Opportunities and Challenges using AI/Data Science to Improve Healthcare Delivery

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BRIGHAM HEALTH
BWH BRIGHAM AND WOMEN'S HOSPITAL
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL
Mass General Brigham

Outline

- Opportunity for AI/data science to improve health care delivery
- Highlight 3 Challenges
  1. Privacy & Cybersecurity
  2. Interoperability
  3. Clinical workflow integration
- Discussion

Exciting Time in Healthcare

	Old World	New World
Payment	Fee-for-service	Outcome-based
Incentive	Volume	Value
Focus	Acute episodes	Population health
Role of Provider	Single episodes	Care continuum
Information	Retrospective	Predictive

Source: Cleveland Clinic Global Cardiovascular Innovation Center

The Health Opportunity: The Quadruple Aim

+

Improving Clinician Experience

Health Affairs 27, no.3 (2008):759-769
http://www.ihi.org/Engage/Initiatives/TripleAim/pages/default.aspx
https://www.ahah.net/who-we-are/tripleaim.png
Ann Fam Med. 2014 Nov; 12(6): 573–576.

Digital Transformation

Other Industries 2020

Healthcare 2020

US Adoption of Health IT from 2008 to 2015

	2008	2015
Hospital		
Basic EHR	9%	84%
Certified EHR	--	96%
Ambulatory		
Basic EHR	16.9%	53.9%
Any EHR	42%	86.9%

Office of the National Coordinator for Health Information Technology. 'Office-based Physician Electronic Health Record Adoption,' Health IT Quick-Stat #50. dashboard.healthit.gov/quickstats/pages/physician-ehr-adoption-trends.php. December 2016.

Office of the National Coordinator for Health Information Technology. 'Non-federal Acute Care Hospital Electronic Health Record Adoption,' Health IT Quick-Stat #47. dashboard.healthit.gov/quickstats/pages/FIG-Hospital-EHR-Adoption.php. May 2016.

Where We're Headed

FUTURE: DIGITAL HEALTH

CLINICAL INFORMATICS 2.0

Data presentation/visualization
Interoperability – data from all care venues
Support for population health and quality improvement
Usability and clinician experience

CLINICAL INFORMATICS 1.0

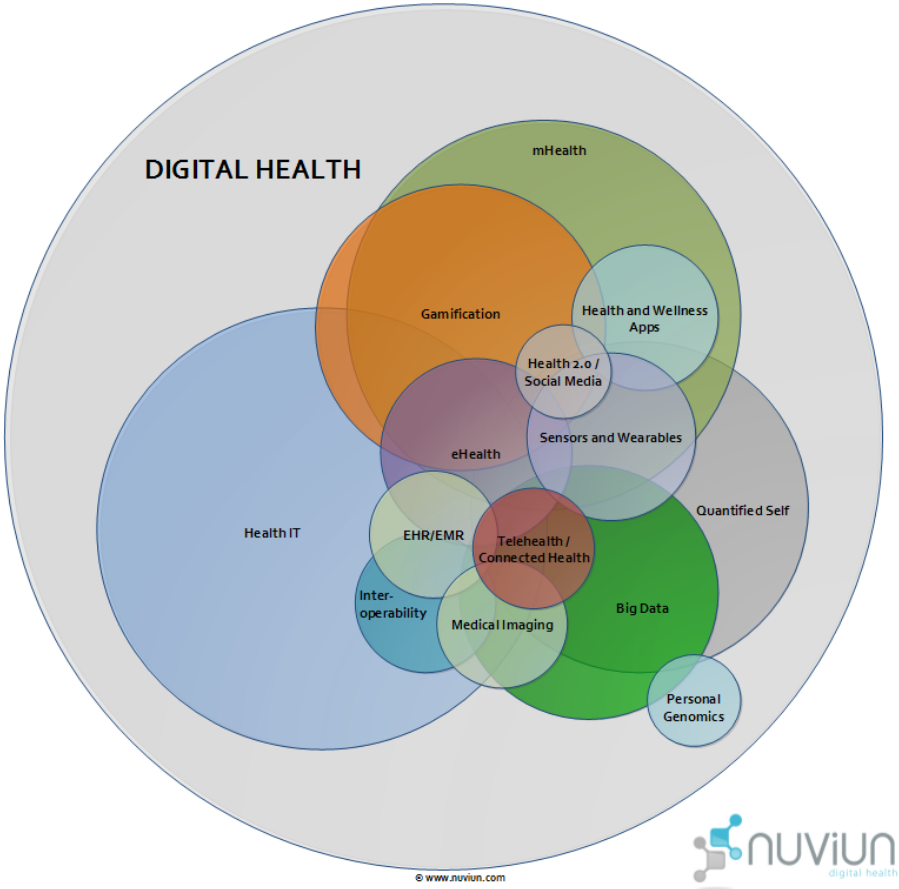
Collection of data
EHR adoptions
Optimizing EHR

George Reynolds, M.D., CIO and CMIO of Children's Hospital Medical Center in Omaha.
http://www.healthcare-informatics.com/article/top-ten-tech-trends-clinical-informaticists-20?page=2

Digital Health

No Single Definition:

Convergence of digital technologies with health and healthcare data with the goals of reducing inefficiencies in healthcare delivery, improving access, reducing costs, increasing quality

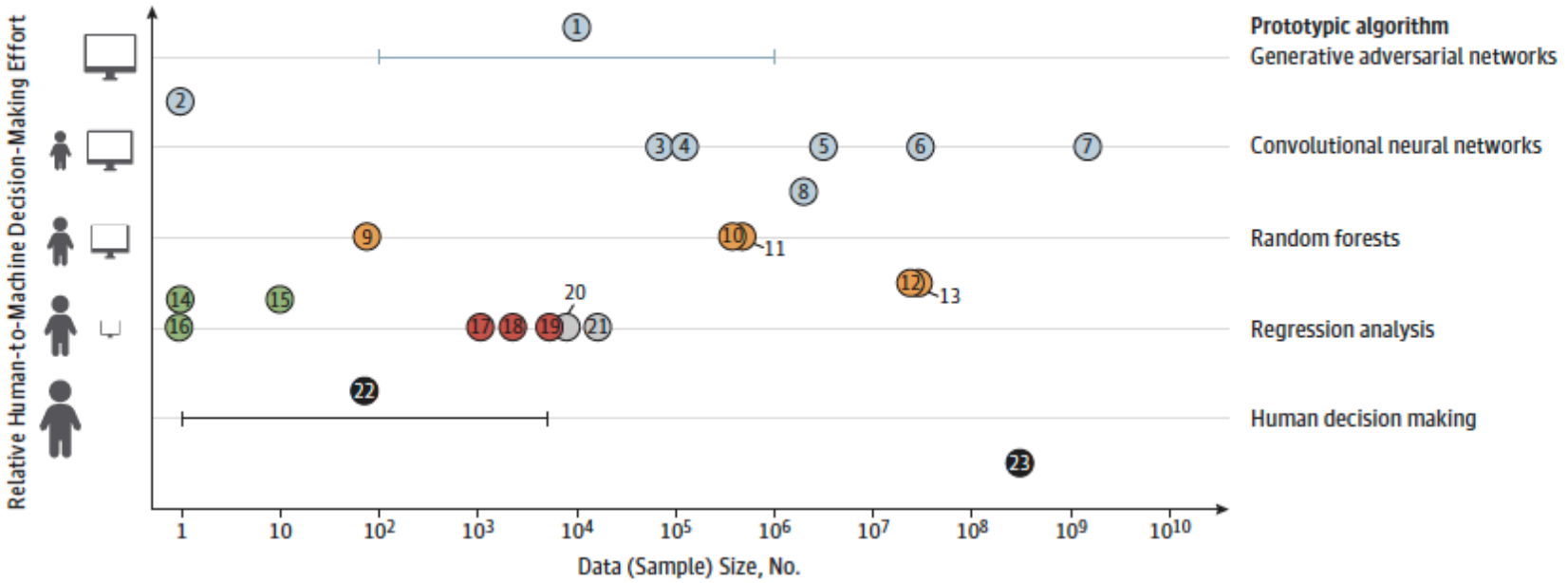


http://en.wikipedia.org/wiki/Digital_health, accessed Feb 9, 2015
Sonnier, P. Story of Digital Health: https://www.youtube.com/watch?v=HSOhdmV8WsY

Machine Learning in Healthcare

Machine Learning – "a program that learns to perform a task or make a decision automatically based on data"

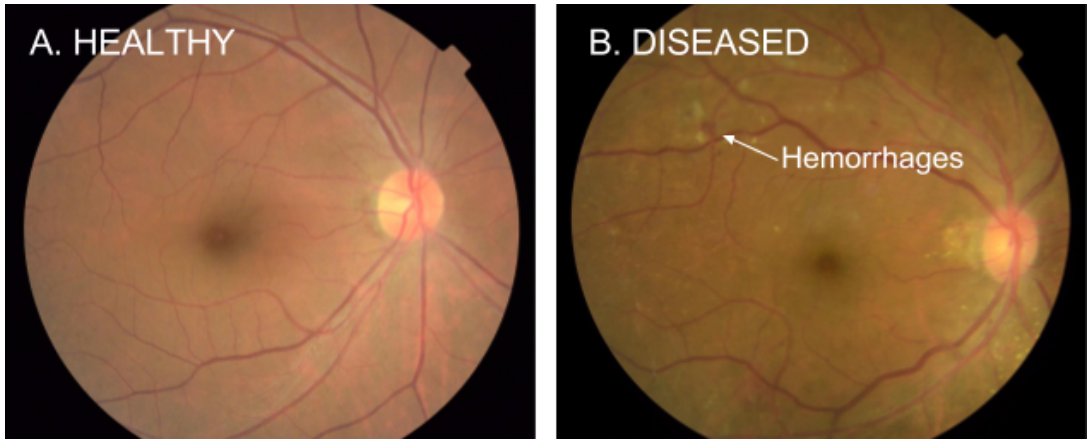
Figure. The Axes of Machine Learning and Big Data



Beam AL, Kahane IS. Big Data and Machine Learning in Health Care. JAMA. 2018 Apr 3;319(13):1317-1318.

Example: Diabetic Retinopathy

- Deep learning algorithm capable of interpreting signs of DR in retinal photographs
- 2 validation sets of 9963 images and 1748 images
- At operating point selected for high sensitivity, the algorithm had 97.5%and 96.1%sensitivity and 93.4%and 93.9% specificity



https://ai.googleblog.com/2016/11/deep-learning-for-detection-of-diabetic.html

Clinical, Ethical, and Legal Challenges

as we move to real-world implementation

Clinical	Ethical	Legal
Clinical validation in real-world setting	Informed consent to use	Safety and effectiveness
Workflow integration	Safety and transparency	Liability
Clinician and patient education	Algorithm fairness and bias	Data protections and privacy
Data interoperability	Data Privacy	Cybersecurity
		Intellectual property

Gerke S, Minssen T, Cohen G. Chapter 12 - Ethical and legal challenges of artificial intelligence-driven healthcare, in Artificial Intelligence in Healthcare, Academic Press,
2020,Pages 295-336. https://www.sciencedirect.com/science/article/pii/B9780128184387000125?via%3Dihub

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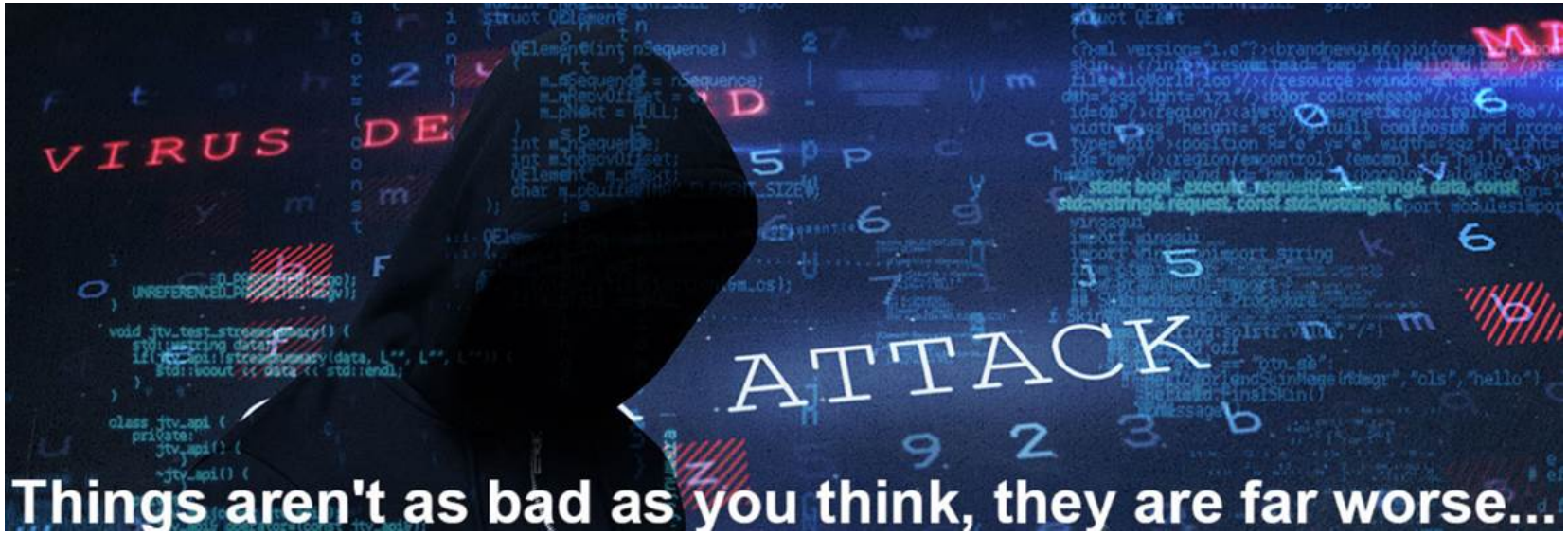
Privacy & Cybersecurity

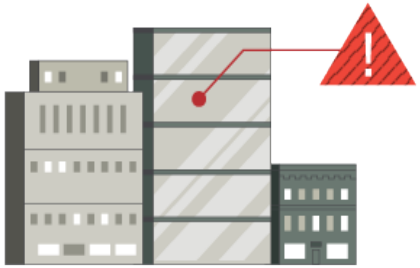


Privacy

- Patients, customers and subjects expect you to handle confidential data in a secure manner
- In the United States, health privacy is largely regulated by the Health Insurance Portability and Accountability Act (HIPAA)
  - Limits who can view and use patient information and who the data can be shared with
  - Fully identifiable information cannot be shared without the patient or research subject's consent unless for **Treatment**, **Payment**, or **Operations**

Why HIPAA Matters?

- Report confirmed breaches of protected health information to HHS
- Notify affected patients in writing
- Notify the media for breaches affecting 500+ patients



$150-$250

The average cost per breached medical record

$5.6 billon

Yearly cost to the healthcare industry, due to breaches

Cybersecurity as a Public Health Threat

- As clinicians, we see cybersecurity as a public health and patient safety concern
  - Canceled surgeries and appointments
  - Diverted ambulances
  - Disruption in access to clinical information
  - Device security
  - Manipulated clinical information

THE University of Vermont HEALTH NETWORK

The NEW ENGLAND JOURNAL of MEDICINE

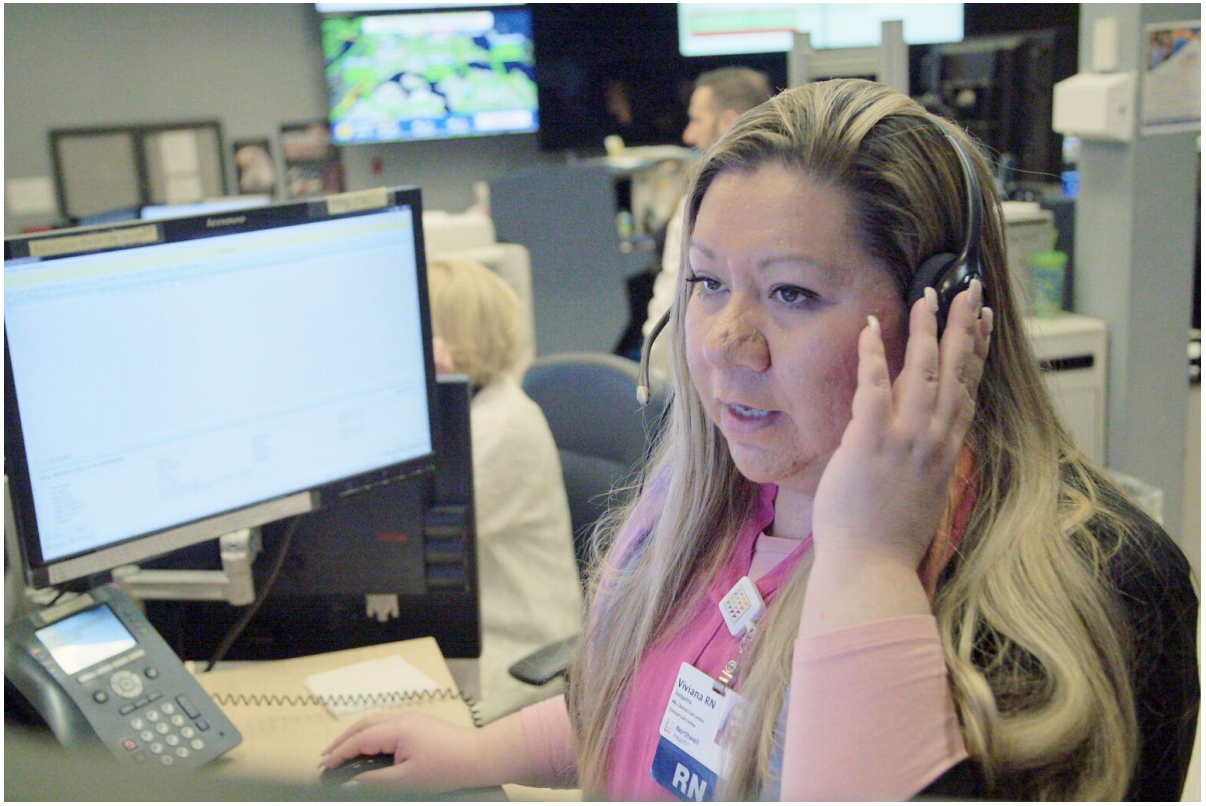
Perspective

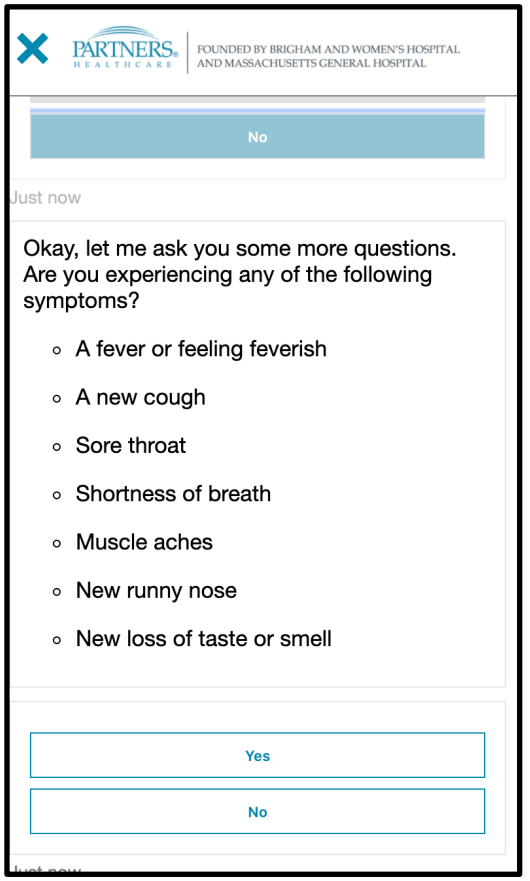
Threats to Information Security — Public Health Implications

William J. Gordon, M.D., Adam Fairhall, A.L.M., and Adam Landman, M.D., M.I.S., M.H.S.

Interoperability

Example: COVID-19 Patient Screener (Chatbot)





Harvard Business Review

INNOVATION

How Hospitals Are Using AI to Battle Covid-19

by Kelley A. Wittbold , Colleen Carroll , Marco Iansiti , Haipeng Mark Zhang and Adam B. Landman

April 03, 2020

https://covid.partners.org/

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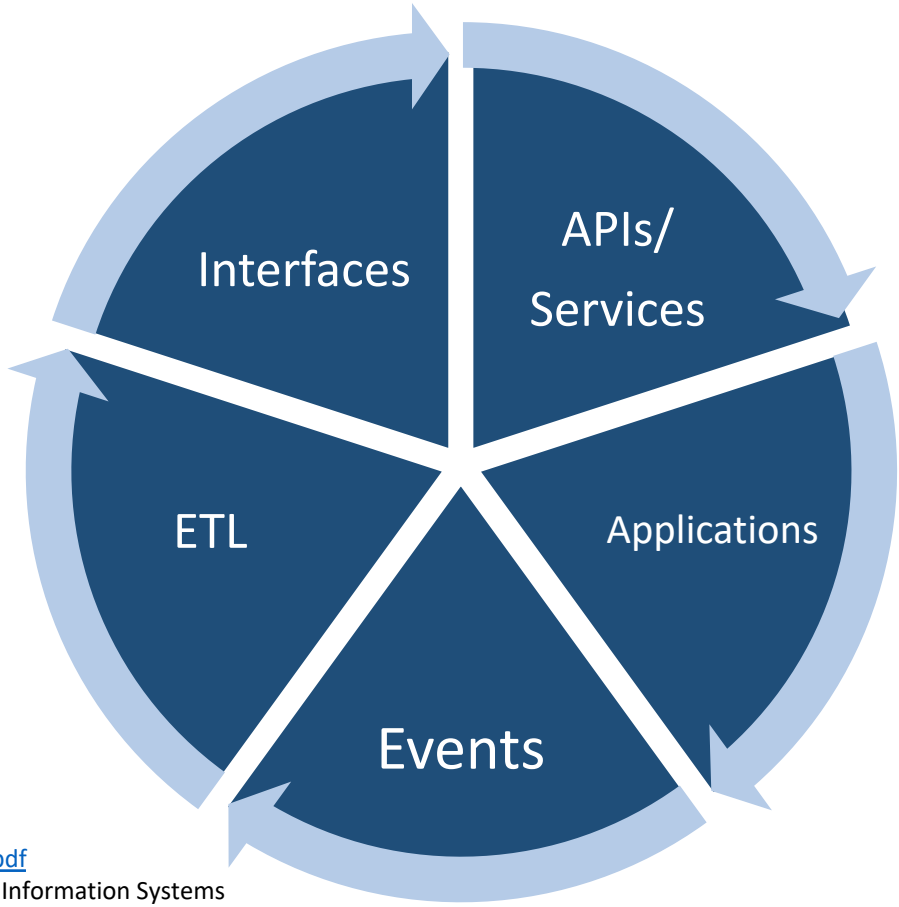
Interoperability & Integration

Interoperability

"Enables the secure exchange of electronic health information (EHI) with, and use of EHI from, other health IT without special effort on the part of the user"

Integration



https://www.healthit.gov/sites/default/files/nprm/ONCCuresNPRMImplementation.pdf

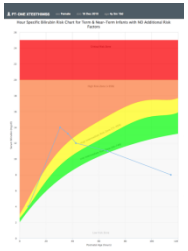
John Pappas, Dan Fuchs, Chris Custer, Dan Higgins, Mass General Brigham Healthcare Information Systems

Fast Healthcare Interoperability Resources

- Application Programming Interface (API)
  - allows software to electronically access data and services from another software program
- ***Open*** Health Level 7 Standard
  - Leverages previous HL7 expertise
- Fast and easy to implement
  - Specifications are free
  - Based on web standards (HTTP, OAuth, XML, JSON)
  - Supports RESTful architectures

FHIR Enables Innovation Across EHRs

Apps



FHIR®©

FHIR API

FHIR Data Profiles

SMART®

- Authentication/Authorization (OAuth2)
- Ability to launch and embed apps

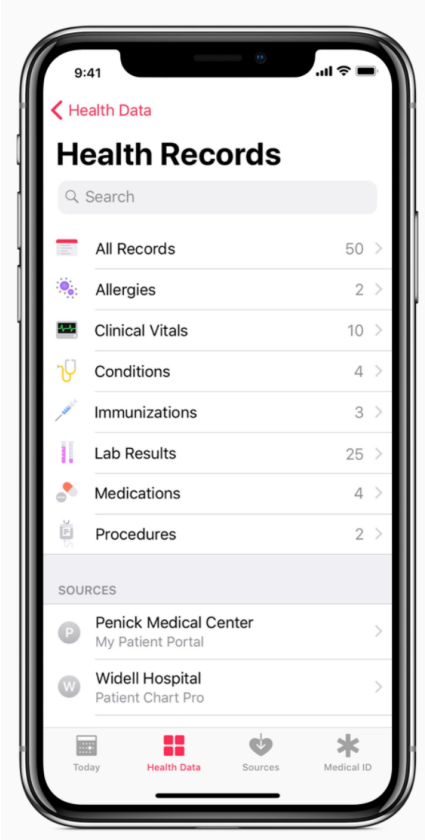
Electronic Health Record

Epic **Cerner** **athenahealth** **Other EHR Systems**

Mandl KD and Kohane IS, Escaping the EHR Trap – The Future of Health IT, NEJM 2012;366:2240-2.
http://smarthealthit.org/wp-content/uploads/SmartonFhirPresentation-HIMSS-v8.pdf

Will EHR Vendors Support APIs?

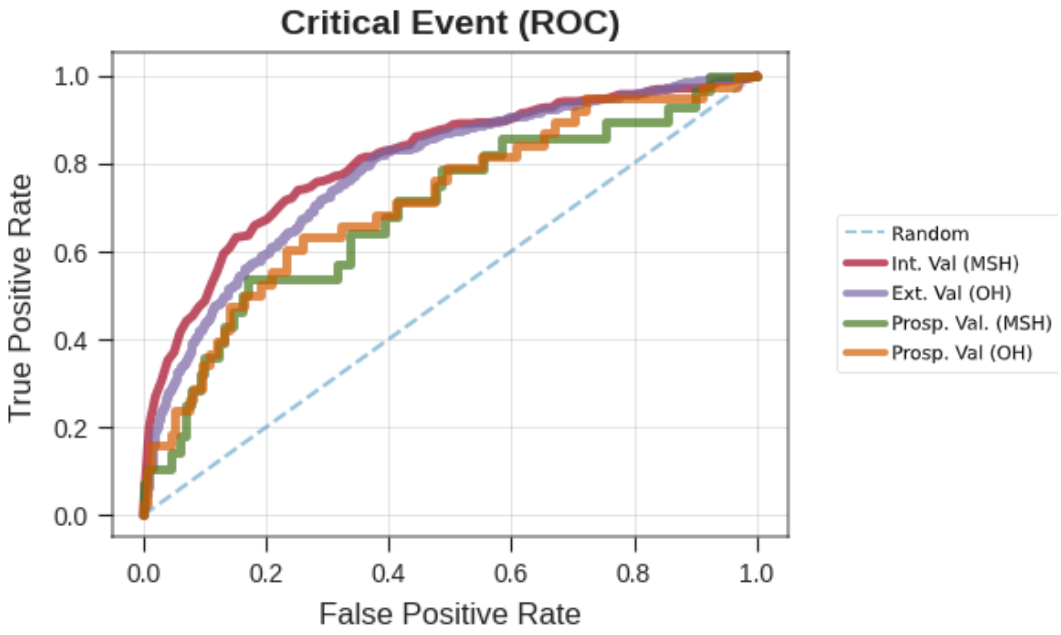
- Stage 3 Meaningful Use requires APIs within EHRs be made available to third party applications or devices by patients
  - As a result, most major EHR vendors have built functionality to support requirement, including Epic and Cerner
  - Apple's Health Records on iPhone leverages FHIR APIs
- EHR vendors are also creating "app stores" for third-party products for health care providers



https://www.federalregister.gov/documents/2015/10/16/2015-25595/medicare-and-medicaid-programs-electronic-health-record-incentive-program-stage-3-and-modifications

Workflow Integration

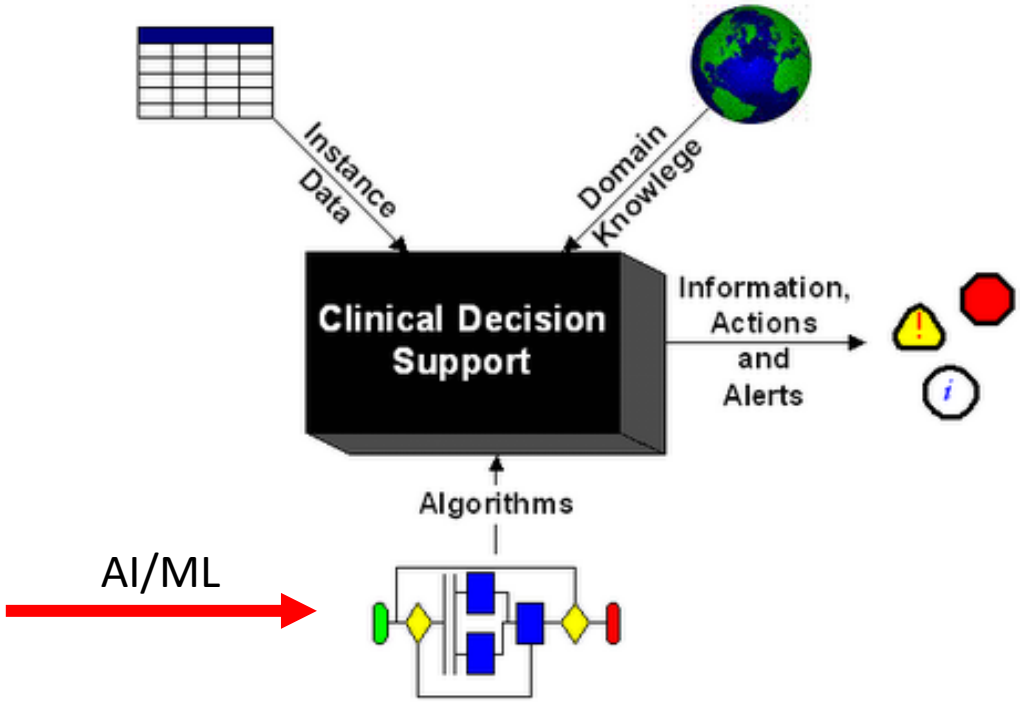
Example: Predicting COVID-19 Critical Events & Mortality



Vaid A, Somani S, Russak AJ, et al. Machine Learning to Predict Mortality and Critical Events in a Cohort of Patients With COVID-19 in New York City: Model Development and Validation. J Med Internet Res 2020;22(11):e24018.

Clinical Decision Support (CDS)

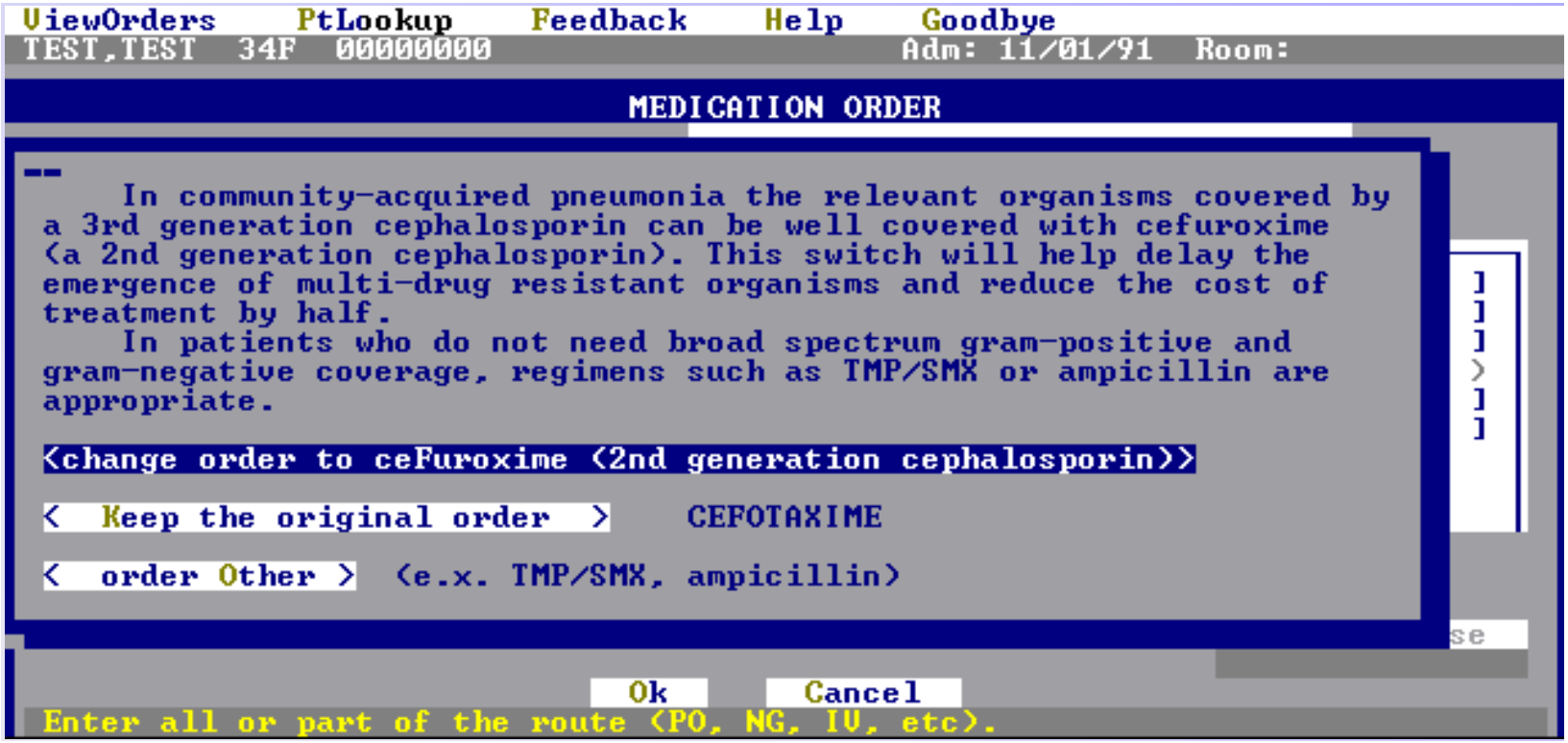
- "any computer-based system that presents information in a manner that helps clinicians, patients, or other interested parties make optimal clinical decisions"



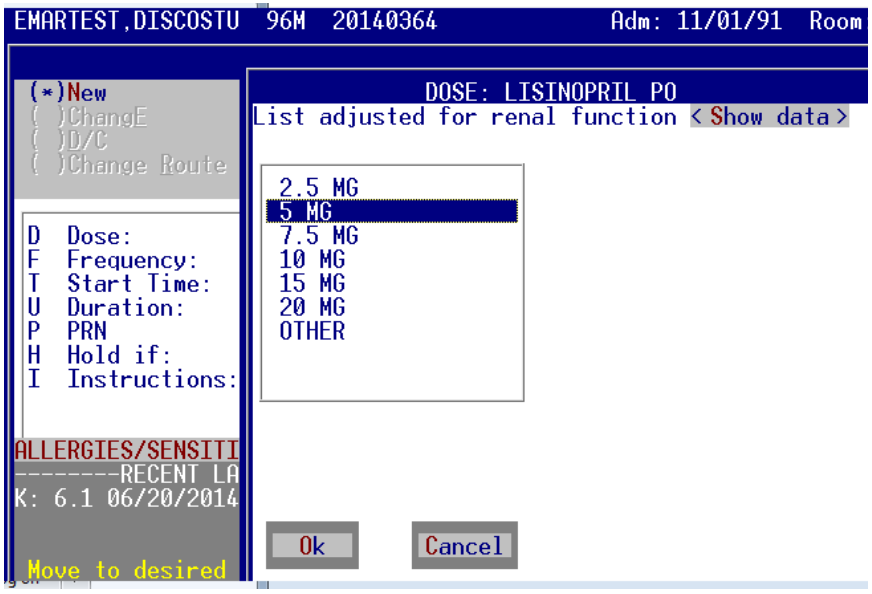
Wright et al., J Am Med Inform Assoc 2011, 18:187-194.

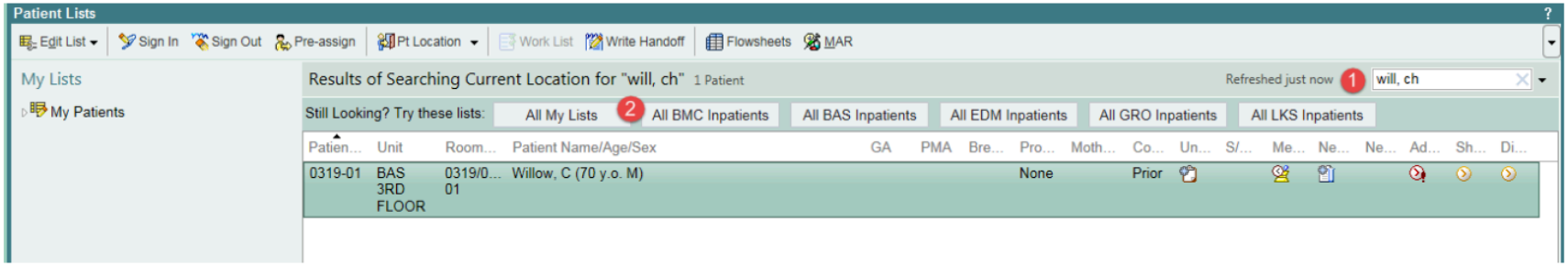
http://motorcycleguy.blogspot.com/2008/06/clinical-decision-support.html

CDS Can Suggest Safer, Less Expensive Drugs



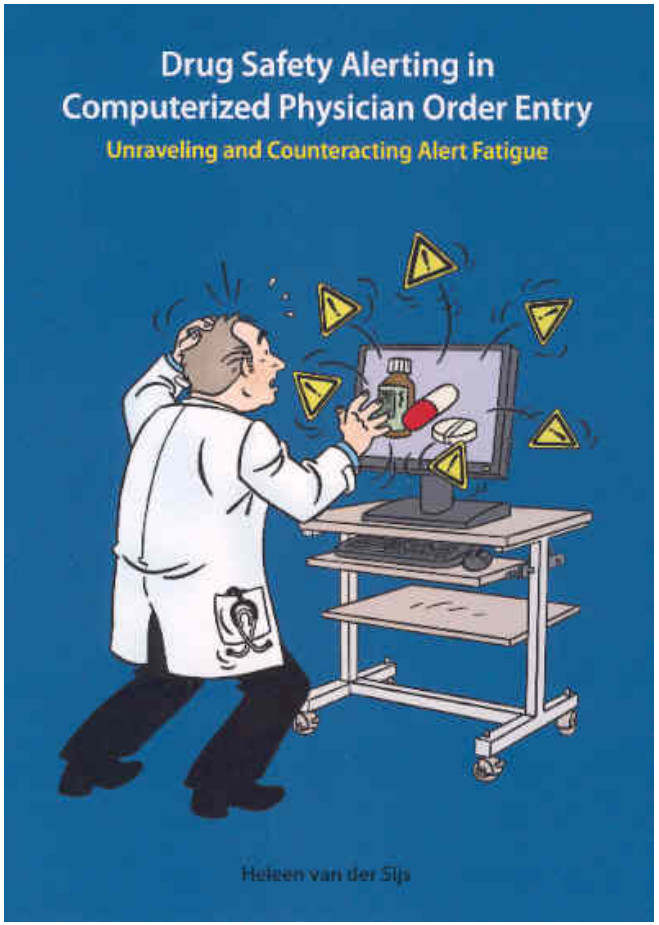
Decision Support Doesn't Have to be "In Your Face"





CDS Can Be Difficult to Implement Effectively

- Often ignored, or overridden by clinicians (“alert fatigue”)
  - 49-96% overrides
- Often incorrect (false positives)
  - 20% inappropriate
- Interrupts clinicians’ workflow, train of thought, clinical routine
- Requires clinical and IT personnel to create, test, and maintain



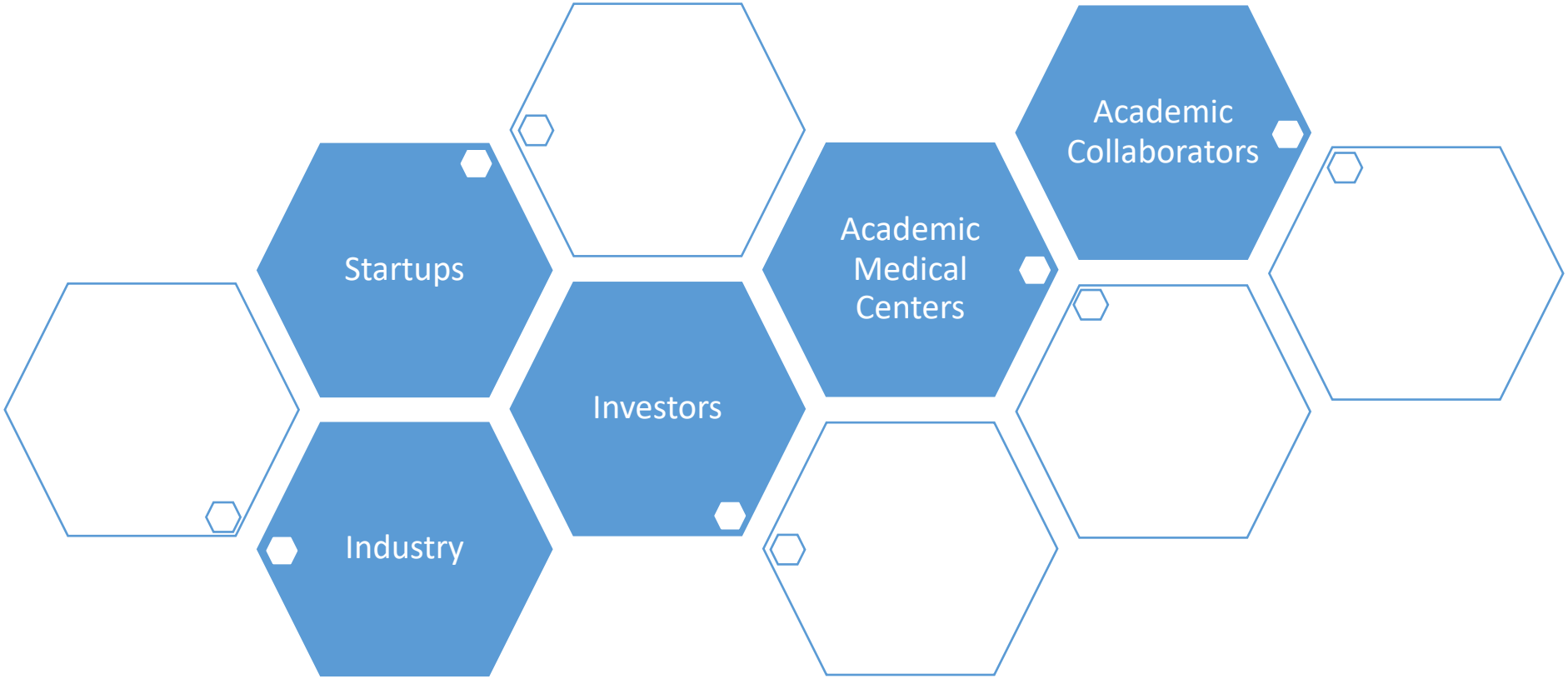
Ten Commandments for Effective CDS

- **RIGHT INFORMATION**
  - Quality of knowledgebase
  - Provide recommendations, not just assessments
- **RIGHT PERSON**
  - Who needs/will use the information
- **RIGHT FORMAT / IMPLEMENTATION OF CDS**
  - Speed, comprehensibility, ease of use
- **RIGHT CHANNEL / MODE**
- **RIGHT TIME AND LOCATION**
  - Workflow integration
  - Intervene at the time/location of the decision
  - Facilitate activation of the recommendations

D.W. Bates, G.J. Kuperman, S. Wang, et al. Ten commandments for effective clinical decision support: making the practice of evidence-based medicine a reality. J Am Med Inform Assoc, 10 (6) (2003), pp. 523–530.

The Path Forward

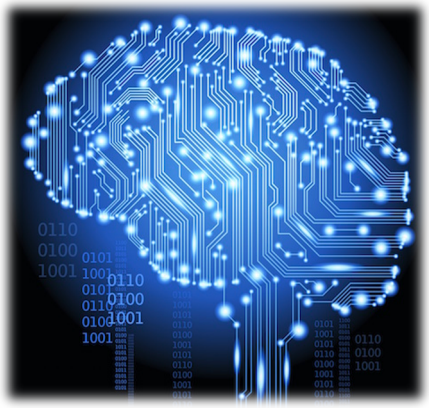
- Collaboration across organizations and disciplines is critical to advancing digital health



Conclusions

- Exciting opportunity and time for technology to improve health care delivery
- Data science/AI will play critical and increasingly role in healthcare
- To be successful, AI solutions need to carefully consider privacy, interoperability, and workflow (among other factors)

Thank You



Digital will be at the core of everything we do

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