Health Informatics on FHIR

Module 3 Overview

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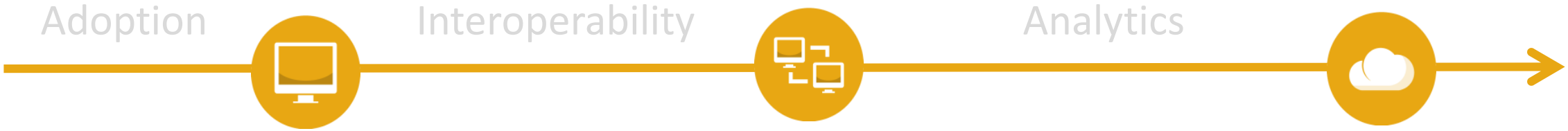
Real World Applications & Challenges

Module Objectives

- Become familiar with some key real world applications of health informatics
- Understand design challenges and potential solutions
- Become familiar with a few analytics-based health informatics tools

Implementing IOM's Vision: "Secondary" Challenges



Usability

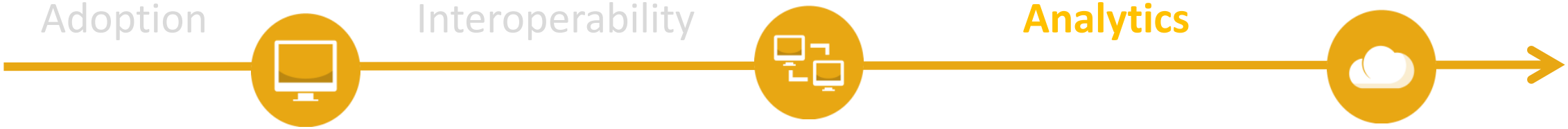
Workflow/Process

Privacy/Security

Data Quality

Implementing IOM's Vision: "Secondary" Challenges

Adoption → Interoperability → **Analytics**



Usability

Workflow/Process

Privacy/Security

Data Quality

Implementing IOM's Vision: "Secondary" Challenges

Adoption

Interoperability

Analytics

Usability

Workflow/Process

Privacy/Security

Data Quality

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Real World Applications & Challenges: Usability

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Real World Applications & Challenges: Usability

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Usability: Patient Safety

"Health care in the United States is not as safe as it should be--and can be. At least 44,000 people, and perhaps as many as 98,000 people, die in hospitals each year as a result of **medical errors that could have been prevented**"

To Err is Human, IOM, November, 1999

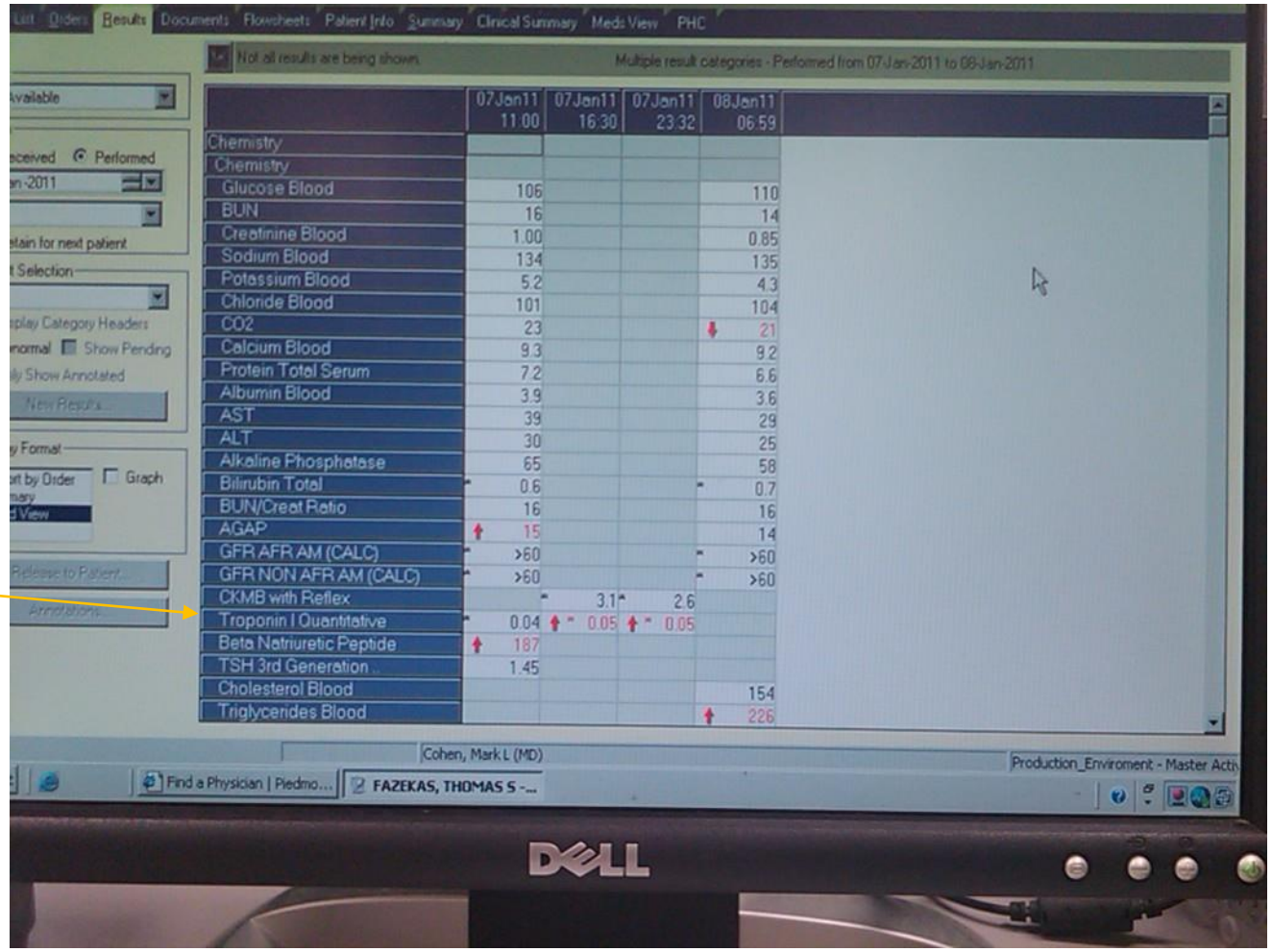
Usability: Patient Safety

"Poor EHR system design and improper use can cause **EHR-related errors** that jeopardize the integrity of the information in the EHR, leading to errors that endanger patient safety or decrease the quality of care."

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3797550/

Usability: EHR-related Errors

Troponin: a highly specific marker for **myocardial infarction** *or heart muscle cell death*

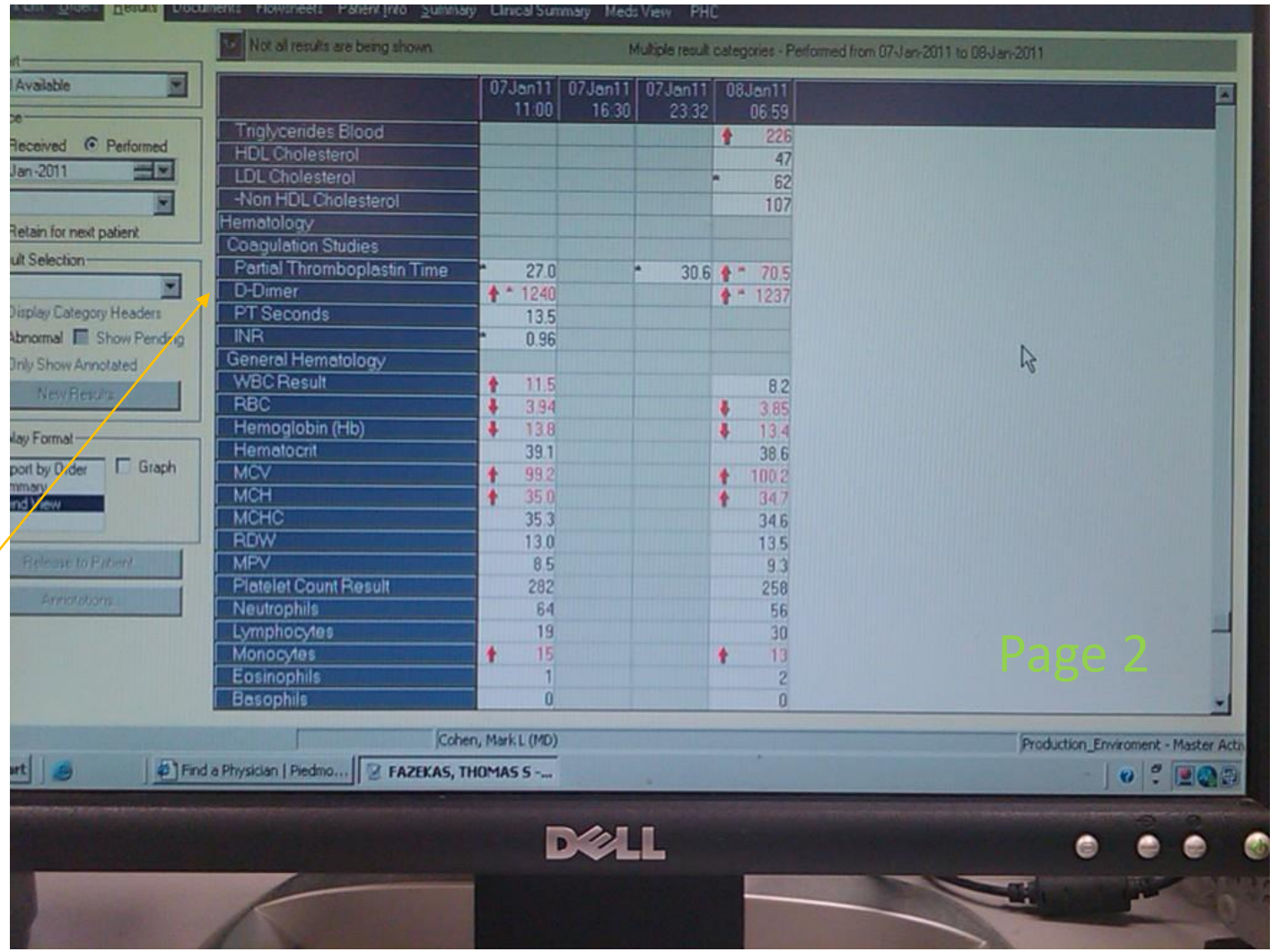


Usability: EHR-related Errors

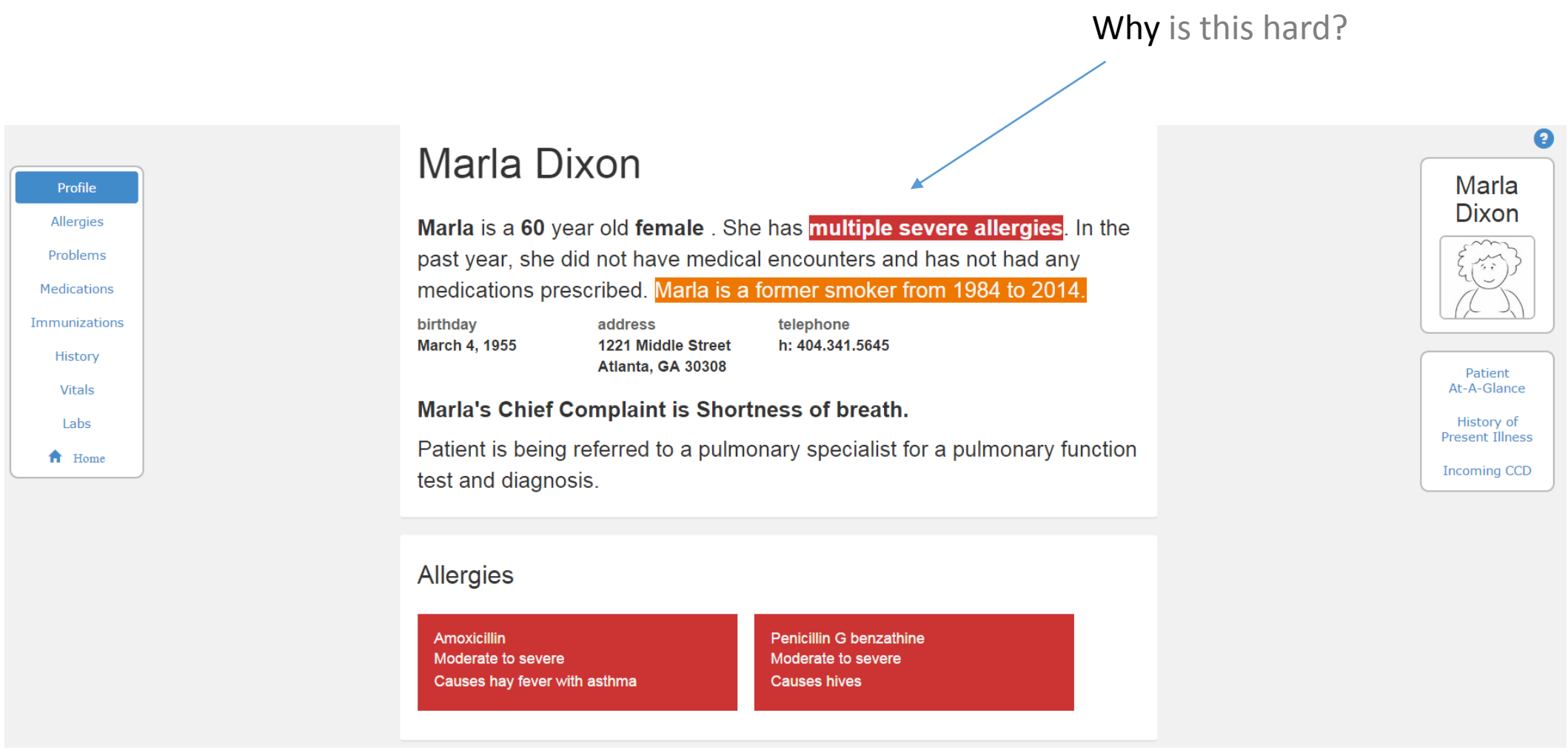
"one-third of patients clinically diagnosed as having **pulmonary embolism** presented with elevated serum troponin I concentrations"

J Am Coll Cardiol. 2000 Nov 1;36(5):1632-6

D-dimer: a non-specific marker for pulmonary embolus

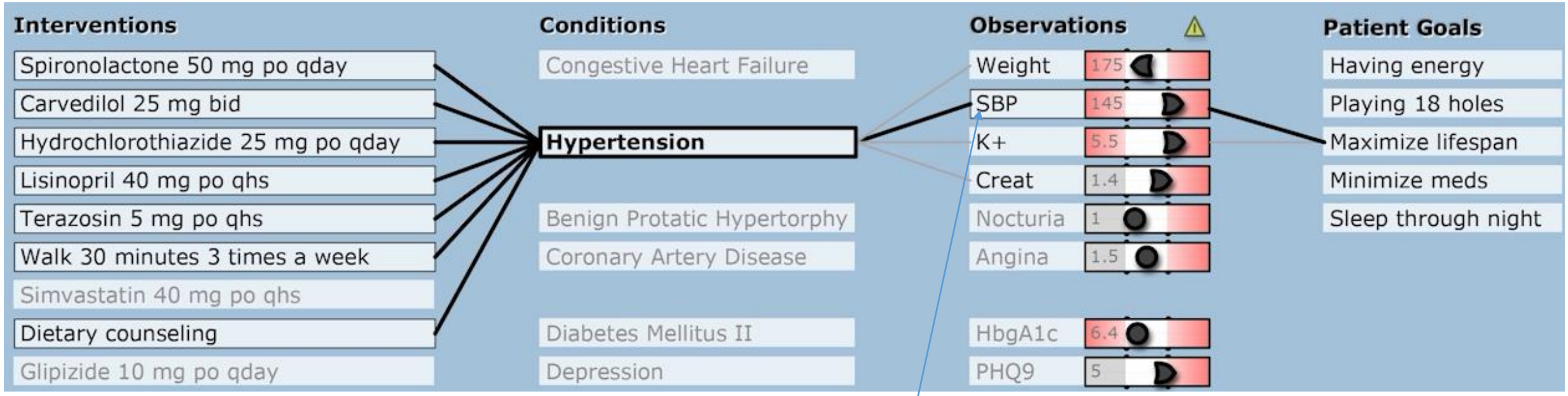


Usability: Analytics Based Solution – Highlight the Important



Real World Applications and Challenges:

EHRs Typically Ignorant of Clinical Relationships

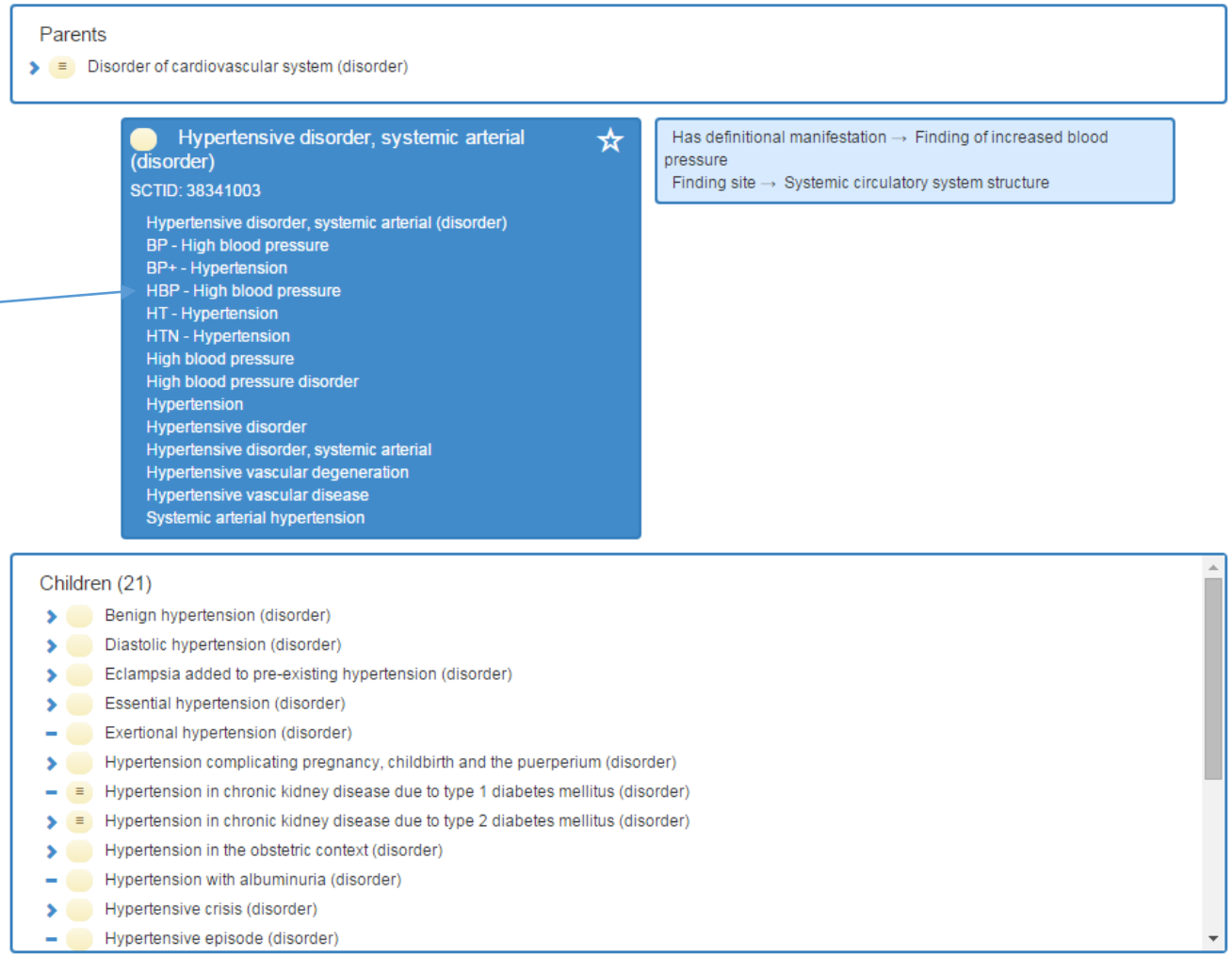


How is hypertension related to systolic blood pressure?

Real World Applications and Challenges:

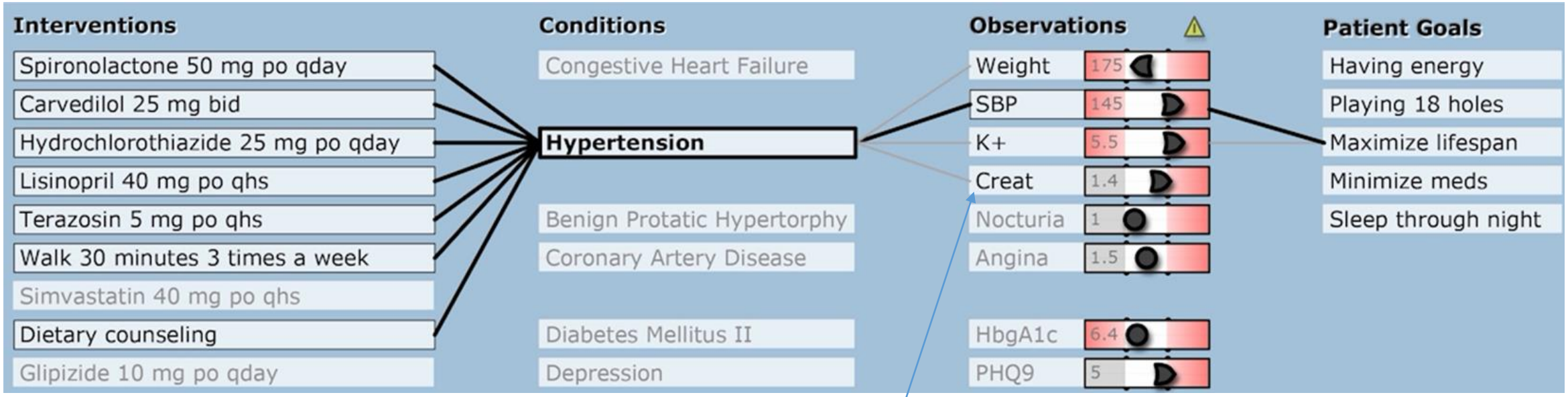
Standards Can Help in Some Cases

Elevated



Real World Applications and Challenges:

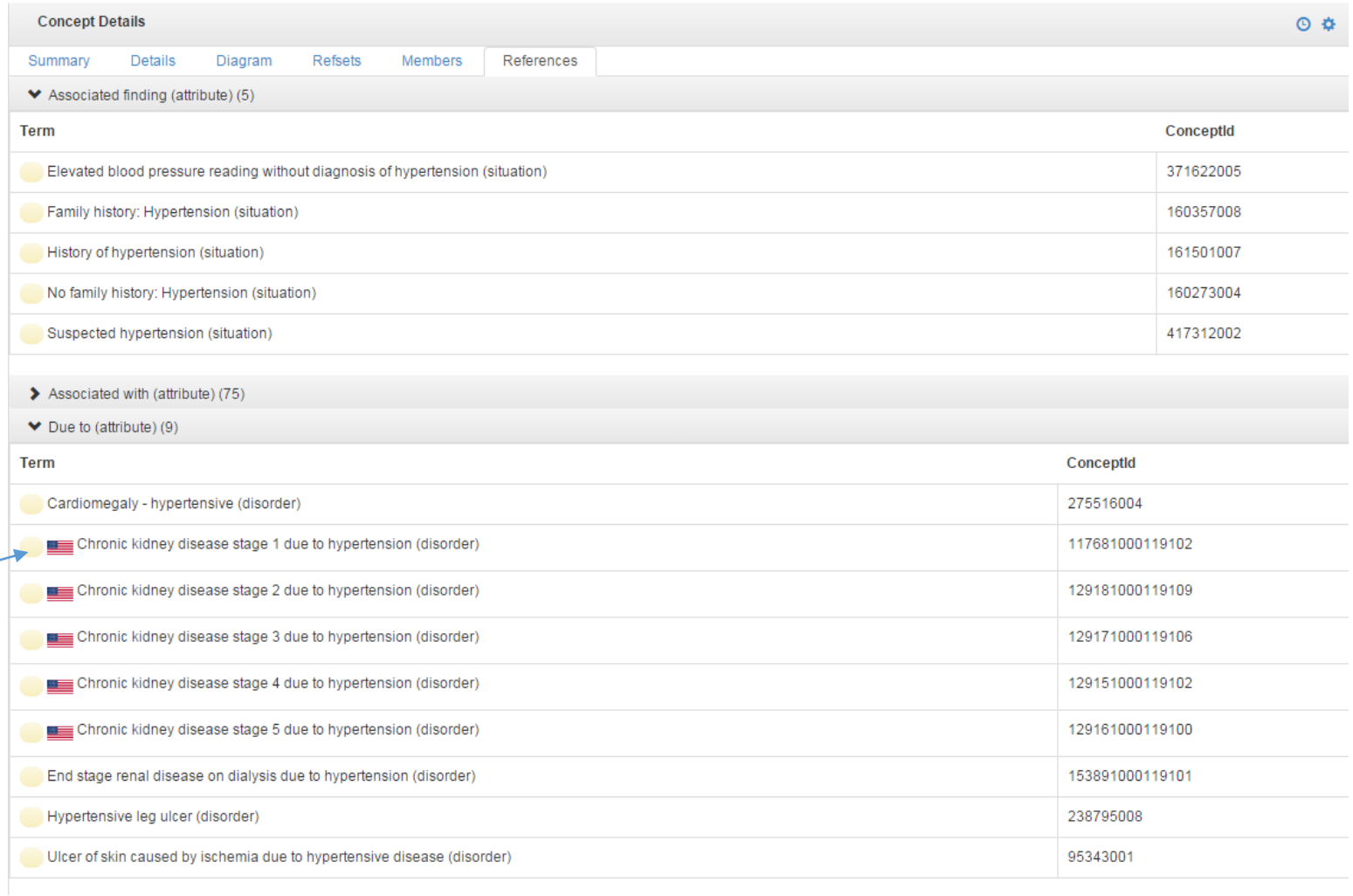
EHRs Typically Ignorant of Clinical Relationships



How is hypertension related to serum creatinine?

Real World Applications and Challenges:

Standards (SNOMED-CT) Can Help



Concept Details

Summary | Details | Diagram | Refsets | Members | References

Associated finding (attribute) (5)

Term	ConceptId
Elevated blood pressure reading without diagnosis of hypertension (situation)	371622005
Family history: Hypertension (situation)	160357008
History of hypertension (situation)	161501007
No family history: Hypertension (situation)	160273004
Suspected hypertension (situation)	417312002

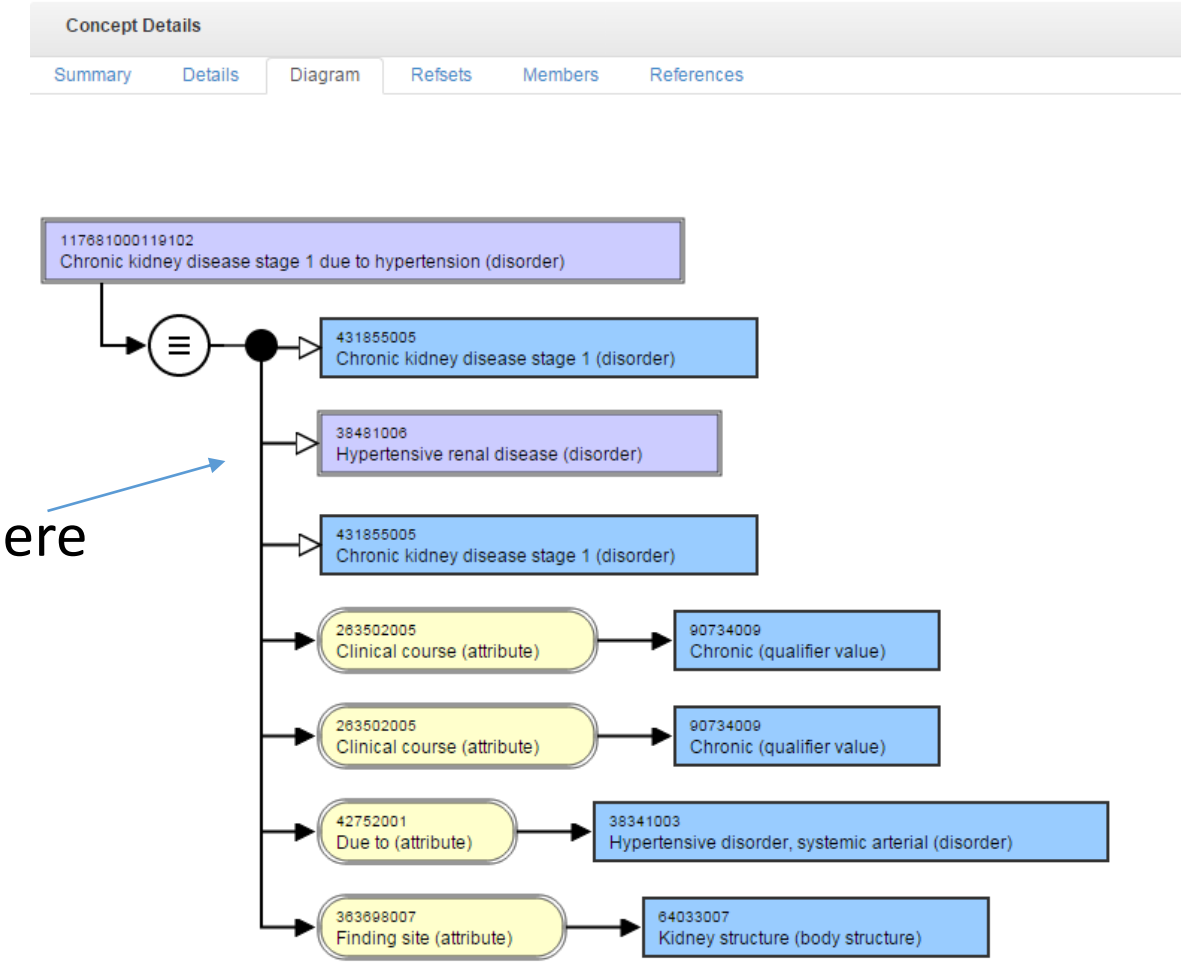
Associated with (attribute) (75)

Due to (attribute) (9)

Term	ConceptId
Cardiomegaly - hypertensive (disorder)	275516004
Chronic kidney disease stage 1 due to hypertension (disorder)	117681000119102
Chronic kidney disease stage 2 due to hypertension (disorder)	129181000119109
Chronic kidney disease stage 3 due to hypertension (disorder)	129171000119106
Chronic kidney disease stage 4 due to hypertension (disorder)	129151000119102
Chronic kidney disease stage 5 due to hypertension (disorder)	129161000119100
End stage renal disease on dialysis due to hypertension (disorder)	153891000119101
Hypertensive leg ulcer (disorder)	238795008
Ulcer of skin caused by ischemia due to hypertensive disease (disorder)	95343001

But only partially in this case …

Real World Applications and Challenges:
Standards (SNOMED-CT) Can Help



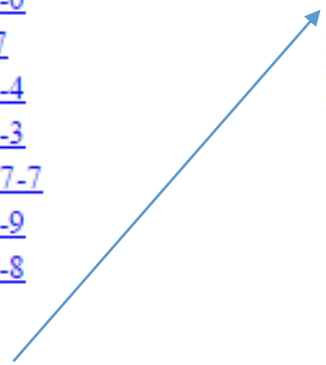
… and here

Real World Applications and Challenges: LOINC

68996-8 Laboratory - end stage renal disease form 2728

PANEL HIERARCHY

LOINC#	LOINC Name	R/O/C	Cardinality	Ex. UCUM Units
68996-8	Laboratory - end stage renal disease form 2728			
1751-7	Albumin [Mass/volume] in Serum or Plasma	O		g/dL
49049-0	Collection time of Unspecified specimen	C		{clock_time}
68900-0	Albumin Lab Method	O		
2160-0	Creatinine [Mass/volume] in Serum or Plasma	R		mg/dL
718-7	Hemoglobin [Mass/volume] in Blood	O		g/dL
4548-4	Hemoglobin A1c/Hemoglobin.total in Blood	O		%
2093-3	Cholesterol [Mass/volume] in Serum or Plasma	O		mg/dL
13457-7	Cholesterol in LDL [Mass/volume] in Serum or Plasma by calculation	O		mg/dL
2085-9	Cholesterol in HDL [Mass/volume] in Serum or Plasma	O		mg/dL
2571-8	Triglyceride [Mass/volume] in Serum or Plasma	O		mg/dL



Real World Applications and Challenges: FHIR Value Sets

Path	Definition	Type	Reference
Condition.code Condition.relatedItem.code	Identification of the Condition or diagnosis.	Example	http://hl7.org/fhir/vs/condition-code
Condition.category	A category assigned to the condition. E.g. finding | Condition | diagnosis | concern | condition	Incomplete	http://hl7.org/fhir/vs/condition-category
Condition.status	The clinical status of the Condition or diagnosis	Fixed	http://hl7.org/fhir/condition-status
Condition.certainty	The degree of confidence that this condition is correct	Example	http://hl7.org/fhir/vs/condition-certainty
Condition.severity	A subjective assessment of the severity of the condition as evaluated by the clinician.	Example	http://hl7.org/fhir/vs/condition-severity
Condition.relatedItem.type	The type of relationship between a condition and its related item	Fixed	http://hl7.org/fhir/condition-relationship-type

due-to

this condition follows the identified condition/procedure/substance and is a consequence of it.

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Real World Applications & Challenges: Efficiency

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Real World Applications & Challenges: Efficiency

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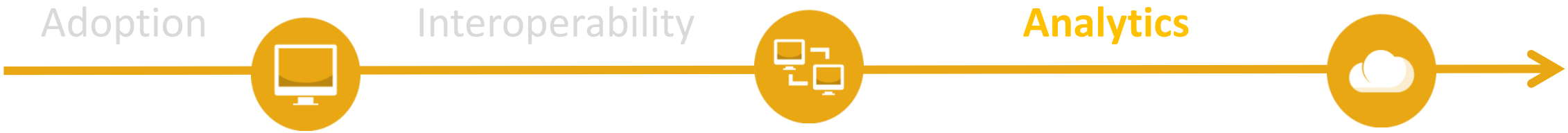
Usability versus Complexity: Balance



Usability

Workflow/Process

Privacy/Security

Data Quality

Physician Attitudes to Date: Mixed

Positives:

In our practice, our electronic health record improves the quality of care 61%

Using an electronic health record enhances patient-doctor communication that is not face to-face 54%

Negatives:

When I am providing clinical care, our electronic health record slows me down 43%

Our electronic health record requires me to perform tasks that other staff could perform 61%

Our electronic health record improves my job satisfaction 38%

Using an electronic health record interferes with patient-doctor communication during … clinical care 36%

I receive an overwhelming number of electronic messages in this practice 31%

Overall:

Based on my experience to date, I prefer using paper medical records instead of electronic records 18%

Factors Affecting Physician Professional Satisfaction and Their Implications for Patient Care, Health Systems, and Health Policy, RAND/AMA 2013

Real World Applications and Challenges

Positive- Improved Care

In our practice, our electronic health record improves the quality of care 61%

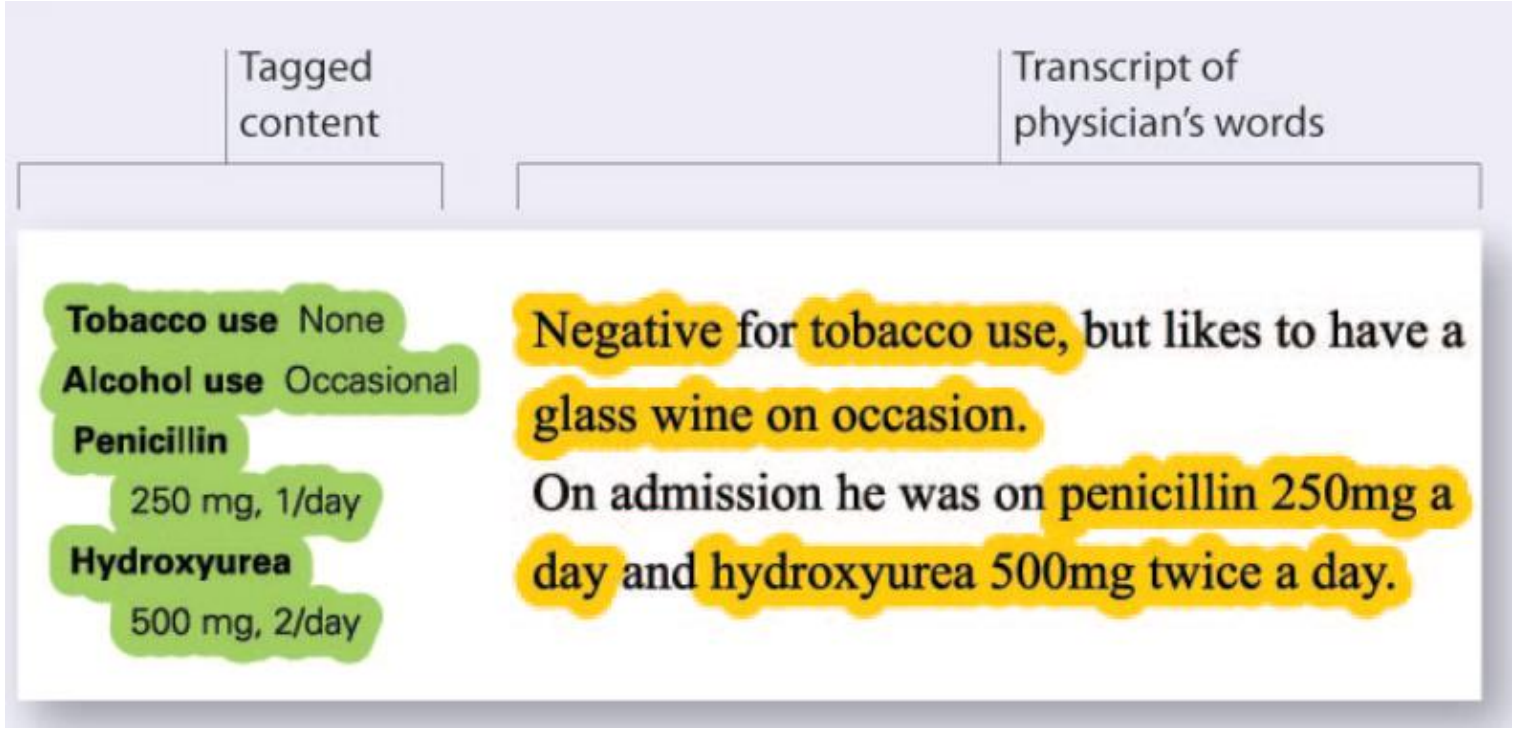
I think [the EHR is] fantastic. … **A real EHR, one that actually gives you things in fields that are usable and useful, makes all the difference.** I can click a button and I can see the blood pressures over time. I'm not like thumbing through pages to say, "What was your last blood pressure?" "Oh, and what was the one before that?" and then try to think about them. I click a button and [the EHR] graphs them for me. I can see trends. I can see what's been happening. It is incredible in facilitating communication. I mean, we have a huge practice, … and we work together as a team. How would you do that on paper?

Factors Affecting Physician Professional Satisfaction and Their Implications for Patient Care, Health Systems, and Health Policy, RAND/AMA 2013

Real World Applications and Challenges: Usability Solutions

*Speech Understanding: m*modal*

SNOMED-CT



Factors Affecting Physician Professional Satisfaction and Their Implications for Patient Care, Health Systems, and Health Policy, RAND/AMA 2013

Real World Applications and Challenges: Usability Solutions

Clinically Adaptive EHR

The clinician interacts with models and abstractions of the patient that **place the raw data into context and synthesize them with medical knowledge in ways that make clinical sense for that patient**.

These virtual patient models are the computational counterparts of the clinician's conceptual model of a patient.

The use of these models to **establish clinical context**, would free the clinician from having to make direct sense of raw data, and thus he or she would have a much easier time defining, testing, and exploring his/her own working theory.

What links the raw data to the abstract models might be called medical logic—that is, computer-based tools that **examine raw data relevant to a specific patient and suggest their clinical implications** given the context of the models and abstractions.

Computers can then provide decision support—that is, tools that help clinicians decide on a course of action in response to an understanding of the patient's status.

http://www.nap.edu/catalog/12572/computational-technology-for-effective-health-care-immediate-steps-and-strategic

Real World Applications and Challenges: Usability Solutions

Clinically Adaptive EHR: Praxis

SINGLE & SOLO PHYSICIAN PRACTICES: ALL SPECIALTIES

1 PRAXIS
2 HEALTHFUSION
3 DRCHRONO
4 KAREO
5 ATHENAHEALTH
6 MODERNIZING MEDICINE
7 ADP ADVANCEDMD
8 PRACTICEFUSION
9 NEXTECH
10CARECLOUD

INTERNAL MEDICINE

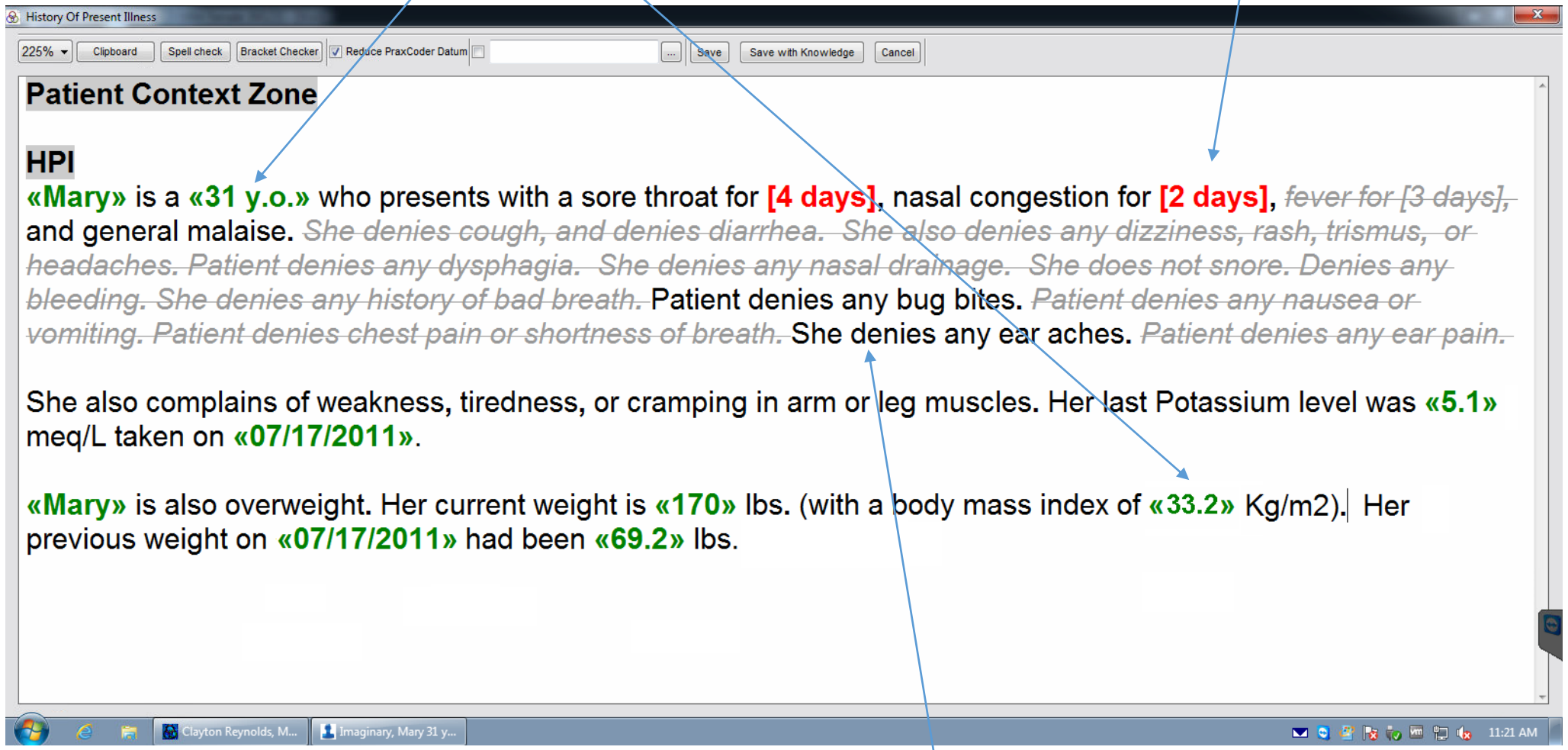
1 – PRAXIS
2 – CARECLOUD
3 – ATHENAHEALTH
4 – CERNER
5 – PRACTICE FUSION
6 – KAREO
7 – NEXTGEN
8 – ALLSCRIPTS
9 – GREENWAY
10 – CARE 360 QUEST MEDPLUS #^)

Buy the full Report

http://blackbookmarketresearch.com/ambulatory-alternate-site-ehr/

"Datum" auto populates from patient's record can be calculated (e.g. BMI)

Information that must be edited for this patient



Clicking accepts this "clinical concept"

Courtesy Praxis

Real World Applications and Challenges: Usability Solutions

Reinvent the EHR: MCIS

EHR

A cloud-based EHR designed to optimize care team workflow, MCIS Clinicals produces an easy-to-read clinical note generated from structured data collected during the visit.

Learn more

Analytics

Industry-leading analytics that provide real-time insight into your practice, making it actionable before, during and after the patient visit.

Learn more

Patient Portal

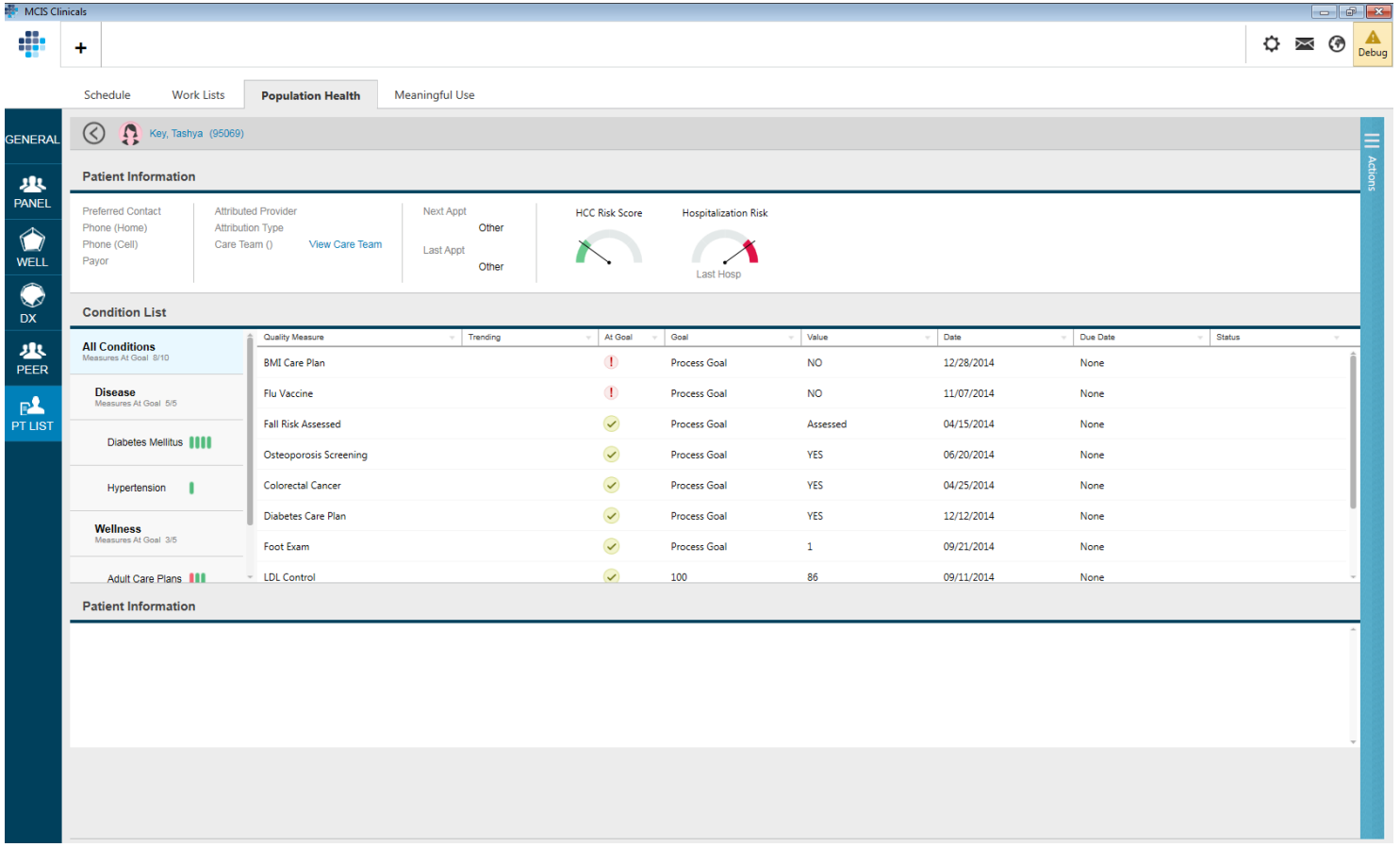
Sophisticated patient portal that drives patient engagement beyond the office visit with access to their health information and care team anywhere, anytime.

Learn more

https://www.mcis.com/Products.aspx

Real World Applications and Challenges: Usability Solutions

Reinvent the EHR: MCIS

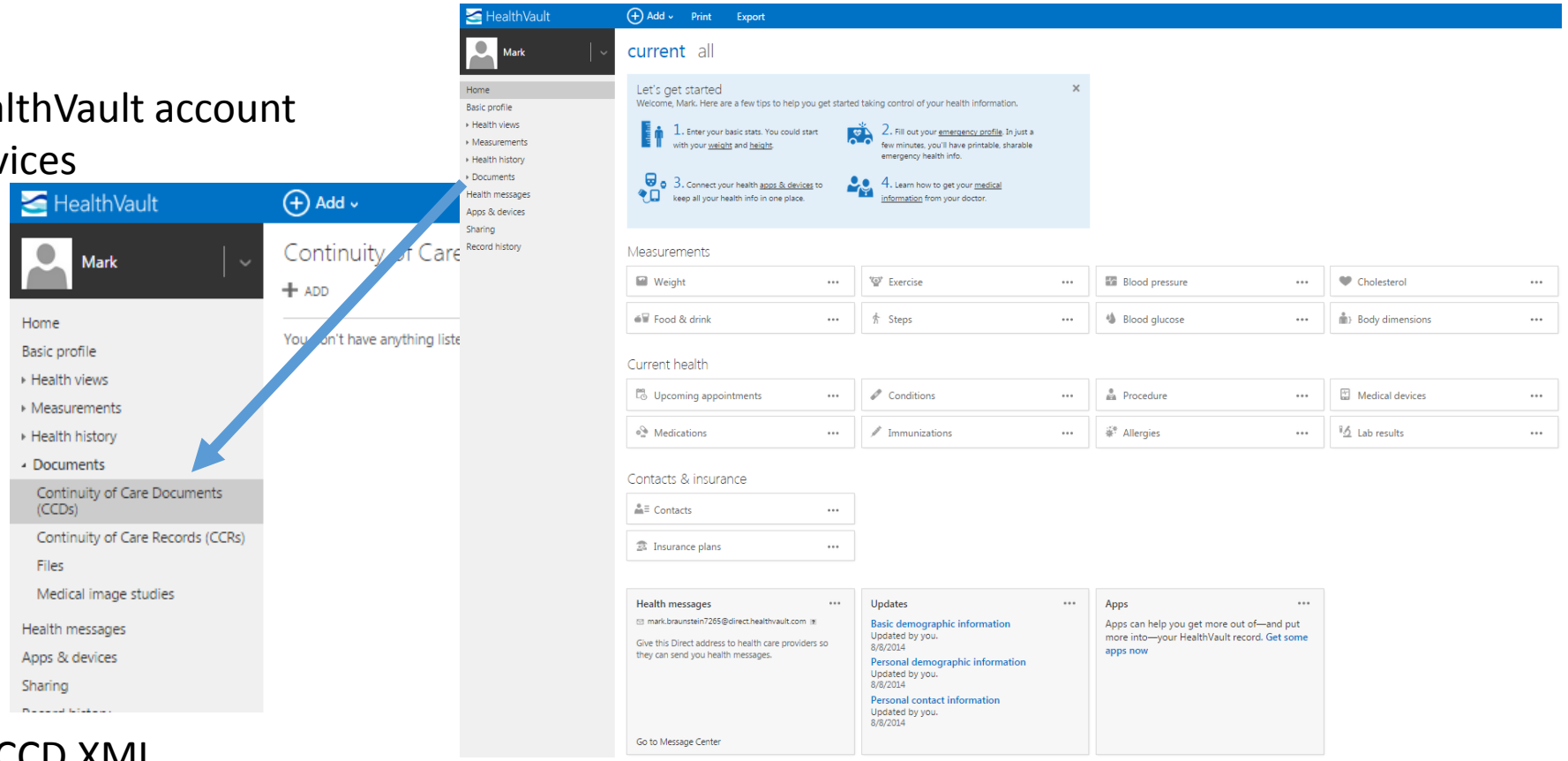


Interview with Bradley P Bekkum, MD

Real World Applications and Challenges

Personal Health Records *HealthVault*

Create your own HealthVault account
Explore apps and devices



1. Upload Marla's CCD XML
2. Add all her data
3. Manually add some weights
4. Chart her weight

Health Informatics on FHIR

Real World Applications & Challenges: Workflow/Process

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Real World Applications & Challenges: Workflow/Process

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Real World Applications and Challenges: Workflow/Process

Adoption

Interoperability

Analytics

Usability

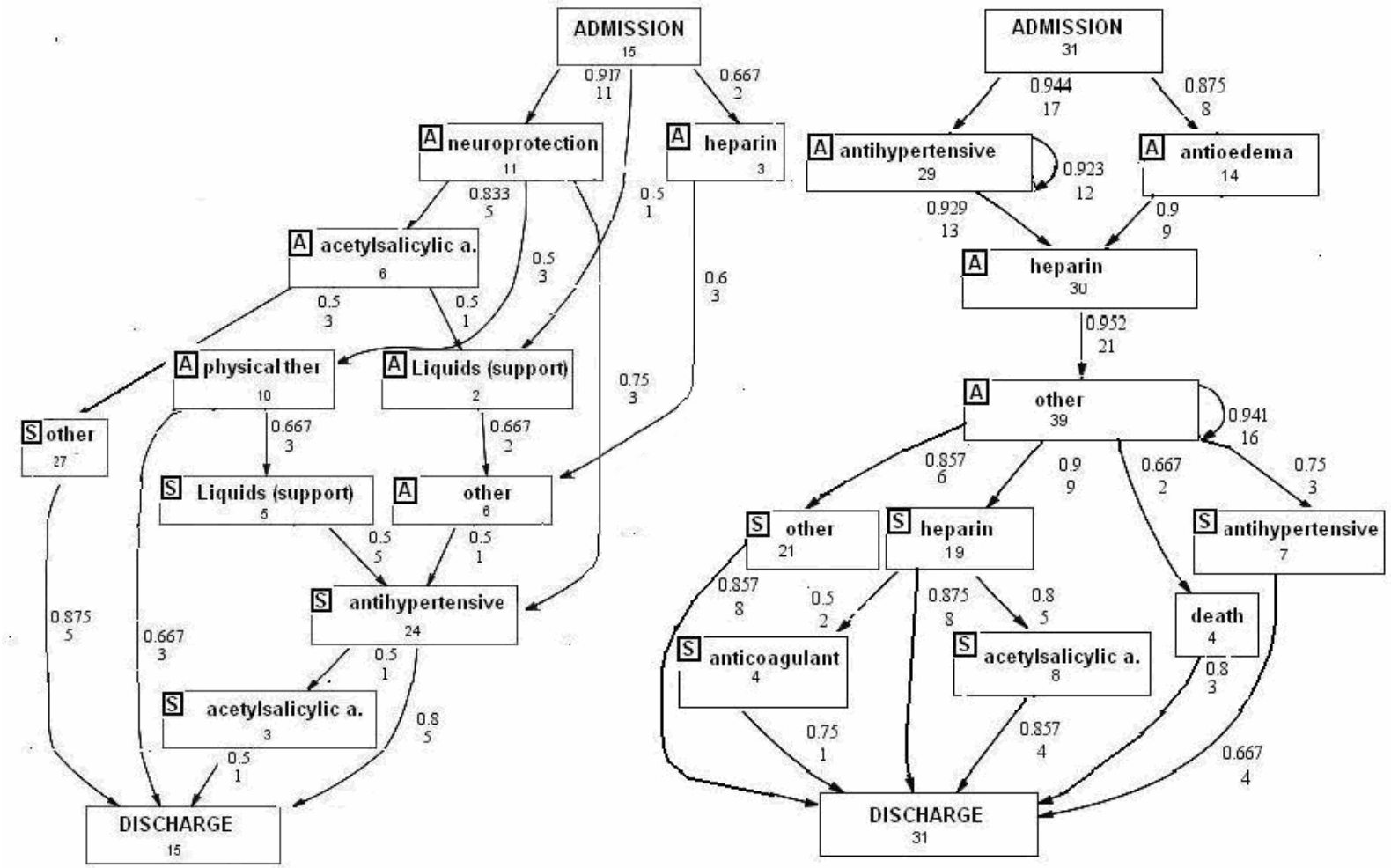
Workflow/Process

Privacy/Security

Data Quality

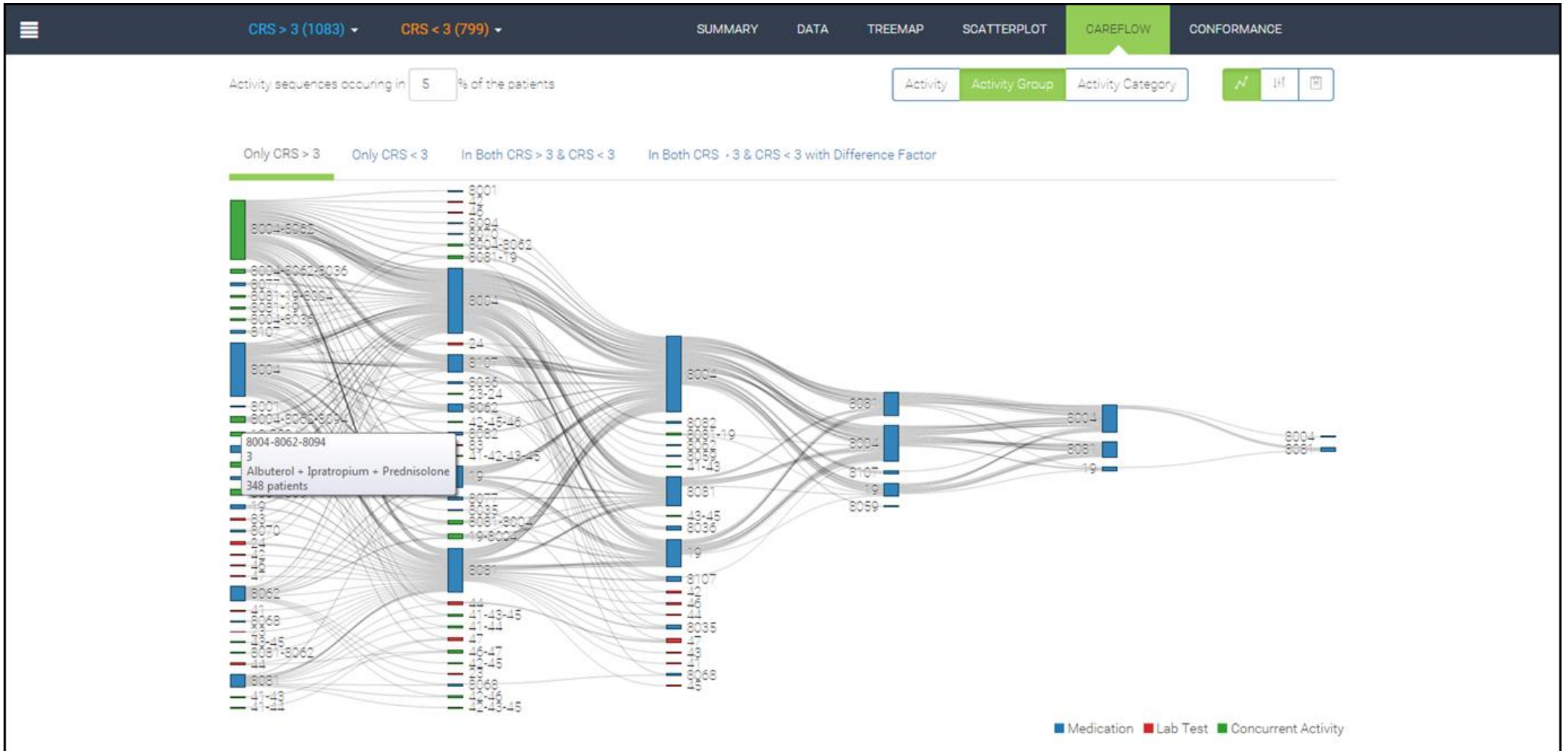
Real World Applications and Challenges

Workflow/Process: *Process Mining*



Ronny Mans: PhD Project under W.M.P. van der Aalst

Real World Applications and Challenges: Workflow/Process



Courtesy Rahul Basole, Georgia Tech

Health Informatics on FHIR

Real World Applications & Challenges: Privacy/Security

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Real World Applications & Challenges: Privacy/Security

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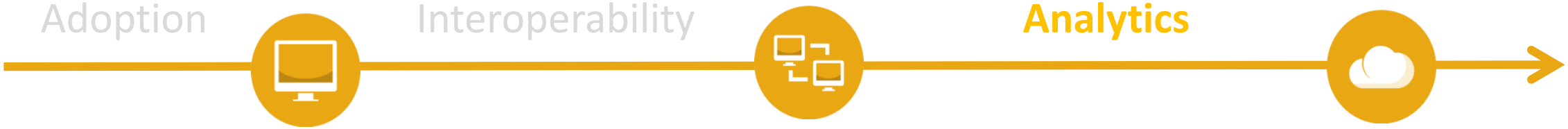
Real World Applications and Challenges: Privacy/Security

Adoption

Interoperability

Analytics



Usability

Workflow/Process

Privacy/Security

Data Quality

Real World Applications and Challenges:

Privacy/Security

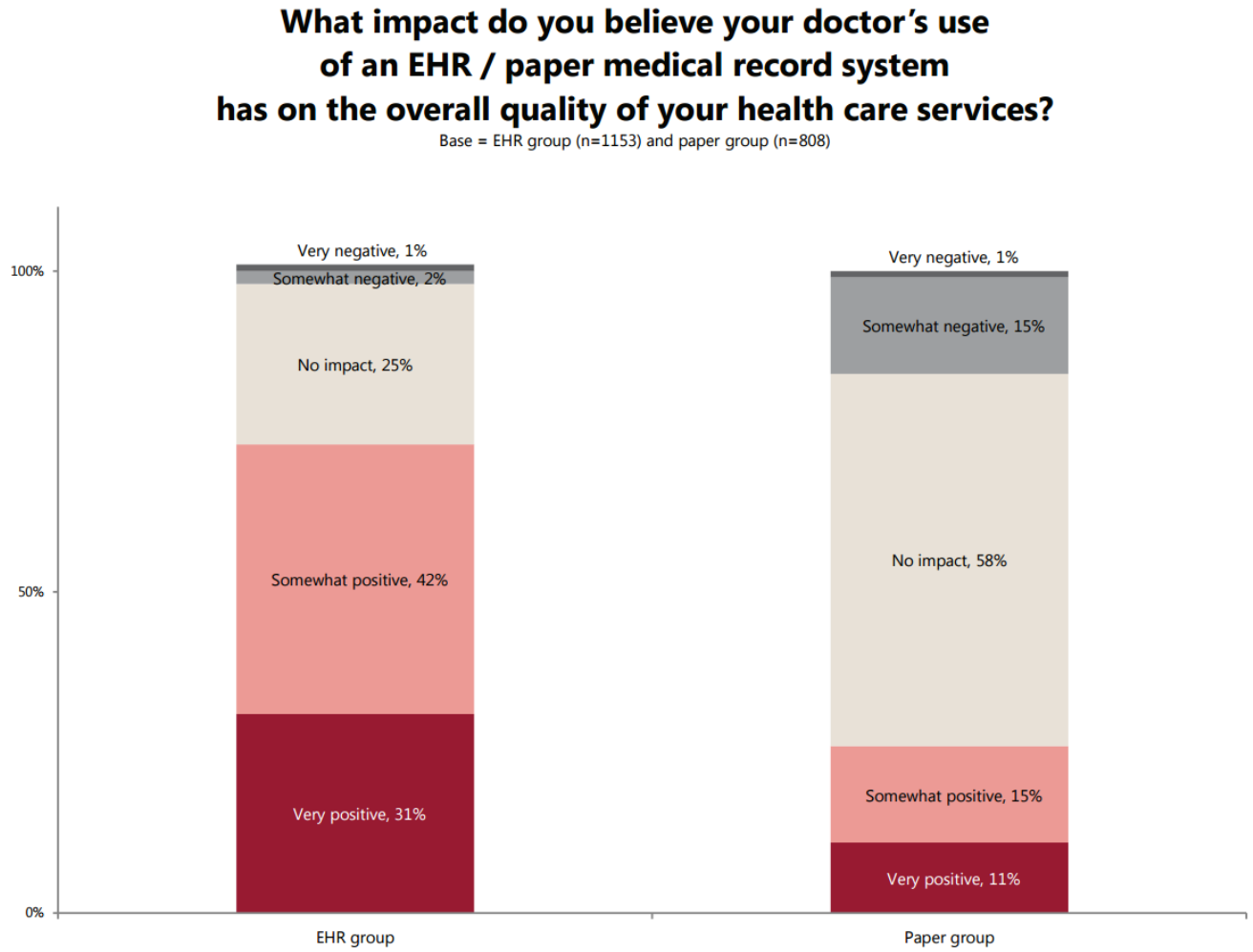
"long and sometimes heated debate on the appropriate approach to the privacy of patients and confidentiality of their data has stalled the development of a framework that protects confidentiality while supporting the legitimate use of data for improving quality, research and public health. Unquestionably, privacy is a valuable and valued social good. But so too are altruism, health and freedom. **Currently, health information policy seems to be giving too much weight to privacy at the expense of freedom and health."**

--Don E Detmer, MD

http://issues.org/25-4/detmer/

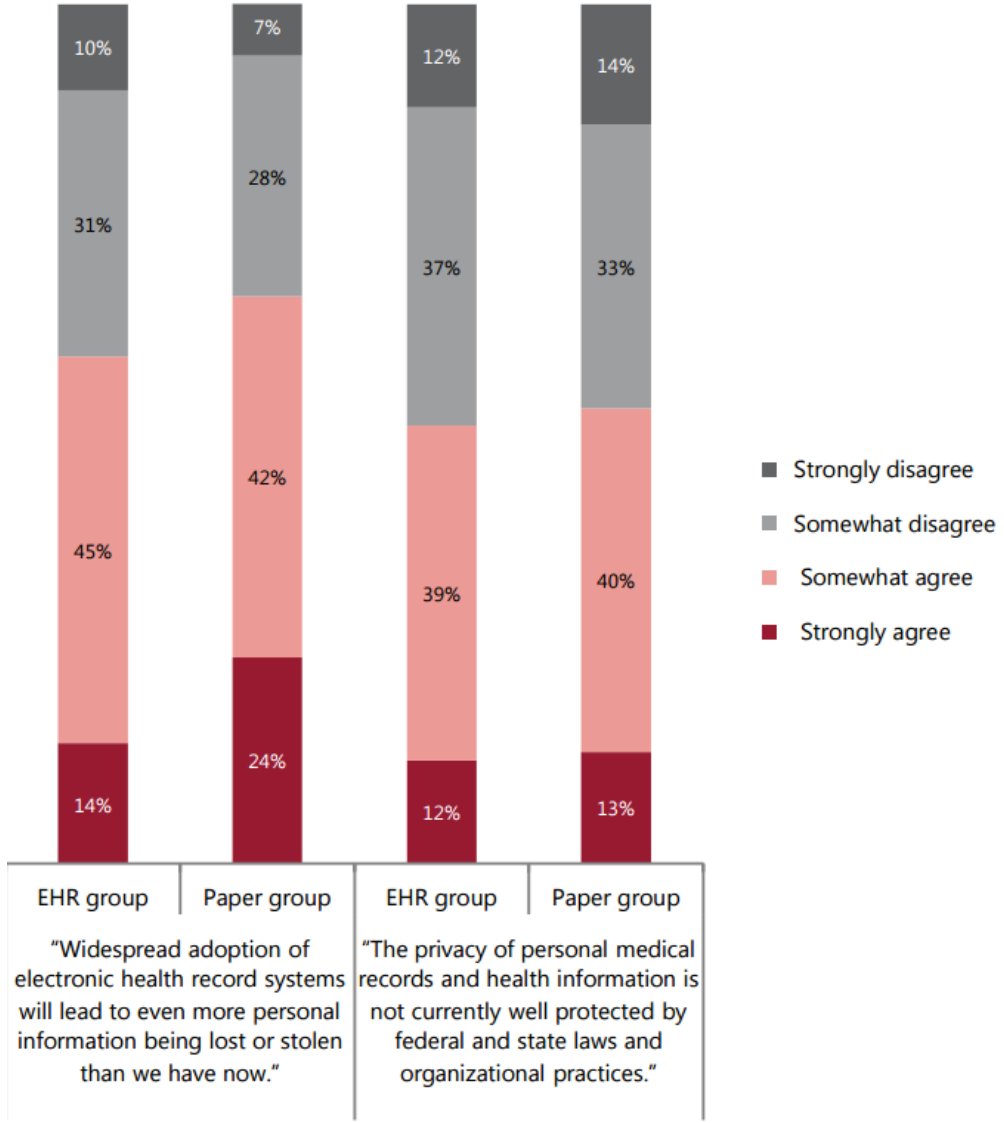
Real World Applications and Challenges:

Privacy/Security



Real World Applications and Challenges:

Privacy/Security



Real World Applications and Challenges:

Data Types

- Protected Health Information (PHI)
- De-identified Health Information
- Synthetic Health Information

Real World Applications and Challenges: PHI

- Protected Health Information (PHI)
- De-identified Health Information
- Synthetic Health Information

Real World Applications and Challenges: TPO

- Protected Health Information (PHI)
- De-identified Health Information
- Synthetic Health Information

Treatment, Payment, and Health Care Operations (TPO)

T: Referral
P: Claims
O: Quality Reporting

Real World Applications and Challenges:

De-identified

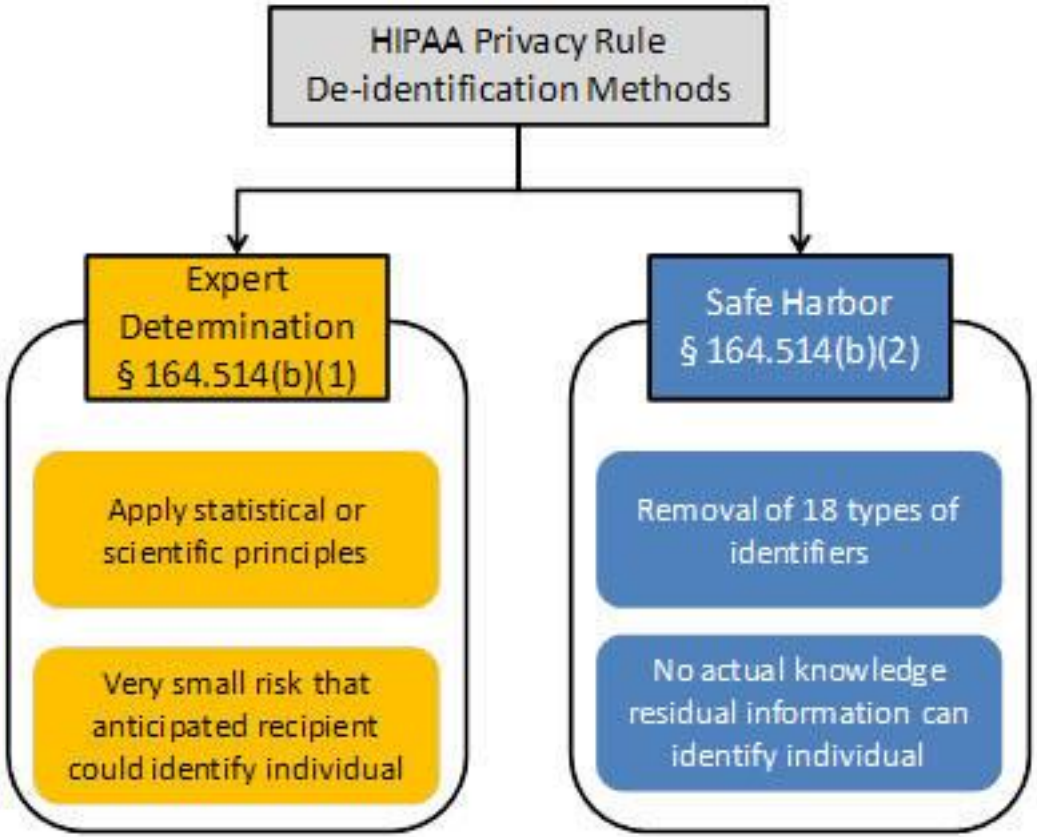
- Protected Health Information (PHI)
- De-identified Health Information
- Synthetic Health Information

Real World Applications and Challenges:

De-identification

- Protected Health Information (PHI)
- De-identified Health Information
- Synthetic Health Information

Real World Applications and Challenges:
De-identification



Real World Applications and Challenges: De-identification

Analytic Tool for Expert Method

NORC Input X-ID at the UNIVERSITY of CHICAGO

Module F: Domain Extraction (demo)

This module allows you to specify specific domains of interest and extract them as AL-PUF variables.

Observations: 2326856 | Variables: 39 | Transformed Variables: 89 | Strata: 24 | Groups: 64 | Micro Groups: 155170 | Schema

Back to Project Menu

Here are the results for your disclosure and low utility events for each of the sampling schemes you ran through the simulator. Using the slider below, you can select the scheme with the highest utility given a maximum probability of a disclosure event occuring. The schemas that fall under the desired threshold for a disclosure event occuring will be highlited in green, of these the schema with the highest utility will have bolded text.

Balance

Risk Threshold: 0.07

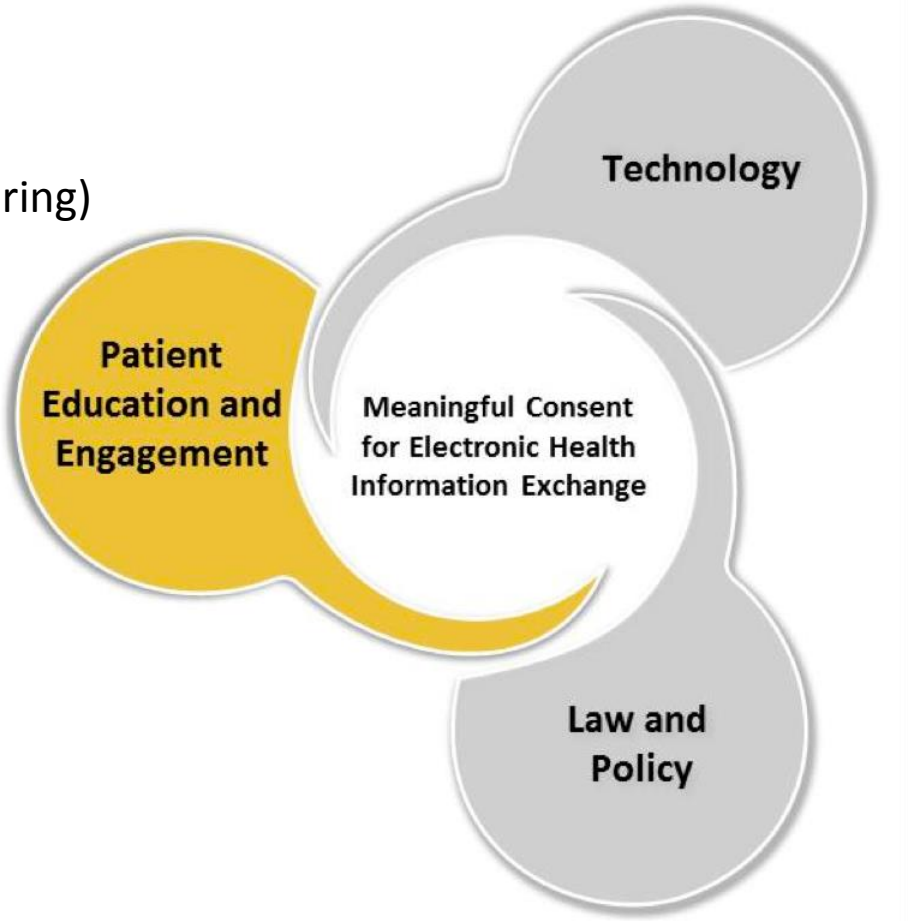
S1	S2	S3	Disclosure Risk	Utility	Select Scheme
90	90	60	0.088	0.94	Select Scheme
90	90	40	0.074	0.886	Select Scheme
90	90	20	0.068	0.748	Select Scheme
90	**80**	**60**	**0.04**	**0.926**	Select Scheme
90	80	40	0.042	0.866	Select Scheme
90	80	20	0.02	0.722	Select Scheme

Courtesy NORC, University of Chicago

Real World Applications and Challenges: Privacy/Security
Patient Consent

No Consent (all data shared)
Opt In (only shared with consent)
Opt Out (no sharing)
Opt In with Exceptions (only patient specified sharing)

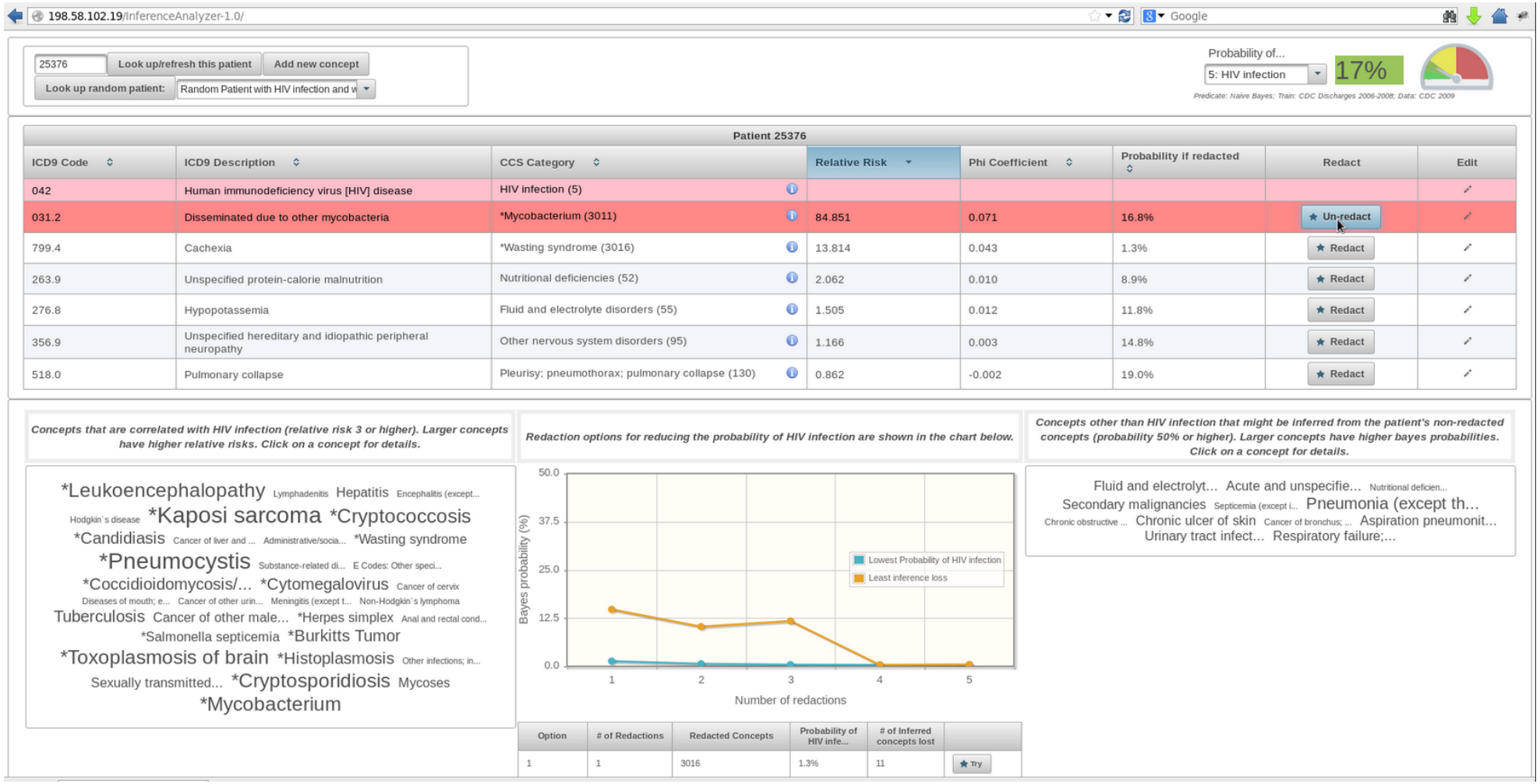
"Optimal" but requires segmentation



Healthit.gov

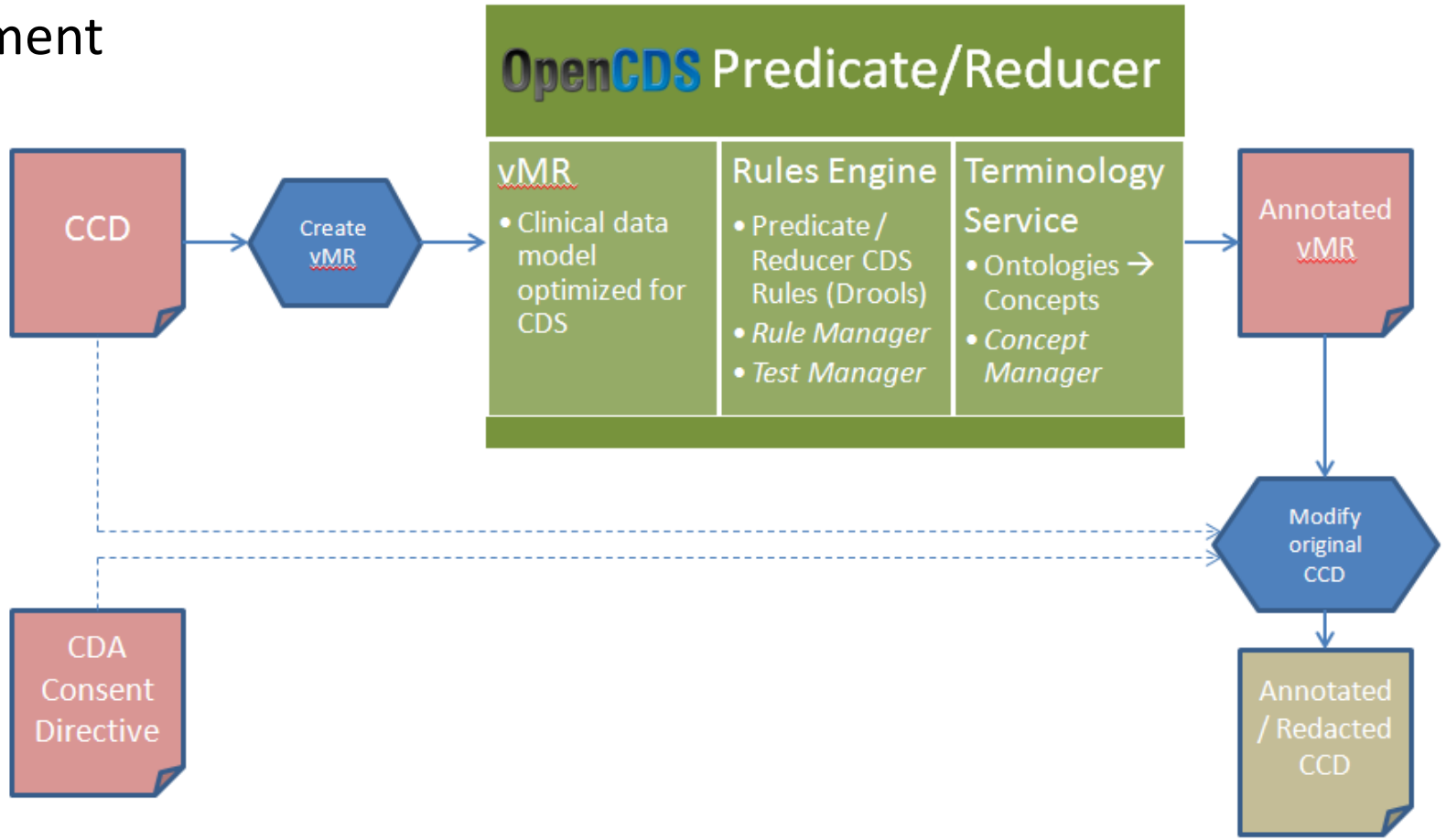
Real World Applications and Challenges: Privacy/Security

Analytic Tool for Data Segmentation



https://sharps-ds2.atlassian.net/wiki/display/DS2/SHARPS+DS2

Key TOC document standard



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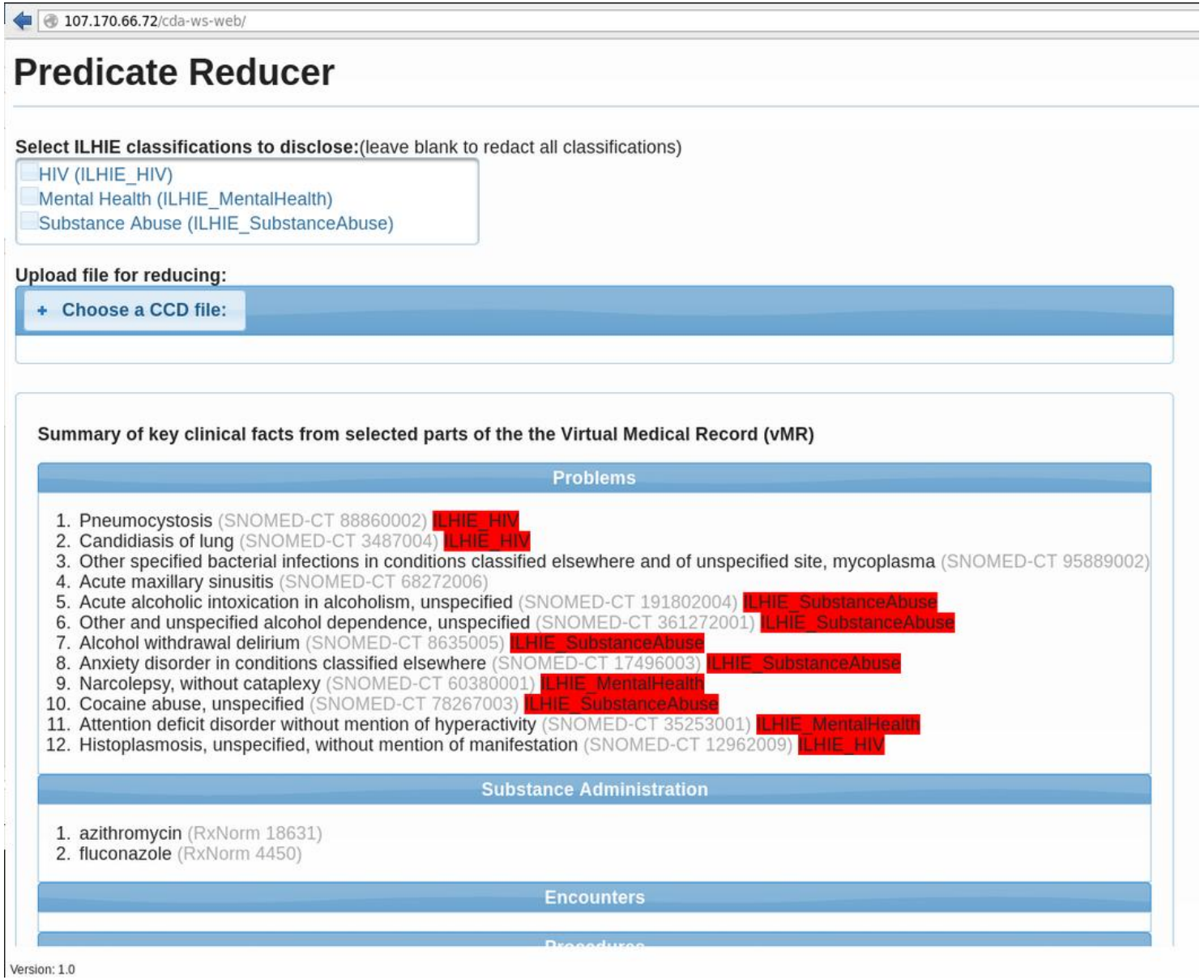
Redacted CCD based on patient's data sharing preferences



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Real World Applications & Challenges: Data Quality

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Real World Applications & Challenges: Data Quality

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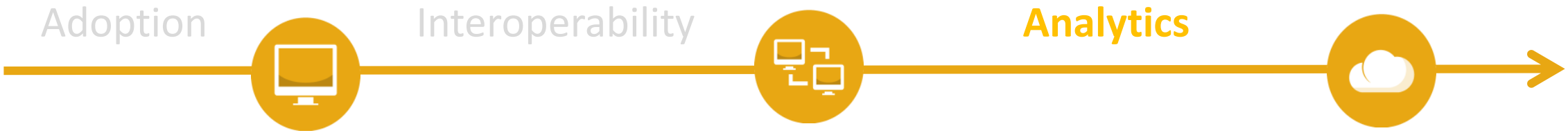
Real World Applications and Challenges: Data Quality



Usability

Workflow/Process

Privacy/Security

Data Quality

Real World Applications and Challenges: Data Quality
Common Data Quality Issues

Heterogeneous (free text, codes, images, continuous analog/digital measures)
Missing or inaccurate values
Inaccurate or missing data/time stamps
Dynamic and evolves over time

Type 2 diabetes in a newborn

Also various levels from individuals to processes, enterprises or the delivery system (modeling challenge)

Real World Applications and Challenges: Data Quality
Accurate Problem Lists

Problem List Suggestion

Based on patient's clinical and billing data, the patient may have the following problems. Upon save, checked items will be added to the problem list. Unchecked items will not be added, and you will not be prompted again.

Expand All

Add	Problem Description	
☑	**Coronary arteriosclerosis:** Patient is taking a platelet aggregation inhibitor and has been billed at least once for CAD.	Enter Customizable Description...
☑	**Congestive heart failure:** Patient is on at least two CHF medications and has been billed at least twice for CHF.	Enter Customizable Description... Related terms
☑	**Diabetes mellitus:** Patient has a HbA1c >= 7.0%.	Enter Customizable Description... Related terms
☑	**Hypertensive disorder:** Patient has been billed for hypertension and is on an antihypertensive agent.	Enter Customizable Description... Related terms
☑	**Hypothyroidism:** Patient is on thyroid hormone.	Enter Customizable Description...

Explanations Save Cancel

Courtesy Diameter Health