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Biomedical and Health Informatics Year in Review: Putting the Working Groups to Work

Session: S22

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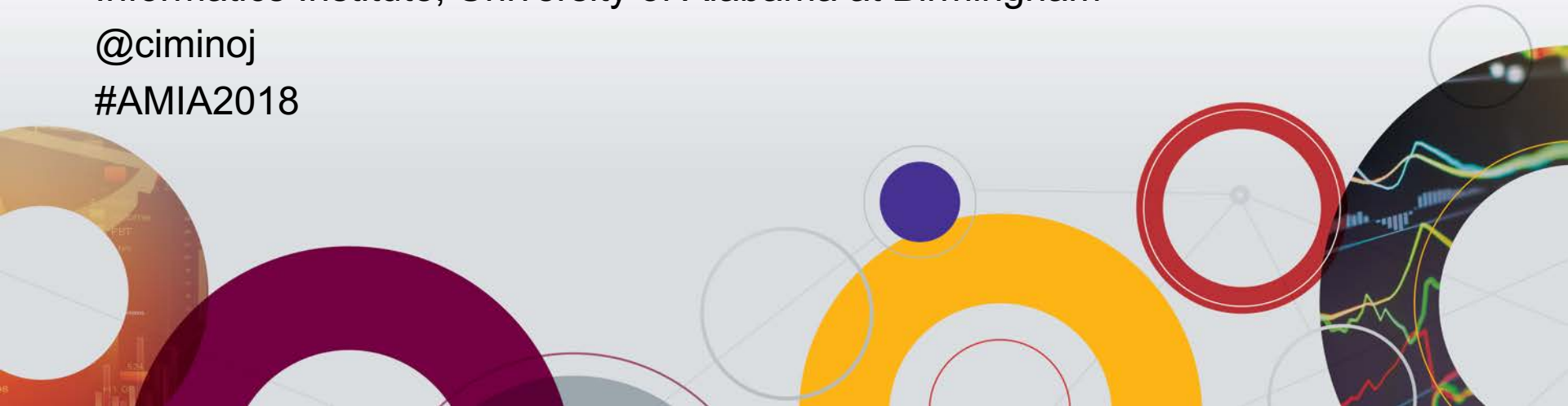
@ciminoj

#AMIA2018



Disclosure

I and my spouse have no relevant relationships with commercial interests to disclose.

Learning Objectives

After participating in this session you should be able to:

- have a sense of the full scope of informatics research
- think about which Working Groups match your interests
- be inspired to publish significant work

Overview

- Process
- Major and minor papers by WG domain
- Occasional tutorials
- Other stuff I might include
- Trying to make sense of it all
- Acknowledgements and bibliography

Year in Review Process

- Asked for volunteer(s) from each Working Group
- Excluded *Clinical Research Informatics* and *Genomics and Translational Bioinformatics*
- Volunteers given search instructions
- Told to select top 4, with justification
- I reviewed all - selected major/minor based on:
  - Justification
  - Visuals
  - Personal opinion of what is significant and cool
- The presentation is a tour of the resulting slides set resource

Search Instructions

Top journals (543,513): ("BMJ"[Journal] or "Lancet"[Journal] or "Nature"[Journal] or "N Engl J Med"[Journal] or "Ann Intern med"[Journal] or "Cancer"[Journal] or "JAMA"[Journal])

And dates (11,098): (("2017/09/01"[Date - Publication] : "3000"[Date - Publication])

And “Informatics” (223) and search WG domain

Informatics journals (10,868): "j biomed inform"[journal] or "appl clin inform"[Journal] or "int j med inform"[Journal] or "j am med inform assoc"[Journal] or "methods inf med"[Journal]

And dates (782): (("2017/09/01"[Date - Publication] : "3000"[Date - Publication])

2017 AMIA Proceedings are worthy of consideration, but at least consider the nominees for best paper (PubMed links provided)

Working Groups

Biomedical Imaging Informatics
Clinical Decision Support
Clinical Information Systems
Consumer and Pervasive Health Informatics
Dental Informatics
Education
Evaluation
Global Health Informatics
Intensive Care Informatics
Knowledge Representation and Semantics
Knowledge Discovery and Data Mining
Mental Health Informatics
Natural Language Processing
Nursing Informatics
Open Source
Pharmacoinformatics
Primary Care Informatics
Public Health Informatics
Student
Visual Analytics

Results

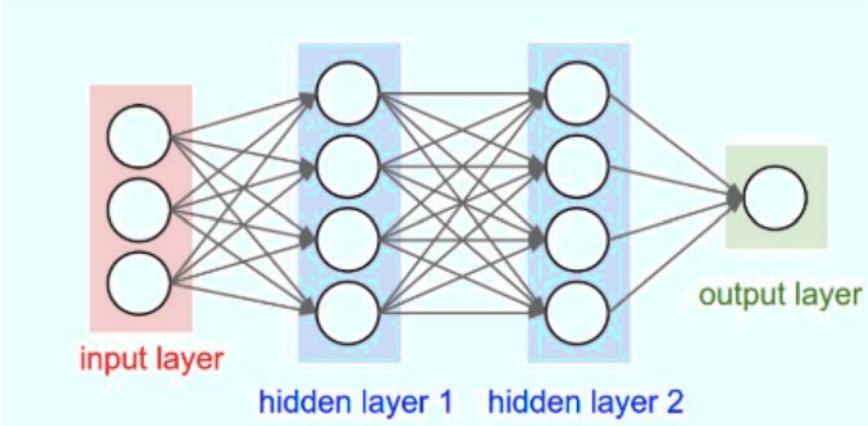
- 20 Working Groups
- 108 papers (106 unique; 2 double nominees)

A Word on My Approach to Presentations

- 67 papers presented
- Major and minor papers (one to six per topic)
- Sometimes compared/contrasted in groups
- Abbreviated citation (all papers cited at end)
- With ~ 1 minute/paper I will not be explaining a lot
- Introduce the topic and say a word on what is novel
- I apologize in advance for mangling name pronunciations

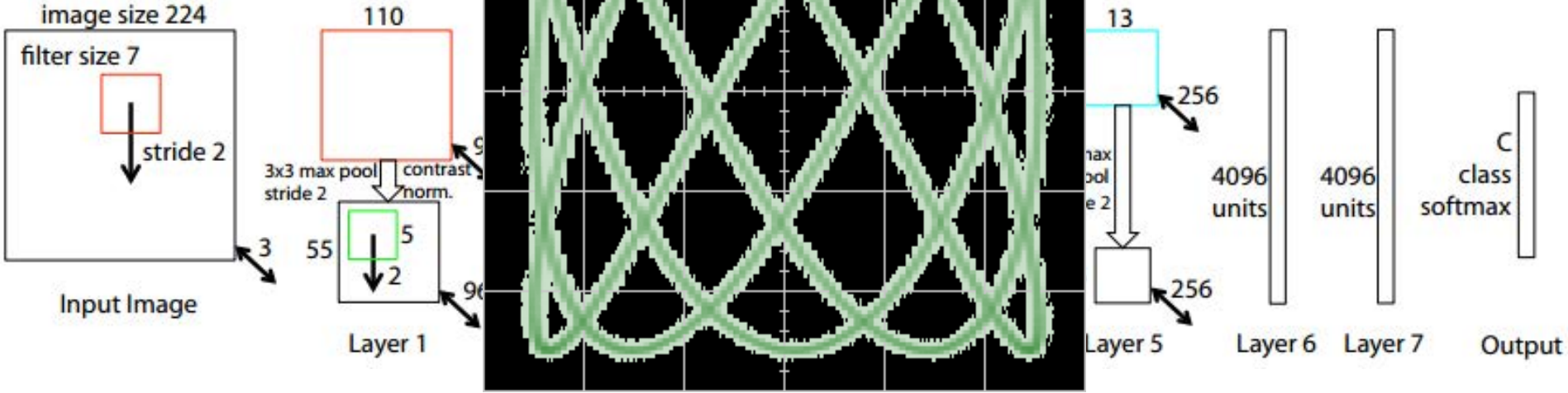
Tutorial: Deep Learning

- Think “artificial neural network” (ANN)
- Simulated set of “neurons” – each takes multiple inputs, applies weights, and send output
- Inputs can be data or outputs from other neurons
- Input weights are learned
- Zero-to-many hidden layers



Tutorial: Convolutional Neural Network (CNN)

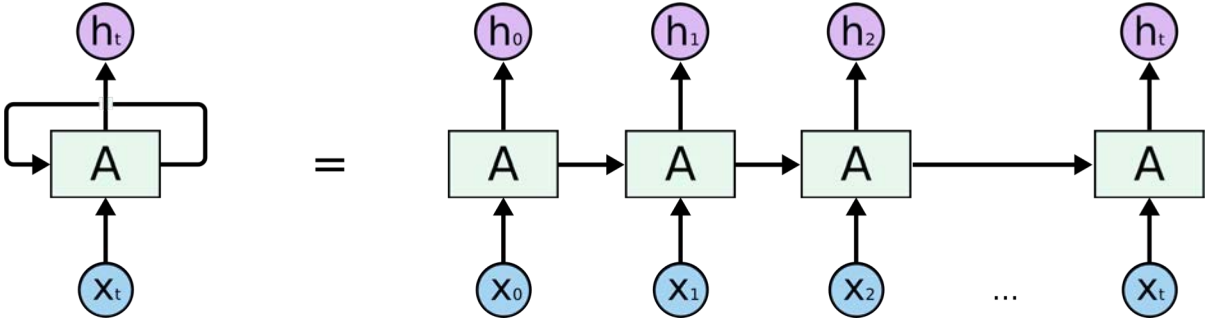
- Not “convoluted” … derived from two given functions by … es how the shape of one is modified … image processing



https://arxiv.org/abs/1311.2901

Tutorial: Recurrent Neural Network (RNN)

- Connections between nodes form a directed graph; can model temporal behavior, cycles permitted
- Useful in for voice recognition/speech understanding
- Simulate memory



http://colah.github.io/posts/2015-08-Understanding-LSTMs/

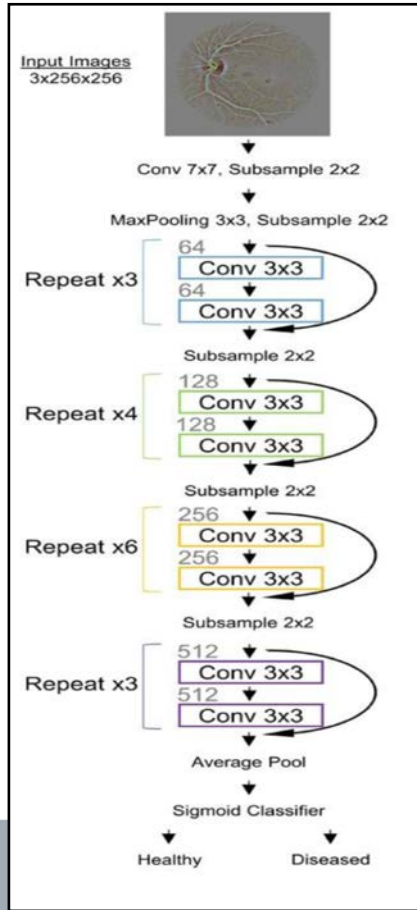
Bioimaging: Bring Mohamed to the Mountain

Ken Chang… Jayashree Kalpathy-Cramer. Massachusetts General Hospital. **Distributed deep learning networks among institutions for medical imaging.** *JAMIA*

- Rating of retinal photographs, mammograms and images from ImageNet
- Convolutional neural network with 34 layers
- Training requires large data sets
- Individual institutions may not have enough images
- Sharing data is slow and requires data sharing agreements

Bioimaging: Bring Mohamed to the Mountain

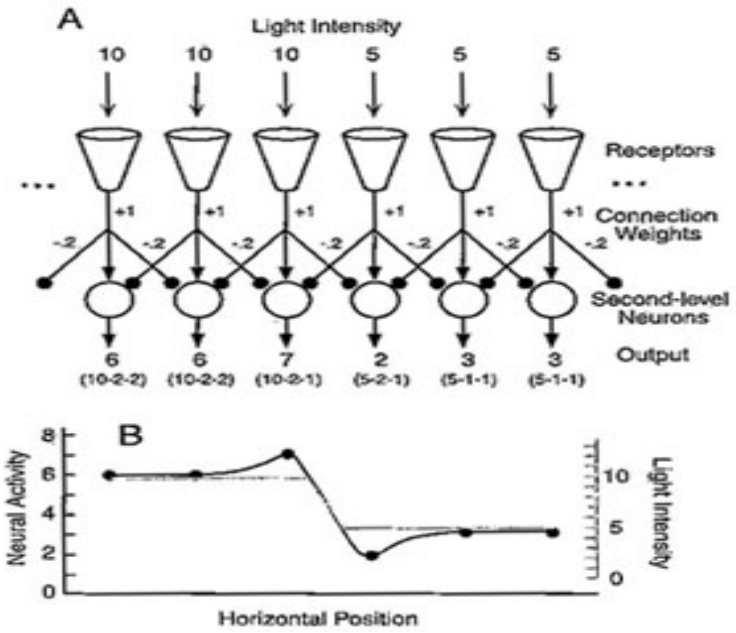
- Sharing the neural network model is easy: small, not PHI
- Model was trained with subset at each (simulated) institution
- Then passed to next (simulated) institution
- Cyclical training worked as well as pooled data



Bioimaging: Bring Mohamed to the Mountain

Serendipity:

- Retinal neurons interact to produce lateral inhibition for edge detection
- Retina is a neural net
- Retinal images studied by Chang et al.

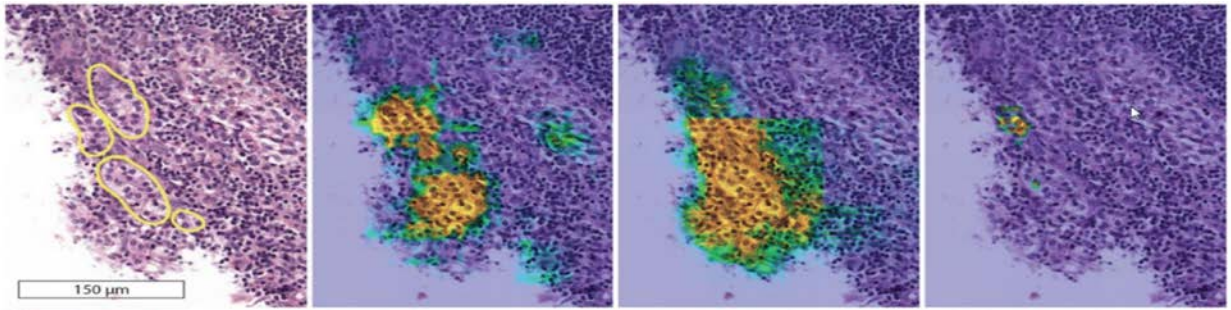


So: Chang et al. used a retinal model to simulate a retina to interpret retinal images

Bioimaging: Beating the Pathologists

Babak Ehteshami…Jeroen van der Laak J. Radboud University. **Diagnostic Assessment of Deep Learning Algorithms for Detection of Lymph Node Metastases in Women With Breast Cancer**. *JAMA*

- 23 teams, 32 algorithms, 25 were CNNs
- Mean area under the curve (AUC): top 5 algorithms 0.966 versus pathologist AUC=0.960

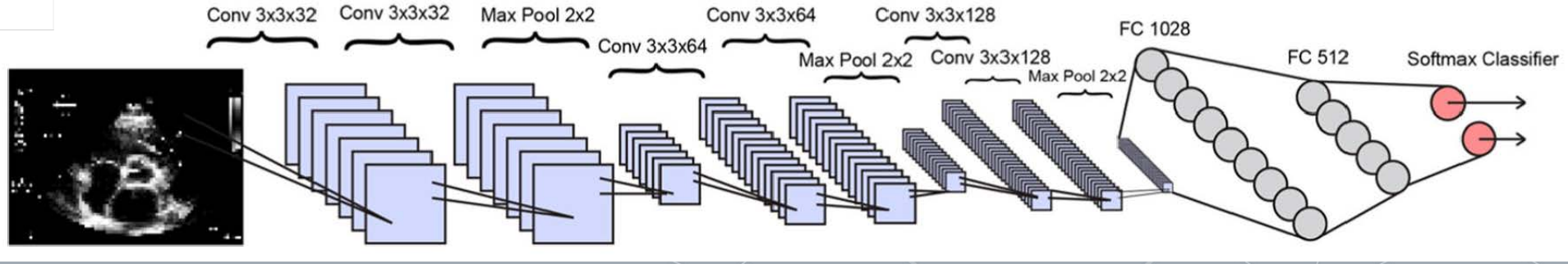


Bioimaging: Beating the Cardiologists

Ali Madani…Rima Arnaout. University of Callifornia-Berkley. **Fast and accurate view classification of echocardiograms using deep learning**. *Nature Digital Medicine*

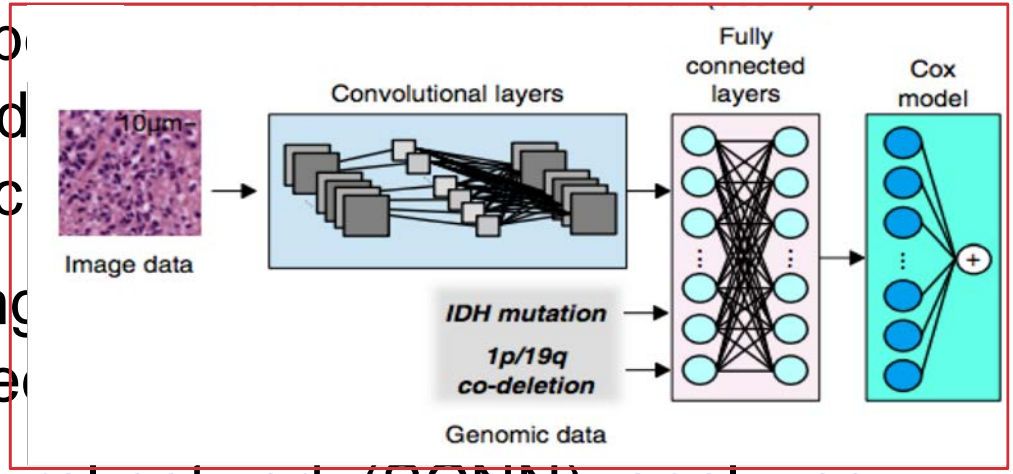
- Machine learning has "proven unreasonably successful"

- Trained only 267 echocardiograms, achieved 97.8% accuracy



Bioimaging: Mortality Prediction

Mobadersany P, et al., Coop
outcomes from histology and
networks. Proc Natl Acad Sc



- Predict time-to-event using
  data for patients diagnose
- Survival convolutional neural network (SCNN): analyzes regions of interest, feeds visual features into Cox model layer
- Genomic data fed into the fully connected layers (GSCNN)

Knowledge Discovery: Inferring Heritability

Fernanda Polubriaginof, …, Nicholas Tatonetti. Columbia University. **Disease Heritability Inferred from Familial Relationships Reported in Medical Records**. *Cell*

- Even in post-genomic era, family history is still important
- Family history is often inaccurate (“cancer”) or absent
- Family members are often patients (with personal history)
- Contact information links patients and family members
- Are family relationships associated with known inherited traits?

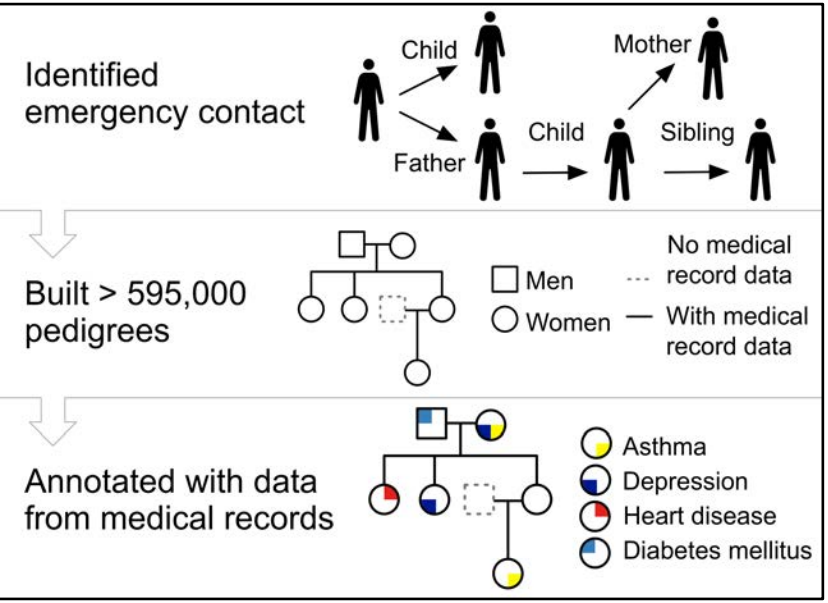
Knowledge Discovery: Inferring Heritability

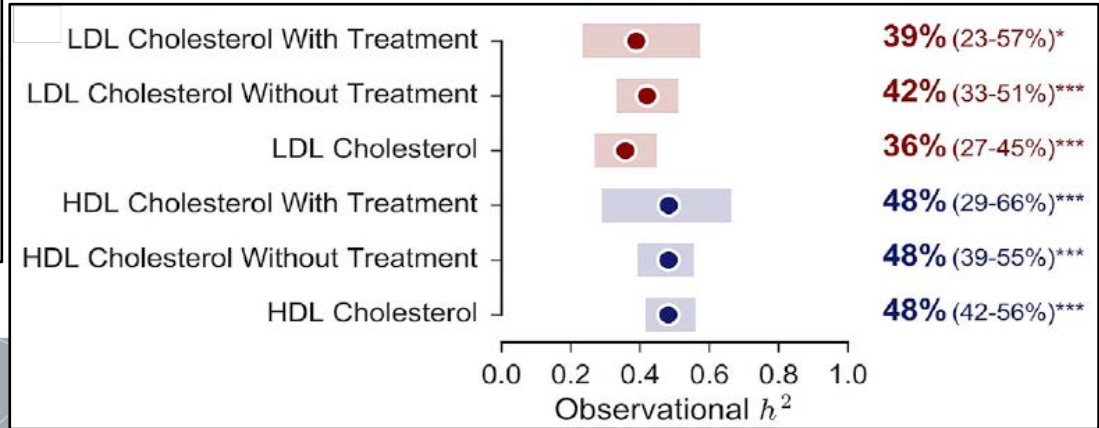
3.5M patients → 6.5M contacts → 2M patients → 1.5M add'l contacts

= 7.4M 1st – to – 4th degree relationships

= 566K families (2 to 153 members)

- Relatedness confirmed with genetic tests
- Familial co-occurrence of disease matched estimates from the medical literature



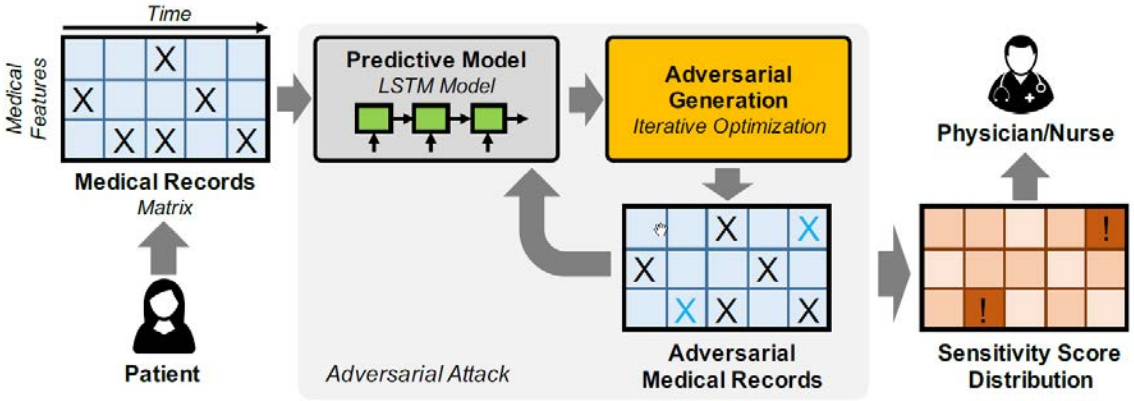


Knowledge Discovery: Attacking EHRs

Mengying Sun…Jiayou Zhou. Michigan State University. **Identify Susceptible Locations in Medical Records via Adversarial Attacks on Deep Predictive Models**. *Proceedings of the 24th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining*

- False data (“adversarial samples”) can fool machine learning
- Question: which parts of the EHR are most sensitive to errors?
- Can guide sampling rates for phenotype determination

Knowledge Discovery: Attacking EHRs



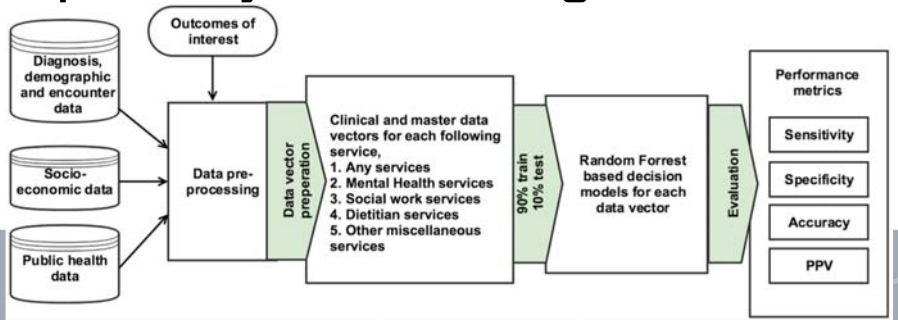
https://www.youtube.com/watch?v=uyjp973CNNA

Rank	0-1 Attack	
	Measurement	Susceptible Score
1	Na	0.64 (0.13)
2	PaCO2	0.61 (0.13)
3	HCO3	0.57 (0.13)
4	Glc	0.51 (0.12)
5	Cre	0.46 (0.15)
6	Albumin	0.39 (0.07)
7	HR	0.30 0.05)
8	Mg	0.25 (0.06)
9	BUN	0.20 (0.03)
10	K	0.19 (0.06)
11	RR	0.15 (0.08)
12	PH	0.14 (0.12)
13	SPO2	0.13 (0.11)
14	Ca	0.11 (0.04)

Knowledge Discovery: Social Determinants

Suranga Kasthurirathne…Shaun Grannis. Indiana University. **Assessing the capacity of social determinants of health data to augment predictive models identifying patients in need of wraparound social services**. *JAMIA* *

- Societal factors unemployment, “food desserts”, addiction, crime are important determinants of health status
- Inferred from publicly available geocoded databases



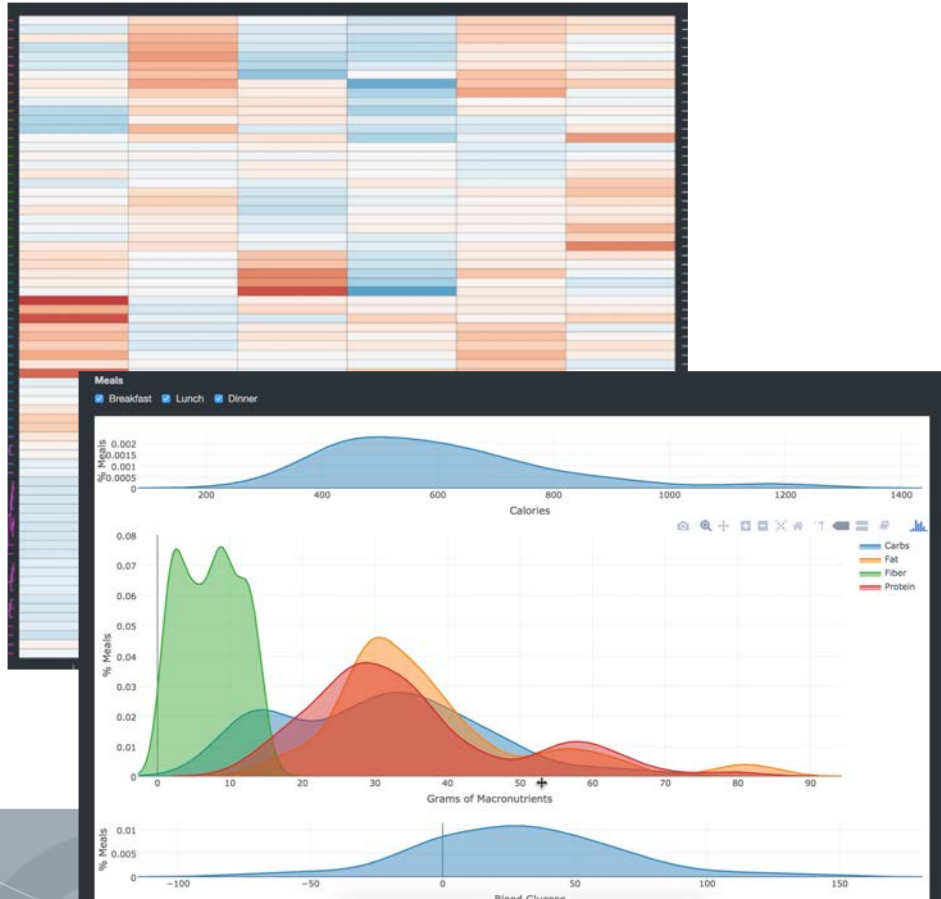
Visual Analytics: Patient-Generated Data

Daniel Feller, …, Lena Mamykina. Columbia University. **A visual analytics approach for pattern-recognition in patient-generated data**. *JAMIA*.

- Massive amounts of patient-generated data (glucometers, fitness trackers, etc.)
- Clinicians will need tools to visualize and interpret these data
- Authors developed Glucolyzer to help dieticians interpret glucose and meal data
- Examined statements made about data

Visual Analytics: Patient-Generated Data

- Heat maps of glucose and macro nutrients
- Probability density plots to help dietitians understand nutritional trends
- Users generated 50% more observations, compared to logbooks, with better accuracy



Visual Analytics: Vision Helps Visualization

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Vishakha Sharma… Subha Madhavan. Georgetown University.

Eye-Tracking Study to Enhance Usability of Molecular Diagnostics Reports in Cancer Precision Medicine. *JCO Precision Oncology*.


FOUNDATIONONE

Patient Name | Report Date 2016 | Tumor Type Pancreas ductal adenocarcinoma

Date of Birth | Medical Facility | Specimen Received 2016
Sex | Ordering Physician | Specimen Site Liver
FMI Case # | Additional Recipient | Date of Collection 2016
Medical Record # | Medical Facility ID # | Specimen Type Block
Specimen ID | Pathologist Not Provided

ABOUT THE TEST:

FoundationOne™ is a next-generation sequencing (NGS) based assay that identifies genomic alterations within hundreds of cancer-related genes.

PATIENT RESULTS

3 genomic alterations
2 therapies associated with potential clinical benefit
0 therapies associated with lack of response
6 clinical trials

TUMOR TYPE: PANCREAS DUCTAL ADENOCARCINOMA

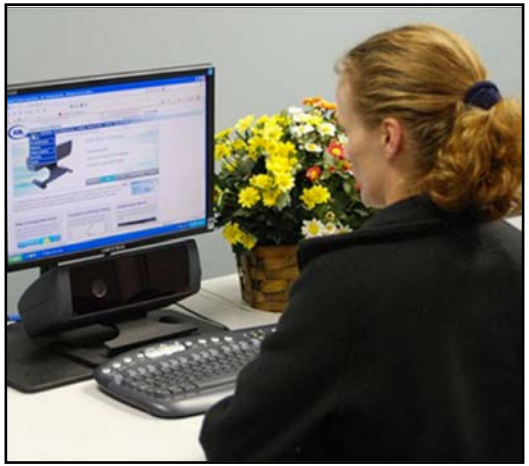
Genomic Alterations Identified†
KRAS G12D
TP53 R248Q
KDM6A R1054fs*29

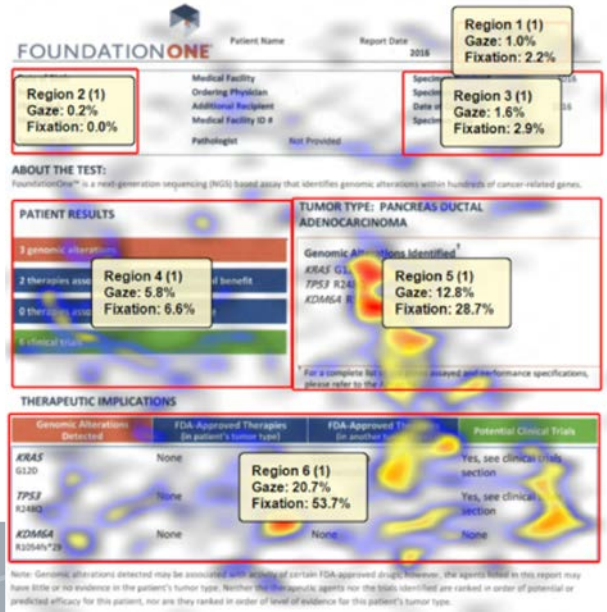
† For a complete list of the genes assayed and performance specifications, please refer to the Appendix

THERAPEUTIC IMPLICATIONS

Genomic Alterations Detected	FDA-Approved Therapies (in patient's tumor type)	FDA-Approved Therapies (in another tumor type)	Potential Clinical Trials
KRAS G12D	None	Cobimetinib Trametinib	Yes, see clinical trials section
TP53 R248Q	None	None	Yes, see clinical trials section
KDM6A R1054fs*29	None	None	None

Note: Genomic alterations detected may be associated with activity of certain FDA-approved drugs; however, the agents listed in this report may have little or no evidence in the patient's tumor type. Neither the therapeutic agents nor the trials identified are ranked in order of potential or predicted efficacy for this patient, nor are they ranked in order of level of evidence for this patient's tumor type.





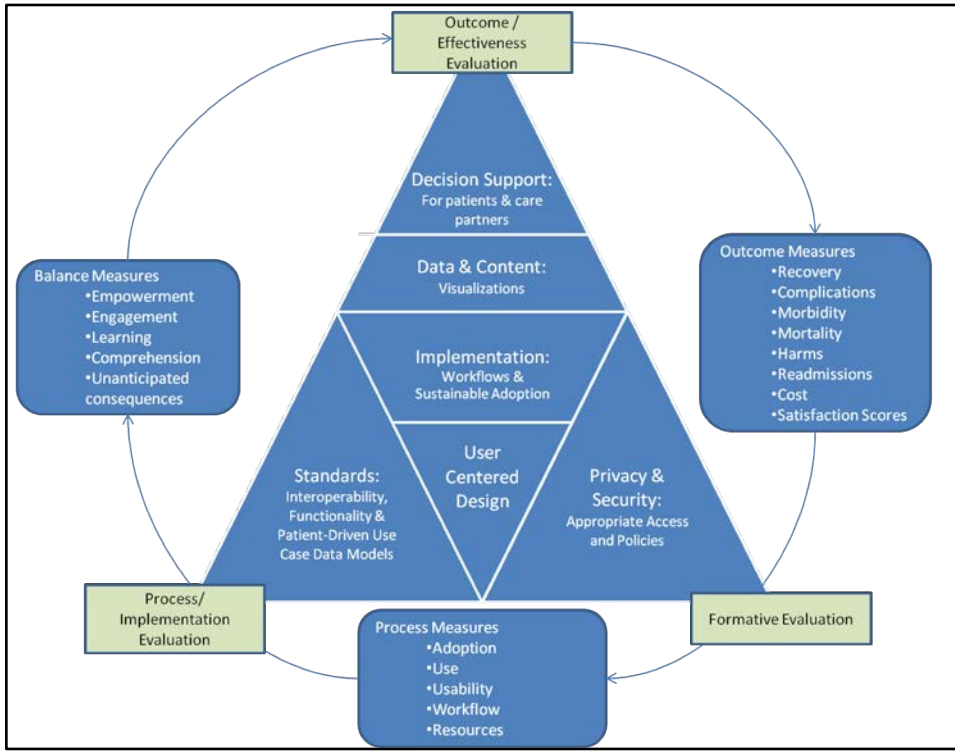
Nursing Informatics: Engagement Research

Sarah Collins, …, Anuj Dalal. **An informatics research agenda to support patient and family empowerment and engagement in care and recovery during and after hospitalization**. Brigham and Women's Hospital. *JAMIA*.

- Shorter hospitalizations → more complex transitions and post-hospitalization care
- Burden falls to patients and care partners
- 2016 Acute Care Portal Workshop (71 attendees, 30+ institutions)
- Defined sociotechnical and evaluation research needs

Nursing Informatics: Engagement Research

1. Standards (interoperability)
2. Privacy and security (remote access; proxies)
3. User-centered design (complex data, communication)
4. Implementation (adoption, cost, tech support, integration)
5. Data and content (EHR, knowledge)
6. Clinical decision support (slips and mistakes)
7. Measurement (standards, formative assessments, outcomes)



Nursing Informatics: Applied Research

Megha Kalsy, …, Katherine Sward. Salt Lake City VA Healthcare System. **Role of Nursing Informatics in the Automation of Pneumonia Quality Measure Data Elements**. *Computers, Infor*

"The role of nurse informaticists includes the use of knowledge within local nursing documentation artifacts and binding these to standard terminologies and models in a manner sufficient to support eMeasures."

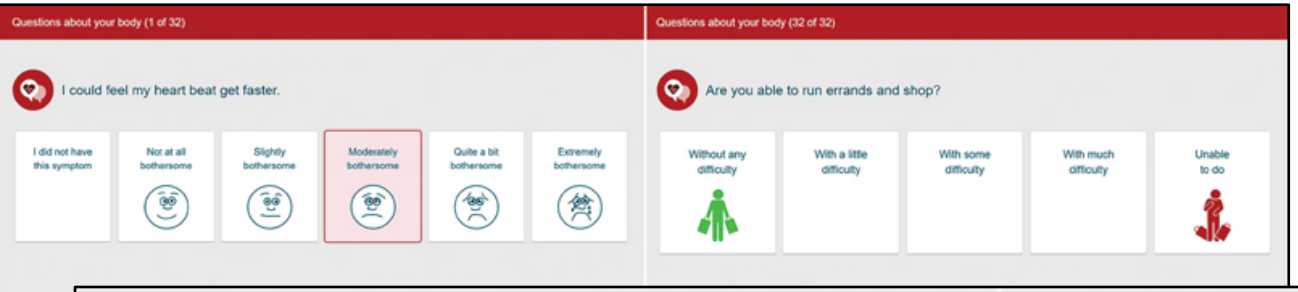
- Qu
- Ma s
- Can core measure reporting be automated using existing data?
- Trials and tribulations are described

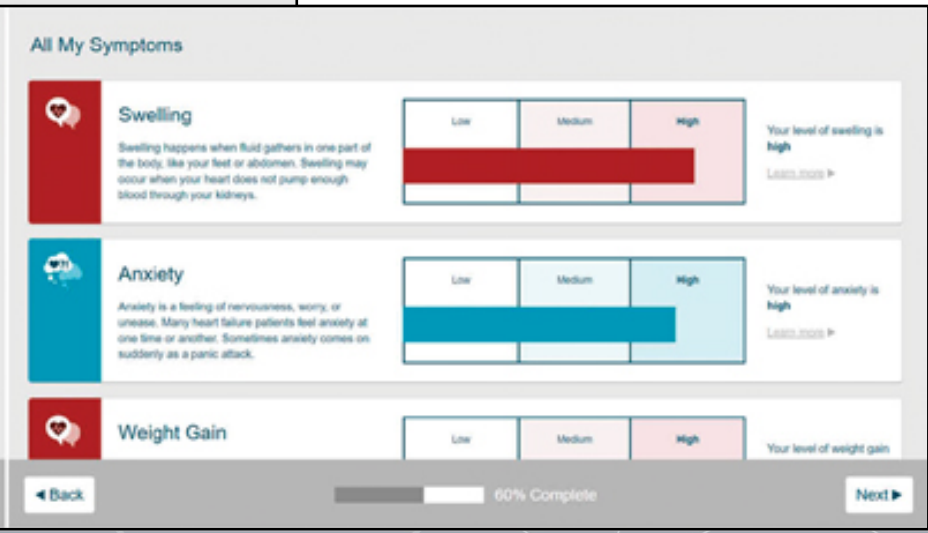
Nursing Informatics: Visualizing PROs

Lisa Grossman, … Ruth Masterson. Columbia University. **Leveraging Patient-Reported Outcomes Using Data Visualization**. *Applied Clinical Informatics*.

- Patient and clinician interviews to assess perception PRO value
  - They help patient reflect on their symptoms
  - Questions, answer choices and results are difficult to interpret
- Built and evaluated usability of visualization tools

Nursing Informatics: Visualizing PROs



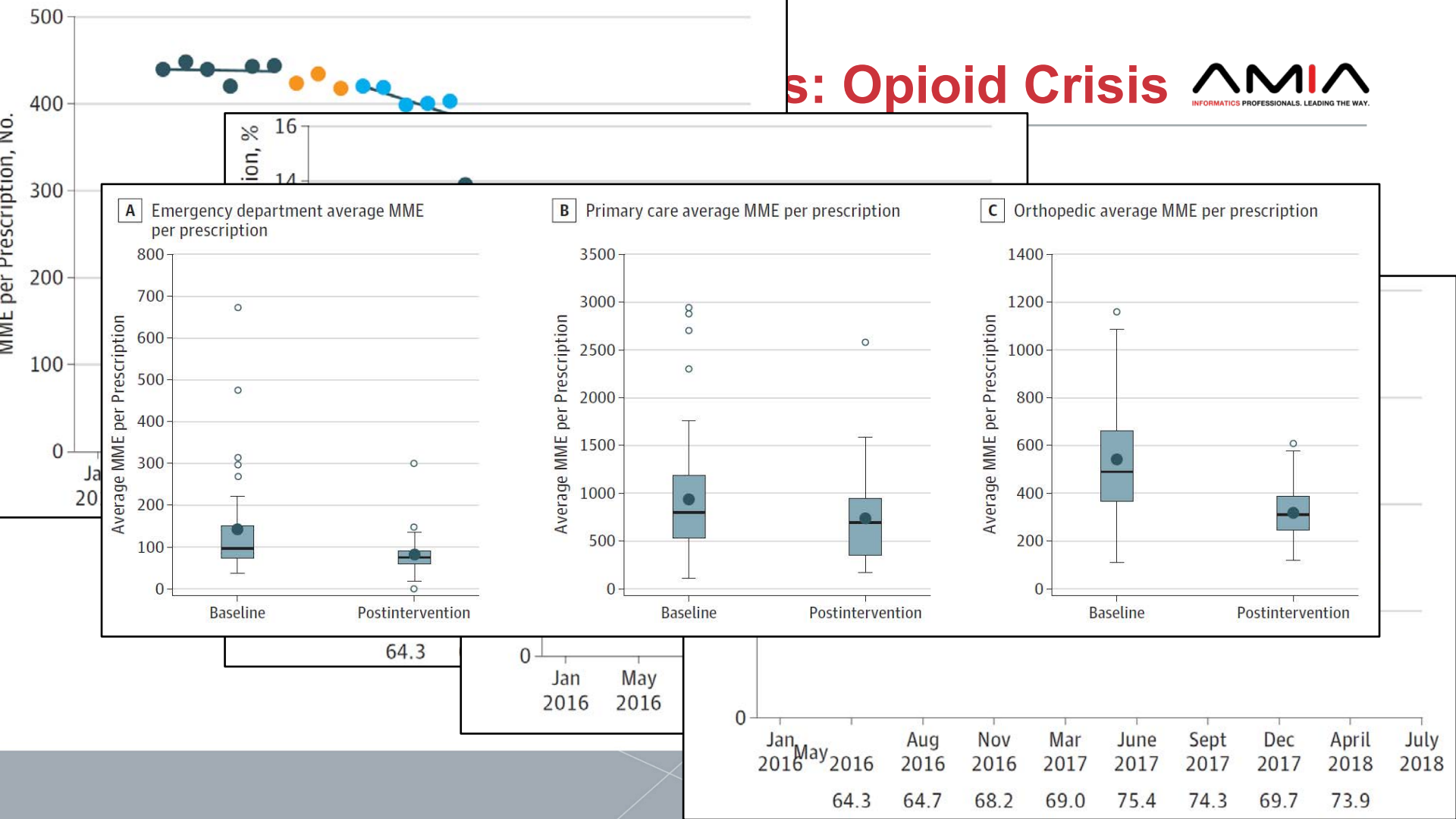


Clinical Information Systems: Opioid Crisis

Barry Meisenberg, …, Daniel Korpon. Anne Arundel Health System. **Assessment of Opioid Prescribing Practices Before and After Implementation of a Health System Intervention to Reduce Opioid Overprescribing.** *JAMA Network Open*.

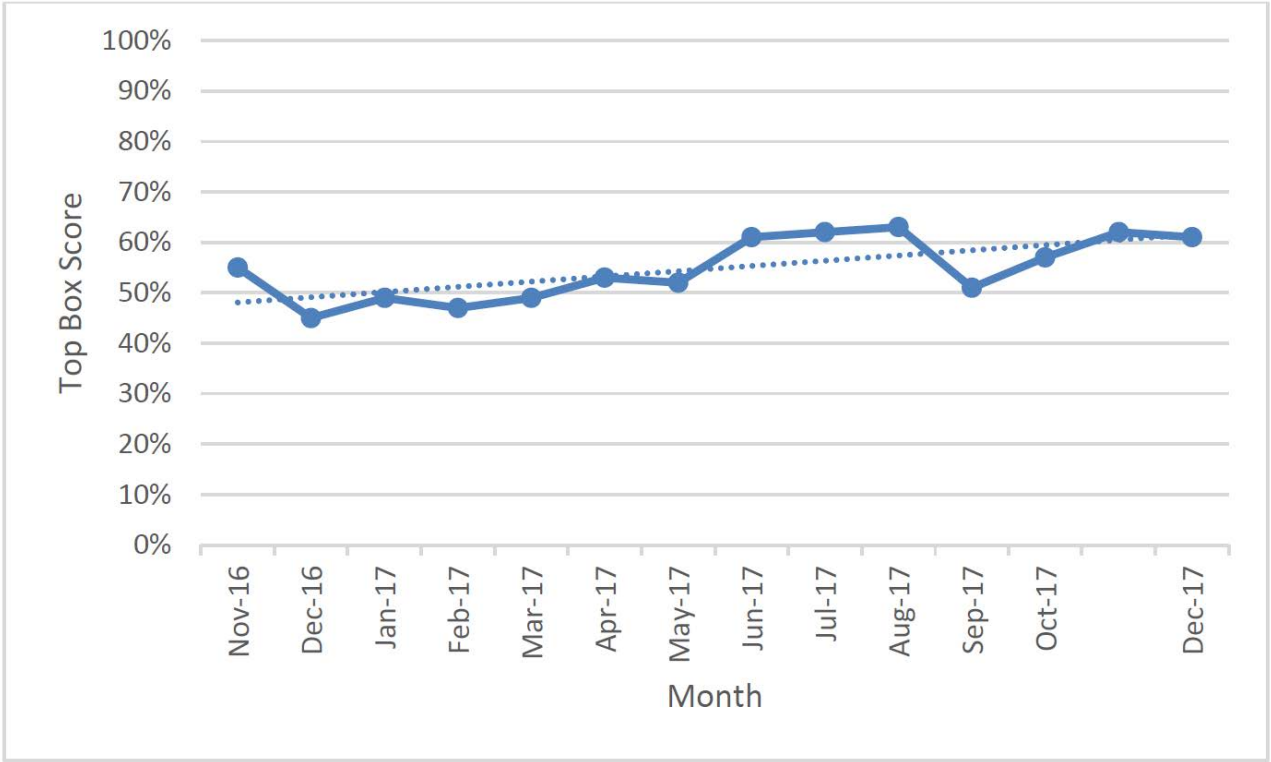
- Interventions:
  - Prescriber education and accountability
  - Enhanced oversight
  - Discharge prescription tools
  - Reduction in standard amounts in orders
  - Patient and public education material
- Opioids per prescription, prescriptions per month

s: Opioid Crisis



Clinical Information Systems: Opioid Crisis

- Multi-prc ffect
- Strong p
- Other he ıg and *infor*
- Multiple prescript
- And wha prescript



Clinical Information Systems: Data Capture

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Northern C cribes in
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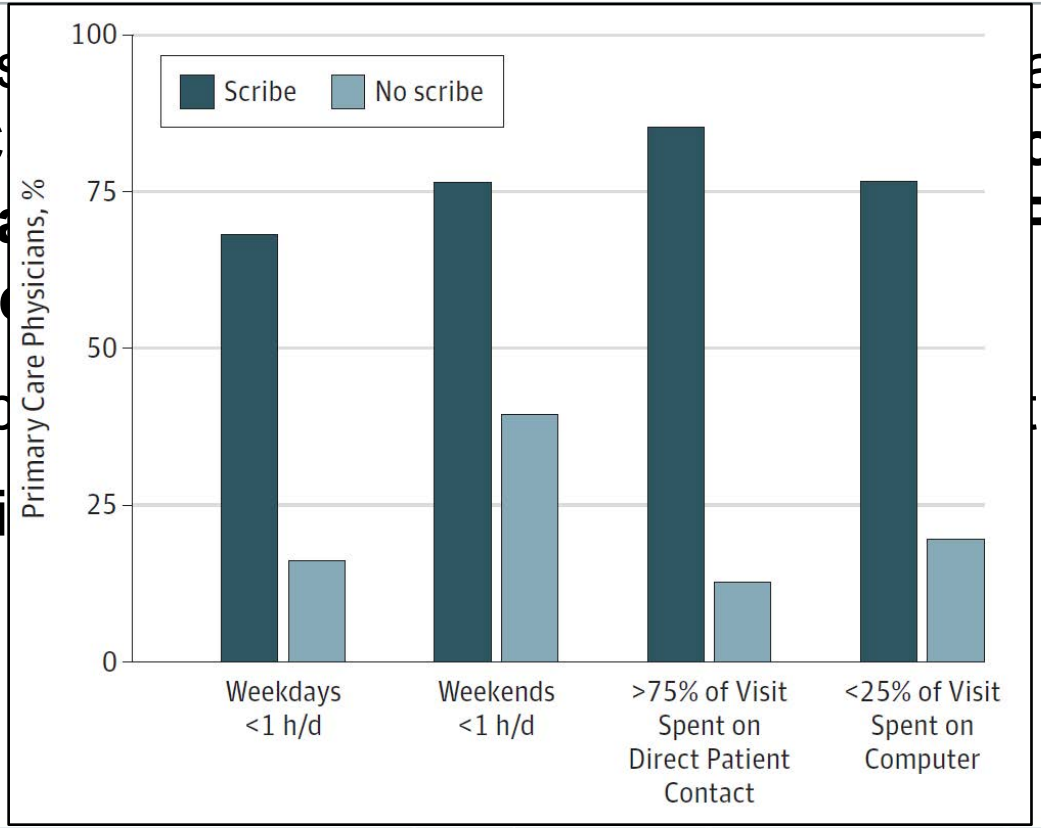
Experienc

- Transcrib time
- Randomi



Clinical Information Systems: Data Capture

Thomas Payne, … Andrew White. University of Washington. **Using voice to create hospital progress notes: Description of a mobile application and supporting system integrated with a commercial electronic health record**. *JBI*

- Mobile phone with transcription
- Sent to in-box for use in note construction

http://depts.washington.edu/simcentr/temp/vgeen/ahrq-2.mp4

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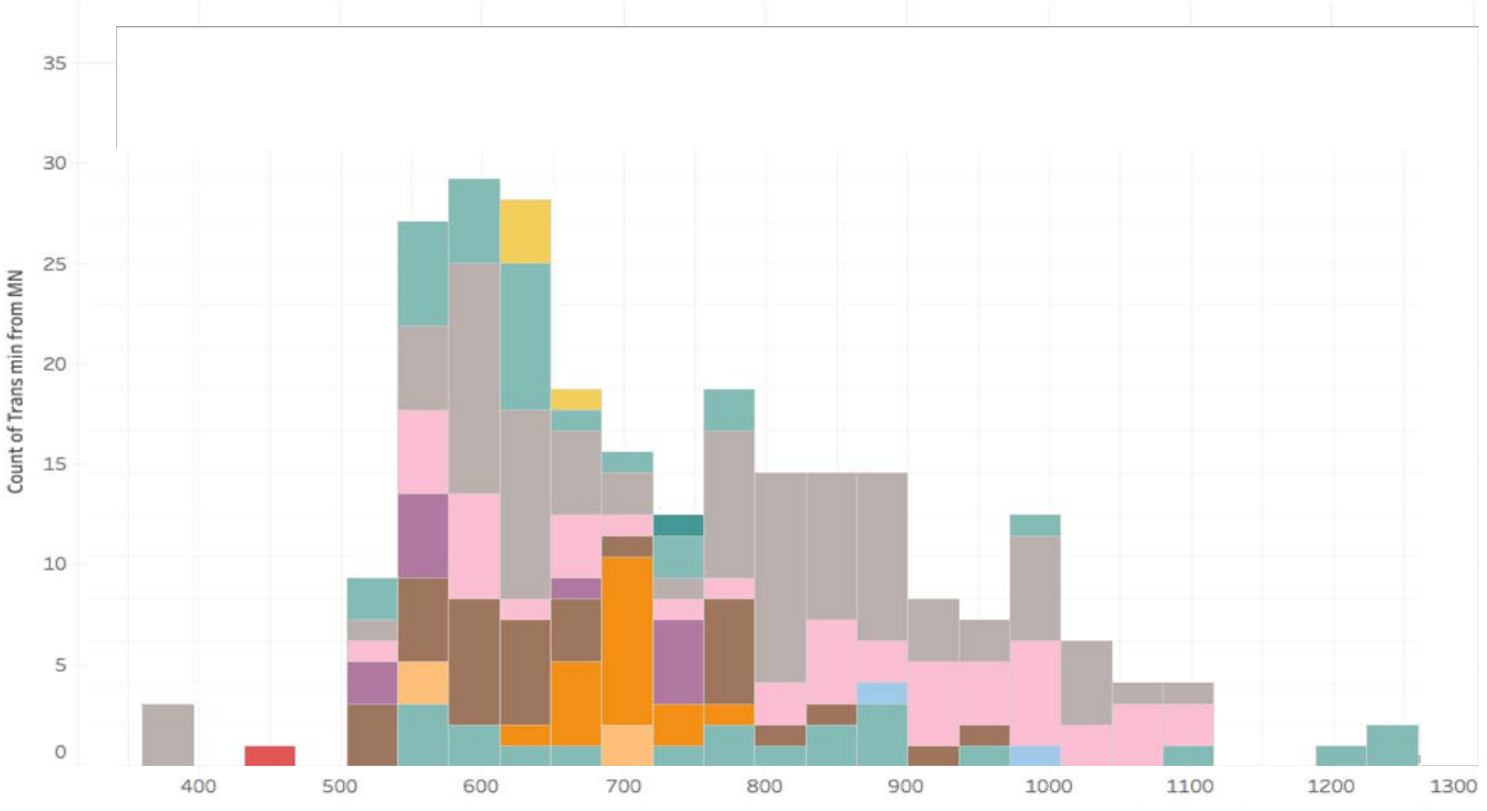
Minutes of Note Transcription Post-Midnight



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- Checked note quality

http://depts.washington.edu/simcentr/temp/vgeen/ahrq-2.mp4

Clinical Information Systems: Data Capture

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INPATIENT PROGRESS NOTE

HOSPITAL DAY: 3

IDENTIFICATION/CHIEF CONCERN: with depression admitted after suicide attempt by ingestion

INTERVAL HISTORY:
Evaluated and deferred by MHP yesterday
Feels much better physically today but feels trapped
"Even in jail I wasn't tied down"
No events overnight
Feeling fine, just wants to go home

ALLERGIES:
NKA

SCHEDULED MEDICATIONS:
magnesium oxide 800 mg PO Daily

PHYSICAL EXAM:
T 36.4 HR BP MAP 76 O2 Sat 98% on RA
In: ; Out: 0; Net: *(last 24 hours)*

GEN: young woman sitting up in bed, awake and alert. Smiling and engaged with boyfriend, quite cooperative with me
HEENT: PERRL, sclera anicteric, OP clear w/MMM
CV: RRR no
: CTA bl with normal respiratory effort
: +BT soft NT ND
: warm, no edema, locked restraint L R ankle
Skin: warm and dry
Neuro/psych: minimal significant engagement, cooperative with exam, brighter affect, MAE

LABS: *(Most recent results in last 24 hours range.)*

RESULTS FROM TODAY

RESULTS FROM YESTERDAY
02/17/16 17:35

No CBC Results Found.
salicylate level 2/17 < 3

ASSESSMENT & PLAN:

with depression/anxiety and h/o prior suicide attempts admitted to the ICU 2/14 after attempting suicide by ingesting diphenhydramine, ASA, and . MHP detained patient, medically cleared for psych when bed available.

Suicide attempt: She had called her boyfriend and reported taking 48 tablets of , 44 tabs of PM (, ASA,). Unclear trigger. Declining to engage with psych for eval so MHP called. Boyfriend is at bedside, appears very supportive. Toddler daughter is with patient's mother, came in for visit

Identification/chief complaint:
This is a -year-old woman with metastatic adenocarcinoma of unknown primary mostly involving the hip head then started and sternum admitted for pain.

Interval history:
Continues to have poorly controlled pain. She thinks her leg pain is slightly better but her chest pain continues to worsen. Her fentanyl PCA was increased further to 75 µg incremental doses with the addition of a 75 µg per hour continuous infusion. We discussed the balance between function and pain control and she may have to sacrifice wakefulness/function in order to achieve the level of pain control that she desires. She is recognizing that it may not be possible to stay awake and have improved pain level. Of note, the hospice agency has introduced the idea of sending her home directly with the 24 hour nurse.
Significantly increased pain overnight. Her fentanyl PCA had been reduced from 50 to 25 but she required several subsequent boluses. She is in significant pain this morning and is barely able to speak as a result of that. Her pain is again located in the hips and also in the chest. She also had a discussion with her oncologist earlier this hospitalization about death with dignity and had another discussion with Dr. Carolyn Sy this morning who acted as a second opinion. The social worker for the death w/ dignity program will meet with her as well.

Medications:
Medications were reviewed. For pain, she has an intrathecal pump and with morphine and bupivacaine. She also is on a fentanyl PCA with an incremental dose of 75 mg and a continuous infusion at 75 µg per hour mcg.

Physical exam:
Vitals: Temperature 36.2 37.3, heart rate 76-90, respiratory rate 12-18 15-16, oxygen saturation 95-97%, 98% on room air, blood pressure 88-898/48-85 86-98/52-62
General: Thin frail Chronically ill-appearing woman lying in bed grimacing in clear distress
HEENT: Dry oral mucosa
Cardiovascular: Regular rate and rhythm
Respiratory: Breathing is unlabored, Normal respiratory effort and rate is completely normal on room air, lungs are clear anteriorly
Abdomen: Soft, nondistended
Neuro: She is fully awake Alert and oriented, no signs of somnolence x4

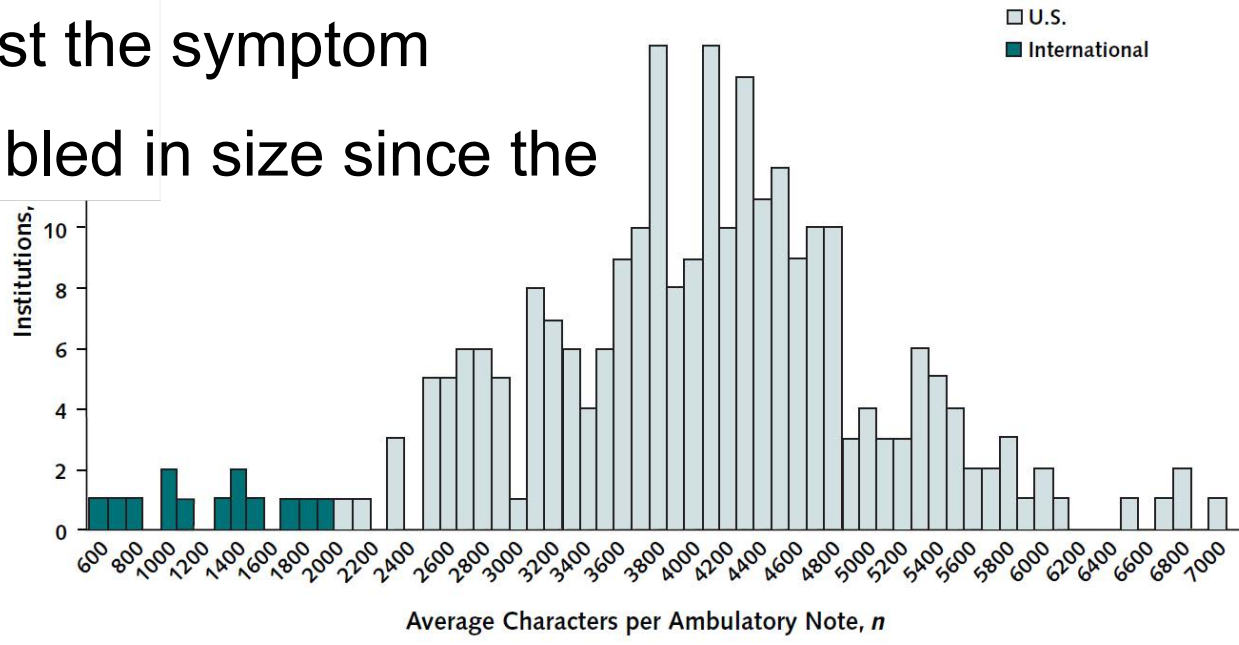
Assessment and plan:
This is a -year-old woman with adenocarcinoma of unknown primary admitted for uncontrolled cancer related pain in the left hip and sternum. She remained remains inpatient due to poorly controlled for titration of her pain with a planned medications before discharge to inpatient hospice.

1. Acute on chronic pain: He continues to be Her pain was very poorly controlled overnight. Her fentanyl PCA dose has subsequently

Clinical Information Systems: Burnouts

Lance Downing, … Chris Longhurst. Stanford University. **Physician Burnout in the Electronic Health Record Era: Are We Ignoring the Real Cause?** *Annals of Internal Medicine*.

- Maybe the EHR is just the symptom
- EHR notes have doubled in size since the Affordable Care Act



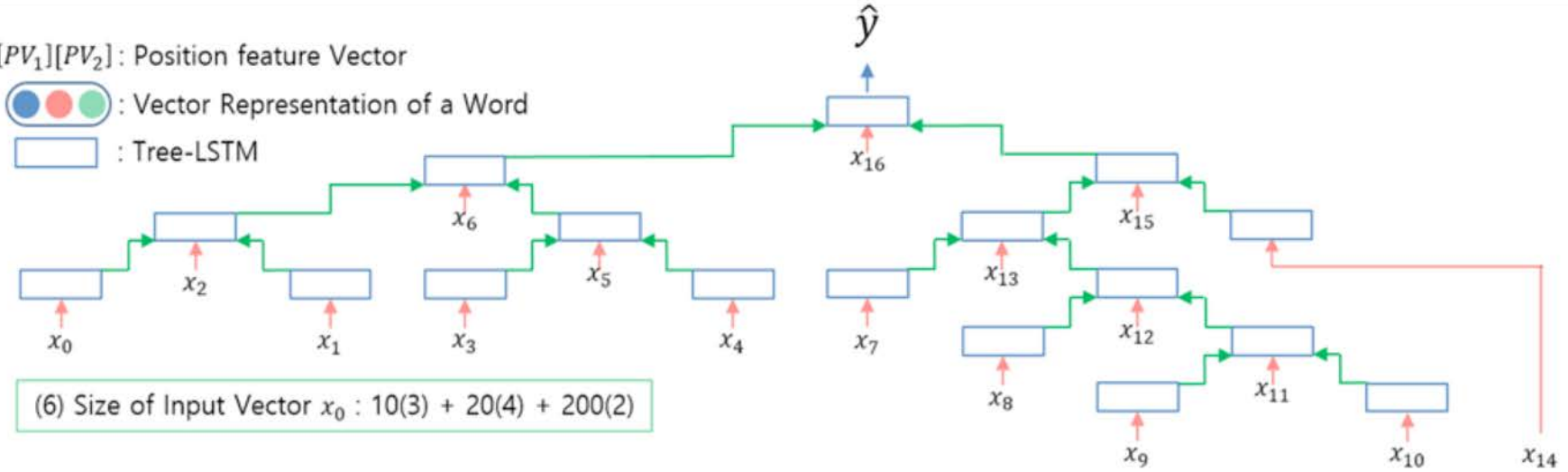
Tutorial Time: Embedding

- A language modeling technique in which words are mapped to vectors of numbers
- Semantically similar words usually have close embedding vectors
- https://www.analyticsvidhya.com/blog/2017/06/word-embeddings-count-word2veec/

$[PV_1][PV_2]$: Position feature Vector

: Vector Representation of a Word

: Tree-LSTM



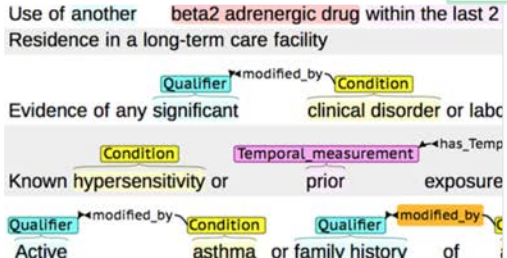
(6) Size of Input Vector x_0 : 10(3) + 20(4) + 200(2)

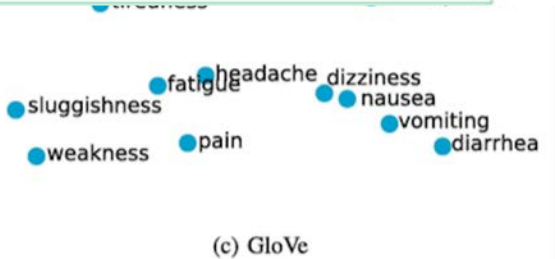
(1)	The	metabolism	of	Ddrug0	is	accelerated	by	Ddrug1	;	
(2)										
(3)	[0 0 ... 0]	[0 0 ... 0]	[0 0 ... 0]	[1 1 ... 1]	[0 0 ... 0]	[0 0 ... 0]	[0 0 ... 0]	[1 1 ... 1]	[0 0 ... 0]	
(4)	$[PV_1][PV_2]$	$[PV_1][PV_2]$	$[PV_1][PV_2]$	$[PV_1][PV_2]$	$[PV_1][PV_2]$	$[PV_1][PV_2]$	$[PV_1][PV_2]$	$[PV_1][PV_2]$	$[PV_1][PV_2]$	

(5) : [1 1 0 0 0 0 0 0 0 0 0] [1 1 0 0 0 0 0 0 0 1]

Sangra

the lite





(c) GloVe

(d) Google News

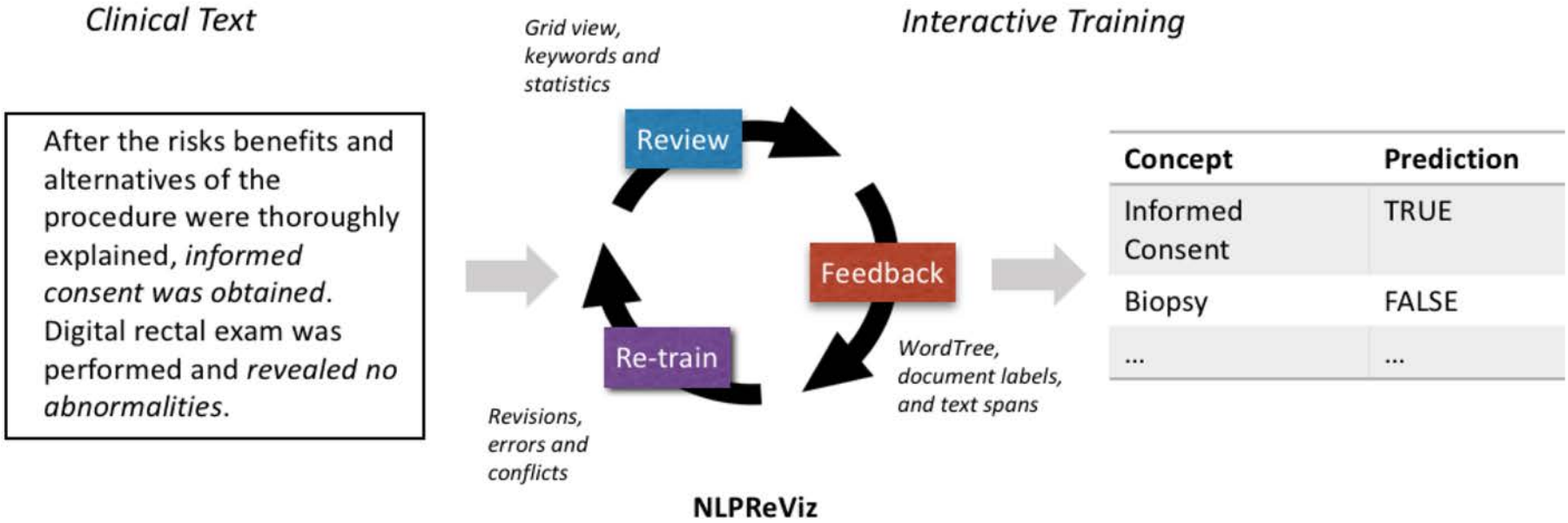
NLP: What went wrong?

Sangrak Lim…Jaewoo. Korea University. **Drug drug interaction extraction from the literature using a recursive neural network**. *PLoS One*

PAS_ReSC	True	There is usually complete cross-resistance between PURINETHOL*drug0*(mercaptopurine*drug1*) and TABLOID*drug2* brand Thioguanine*drug3*.
DEP_ReSC		
Our Model (	True	The bioavailability of SKELID*drug0* is decreased 80% by calcium*drug1*, when calcium*drug2* and SKELID*drug3* are administered at the same time, and 60% by some aluminum*drug4*—or magnesium*drug5* -containing antacids*drug6*, when administered 1 hour before SKELID*drug7*.
Our Model (		
	False	The drug interaction between proton pump inhibitors*drug0* and clopidogrel*drug1* has been the subject of much study in recent years.

NLP: Review and Revision

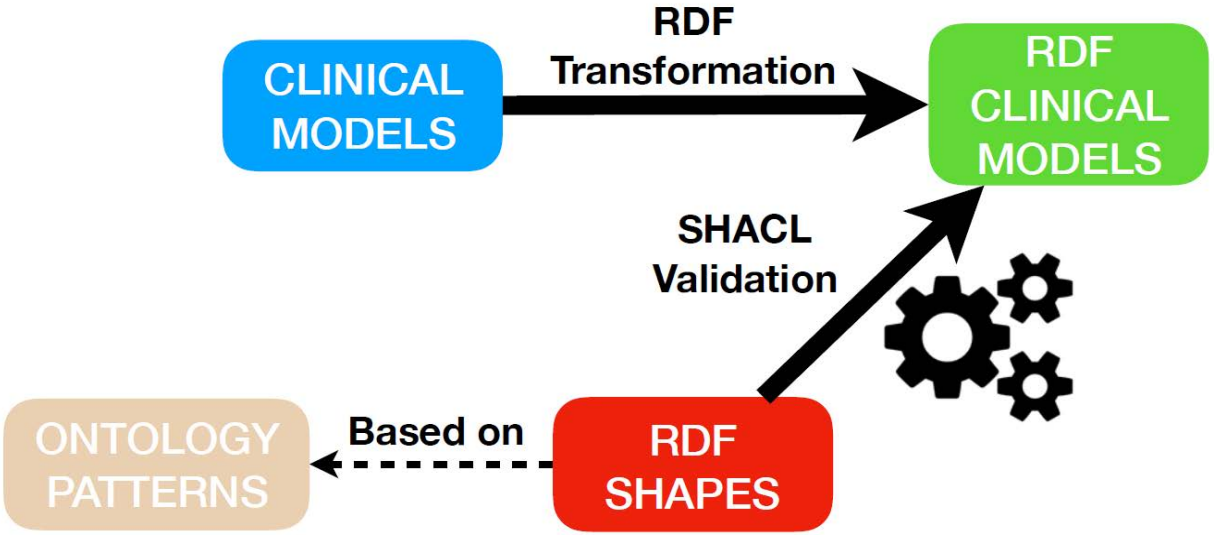
Gaurav Trivedi…Harry Hochheiser. University of Pittsburgh. **NLPReViz: an interactive tool for natural language processing on clinical text**. *JAMIA*

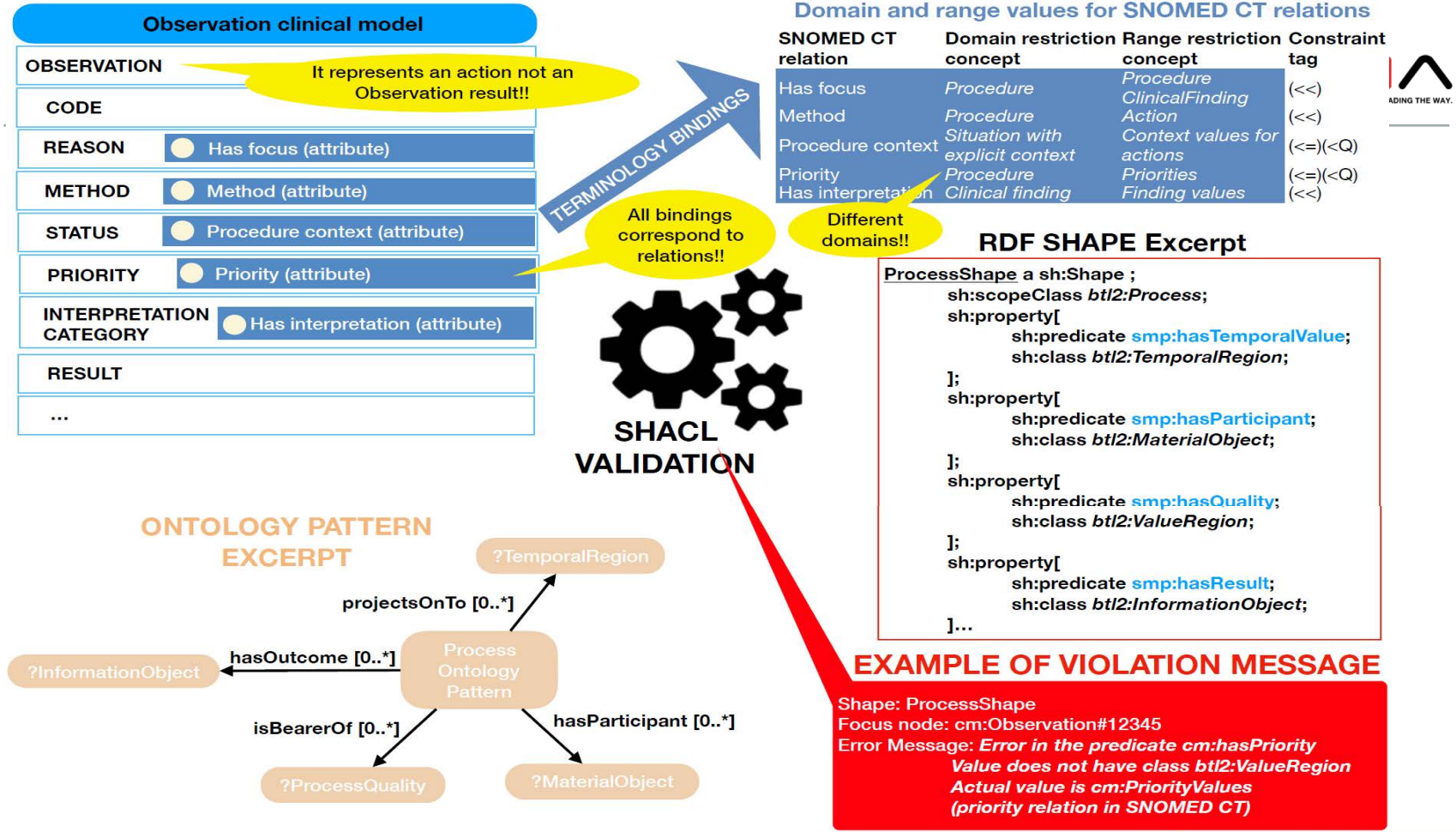


https://drive.google.com/file/d/1Cvq7IH5mymufbNr53j4nj4qO7rvxRI_E/view?usp=sharing

Knowledge Rep: EHR Modeling

Catalina Martínez-Costa and Stefan Schulz S. Medical University of Graz. **Validating EHR clinical models using ontology patterns**. *JBI*

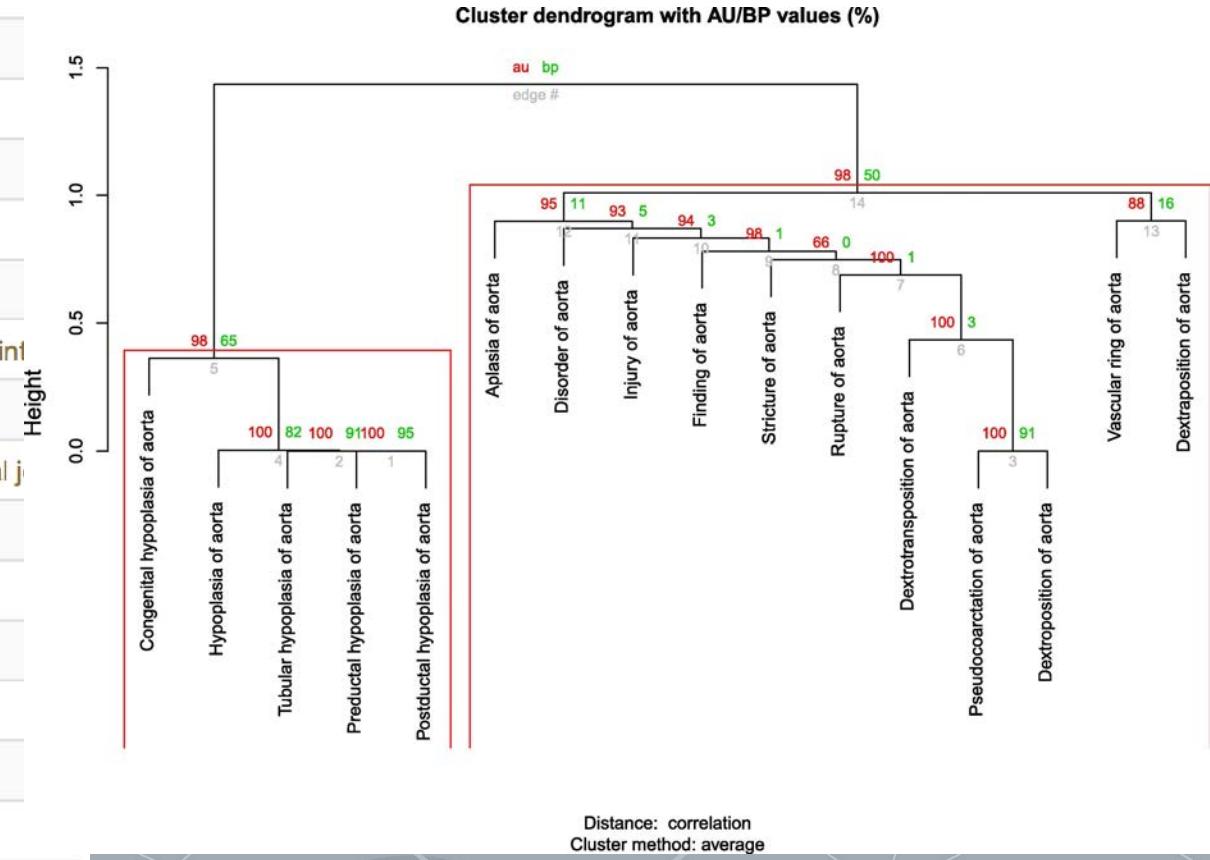



Observation clinical model
OBSERVATION
It represents an action not an Observation result!!
CODE
REASON
Has focus (attribute)
METHOD
Method (attribute)
STATUS
Procedure context (attribute)
PRIORITY
Priority (attribute)
INTERPRETATION CATEGORY
Has interpretation (attribute)
RESULT
...
TERMINOLOGY BINDINGS
All bindings correspond to relations!!
Domain and range values for SNOMED CT relations
SNOMED CT relation
Domain restriction concept
Range restriction concept
Constraint tag
Has focus
Procedure
Procedure ClinicalFinding
(<<)
Method
Procedure
Action
(<<)
Procedure context
Situation with explicit context
Context values for actions
(<=)(<Q)
Priority
Procedure
Priorities
(<=)(<Q)
Has interpretation
Clinical finding
Finding values
(<<)
Different domains!!
SHACL VALIDATION
RDF SHAPE Excerpt
ProcessShape a sh:Shape ;
sh:scopeClass btl2:Process;
sh:property[
sh:predicate smp:hasTemporalValue;
sh:class btl2:TemporalRegion;
];
sh:property[
sh:predicate smp:hasParticipant;
sh:class btl2:MaterialObject;
];
sh:property[
sh:predicate smp:hasQuality;
sh:class btl2:ValueRegion;
];
sh:property[
sh:predicate smp:hasResult;
sh:class btl2:InformationObject;
]...
ONTOLOGY PATTERN EXCERPT
?TemporalRegion
projectsOnTo [0..*]
?InformationObject
hasOutcome [0..*]
Process Ontology Pattern
isBearerOf [0..*]
hasParticipant [0..*]
?ProcessQuality
?MaterialObject
EXAMPLE OF VIOLATION MESSAGE
Shape: ProcessShape
Focus node: cm:Observation#12345
Error Message: Error in the predicate cm:hasPriority
Value does not have class btl2:ValueRegion
Actual value is cm:PriorityValues
(priority relation in SNOMED CT)
cm:hasPriority rdf:Property;
rdfs:subPropertyOf smp:hasQuality

Knowledge Rep: Ontology Management

Philip
Amst
for t
onto

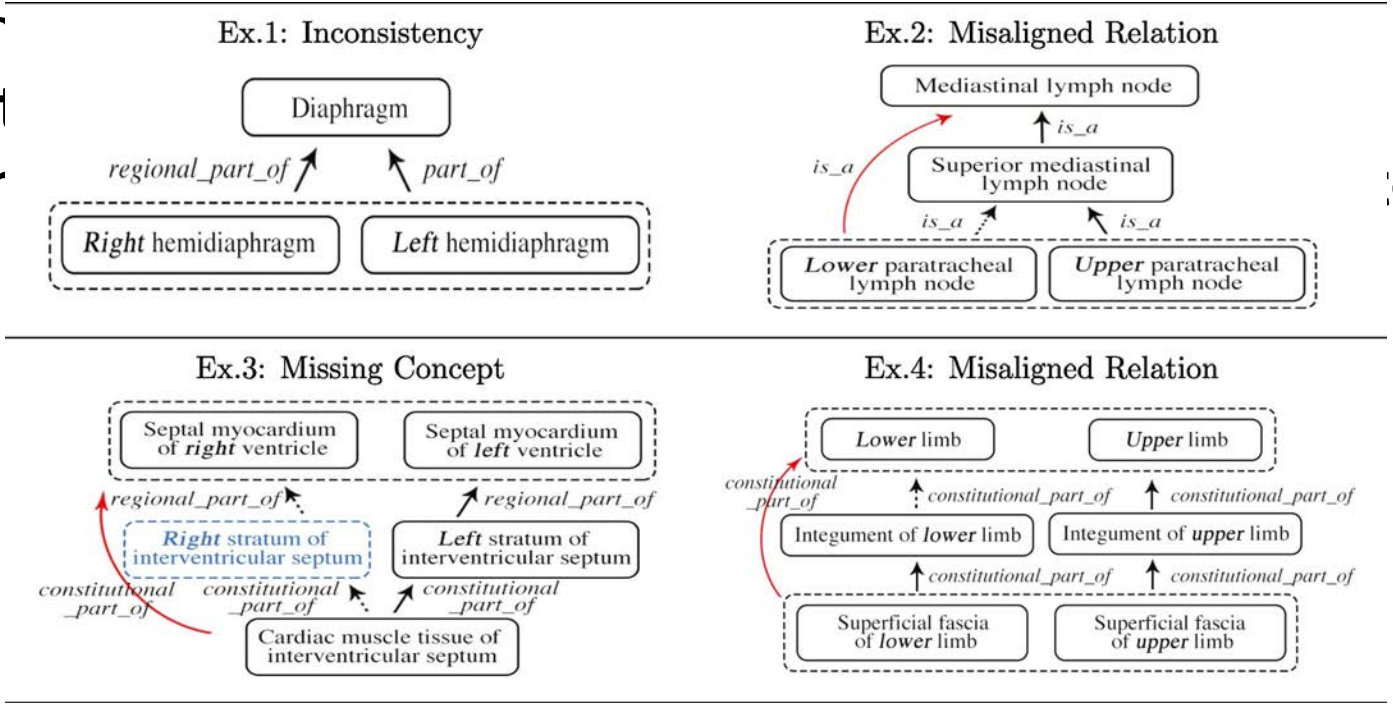
- Chronic osteoarthritis
- Osteoarthritis of spinal facet joint
- Osteoarthritis of foot joint
- Osteoarthritis of finger joint
- Osteoarthritis of toe joint
- Osteoarthritis of distal interphalangeal joint
- Osteoarthritis of knee
- Osteoarthritis of proximal interphalangeal j
- Osteoarthritis of glenohumeral joint
- Osteoarthritis of elbow
- Patellofemoral osteoarthritis
- Interphalangeal osteoarthritis
- Osteoarthritis of ankle
- Osteoarthritis
- Osteoarthritis of hip



Knowledge Rep: Ontology Management

Lingyur
Evalua
relatior
quality

owards



Knowledge Rep: Ontology Management

Alejandro …Michael Lawley. Royal Brisbane and Women's Hospital. **Ontoserver: a syndicated terminology server**. *J Biomed Semantics*

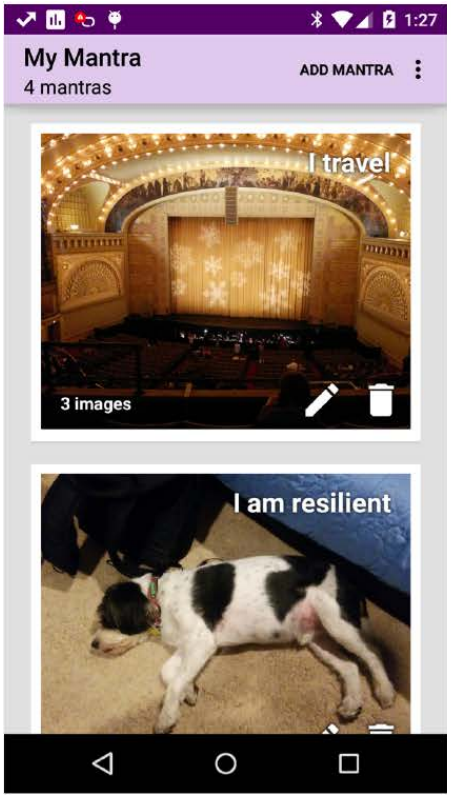
https://www.youtube.com/watch?v=7BE8Vx6h6rY

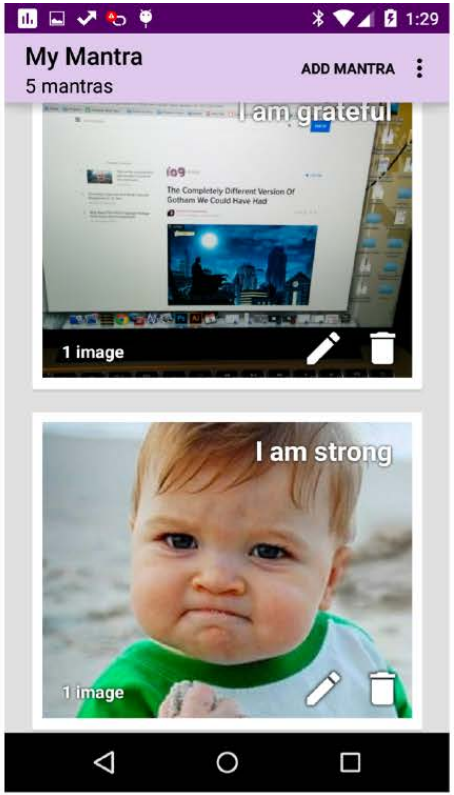
Mental Health: App Loyalty

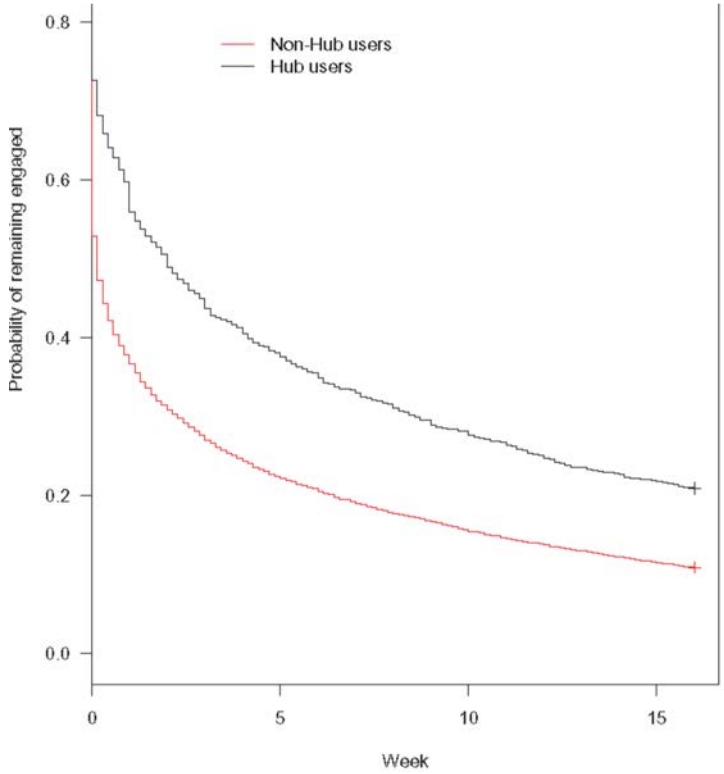
Ken Cheung…David Mohr. Co
of a recommender app for ap
depression and anxiety: an a
engagement. *JAMIA*

- Mobile phone apps can fill a
- People with depression and
- Intellicare – a suite of depres
- Examined “loyalty” and “regu

Mental Health: App Loyalty







Tutorial Time: Systematic Reviews

- 10 of 108 papers are
- 33 others reference
- 6 discussed here
- Methods:
  1. Framing the qu
  2. Identify relevar
  3. Assessing the
  4. Summarize the
  5. Interpret the fir
- PRISMA and PROS

Mental Health: Special Issue and Reviews

Özlem Uzuner...Michele Filannino. George Mason university. **A natural language processing challenge for clinical records: Research Domains Criteria (RDoC) for psychiatry**. *JBI*

- 16 papers: Application of previous NLP challenge (de-identification, symptom severity, novel data use) to mental health notes – good extension to new domain

Victor Cornet and Richard Holden RJ. Indiana University. **Systematic review of smartphone-based passive sensing for health and wellbeing**. *JBI*

- 35 papers: accelerometry, location, audio, usage → status/behavior change

Muna Dubad…Steven Marwah. University of Warwick. **A systematic review of the psychometric properties, usability and clinical impacts of mobile mood-monitoring applications in young people**. *Psychol Med*

- 25 papers: positively perceived, may reduce depressive symptoms

Education: Core Informatics Competencies

Johannes Thye…Ursula Hübner. University of Applied Sciences Osnabrück. **What Are Inter-Professional eHealth Competencies?** *Stud Health Technol Inform*

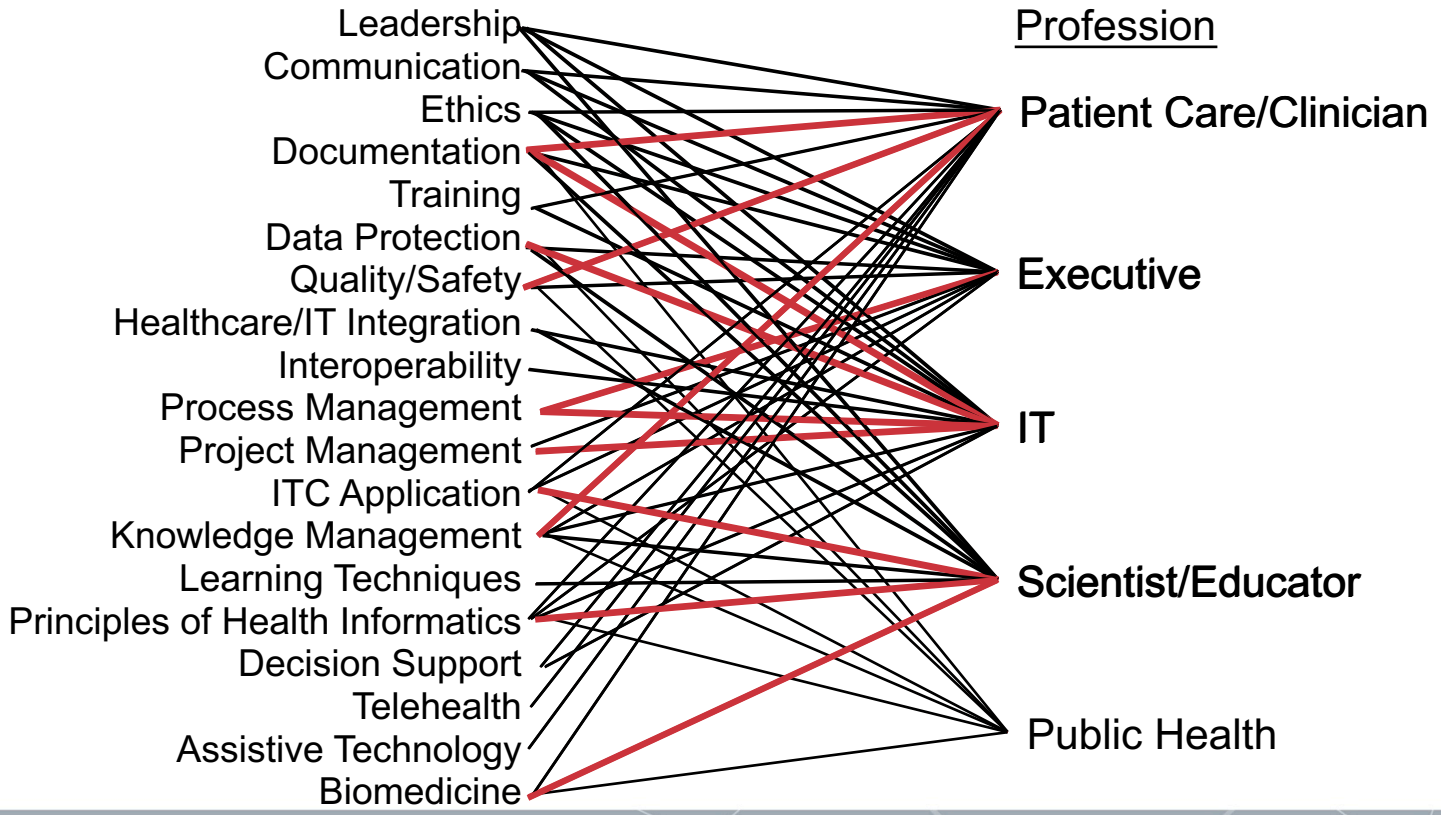
Elske Ammenwerth…Alexander Hörbst. University for Health Sciences, Medical Informatics and Technology. **Building a Community of Inquiry Within an Online-Based Health Informatics Program: Instructional Design and Lessons Learned**. *Stud Health Technol Inform*

Ursula Hübner…Marion Ball. University of Applied Sciences Osnabrück. **Technology Informatics Guiding Education Reform - TIGER**. *Methods Inf Med*

Douglas Wholey…Cynthia Kenyon. University of Minmnesota. **Developing Workforce Capacity in Public Health Informatics: Core Competencies and Curriculum Design**. *Front Public Health*

Nicola Mulder…Lonnie Welch. University of Capetown. **The development and application of bioinformatics core competencies to improve bioinformatics training and education**. *PLoS Comput Biol*

Education: Core Informatics Competencies

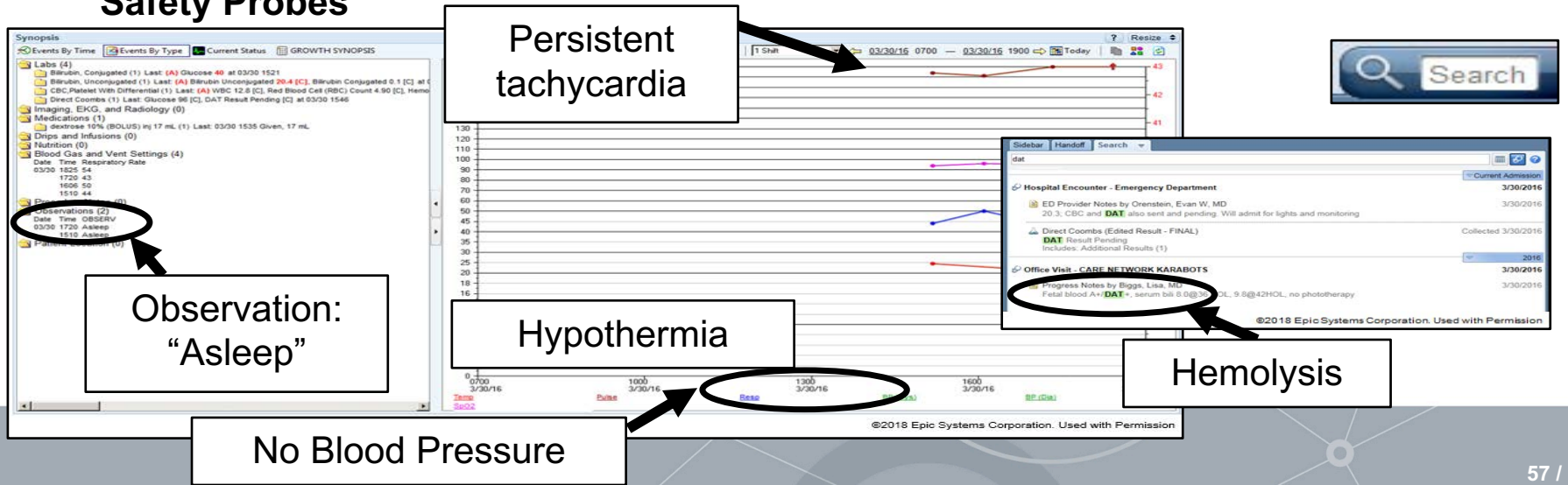


Education: Training with EHR Simulation

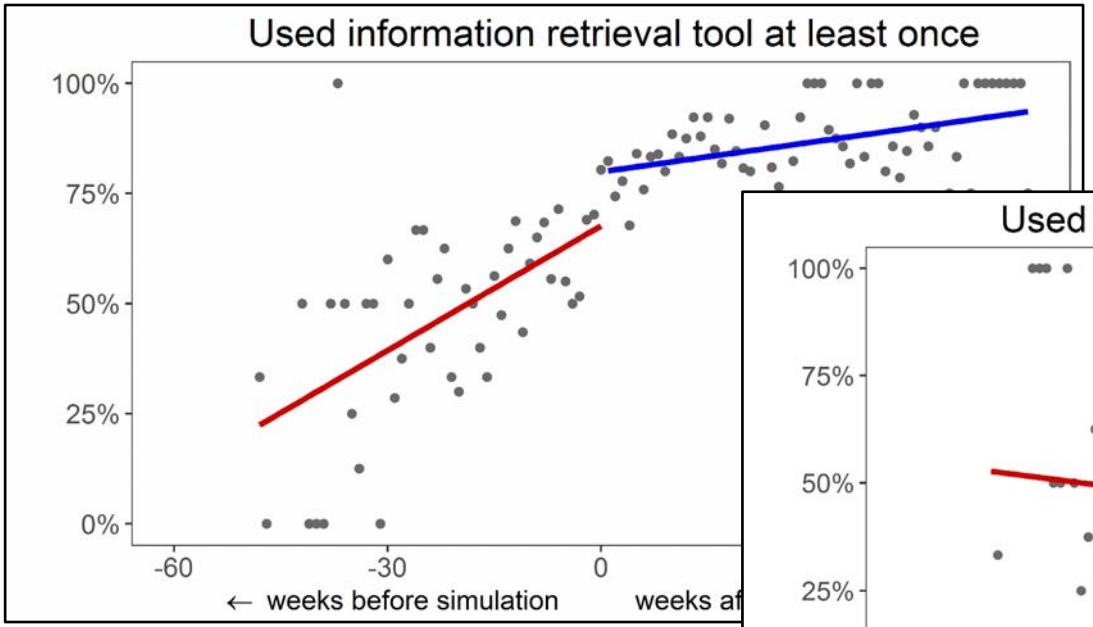
Evan Orenstein…Chris Bonafide. Emory University. **Influence of simulation on electronic health record use patterns among pediatric residents**. *JAMIA*

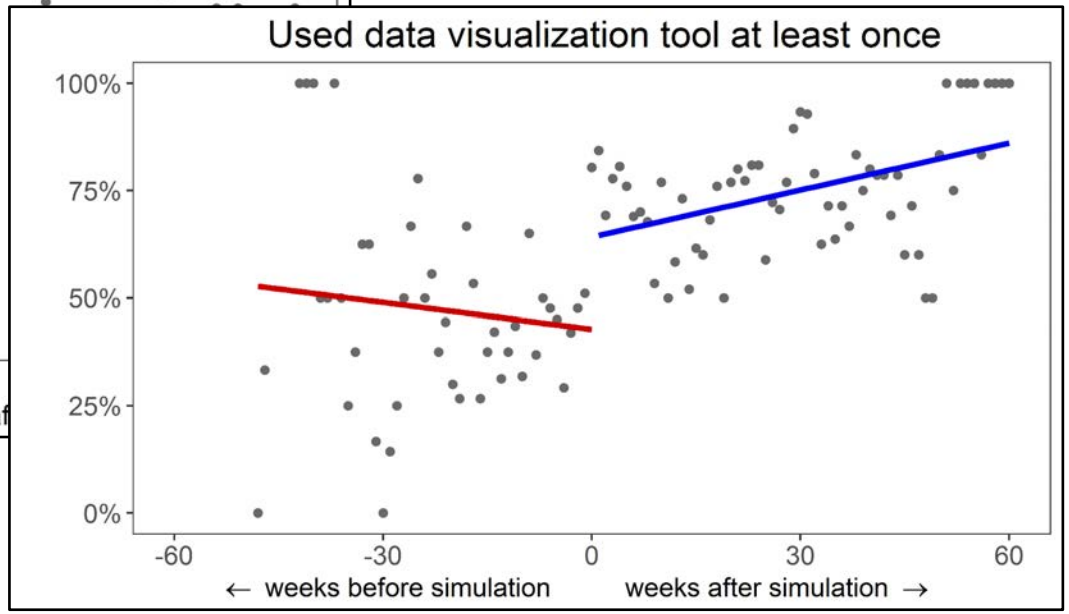
- Intervention: 1-hour simulated admission

Safety Probes



Education: Training with EHR Simulation





Consumer Informatics: Challenges

- Cedric Bousquet…Nathalie Texier. National Institute of Health and Medical Research. **The Adverse Drug Reactions from Patient Reports in Social Media Project: Five Major Challenges to Overcome to Operationalize Analysis and Efficiently Support Pharmacovigilance Process**. *JMIR*

1. Variable quality of information: scoring method
2. Guarantee of privacy: data minimization and access restriction
3. Pharmacovigilance expert response: study workflow
4. Processing web pages: best practices (NLP, dictionaries)
5. Evolutive architecture: component-based, access to web svcs

Consumer Informatics: Caveats

Geoffry Tison...Gregory Marcus. University of California at San Francisco. **Passive Detection of Atrial Fibrillation Using a Commercially Available Smartwatch**. *JAMA Cardiology*

- Selection and completion biases

Sara Ackerman...Courtney Lyles. University of California at San Francisco. **Meaningful use in the safety net: a rapid ethnography of patient portal implementation at five community health centers in California**. *JAMIA*

- Mismatch between MU engagement metrics patient needs

Mollie McKillop...Noémie Elhadad. Columbia University. **Designing in the Dark: Eliciting Self-Tracking Dimensions of Understanding Enigmantic Diseases**. *CHI Conference on Human Factors in Computing Systems*

- Self-tracking modalities must consider personality and emotions

Consumer Informatics: Caveats

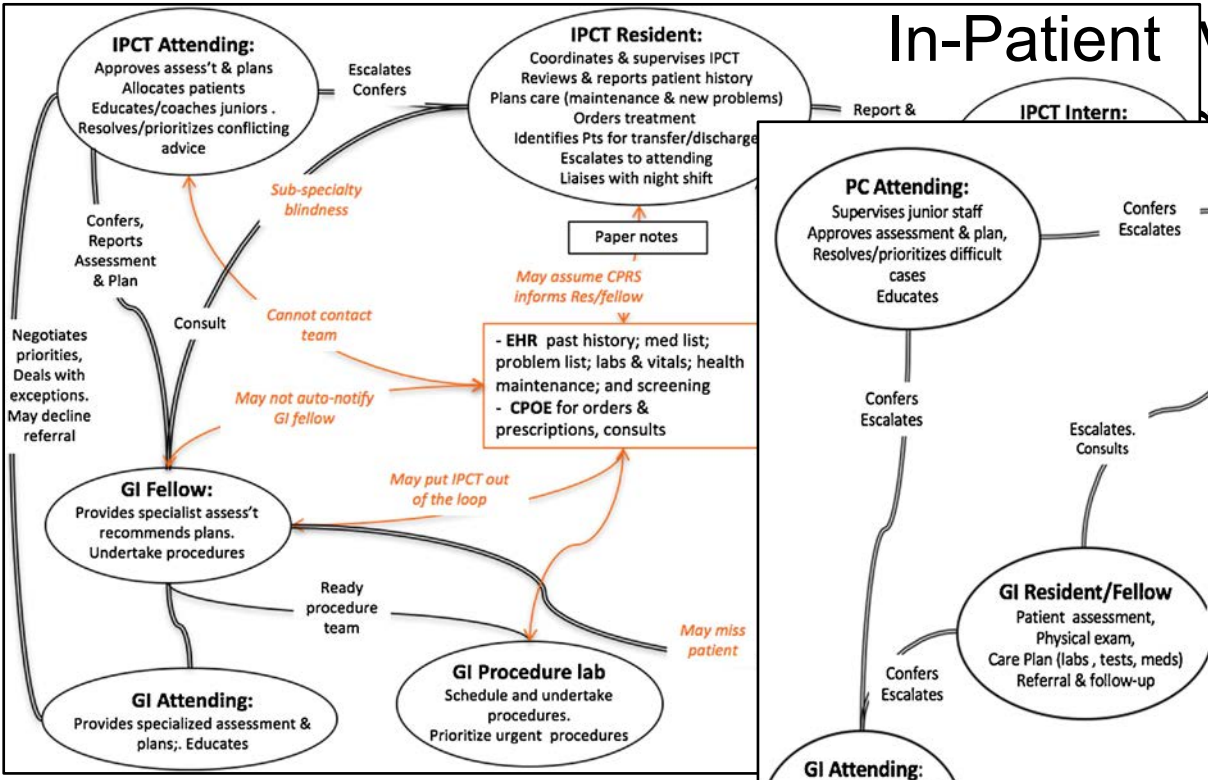
Lauren Holroyd...Gretchen Jackson. Vanderbilt University. **Use of the Multidimensional Health Locus of Control to Predict Information-Seeking Behaviors and Health-Related Needs in Pregnant Women and Caregivers**. *AMIA Annual Symposium Proceedings*

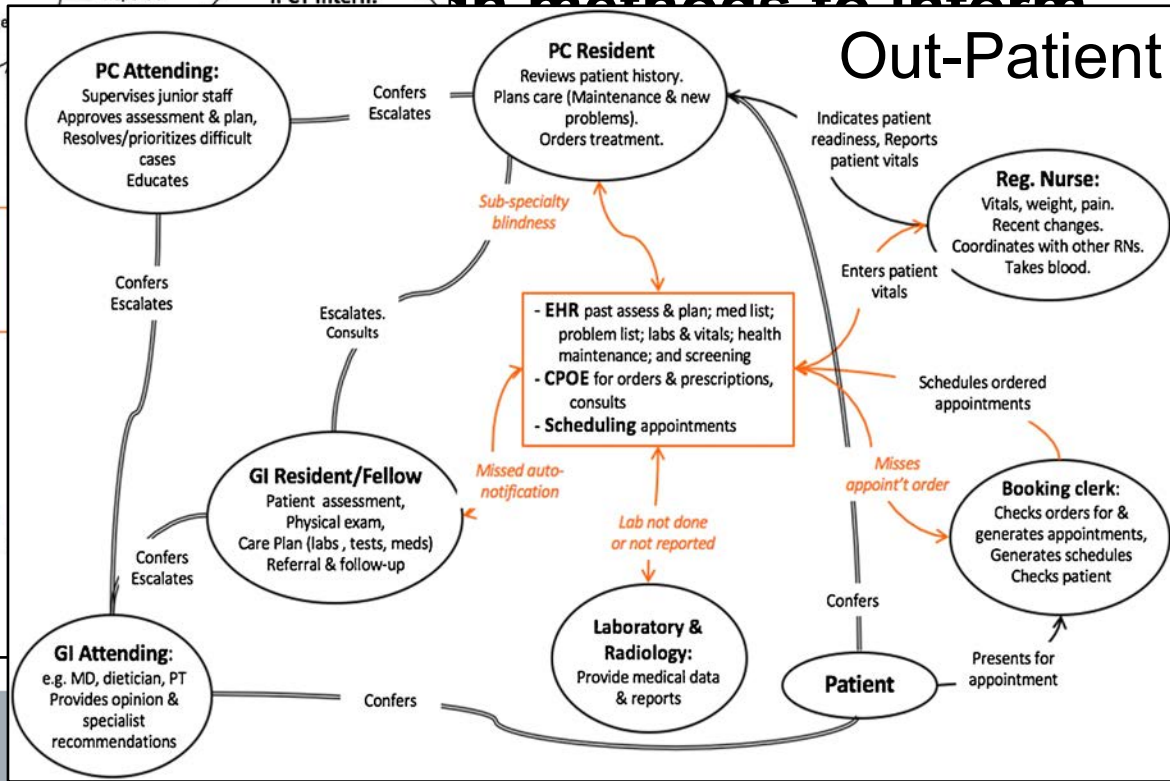
- Belief in luck and "powerful others" reduces information-seeking

Lisa Grossman...David Vawdrey. Columbia University. **Sharing Clinical Notes with Hospitalized Patients via an Acute Care Portal**. *AMIA Annual Symposium Proceedings*

- Don't underestimate the value of sharing or overestimate the risk

Evaluation: It's About Methods

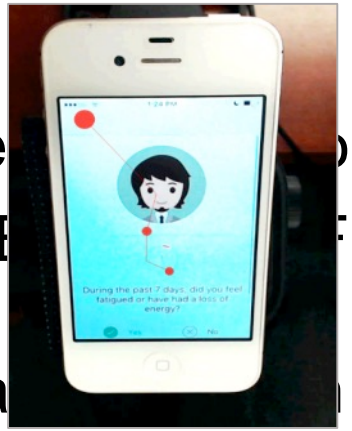
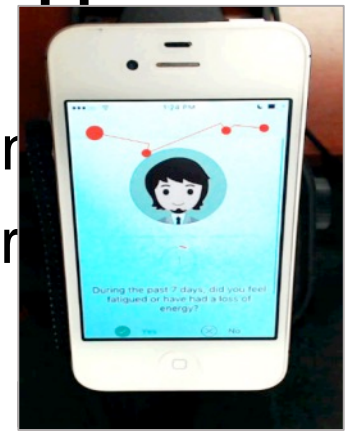




Evaluation: It's About Methods

Hwayoung Cho…Rebecca Schnall. Columbia University. **A multi-level usability evaluation of mobile health applications: A ca** *BI*



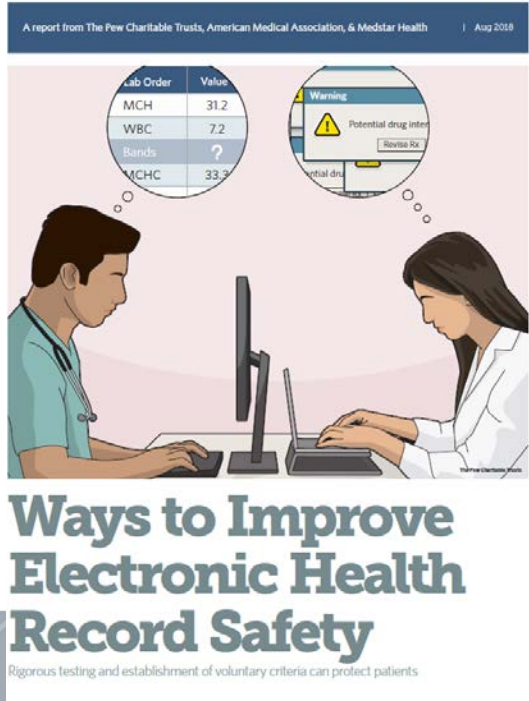



- M mptom se e r
- S of Healt F
  (Y , 2012)
  ered desig a
  - Usability in laboratory: think-aloud with eye tracking, heuristic evaluation
  - Usability in real world: survey and interview

Evaluation: Improving Health Record Safety

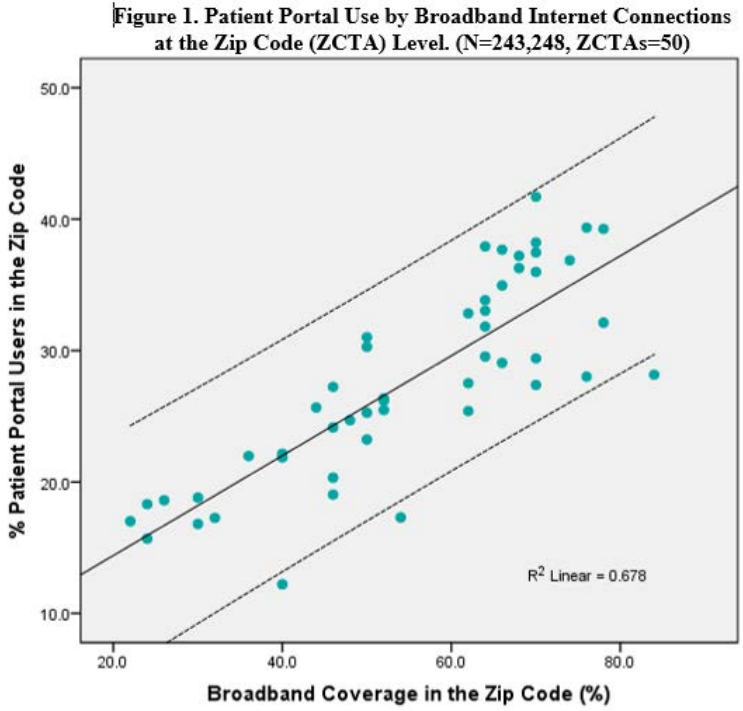
Pew Charitable Trusts, American Medical Association, & Medstar Health. **Ways to Improve Electronic Health Record Safety: Rigorous testing and establishment of voluntary criteria can protect patients**.

- Culture of safety: prioritizes usability and safety hazards; optimize EHR systems to mitigate hazards
- Product design/development: the goal is an EHR product
- Acquisition: the appropriate product to meet provider needs
- Customization: tailored coding and configuration of the product to meet specific needs of the organization
- Implementation and upgrades: Maintain a safe and usable EHR product
- Training: Safety and effectiveness



Public Health: Confounders

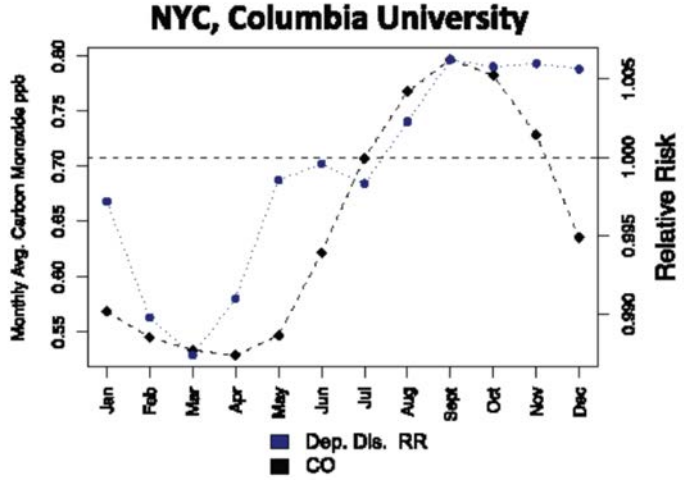
Adam Perzynski…Douglas Einstadter. Case Western Reserve University. **Patient portals and broadband internet inequality**. *JAMIA*

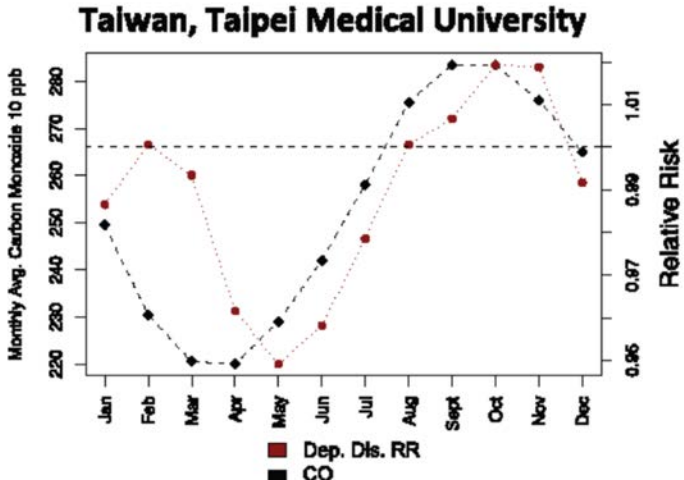


Public Health: Exposures

Mary Boland…Nicolas Tatonetti. University of Pennsylvania. **Uncovering exposures responsible for birth season - disease effects: a global study**. *JAMIA*

- EHRs from three countries (USA, South Korea, Taiwan)
- 12 climate, pollutant and infectious variables





Pharmacoinformatics: CDS Errors

Virginie Korb-Savoldelli...Brigitte Sabatier. Georges Pompidou European Hospital. Prevalence of computerized physician order entry systems-related medication prescription errors: A systematic review. IJMI

- Less than 6.3% of all prescriptions but 26% of prescription errors (“wrong dose”)

Clare Tolley...Sarah Slight. Newcastle University. Factors contributing to medication errors made when using computerized order entry in pediatrics: a systematic review. JAMIA

- False negatives (dosing), false postives (duplication, & system design flaws

Sarah Slight...David Bates. Newcastle University. The national cost of adverse drug events resulting from inappropriate medication-related alert overrides in the United States. JAMIA

- Estimate # orders, # of inappropriate overrides, # of ADEs, cost: $871M-$1.6B, clinician and pharmacist opportunity cost: $16.9M

Pharmacoinformatics: Taxonomy of Errors

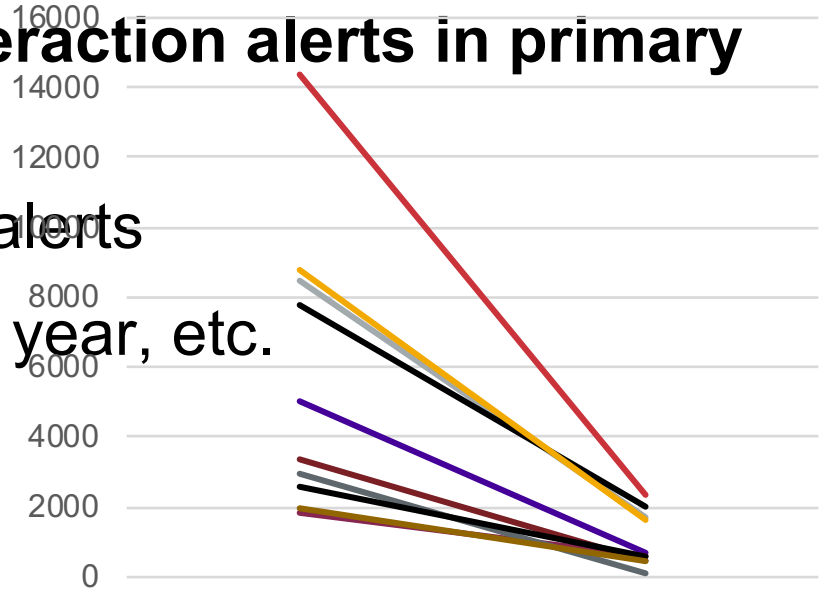
Adam Wright…Dean Sittig. Harvard University. **Clinical decision support alert malfunctions: analysis and empirically derived taxonomy**. *JAMIA*

- Cause (also how and when discovered, and effect)
  - Build error
  - Conceptualization error
  - New code, concept or term introduced, but rule not updated
  - Defect in EHR software
  - Environment migration
  - New value
  - Alert text mismatch
  - External service issue
  - Inadvertent enabling/disabling
  - Unaware of component reuse

Clinical Decision Support Fixing Alerts

Mette Heringa...Marcel Bouvy. SIR Institute for Pharmacy Practice and Policy. **Better specification of triggers to reduce the number of drug interaction alerts in primary care**. *IJMI*

- Consensus panel to reassess alerts
- No trigger if second order, one year, etc.
- Simulation of events →



Clinical Decision Support: Fixing Alerts

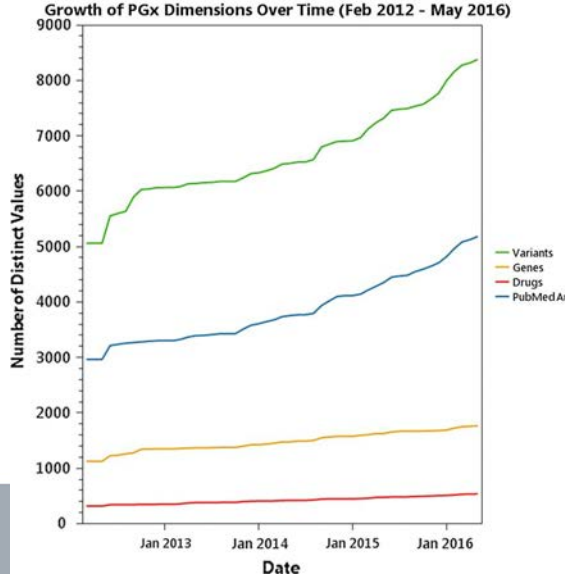
Steven Kassakian...David Dorr. Oregon Health and Science University. **Clinical decisions support malfunctions in a commercial electronic health record**. *Appl Clin Inform*

- Alert used outdate controlled term → use classes in logic and maintain terminology
- Failure to deactivate flu alert → monitor the monitor
- Old data source defunct → monitor the monitor
- Change in alert logic → monitor the monitor

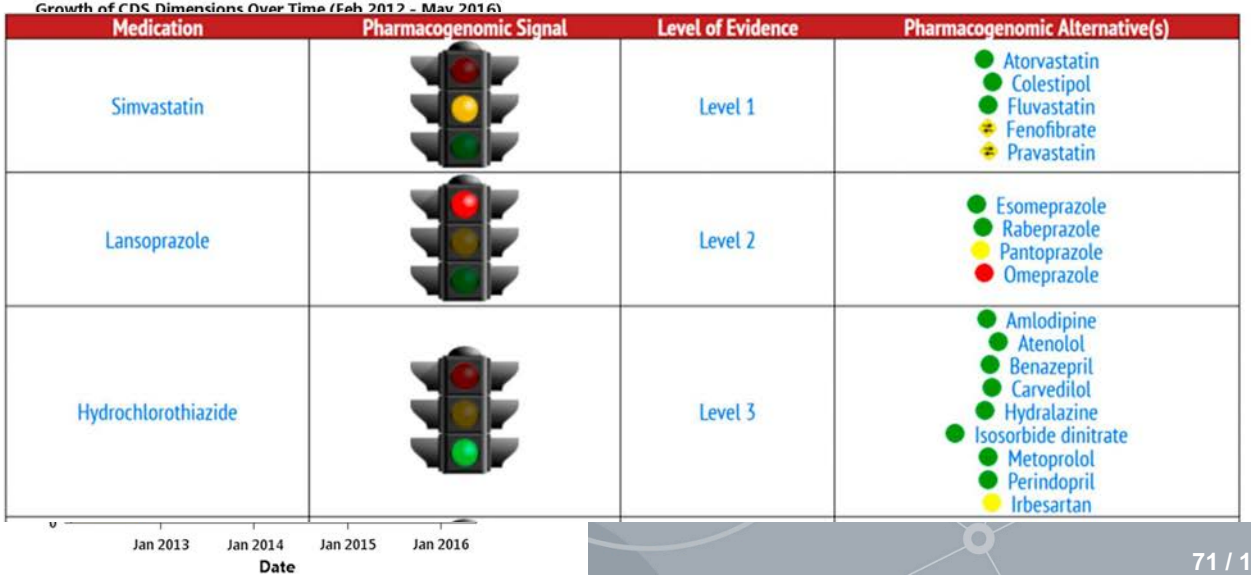
Clinical Decision Support: Genomic Alerts

Keith Danahey...Peter O'Donnell. University of Chicago. **Simplifying the use of pharmacogenomics in clinical practice: Building the genomic prescribing system**. *JBI*

A



B

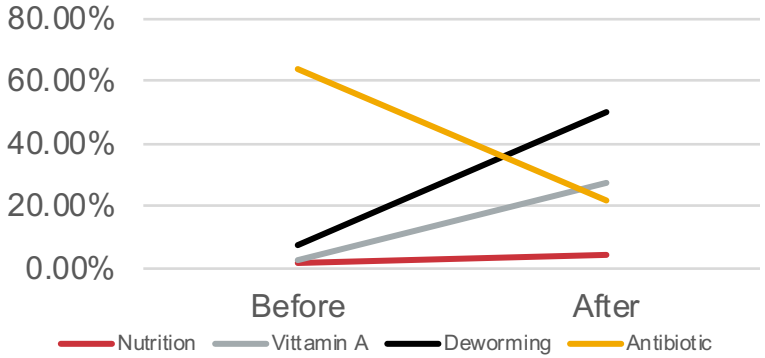


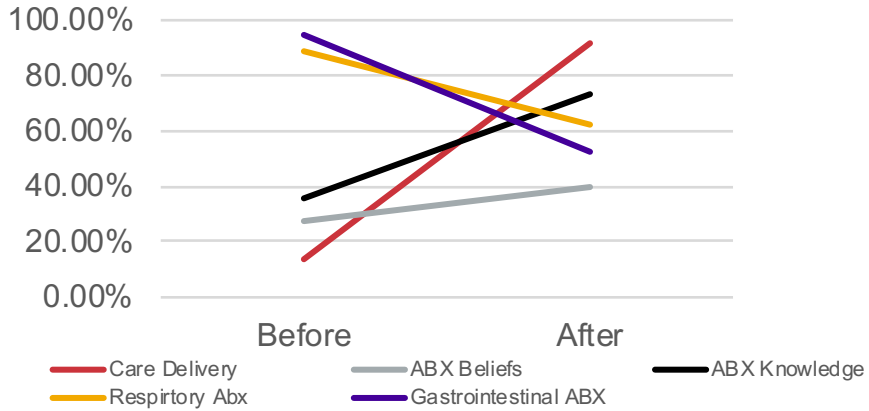
Medication	Pharmacogenomic Signal	Level of Evidence	Pharmacogenomic Alternative(s)
Simvastatin		Level 1	Atorvastatin Colestipol Fluvastatin Fenofibrate Pravastatin
Lansoprazole		Level 2	Esomeprazole Rabeprazole Pantoprazole Omeprazole
Hydrochlorothiazide		Level 3	Amlodipine Atenolol Benazepril Carvedilol Hydralazine Isosorbide dinitrate Metoprolol Perindopril Irbesartan

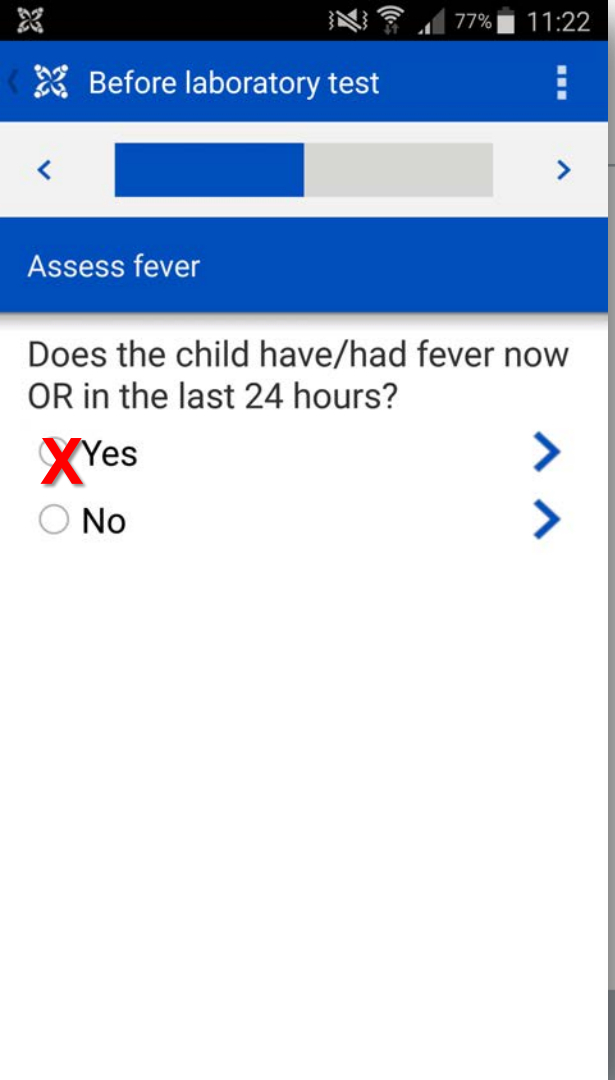
Global Health: Low Resource JIT Information

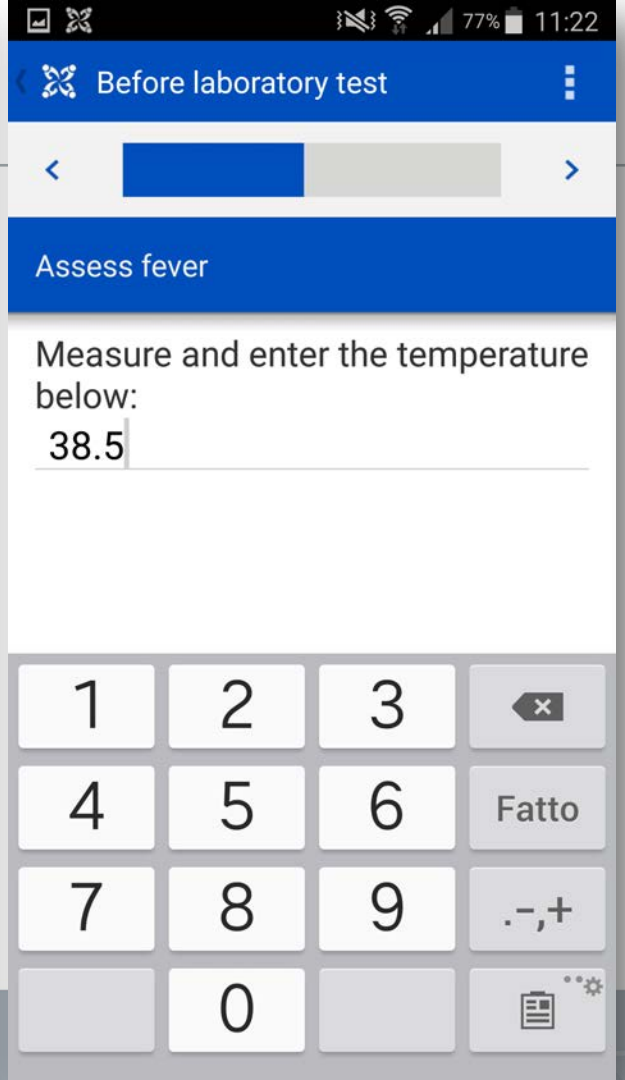
XingRong Shen...Debin Wang. Anhui Medical University. **Web-Based Just-in-Time Information and Feedback on Antibiotic Use for Village Doctors in Rural Anhui, China: Randomized Controlled Trial**. *JMIR*

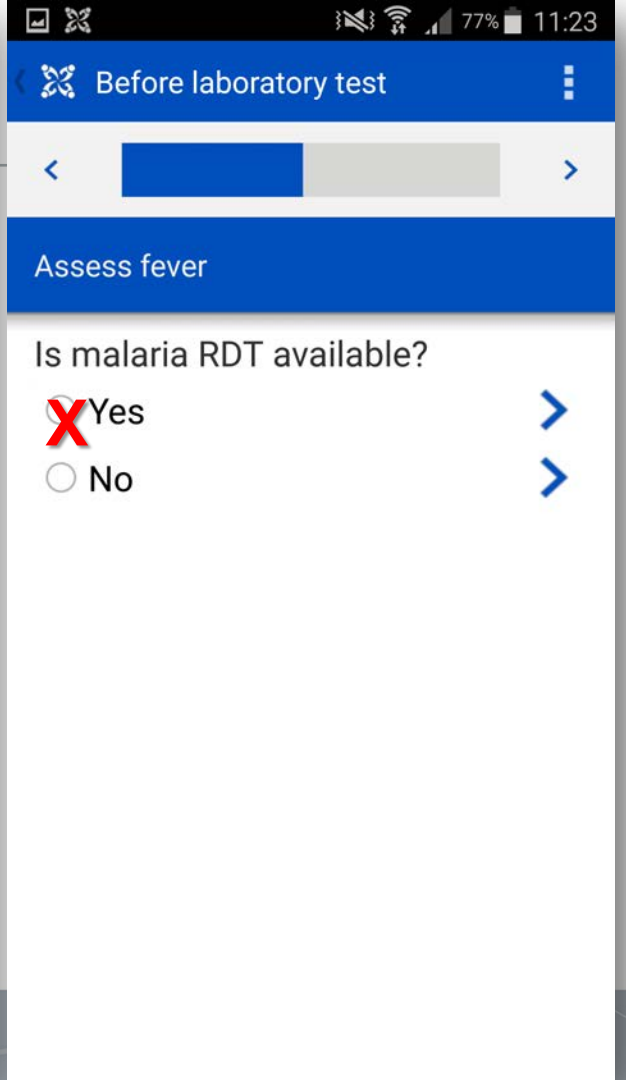
Andrea Bernasconi...Stéphane Du Mortier. International Committee of the Red Cross. **The ALMANACH Project: Preliminary results and potentiality from Afghanistan**. IJMI

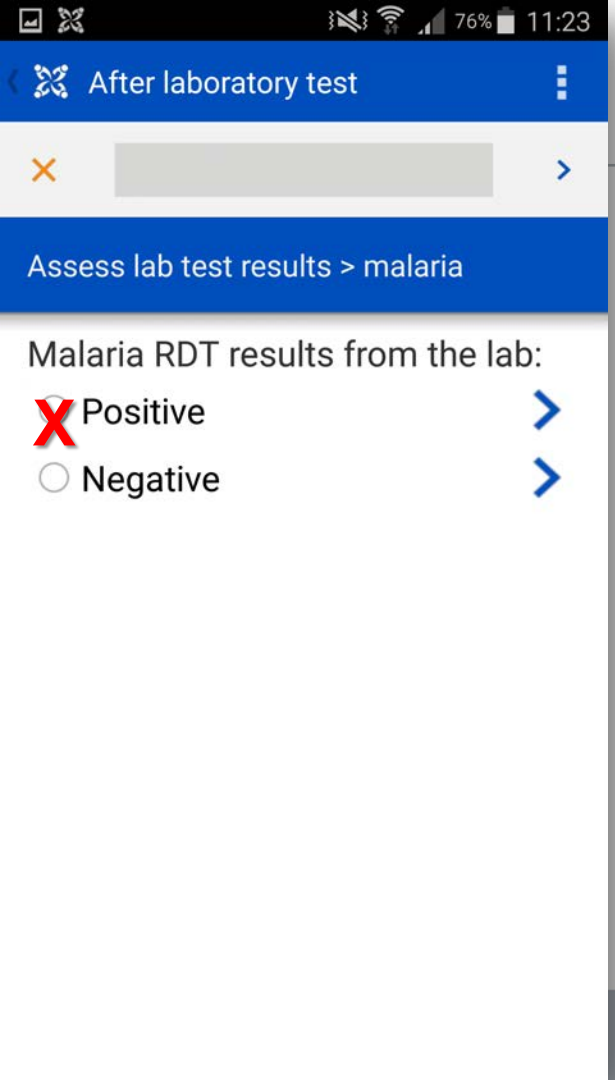


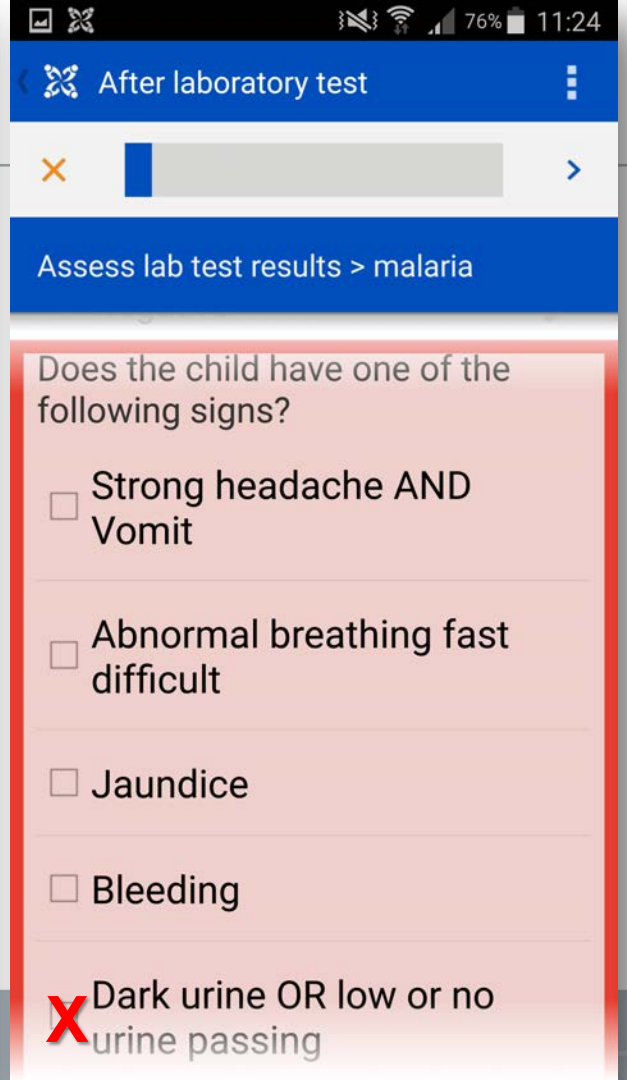


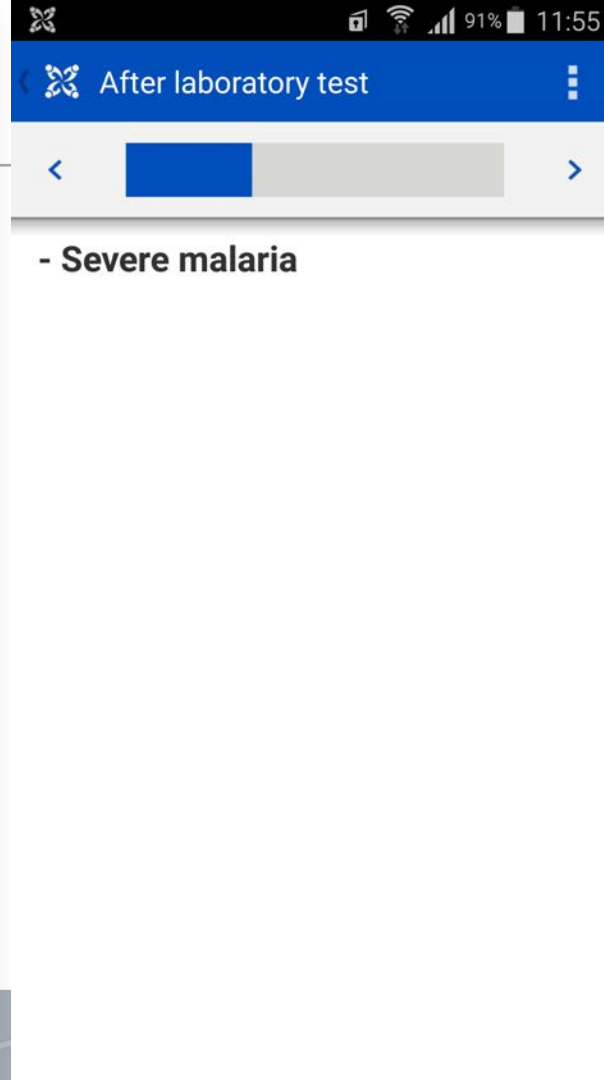

77% 11:22
Before laboratory test
Assess fever
Does the child have/had fever now OR in the last 24 hours?
Yes
No


77% 11:22
Before laboratory test
Assess fever
Measure and enter the temperature below:
38.5
1 2 3
4 5 6 Fatto
7 8 9 .-,+
0


77% 11:23
Before laboratory test
Assess fever
Is malaria RDT available?
Yes
No


76% 11:23
After laboratory test
Assess lab test results > malaria
Malaria RDT results from the lab:
X Positive
Negative


76% 11:24
After laboratory test
Assess lab test results > malaria
Does the child have one of the following signs?
Strong headache AND Vomit
Abnormal breathing fast difficult
Jaundice
Bleeding
X Dark urine OR low or no urine passing


91% 11:55
After laboratory test
- Severe malaria

Assess measles

Measles? Now or within the last 3 months?

(Generalised rash + one of the following: Cough, Runny nose, Red eyes)

Yes

No

Before laboratory test

Assess general danger signs

Does the child show any of the following signs?

- [ ] Unable to drink / breastfeed
- [ ] Vomits everything (don't able to keep anything in the stomach)
- [ ] None of the above

After laboratory test

Severe Malaria

Give first dose of Quinine IM OR Artesunate IV (or IM) OR Arthemeter IM and **REFER the child urgently** to the hospital. Artesunate suppository is a valid alternative to Quinine injection. When possible check for hemoglobin and blood sugar.

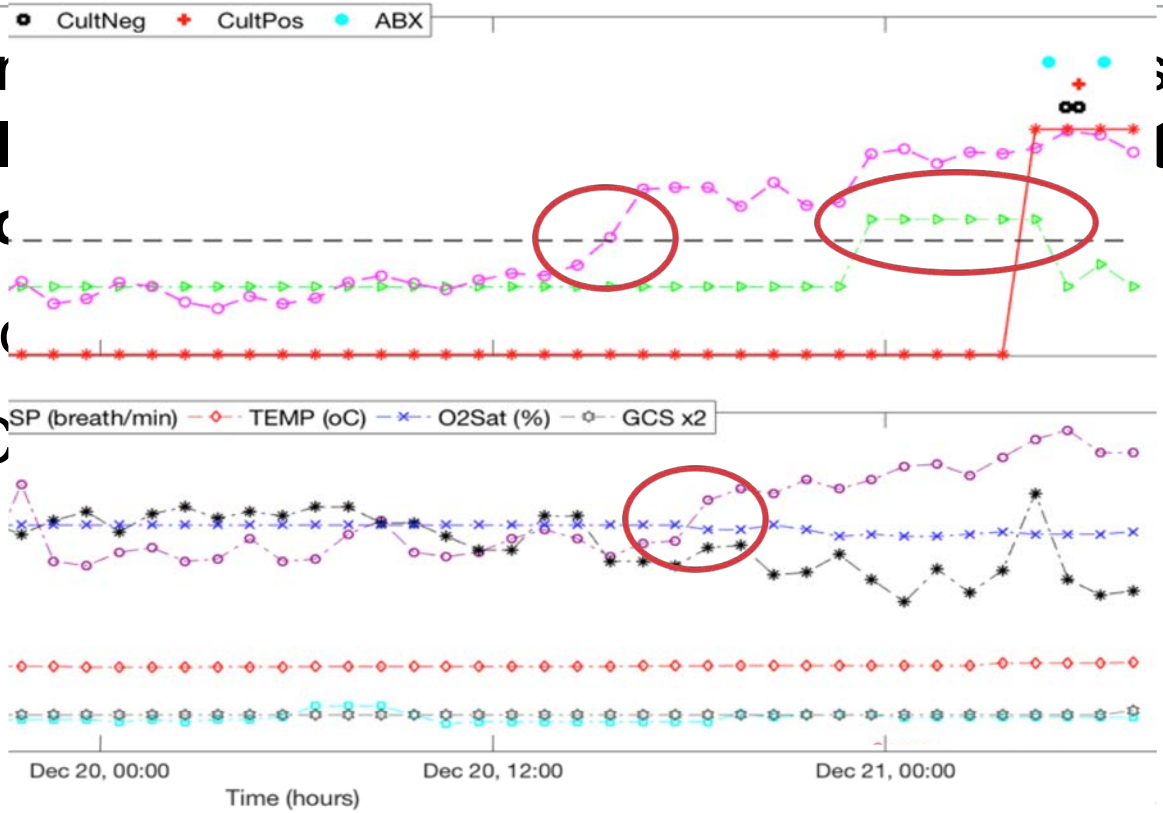
Which of the following drugs will you use? (choose only one)

- ○ Quinine IM
- ○ Artesunate IV or IM
- ○ Arthemeter IM

Intensive Care: Sepsis Prediction

Shamim Ner sity. **An Interpretabl te Prediction**

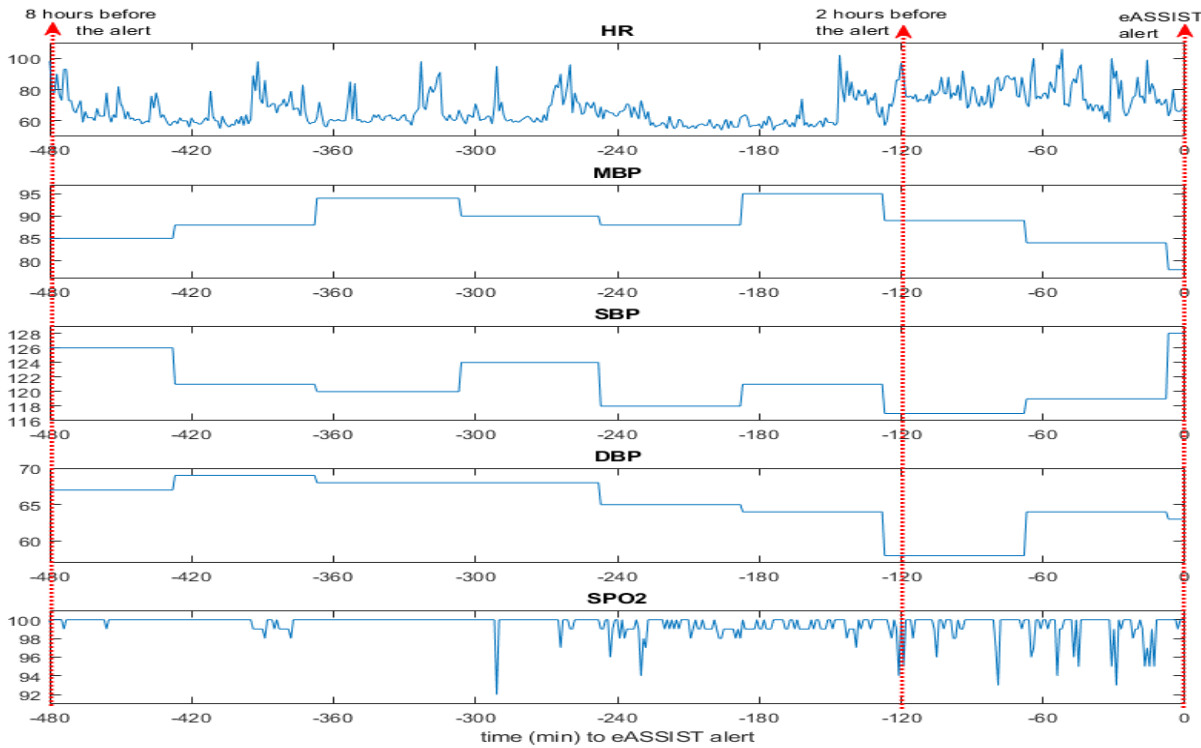
- Weibull-C
- ROC AUC



Intensive Care: Sepsis Prediction

Rishikesa of
Tennesse ntify
Physiom ICU. *Pediatr Crit Care*

- Convol
- Sens/S hours)



Intensive Care: Training

Deepika Mohan…Amber Barnato. University of Pittsburgh. **Efficacy of educational video game versus traditional educational apps at improving physician decision making in trauma triage: randomized controlled trial**. *BMJ*

- Night Shift game
- Simulation: 10 cases over 42 minutes, measures appropriate triage
- Intervention/Controls: 188/188 → 149/148 completed study
- Six-month follow-up: 100/100 → 64/58 completed study

https://www.youtube.com/watch?v=VerlR1LHXZo _https://www.youtube.com/watch?v=wif_Xe6pEFg

Intensive Care: Identifying Subgroups

Kelly Vranas…Vincent Liu. Stanford University. **Identifying Distinct Subgroups of ICU Patients: A Machine Learning Approach**. *Crit Care Med*

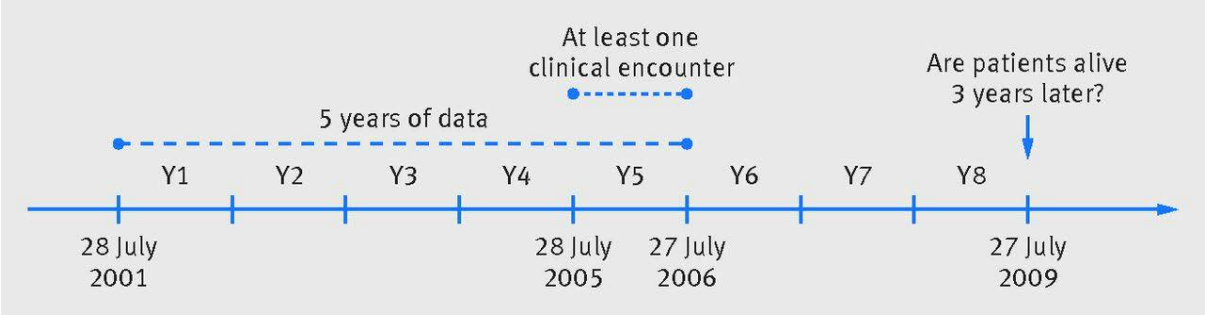
- Unsupervised machine-learning with clustering analysis

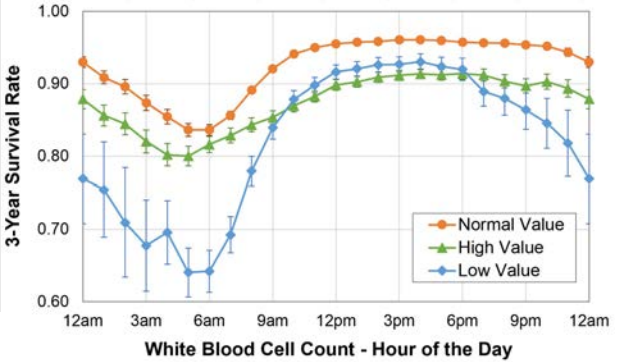
"[S]uccessfully identified six distinct, clinically-recognizable subgroups of ICU patients which may represent potential opportunity for care redesign efforts"

- Healthy short-stay
- Older-catastrophic
- Post-procedural
- Older-long-term-needs
- Prior-healthy-prolonged-stay-good-recovery
- Severe-illness-limiting-life-sustaining-therapy

Primary Care: Observer Effect or Bias?

Denis Agniel…Griffin Weber. **Biases in electronic health record data due to processes within the healthcare system: retrospective observational study**. *BMJ* *





- Test ordering behavior correlates with long-term survival more than test result
- “Doctors typically do not order a white blood cell count test for a patient on the weekend…unless they believe the patient is sick.”
- “[T]he predictive value of healthcare process variables is often stronger than the result of the test when blindly using raw EHR data.”

Open Source: Electronic Health Records

Assel Syzdykova…José Oliveira. University of Aveiro. **Open-Source Electronic Health Record Systems for Low-Resource Settings: Systematic Review**. *JMIR Med Inform*

Mona Alsaffar…Michael Hogarth. University of California-Davis. **The State of Open Source Electronic Health Record Projects: A Software Anthropology Study**. *JMIR Med Inform*

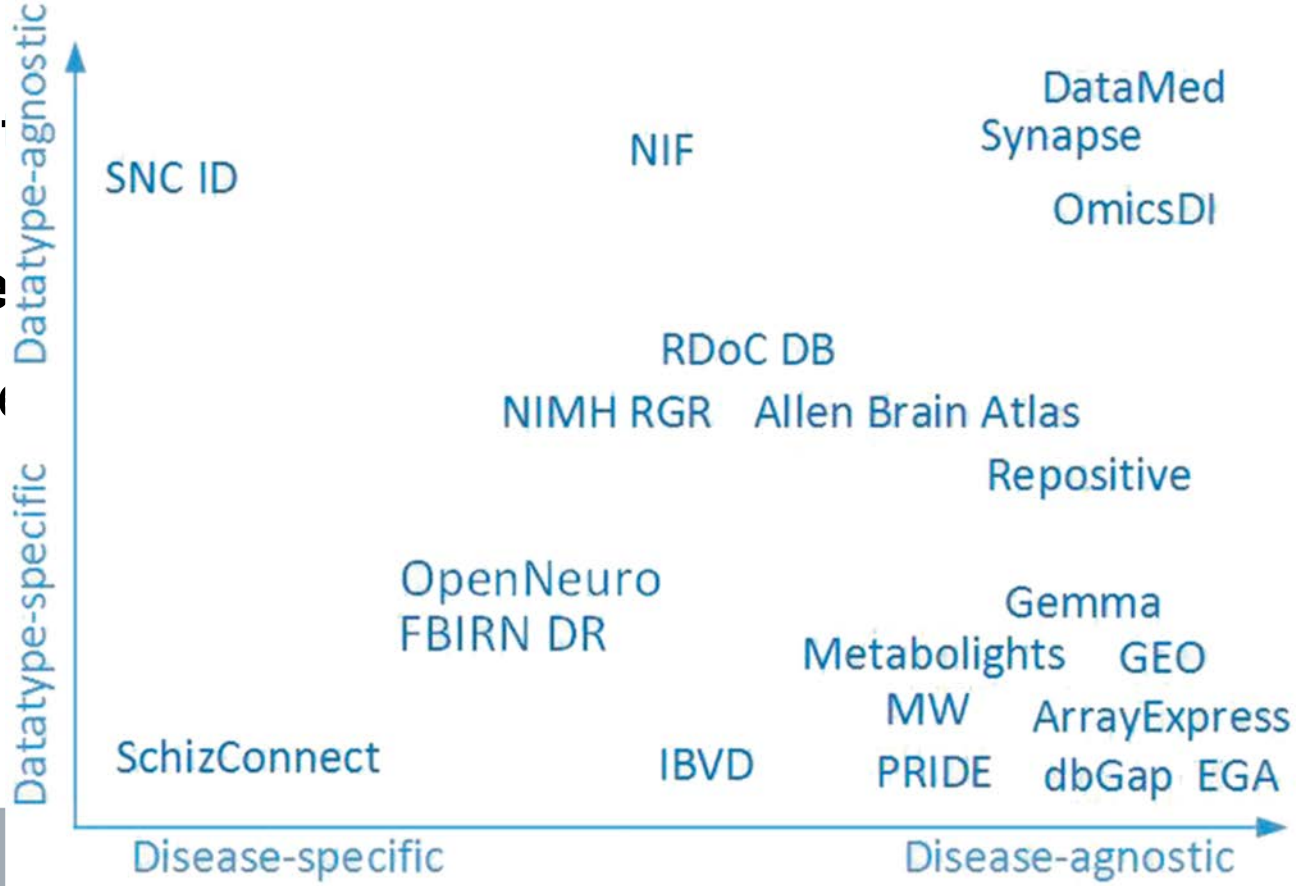
Open Source: Electronic Health Records

- Systems: **GNU Health (2), OpenEMR, FreeMED, OpenMRS,** Bahmni (1), Care2x, OpenClinic GA, Open Hospital, HOSxP, Toven Health Record, OSCAR McMaster
- Characteristics: **in production/stable (10)**, **installation guide (9)**, **demonstration**, user guide (8)
- Features: **configurable reports (4-5)** , **interoperability**, **coding systems**, **access control model**, **web client**, **development activity**, **software modularity**, **user interface**, **community support, customization (3)**, *custom reports (2)*, *custom forms*, *authentication methods*, *cryptographic features*, *flexible data model, offline support*, native client, *other clients*, patient portal (861)

Open Source: Access to Shared Data Sets

Jessica **Transla access discove**

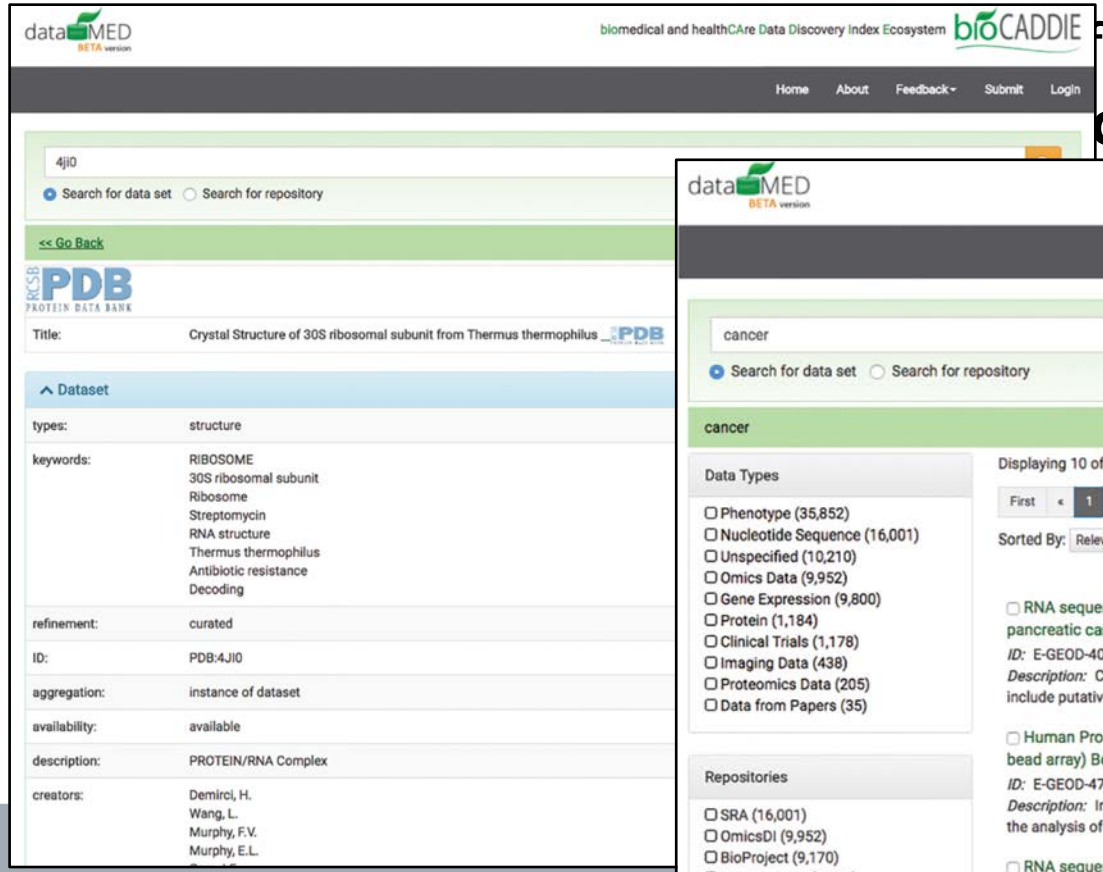
- A revi

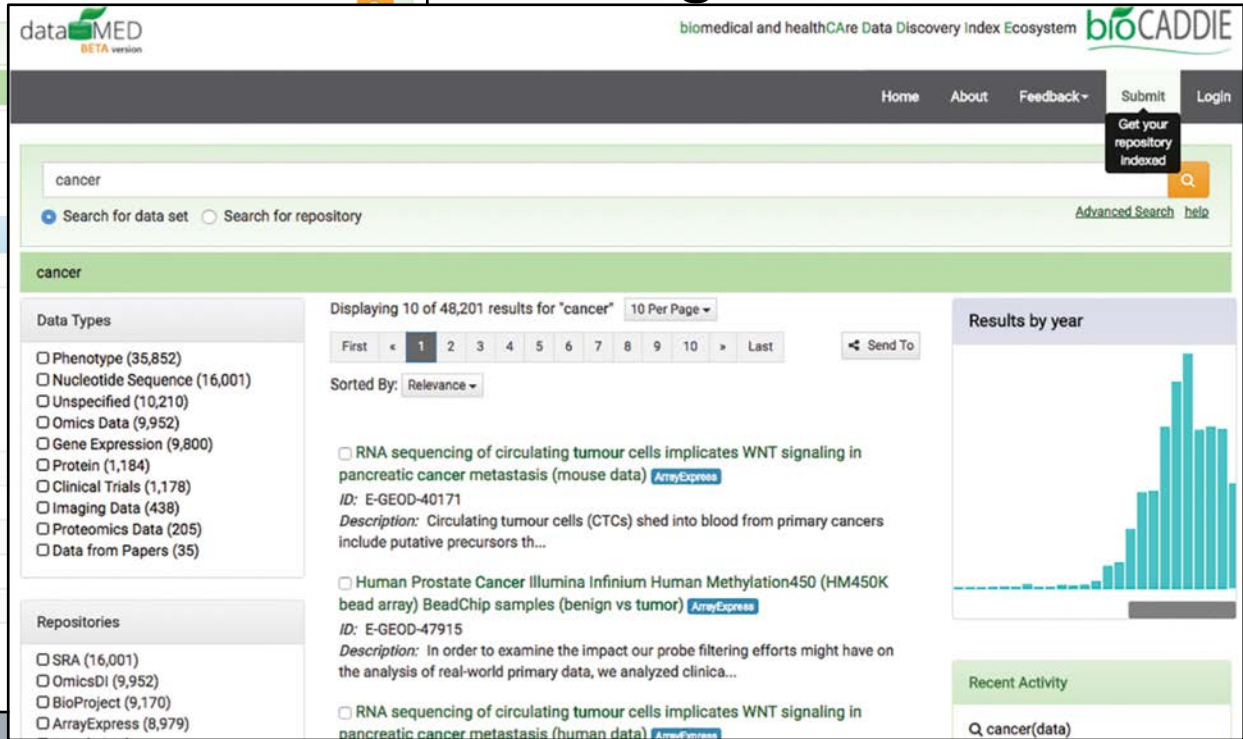


Open Source: Access to Shared Data Sets

AMIA
INFORMATICS PROFESSIONALS. LEADING THE WAY.

f Texas-Houston. **DataMed**
or finding biomedical



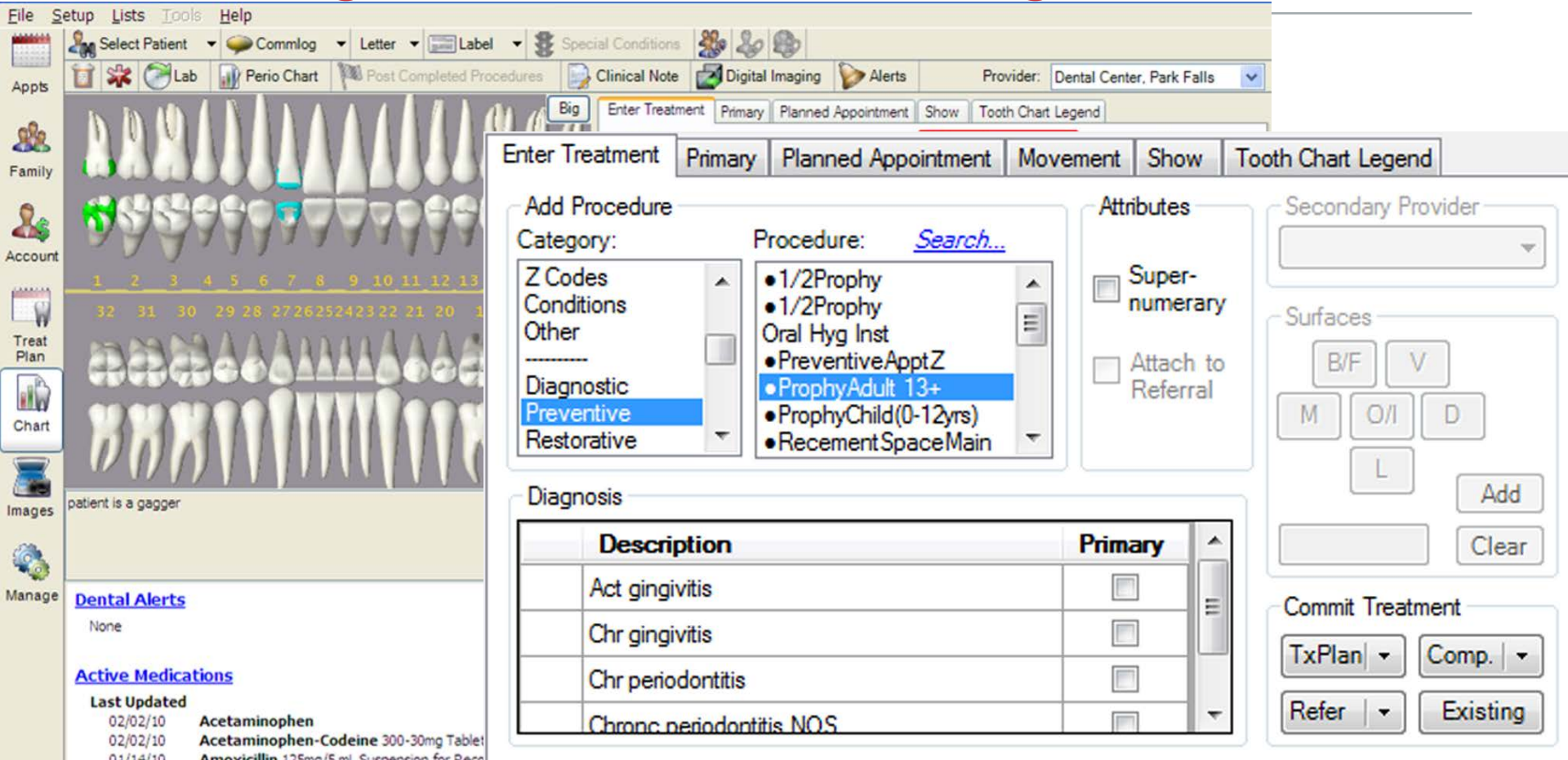


Dental: Diagnostic-Centric, not Billing-Centric

Neel Shimpi…Amit Acharya. Marshfield Clinical research Institute. **Need for diagnostic-centric care in dentistry: A case study from the Marshfield Clinic Health System**. *J Am Dent Assoc*

- Documentation – tend to pick first or last from a diagnosis list
- Lack of standardized dental terminologies limits flagging procedural-diagnostic links, which makes it difficult to evaluate disease patterns
- Having the ability to select multiple diagnosis, along with the capability of indicating primary diagnosis for the corresponding dental condition would be important and clinically significant

Dental: Diagnostic-Centric, not Billing-Centric



Students: Summer Internship

Kim Unertl…Cynthia Gadd. Vanderbilt University. **Next generation pathways into biomedical informatics: lessons from 10 years of the Vanderbilt Biomedical Informatics Summer Internship Program**. *JAMIA Open*

- 90 high school, undergraduate and graduate trainees (38 female) over 10 years
- Conceptual framework for orienting students to a scientific career path
- Bioscience field: 45/63
- Professional degree: 16/63
- Informatics involvement: 15/62
- Published: 28/90

WINDOWS

QUESTIONS:
What is Biomedical Informatics?
What makes informatics interesting and important?
What do people who work in Biomedical Informatics do?

OUTREACH STRATEGIES:
Public Talks
Science on Tap
Visiting Schools and Classrooms
Online Articles for Public Audiences
Marketing and Advertising Campaigns
Opinion Articles in Newspapers/Websites

LEARNING ABOUT BIOMEDICAL INFORMATICS

MIRRORS

QUESTIONS:
Are there people who are like me working in informatics?
Can I apply my skills and expertise in informatics?
Will I be welcome in informatics?

OUTREACH STRATEGIES:
Women in AMIA Initiative
Publicizing Informatics Diversity
Increasing Informatics Diversity
Visiting Schools and Classrooms
Developing Inclusive Work Environments
Partnering with Diversity Outreach Programs

SEEING YOURSELF REFLECTED IN BIOMEDICAL INFORMATICS

OPEN DOORS

QUESTIONS:
How can I get started in Biomedical Informatics?
Where can I learn more about the field?
Who can help me get involved?

OUTREACH STRATEGIES:
Online Outreach Activities
On-Campus Visiting Programs
Activities in Science Museums
Internship Programs for K-12 Students
Internship Programs for Undergraduates
Engaging K-12 Educators in Informatics

INCREASING ACCESS TO INFORMATICS PATHWAYS

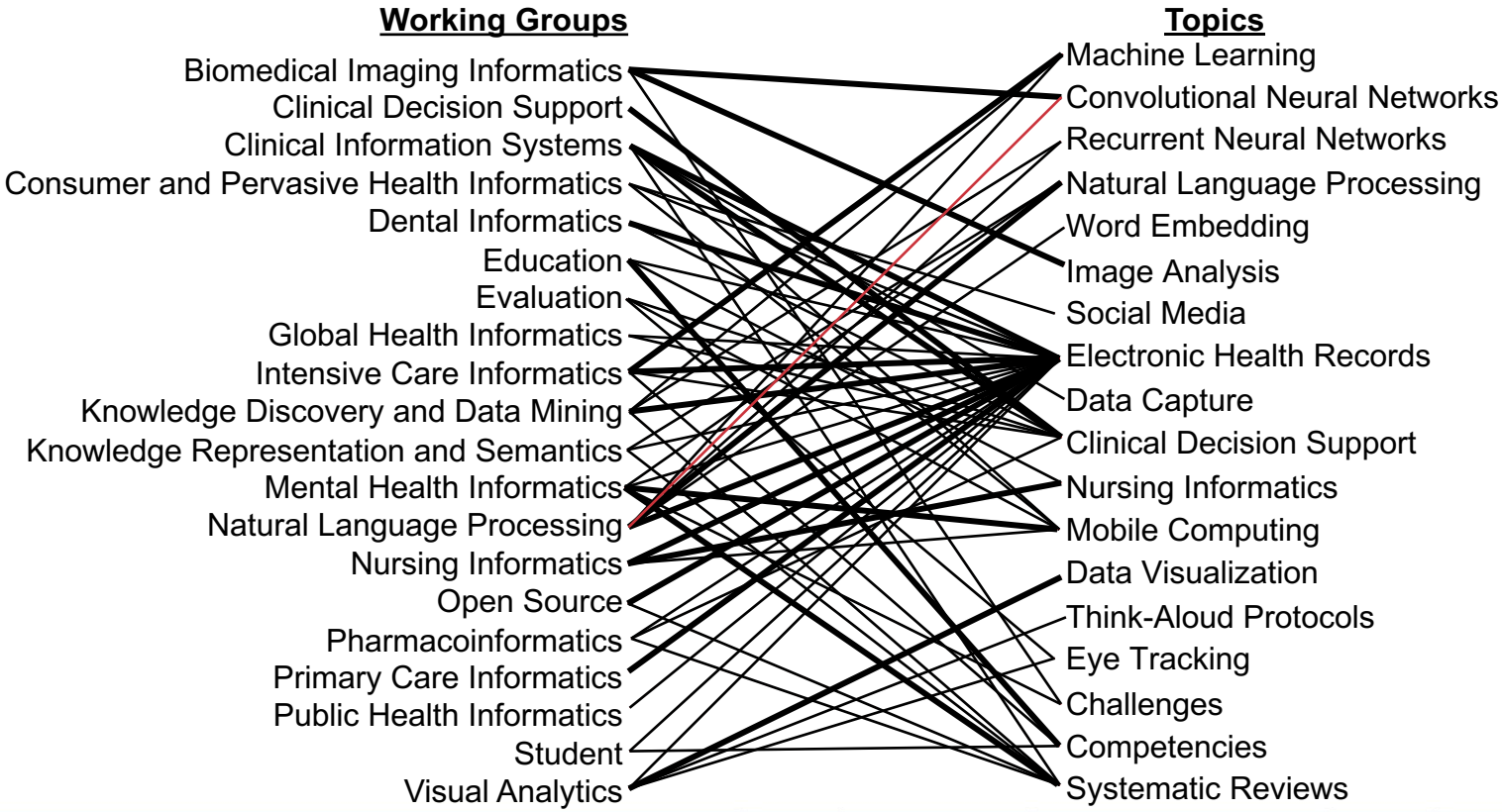
Students: Summer Internship

Type93	Mentor	Project Title
Graduate	Yaa Kumah-Crystal	Voice assistant accuracy in medical query: the case of Siri
High School	Daniel Fabbri	Determing the part of a patient's body that a medic is working on
High School	Kim Unertl	Analyzing resilience in clinical sites during a large-scale health information technology implementation
High School	Adi Bejan	Automatic identification of alcohol usage in clinical notes
College	Scott Nelson	Analysis of electronic prior authorization (ePA) criteria using the FHIR standard
College	Adi Bejan	A text mining approach for capturing the longitudinal exposure of smoking use in the EHR
College	Brad Malin	Using a trust game framework to evaluate attitudes on sharing genomic data
College	Gretchen Jackson	Health management in the home: a qualitative study of pregnant women and their caregivers
College	Jason Slagle	Non-routine events as measures of neonatal safety in the perioperative environment: generating findings via automation
College	Jeremy Warner	A pan-cancer authorship network analysis
College	Laurie Novak	Mapping incident and service request communications in the hospital setting
Under-graduate	Wei-Qi Wei	Machine and deep learning from longitudinal EHRs and genetic data for low CVD risk prediction
College	Yaa Kumah-Crystal	Voice user interface and its applications in the electronic health record
College	You Chen	Temporal pattern discovery to determine risk factors in NICU surgery patients

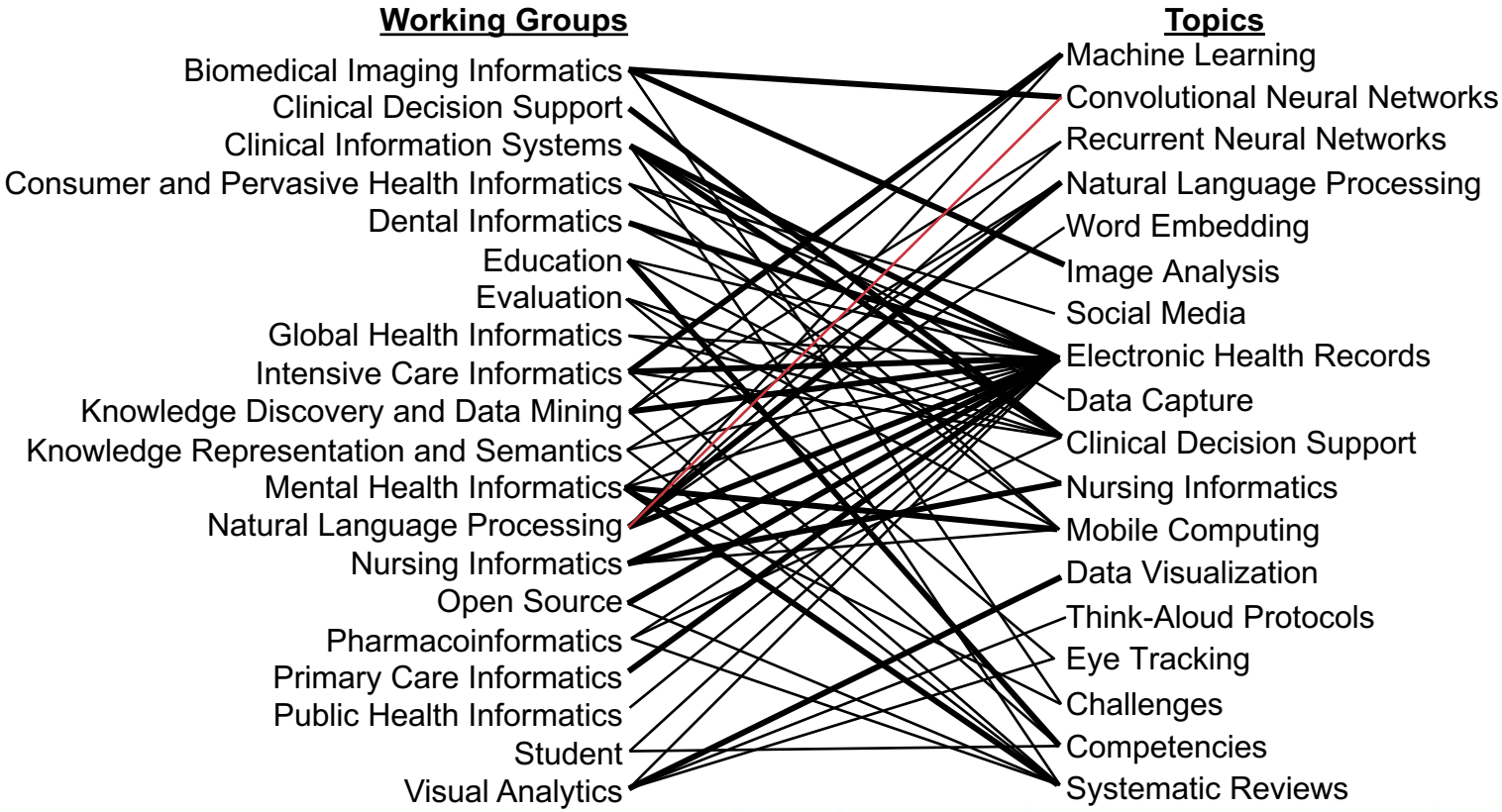
Making Sense of It All

- Innovations are no longer related to terminology/ontology
- Deep learning, especially ANN, is a leading enabler
- Word embedding is a popular, effective tool in NLP
- Systematic Reviews
- Int***ra***disciplinary topics and methods

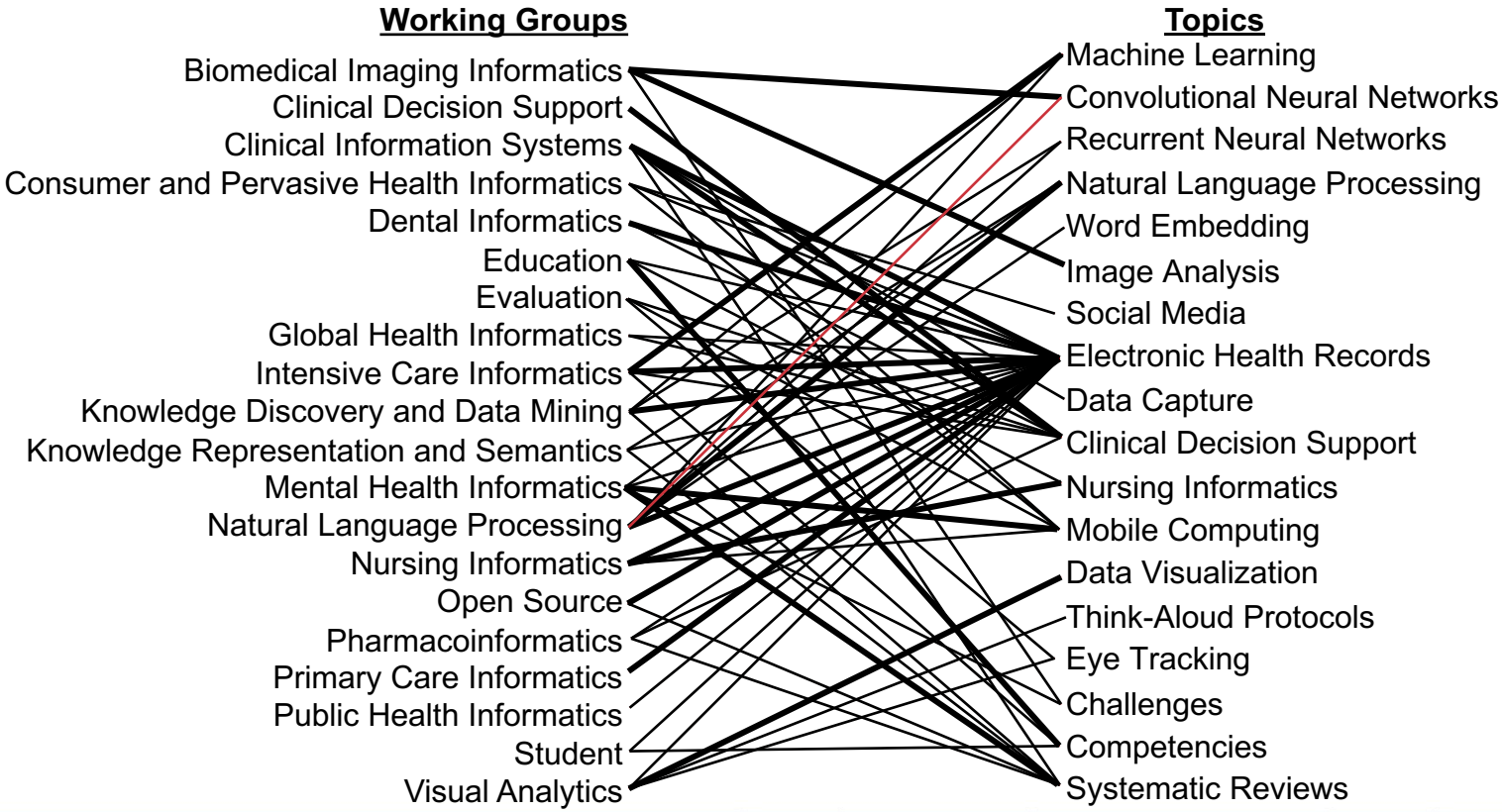
Inter- and Intra-Disciplinary Informatics



Inter- and Intra-Disciplinary Informatics



Inter- and Intra-Disciplinary Informatics



Acknowledgments: Papers and Advice

- Working Group reps: Ranyah Aldekhyyel, Gregory Alexander, Juliana Brixey, Hamish Fraser, Roland Gamache, Yang Gong, Sabrina Hsueh, William Hsu, Ross Koppel, Eileen Koski, Hongfang Liu, Sephen Morgan, Soojin Park, Daniel Schlegel, Christina Stephan, Jessie Tenenbaum, Charlene Weir
- Friends: Sue Bakken, David Bates, John Osborne, Thi Tran Nguyen

Acknowledgments: Authors

Sara Ackerman
Oscar Agoro
Elske Ammenwerth
Rima Arnout
Iman Banerjee
Riccardo Bellazzi
Andrea Bernasconi
Mary Boland
Cedric Bousquet
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Joseph Finkelstein
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Lisa Grossman
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