, was asked what the equivalent of the "Jeopardy!" victory would be in medicine, he responded:

"It'll be when we have a technology that physicians suddenly can't live without,"

http://www.nytimes.com/2015/03/22/opinion/sunday/why-health-care-tech-is-still-so-bad.html?_r=0

Clinical Decision Support Systems

A Clinic-Randomized Trial of a Clinical Decision Support System to Improve Dental Provider Delivery of Brief Tobacco Interventions and Quitline Referrals

Principal Investigator: Brad Rindal, Healthpartners and Heiko Spallek, University of Sydney
Funding Source: National Institute of Dental and Craniofacial Research (NIDCR) - U01DE026135
Award Period: 8/2/2016 – 7/31/2020
Award Amount: $2,488,348

Cloud-based *Knowledge-as-a-Service* directly integrated into a dental EHR to support dental providers' delivery of tobacco cessation interventions

https://projectreporter.nih.gov/project_info_description.cfm?aid=9156468

Cloud-based Dental EHR

Dental schools at the Universities of Michigan, Pittsburgh and North Carolina have partnered with Internet2 and ICE Health Systems to develop a cloud based electronic health record for dental education.

ICE Health Systems on Internet2

http://www.internet2.edu/products-services/cloud-services-applications/ice-health-systems/

Patients and care providers can all view the record for emergencies and consultations.

Acknowledgement

- Tanja Bekhuis,PhD, MS, MLIS
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- Mark Genuis, PhD
- Zsuzsa Horvath, PhD
- Jeannie Irwin, PhD
- Lynn Johnson, PhD
- Joseph Kerr, MBA, PMP
- Marcos Kreinacke, PhD
- Chris Peck, DMD, PhD
- Deborah Polk, PhD
- Marnie Oakley, DMD
- Brad Rindal, DDS
- Bill Rush, PhD
- Titus Schleyer, DMD, PhD
- Mei Song, PhD
- Thankam Thyvalikakath, MDS, MS
- Benita Valappil, MPH
- Muhammad Walji, BS, MS, PhD
- Seth Weinberg, BA, MA, PhD
- Debrah Weiner, MD
- Robert Weyant, MS, DMD, DrPH
- many more…

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http://bit.ly/Heiko-Spallek

Today's slides:
http://bit.ly/AIDPH-Spallek

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