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Tapping Into the Potential of Natural Language Processing in Healthcare



Wendy Chapman
Director, Centre for Digital
Transformation of Health
University of Melbourne

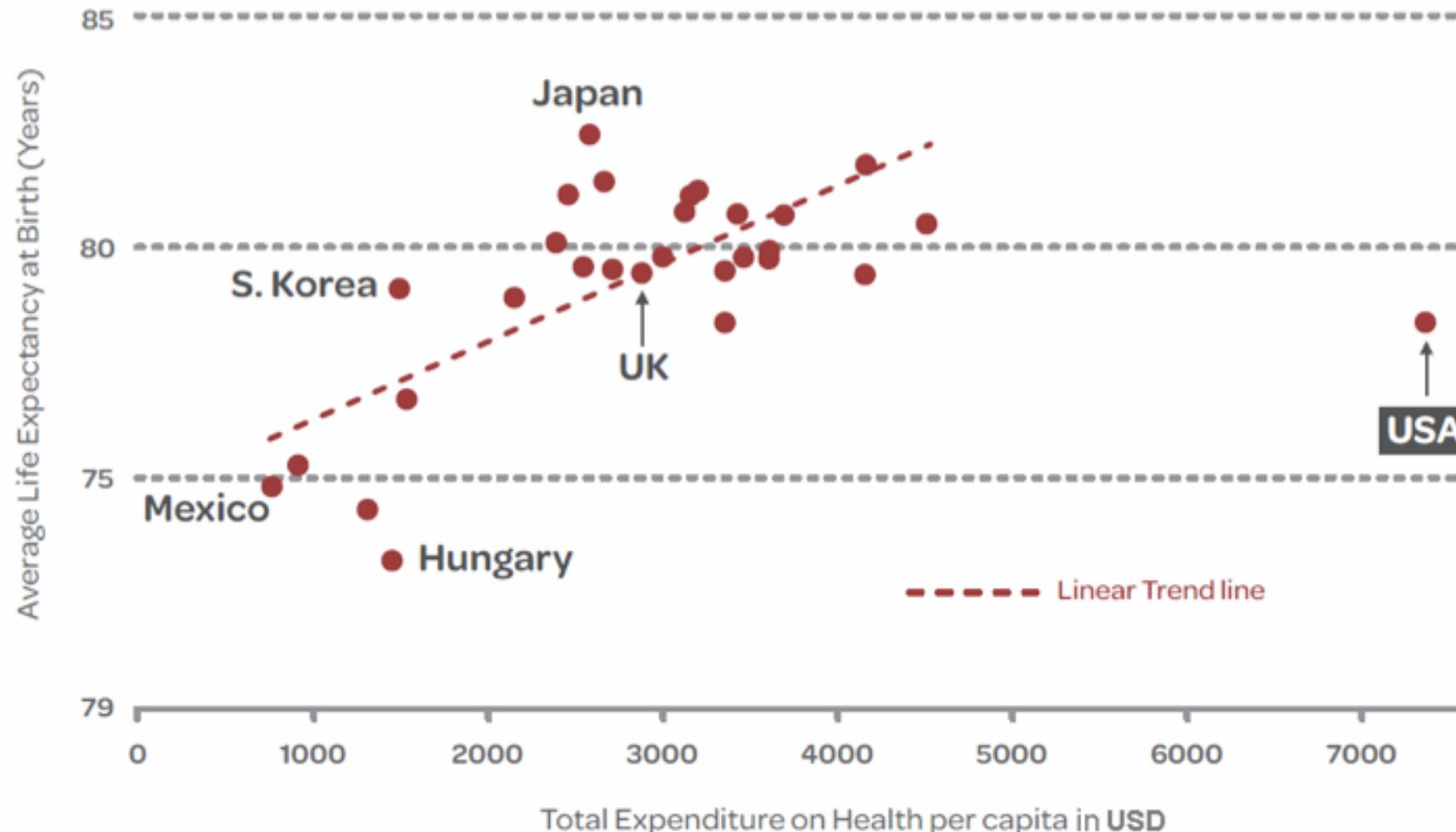


Mike Dow
Senior Director, Data Science,
Health Catalyst

Act 1

The Possibilities are Endless

Healthcare Spending Per Capita vs. Average Life Expectancy Among OECD Countries



The US Health Care System is in *Crisis*

That means the US Economy
is in *Crisis*

Crisis as an Opportunity





The NEW ENGLAND JOURNAL of MEDICINE

[HOME](#)[ARTICLES & MULTIMEDIA](#)[ISSUES](#)[SPECIALTIES & TOPICS](#)[FOR AUTHORS](#)[CME](#)[Free Preview](#)[!\[\]\(d0262bbe9d2356661a2e89321dfcc781_img.jpg\) PRINT](#) | [!\[\]\(8572950e410320d7dd023da827ff014d_img.jpg\) E-MAIL](#) | [!\[\]\(b2b6a2e56e47cc582ad4ec3c8f1864c0_img.jpg\) DOWNLOAD CITATION](#) | [!\[\]\(b51ca72c89286e93c23769c3302173c1_img.jpg\) PERMISSIONS](#)[PERSPECTIVE](#)

Predicting the Future — Big Data, Machine Learning, and Clinical Medicine

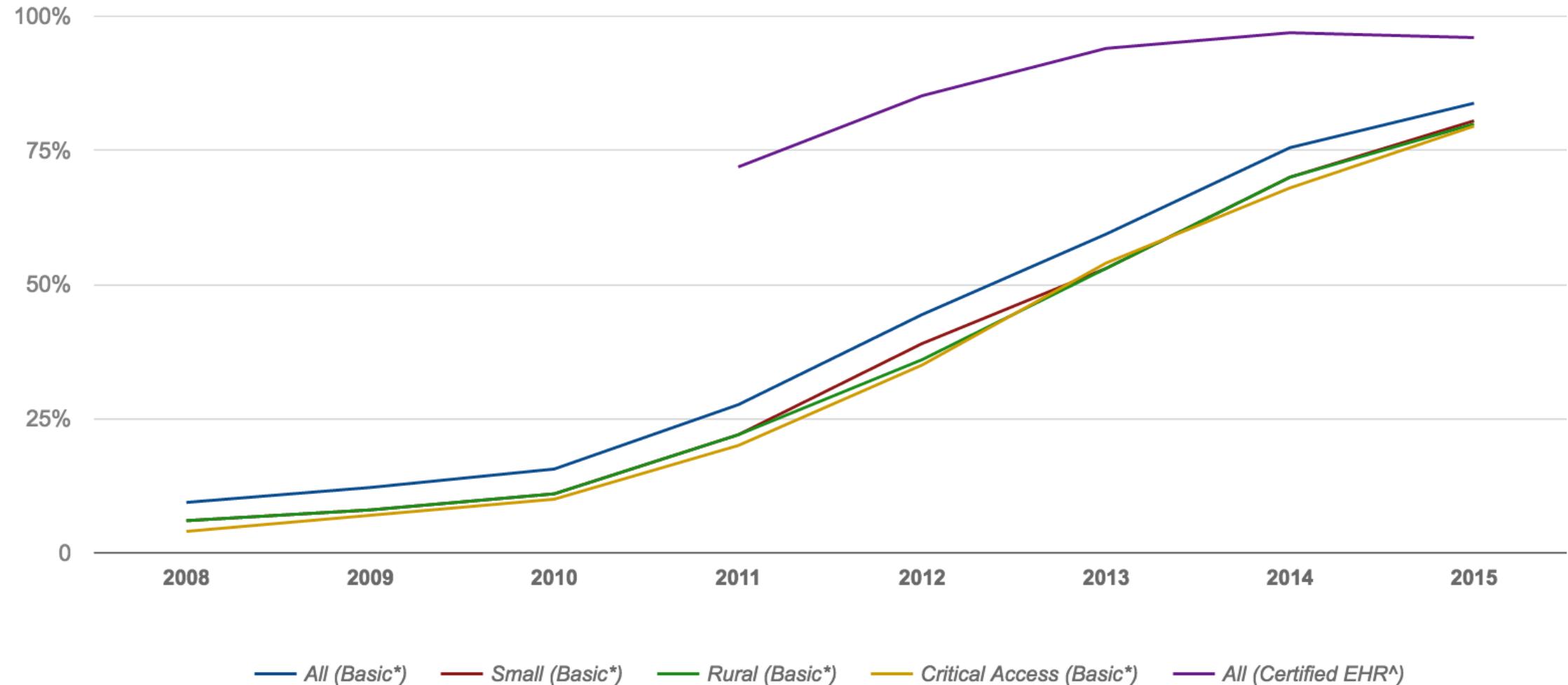
Ziad Obermeyer, M.D., and Ezekiel J. Emanuel, M.D., Ph.D.

N Engl J Med 2016; 375:1216-1219 | September 29, 2016 | DOI: 10.1056/NEJMp1606181

Share:     

The algorithms of machine learning, which can sift through vast numbers of variables looking for combinations that reliably predict outcomes, will improve prognosis, displace much of the work of radiologists and anatomical pathologists, and improve diagnostic accuracy.

Adoption of Electronic Health Records



Your Electronic Health Record?



Electronic Health Records

EHR use a 'frustrating' time suck, physicians tell American Medical Association

Physicians feel investments in electronic health records failed to offer substantial returns due to impractical technology

By [Jessica Davis](#) | December 16, 2015 | 01:14 PM

SHARE 47



HIMSS17
WHERE THE BRIGHTEST
MINDS IN HEALTH AND IT
INSPIRE ACTION
REGISTER NOW AND SAVE

50% of Patient Time Spent on EHR

HEALTH CARE

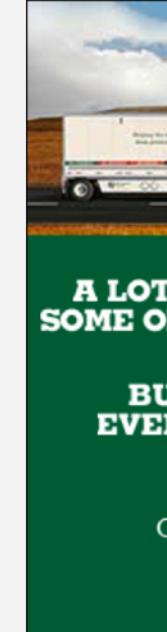
Electronic health records 'inflict enormous pain' on doctors

STAT By Jonathan Bush • Published September 06, 2016

+ Twitter Comment Email Print



(iStock)



A LOT OF
SOME OF
BUT
EVERY

Clin

The Possibilities—
Pain is Endless

Act 2

NLP to the Rescue
(aka “The Hype”)

Social History of Active, Mary / uioio

Created By: GER All, Tester on 11/22/2011 10:13 PM
Last Updated By: GER All, Tester on 11/30/2011 05:57 PM
Time Zone: US/Samoa

Social History

Social History Type * ✓ Please Select

- Relationship
- Employment
- Health Related Behavior
- Alcohol Intake
- Tobacco use and exposure
- Exercise
- Diet
- Drug misuse
- Toxic Exposure

Date (From)

Date (To)



Description *

Back

Save



Help &
Support



Feedback



Live Help



Ideas



Website

Therap®
FirstPage | Quick L

Social History

Social History Type * Please Select
Relationship
Employment
Health Relat
Alcohol Int
Tobacco us
Exercise
Diet
Drug misus
Toxic Expos

Date (From)

Description *

Back

Help & Support

Patient has a past history of pneumonia 2 months ago. He has been taking Augment for the past several days, empirically for a presumptive sinusitis. However, he continues to have a frontal headache. Additionally the patient has had cough productive of green sputum and some dyspnea. This prompted him to come to the Emergency Department this afternoon.

PHYSICAL EXAMINATION:

On my examination the patient is alert and oriented. He is modestly febrile, neither tachypneic or tachycardic and he is normotensive.

HEENT: Normocephalic, atraumatic. Sclerae nonicteric. He has some frontal sinus tenderness. There is no maxillary sinus tenderness. Pupils are equally round and reactive to light. Extraocular movements are intact. Funduscopic exam reveals sharp disk margins. His TMs are clear bilaterally. His throat is without significant erythema or exudate. Temperature is 39.5 C.

NECK: supple without adenopathy or JVD.

LUNGS: His lung sounds have crackles and wheezing predominantly in the right lung fields posteriorly. There is also some wheezing left posteriorly.

ABDOMEN: His abdomen is soft and nontender without hepatosplenomegaly or masses.

EXTREMITIES: Without cyanosis or edema.

SKIN: Without rashes.

NEUROLOGICAL EXAM: Normal.

ED COURSE:

He was hydrated with crystalloid IV solution. The patient received an albuterol aerosol treatment and was feeling much more comfortable from a respiratory perspective subsequent to that. His wheezing had decreased. A chest x-ray was obtained. Per the radiology interpretation it reveals bilateral interstitial pulmonary infiltrates.

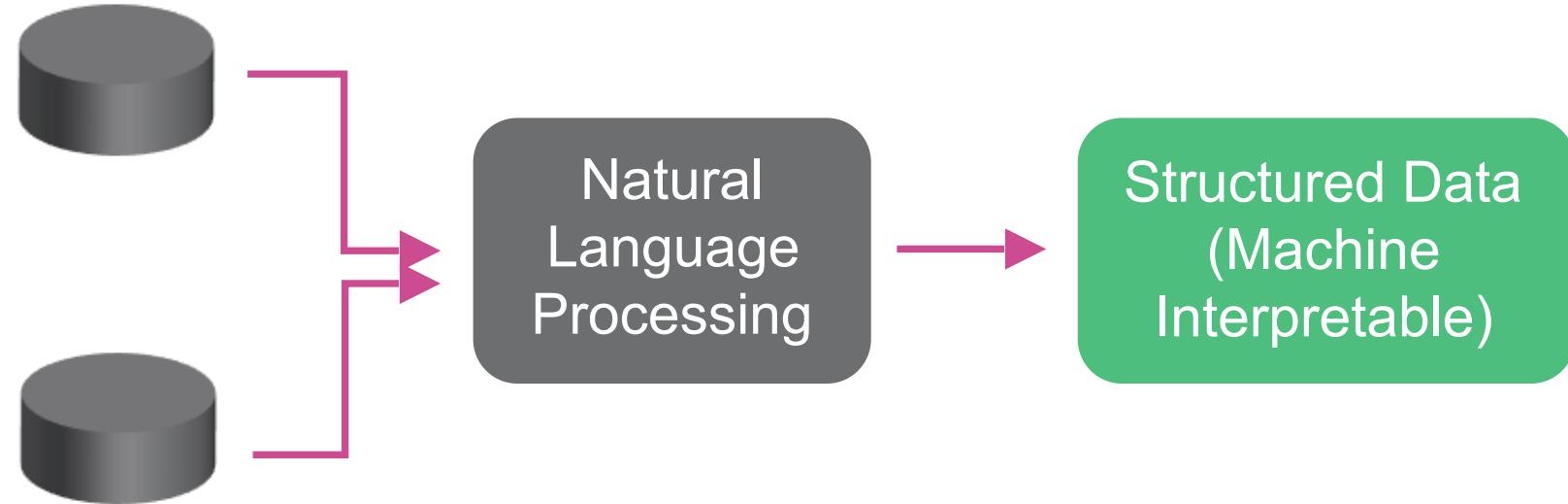
The patient was discharged with antibiotic therapy. Patient should return for increased shortness of breath or recurring fever.

DISCHARGE DIAGNOSIS (ES):

BILATERALLY INTERSTITIAL PNEUMONIA. 4

Natural Language Processing

Electronic Medical Records



- **Classify**
- **Extract**
- **Summarize**

MEDLINE Articles / Abstracts

**EHR
Usability**

**Predictive
Analytics**

Phenotyping

**Quality
Improvement**

EHR Usability

iNYP

Patient List Registry Patient Data

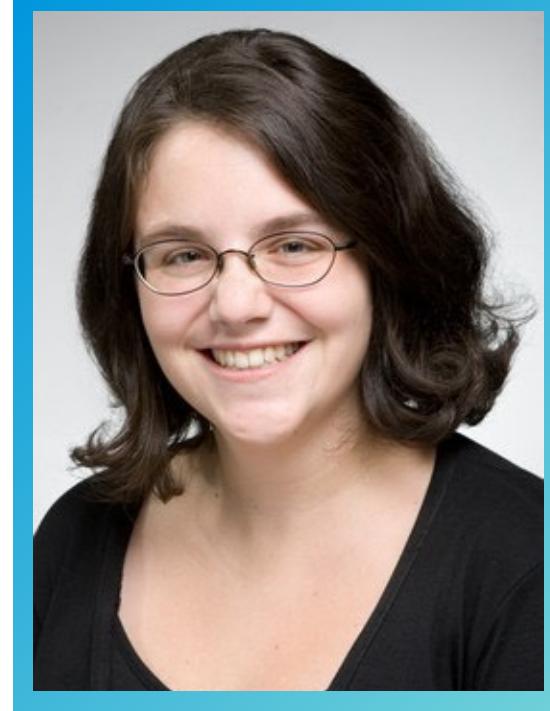
Profile History/Timelines Data Review Summaries

EMPI: NYP/ICU: CMC:

		Filter:	Go	Eclipsys Note - Columbia University (20 -10-17,20 -05-08)			Newer Pg# Older
Laboratory	Apr 23						
Radiology	20 Jul	Cardiology Consult Follow-Up Free Text Note					
Pathology	20 Feb	SW High Risk Screen					
Note		Pastoral Visit Adult					
Eclipsys Note (NYP/ICU)	Apr 17	Milstein Hospitalist Resident/PA Follow-Up Free Text Note					
WebCIS Note	20	Procedure Note, Time Out Not Required					
WebCIS Signout	2008	Medicine Follow-Up Free Text Note					
Discharge Sum		Transfusion Nursing Note					
Eclipsys DSum (NYP/ICU)	20 Jul	Nephrology Consult Free Text Note					
WebCIS DSum	20	Milstein Hospitalist Attending Follow-Up Free Text Note					
Admission		Critical Test/Values Results Reporting					
Eclipsys Admit (NYP/ICU)	20 Jul	Cardiology Consult Follow-Up Free Text Note					
WebCIS Admit	20	Milstein Hospitalist Resident/PA Follow-Up Free Text Note					
Operative		Milstein Hospitalist Attending Follow-Up Free Text Note					
Operative Report	Add	Milstein Hospitalist Resident/PA Follow-Up Free Text Note					
OR Note (NYP/ICU)	20	Milstein Hospitalist Resident/PA Follow-Up Free Text Note					
Neurophys		Milstein Hospitalist Resident/PA Follow-Up Free Text Note					
Cardiology	Mar 7	Cardiology Consult Free Text Note					
Ob/Gyn		Medicine Follow-Up Free Text Note					
GI Endo		Case Manager Plan Of Care					
HEENT		Initial Nutrition Assessment					
Pulmonary		Milstein Hospitalist Resident/PA Follow-Up Free Text Note					
Derm Path		Milstein Hospitalist Resident/PA Follow-Up Free Text Note					
Endocrinol		Cardiology Free Text Note					
Alerts	20	Nursing Adult Admission History					
Pharmacy	20 Jul	Medicine Admission Free Text Note					
Billing Diagnoses	Apr 23	Transfer Note					
All Data		Emergency Department Disposition Note					
		Emergency Resident / Nurse Practitioner / Attending Note (Milstein)					
							Expand Print
Cardiology Consult Free Text Note • 20 -10-10 14:14							

Harvest – New York Presbyterian

- Scalable, distributed NLP
- Problem salience computation
- Presentation of information from multiple care settings

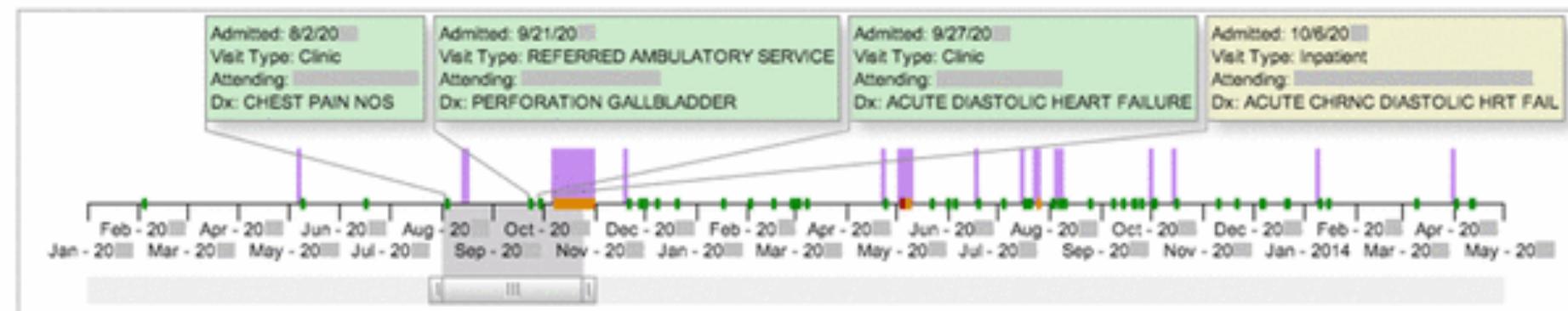


Noemie Elhadad

Visits

Timeline: 8/1/20 to 10/24/20

Timeline - Problems



Salient Problems

stable angina pulmonary hypertension ESRD dyspnea influenza abdominal pain DM CAD

edema volume overload obese OSA chest pain lymphadenopathy morbid obesity pruritis weight gain hypertension DM2 LVH
 leg cramps chest discomfort vitamin D deficiency CKD hyponatremia agitation fistula nausea facial swelling hypoglycemia ischemia
 CHF Dyslipidemia abdominal mass scar hyperphosphatemia anasarca angina hypoventilation ...

More

Notes about dyspnea 8/1/20 - 10/24/20

Cardiology Consult Follow-up Free Text Note	10/15/20	1:32 PM
Milstein Hospitalist Resident/PA Follow-up Free Text Note	10/15/20	7:00 AM
Medicine Follow-Up Free Text Note	10/14/20	4:06 AM

Cardiology Consult Free Text Note

Cardiology Consult

Requested by: Dr. [redacted]

Reason: Fluid overload

HPI: 57 yo woman with a pmhx significant for morbid obesity, HTN, HLD,

“Made me more confident that I wasn’t missing information that can sometimes be buried in the list of [past medical history].”

“It helped pick up on diagnoses within the chart that I otherwise would’ve had a lot of difficulty finding.”

**EHR
Usability**

**Predictive
Analytics**

Phenotyping

**Quality
Improvement**

Predictive Analytics

Mashable ▾

VIDEOS ▾ SOCIAL MEDIA ▾ TECH ▾ BUSINESS ▾ ENTERTAINMENT ▾ WORLD ▾ MORE ▾

Why scientists think your social media posts can help prevent suicide



Image: Getty



Image: Vicky Leta / Mashable

Exploratory Analysis of Social Media Prior to a Suicide Attempt

Glen Coppersmith

Qntfy

glen@qntfy.com

Kim Ngo

Qntfy, University of Notre Dame

kim@qntfy.com

Ryan Leary

Qntfy

ryan@qntfy.com

Anthony Wood

Qntfy

tony@qntfy.com

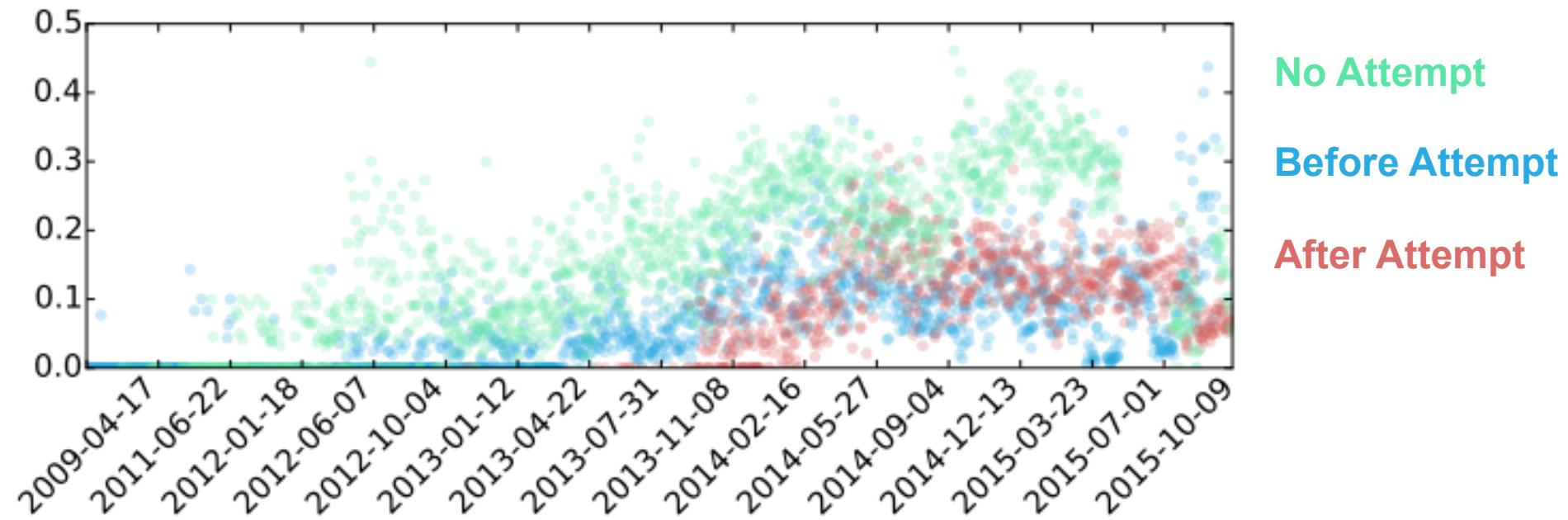
2014 suicide rate in US was 13 per 100,000 people

- 24% increase in last decade

Predict 70% of suicide attempts

- 10% false positive rate

Number of Emojis in Tweets



Fewer emojis

- Narrow group



More tweets with sadness

- Increase in angry and sad tweets before attempt

**EHR
Usability**

**Predictive
Analytics**

Phenotyping

**Quality
Improvement**

Phenotyping

Phenotype

The observable physical or biochemical expression of a specific trait in an organism

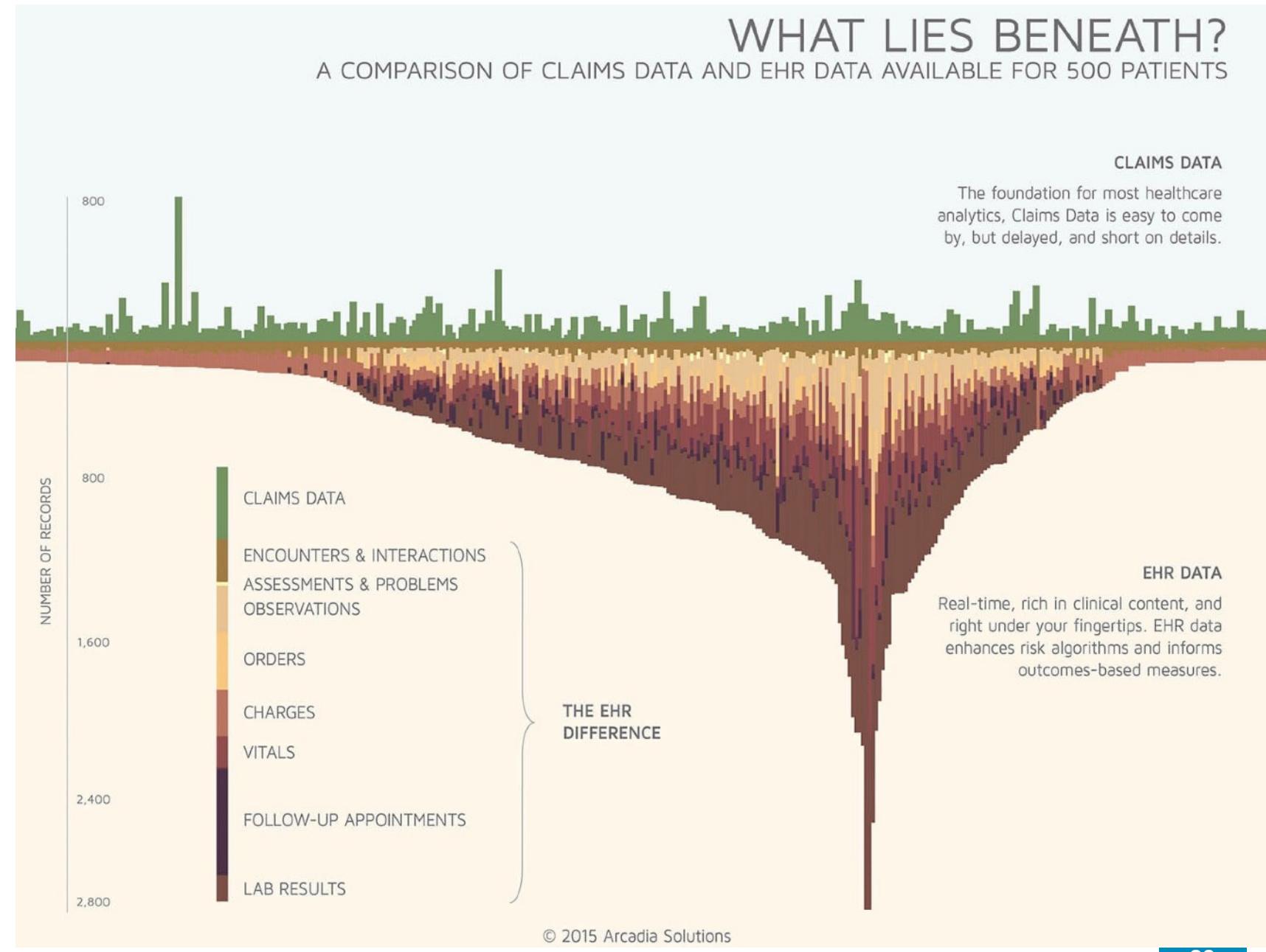
Physical appearance

Biochemical processes

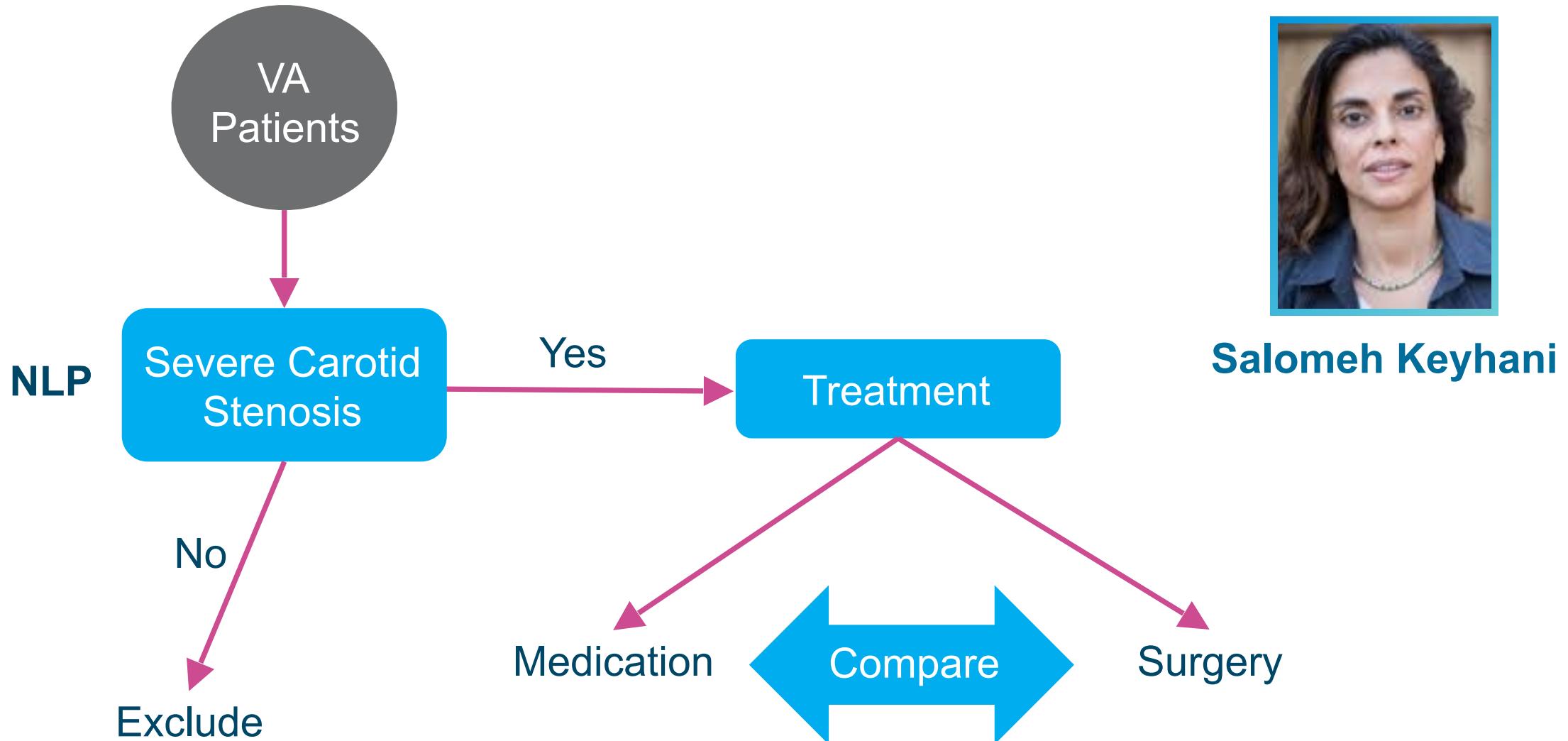
Behavior

Computable Phenotyping

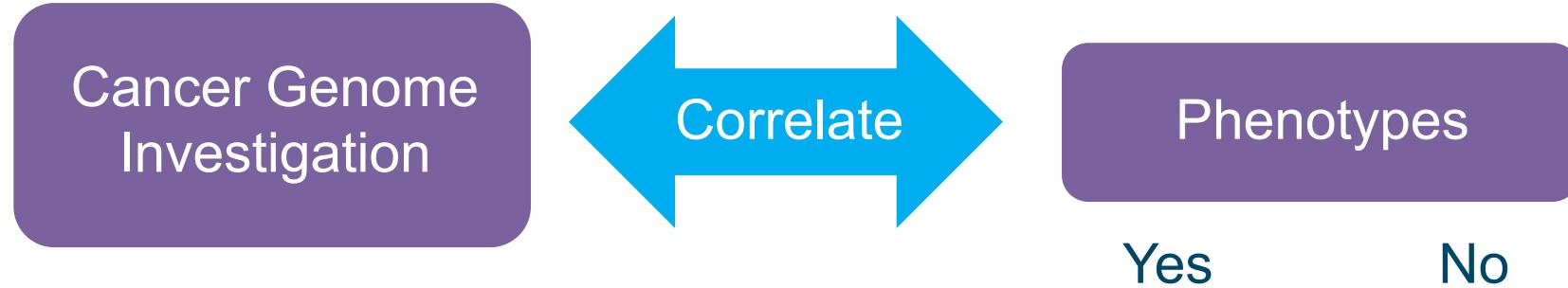
[http://
www.healthcareitnews.com/
infographic/infographic-clinical-
claims-data-what-lies-beneath](http://www.healthcareitnews.com/infographic/infographic-clinical-claims-data-what-lies-beneath)



Natural Language Processing



Deep Computable Phenotyping



Need to be able to identify richer phenotypes



Rebecca Jacobson



Harry Hochheiser



Guergana Savova

Natural Language Processing

Document 3
DIAGNOSIS: Right Breast Cancer, T2N0M0

INTERIM HISTORY: Patient currently on neoadjuvant therapy with Taxol. Due to cardiomyopathy, patient not a candidate for Trastuzumab. Given family history, targeted mutation analysis of BRCA performed but was negative.

PLAN: F/U in 1 month.

Breast Cancer: Yes/No

Composition 3

Event:

Condition: Breast Cancer

Location: Right breast

Stage:

TNM Classification:

T: T2

N: N0

M: M0

Related Items:

Procedure: Neoadjuvant Therapy

Type: Therapeutic

Location: Right breast

Related Items:

Medication Statement:
Taxol

Medication Statement:

Trastuzumab

Was Given: false

Reason Not Given:

Condition:
Cardiomyopathy

DocTimeRel:
Before-Overlap

Observation:
BRCA Status
Interpretation:
Negative

Answer Questions Like...

What histologic types of breast cancer are associated with patients that have a substitution mutation on BRCA-1?

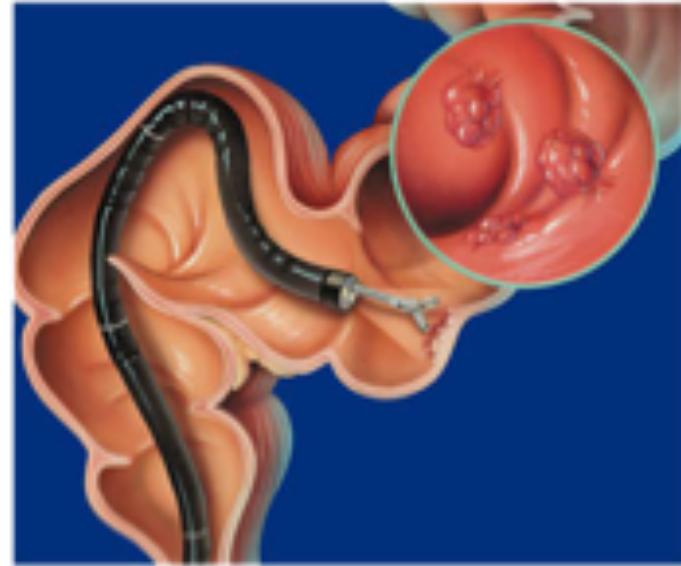
For patients with a papillary breast carcinoma that underwent neoadjuvant treatments regimen, what number of patients have had a recurrence or metastasis?

**EHR
Usability**

**Predictive
Analytics**

Phenotyping

**Quality
Improvement**



Adenoma detection rate
(ADR)



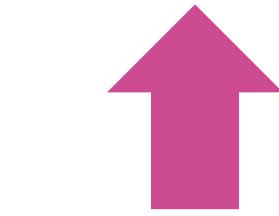
Colonoscopies with 1 adenoma
All screening colonoscopies

ADR Colonoscopy and Pathology Reports

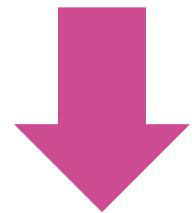
Chart Review or NLP



Andrew Gawron



1% in ADR



**3% in Cancer
Mortality**

Act 3

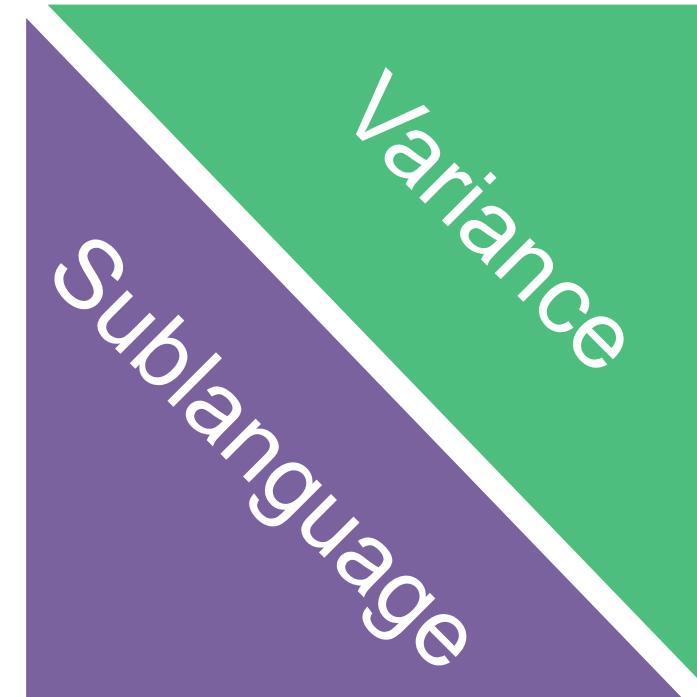
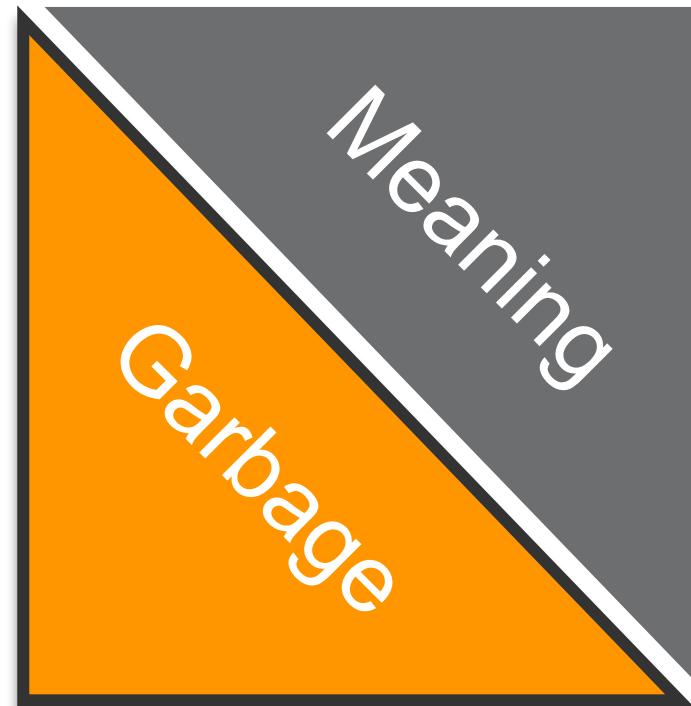
A Peek Under the Hood
(aka “The Reality”)





Why isn't NLP Completely Pervasive?

The Challenges



Garbage in, Garbage Out

Shortcuts for documentation

Templates

Cardiovascular: [] Angina [] MI [x] HTN [] CHF [] PVD [] DVT []
Arrhythmias [] Previous PTCA [] Previous Cardiac Surgery []
Negative - Denies CV problems

GLASGOW SCALE:

Verbal: Conversant, Oriented x 3	5
Eyes: Spontaneous	4
Motor: Obeys Commands	6
TOTAL:	<hr/> 15

Motor Strength Scale:

RUE: Full Strength	5
LUE: Full Strength	5
RLE: Lifts and Assist	4
LLE: Lifts and Assist	4

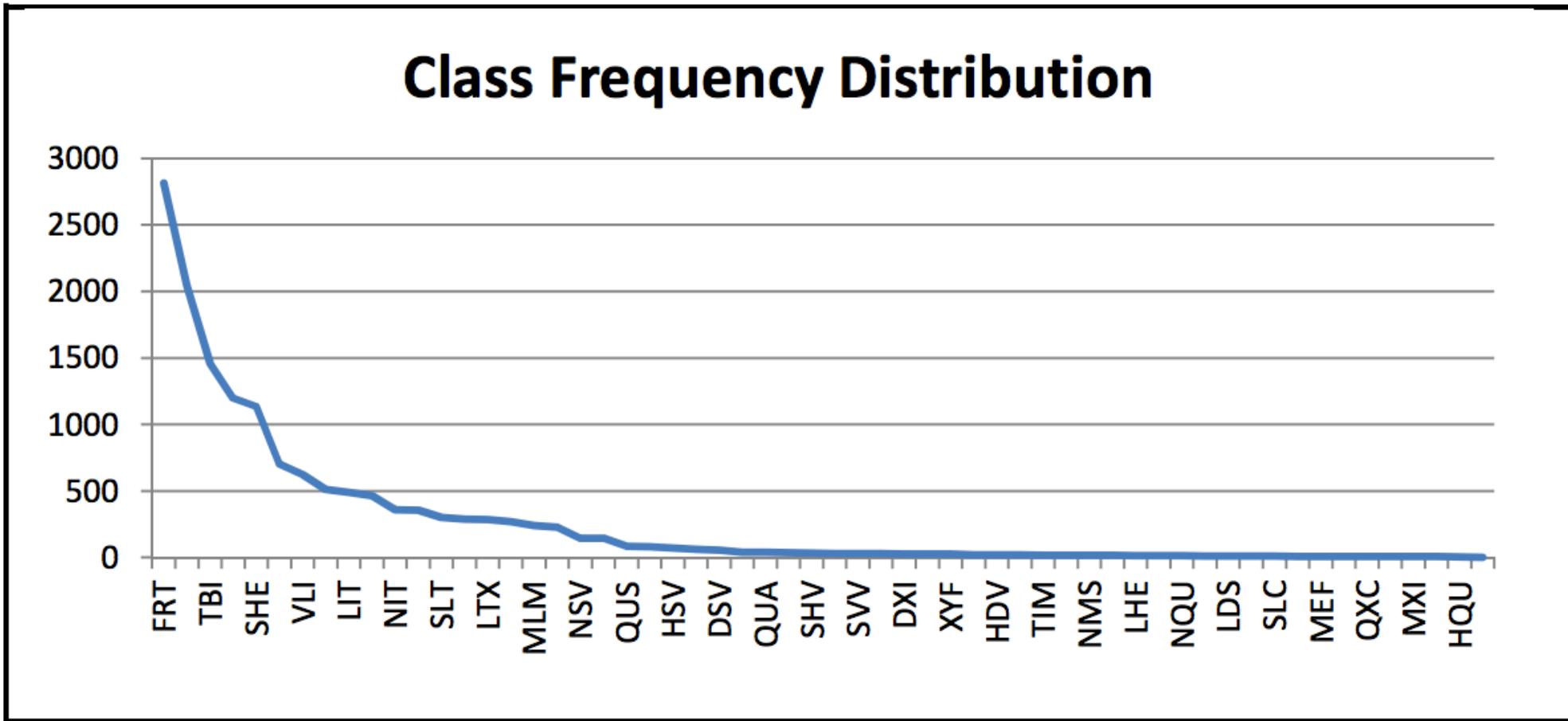
MORSE FALL SCALE:

SCORE:

History of Falls	YES	25
Secondary Diagnosis	YES	15
Ambulatory Aid	None, Bedrest, W/C, Nurse	0
IV Therapy/heparin Lock	YES	20
Gait/Transferring	Weak Gait	10
Mental Status	Oriented to own ability	0

TOTAL of all checked items: 70

Vital Signs: T: 96.5 F [35.8 C] (11/08/2006 13:27) P: 84 (11/08/2006 13:27) R: 20 (11/08/2006 13:27) B/P: 139/67 (11/08/2006 13:27) WGT: 215.4 lb [97.9 kg] (11/08/2006 13:27) BMI: 33.8 PAIN: 0 (11/08/2006 13:27) PULSE OX: 98
VITAL SIGNS: (Most recent as entered in Vista) BP: 157/84 (09/21/2007 10:25) Pulse: 53 (09/21/2007 10:26) Temp: 98.6 F [37.0 C] (09/21/2007 10:25) Pain: 3 (09/21/2007 10:25) (out of ten) Pulse Ox: 97 (9/21/2007 10:26) (Most recent as entered in VISTA) PAIN ASSESSMENT: Pain: 3 (09/21/2007 10:25) (Scale 0-10)
VITALS BP: 119/67 PULSE: 71 Temperature: 98.1 F [36.7 C] (08/15/2006 11:12) Height: 62 in [157.5 cm] (08/15/2006 07:26) Weight: 236.8 lb [107.6 kg] (08/15/2006 11:12) Pain: 5 teeth/back/knee (1-10 scale)
VITALS (Most recent, as listed in VISTA) B/P: 109/66 (05/27/2007 18:01) Pulse: 71 (05/27/2007 18:01) Temperature: 97.6 F [36.4 C] (05/27/2007 16:33) Weight: 250 lb [113.6 kg] (02/22/2007 12:44) Height: 76 in [193.0 cm] (02/15/2002 08:07) Pain (out of 10): 0 (05/27/2007 18:01)
INITIAL VITAL SIGNS: (MOST RECENT AS ENTERED INTO VISTA) Height: 76 in [193.0 cm] (02/15/2002 08:07) Weight: 250 lb [113.6 kg] (02/22/2007 12:44) Temp: 97.6 F [36.4 C] (05/27/2007 16:33) Pulse: 72 (05/27/2007 16:33) Resp: 16 (05/27/2007 16:33) Pain Scale: 2 (05/27/2007 16:33) B/P: 112/73 (05/27/2007 16:33)



58 Classes of Formats

Garbage in, Garbage Out

Shortcuts for documentation

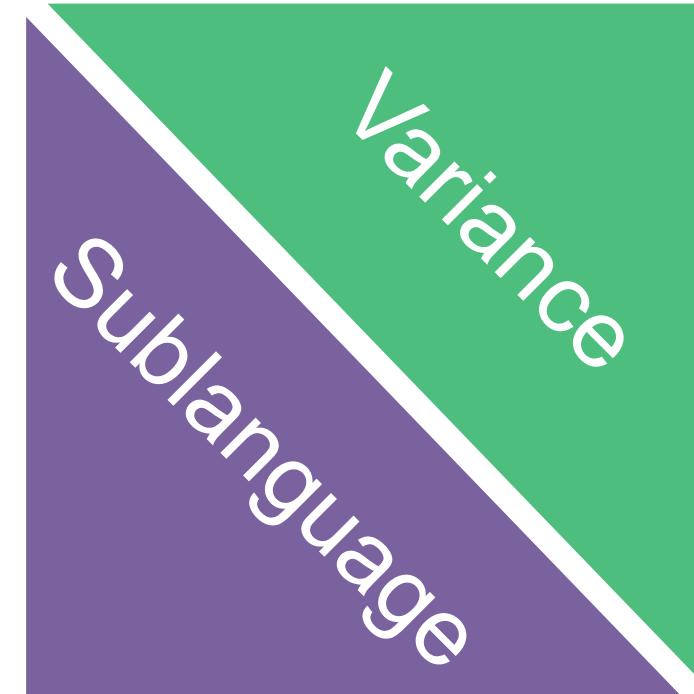
Copy & Paste

- Note
- Outdated or inaccurate
- No author
- Propagation of false information



Why isn't NLP Completely Pervasive?

The Challenges



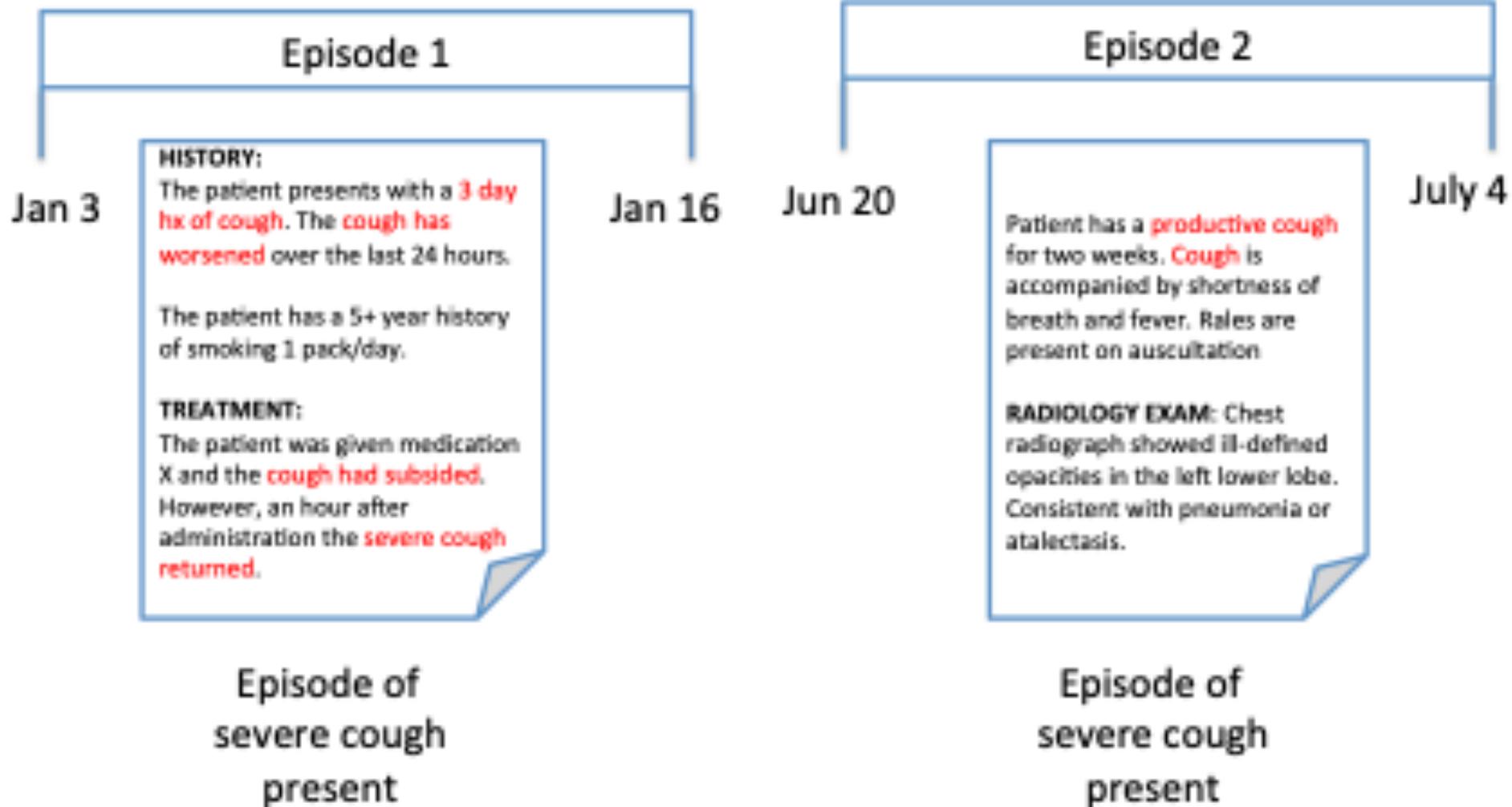
Knowledge Representation

Phenotype: Cough

- At least two episodes of severe cough in one year

Phenotype Variables in Layers

At least two episodes of severe cough in one year



Instance: Map Cough to UMLS



3 day hx of hacking cough.

The cough has worsened over the last 24 hours.

The patient was given medication X and the cough subsided.

However, an hour after administration the severe cough returned.

How long does the cough need to land to meet your criteria?

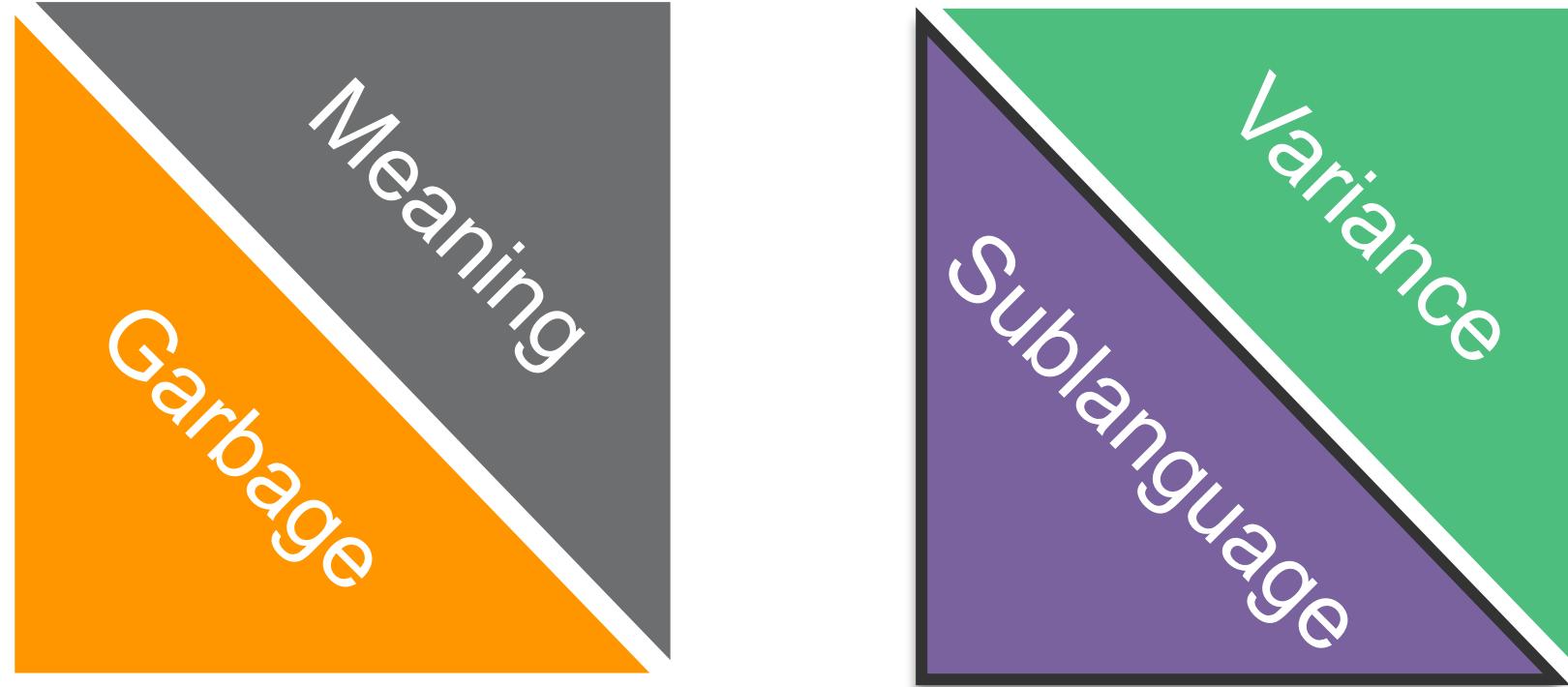
Do changes over time matter?

What about response to treatment?

Does severity matter?

Why isn't NLP Completely Pervasive?

The Challenges



Sublanguage

Zellig Harris

- Sublanguage is a subset of natural language
1. Uses a subset of vocabulary and grammatical rules
 2. Regularity and peculiarities
 - Semantic
 - Syntactic

Social Media Sublanguage

Altered Vocabulary: Status, update

New Vocabulary: Selfie

Emoticons:



Abbreviations: TTOL, LOL, ROTFL

Hashtags: #jointpain

Punctuation: .

Medical Sublanguage

Sublanguage Analysis of Medical Weblogs

Kerstin DENECKE

ICCAS Innovation Centre Computer Assisted Surgery



J Biomed Inform. 2002 Aug;35(4):222-35.

Two biomedical sublanguages: a description based on the theories of Zellig Harris.

Friedman C¹, Kra P, Rzhetsky A.

Medical Blog

Broad Use of Verbs

Measurements

Fewer Semantic Types

Clinical Notes

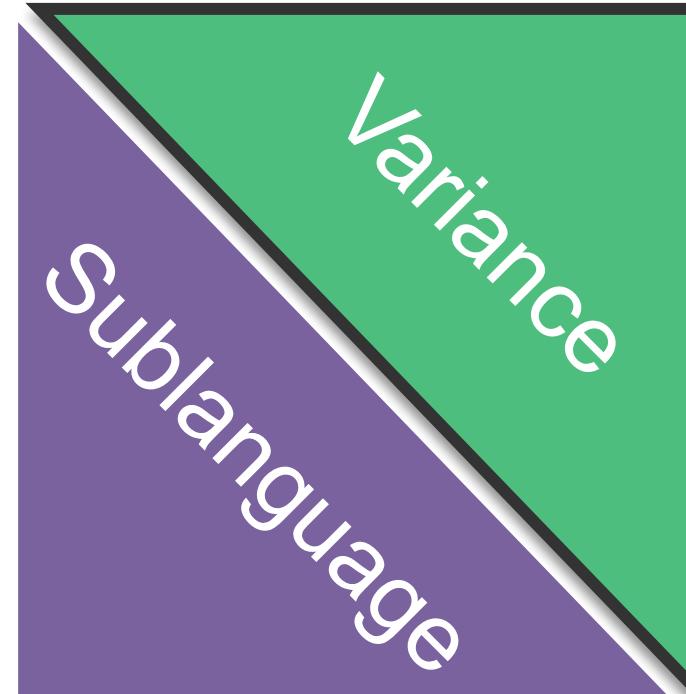
Limited Use of Verbs

General Clinical Descriptions

Broader Semantic Types

Why isn't NLP Completely Pervasive?

The Challenges



Variations on Variations

Linguistic Variation

Different Words with the Same Meaning

Derivation

- Mediastinal = Mediastinum

Inflection

- Opacity = Opacities; Cough = Coughed

Synonymy

- Addison's Disease: Addison melanoderma, adrenal insufficiency, adrenocortical insufficiency, asthenia pigmentosa, bronzed disease, melasma addisonii ...
- Chest Wall Tenderness: Chest wall did demonstrate some slight tenderness when the patient had pressure applied to the right side of the thoracic cage

Polysemy

One Word with Multiple Meanings

General polysemy

- Patient was prescribed codeine upon discharge
- The discharge was yellow and purulent

Acronyms and Abbreviations

- APC: activated protein c, adenomatosis polyposis coli, adenomatous polyposis coli, antigen presenting cell, aerobic plate count, advanced pancreatic cancer, age period cohort, alfalfa protein concentrated, allophycocyanin, anaphase promoting complex, anoxic preconditioning, anterior piriform cortex, antibody producing cells, atrial premature complex ...

Act 4

You Con Do It!



High Hanging Fruit

Low Hanging Fruit

Low Hanging Fruit

Explicit mentions

- “Patient denies chest pain” = Chest_pain – negated

Low Hanging Fruit

Explicit Mentions

- “Patient denies chest pain” = Chest_pain – negated

Expected Classes & Relations

- Diseases
- Problems
- Anatomic locations

Low Hanging Fruit

Explicit Mentions

- “Patient denies chest pain” = Chest_pain – negated

Expected Classes & Relations

- Diseases
- Problems
- Anatomic locations

Unambiguous Vocabulary

- Pneumonia
- Lobe
- Stenosis
- Severe

Examples

Quality
Research
Decision Support

Quality

Monthly Report: PE and VTE in Rad Reports

- 1.5 times more accurate than ICD codes
- Provides more information

Visit Number	NLP Input Id	Result id (PE)	NLP Process	Result Date	PE Result (P)	PE NLP Cert.	PE Impressk	PE Acute	PE Chronic	PE Left Side	PE Right Sid	PE Main Artx	PE Interlobe	PE Lobar Art	PE Segment	PE Subsegm	PE Temporal
221737831	265,623	282,384	9/15/17	6/14/17	n												
221737831	265,623	568,021	9/15/17	6/14/17	n												
221737831	265,623	698,886	9/15/17	6/14/17	n												
221659596	265,605	282,365	9/15/17	6/12/17	n												
221659596	265,605	568,002	9/15/17	6/12/17	n												
221659596	265,605	698,867	9/15/17	6/12/17	n												
222061696	265,710	282,473	9/15/17	6/29/17	y		imcertain			left_yi	si						
222061696	265,710	568,110	9/15/17	6/29/17	y		imcertain			left_yi	si						
222061696	265,710	698,975	9/15/17	6/29/17	y		imcertain			left_yi	si						
221659605	265,606	282,366	9/15/17	6/12/17	n												
221659605	265,606	568,003	9/15/17	6/12/17	n												
221659605	265,606	698,868	9/15/17	6/12/17	n												
222142568	265,737	282,501	9/15/17	6/30/17	y	certain	imcertain	acute	chro_no	left_yes	right_no	main_no	inter_no	lobar_no	seg_yes	subseg_no	present
222142568	265,737	568,138	9/15/17	6/30/17	y	certain	imcertain	acute	chro_no	left_yes	right_no	main_no	inter_no	lobar_no	seg_yes	subseg_no	present
222142568	265,737	699,003	9/15/17	6/30/17	y	certain	imcertain	acute	chro_no	left_yes	right_no	main_no	inter_no	lobar_no	seg_yes	subseg_no	present
222090200	265,719	282,483	9/15/17	6/29/17	n												

Certainty

Acute
Chronic

Side

Artery
Lobe

Segmental

Temporal

Quality

Pilot Deployment Across the U.S. in the VA

QUINCE
Tag line goes right here

Patients Providers Health Systems Welcome Dr Smith ▾ Logout

Metrix Training Plan

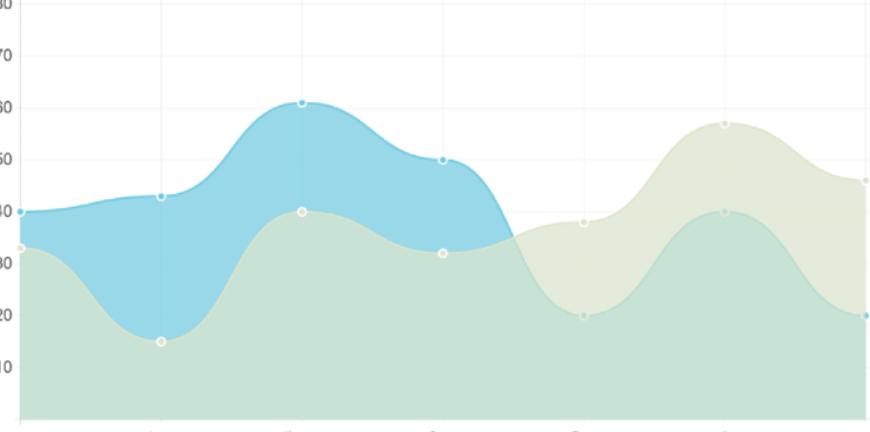
 Adenoma Detection Rate

 Cecal Intubation Rate

 Bowel Preparation Quality

 Withdrawal Time

Adenoma Detection Rate



Period	Adenoma Detection Rate (%)
one	35
two	15
three	60
four	30
five	20
six	55
seven	20



search for providers... 

Dr Smith 

Dr White 

Dr Pink 



Patient Safety Surveillance

- Monitor and document adverse events
 - Study patterns to improve processes
 - Identify at-risk patients based on past cases

Study:
US Ex Lower Venous Duplex LT

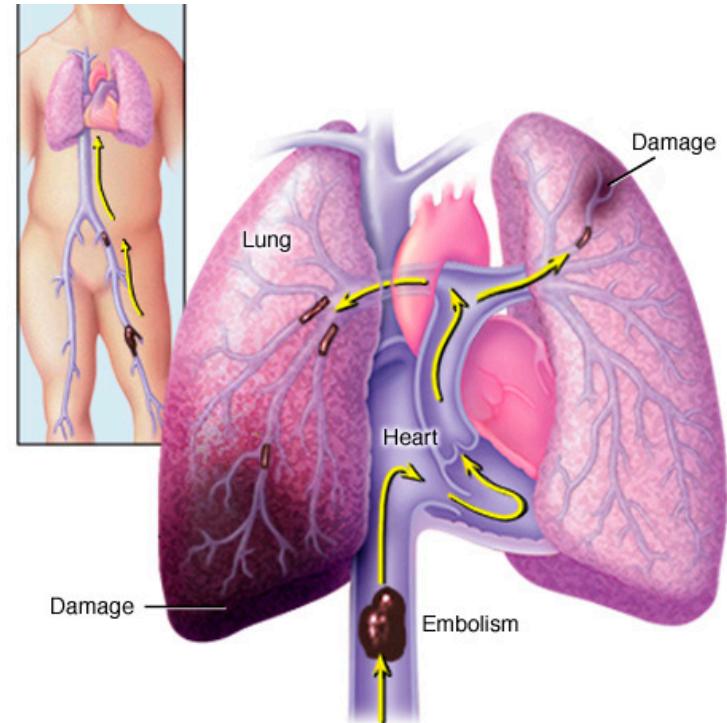
Order #: 3435636

Order Date: 04/24/2017 08:10

Indication: Patient with unilateral left lower swelling concerning for DVT.

Findings: There appears to be a **venous thrombus** in the left superficial femoral vein without propagation into the common femoral vein or iliac vasculature. Compressive US performed on the Right lower extremity without evidence of a venous thrombus.

Impression: Left SFV Thrombosis



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Patient_Detail_Fall Secure | https://itbcn.axshare.com/#p=patient_detail_fall&c=1 Mike

Safety Surveillance

Triggers Chart Review Adverse Events Christine K.

Back to Triggers

ARTHUR, RACHEL B
Mirkwood Healthcare System > County Hospital Regional Medical Center

EMPI: 75643897	Weight: 8.5 kg	Primary Admit Diagnosis: Rule out PE
MRN: 456312	Current Visit Date: 06/10/17 12:43	Length of Stay: 4.5 days
Current Visit #: 8123456-9	Current Unit: 10 MCU-ORM	Current Attending Physician: Rodriguez, Jonathan M
Gender: 8123456-9	Current Location: Room 302- Bed A	Service Line: General Medicine
Date of Birth (Age): April 14 1974 (41)	Current Location: cellulitis, osteomyelitis	Discharge Date: --

Trigger Summary Radiology Study for Emboli or DVT Fall Stage II Pressure Ulcer

Trigger Date/Time: 04/24/17 13:10

Source: Physician Progress Note

Narrative: "Patient fell. Patient examined. Minor trauma. Did not hit head and no breaks"

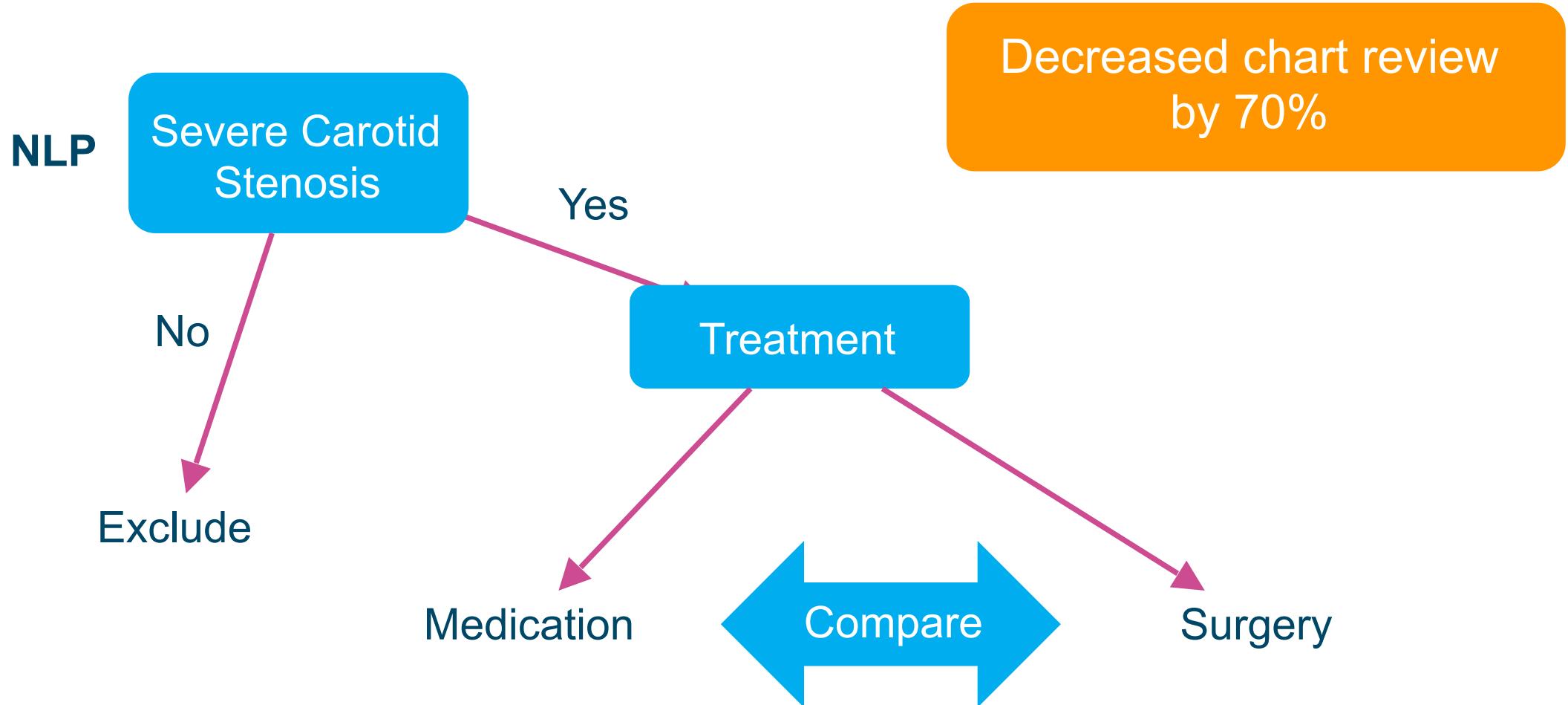
Date/Time: 03/12/2017 07:52

68

Examples

Quality
Research
Decision Support

Research



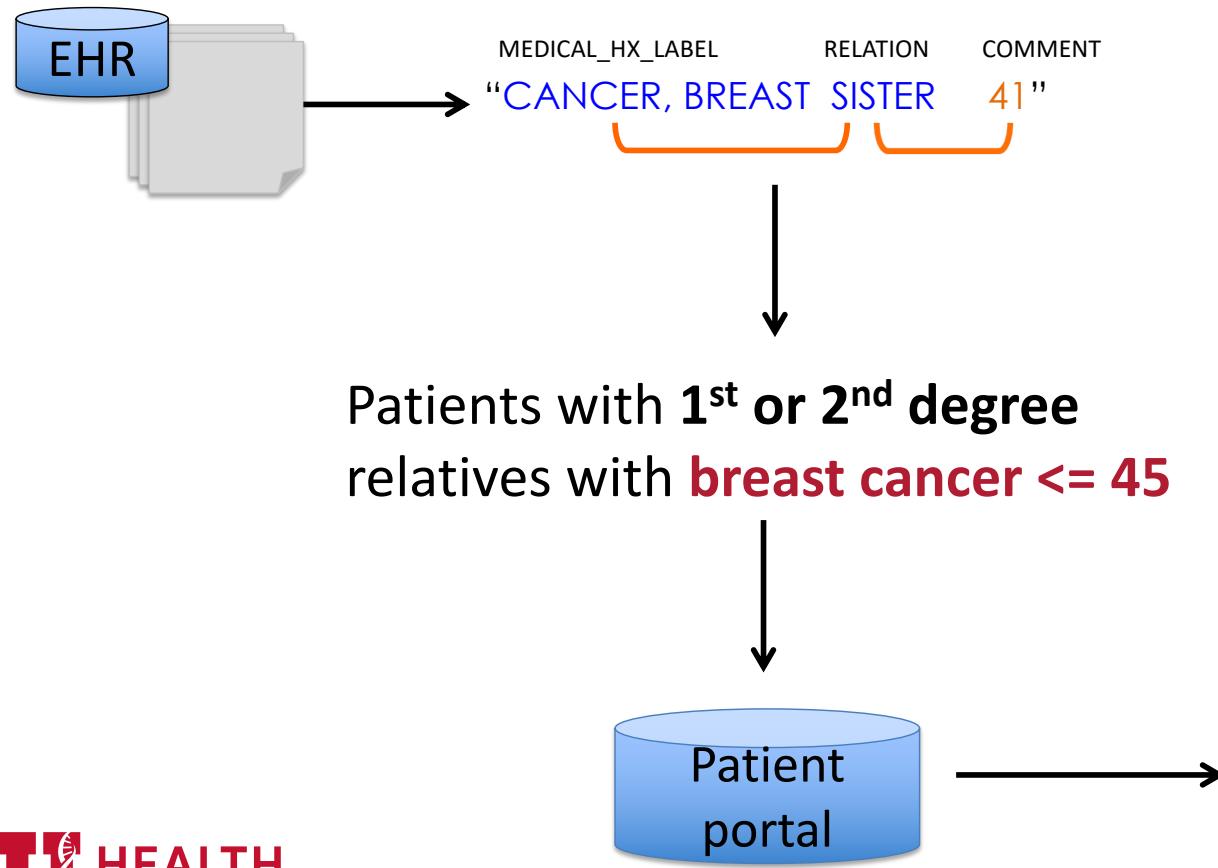
Examples

Quality
Research
Decision Support

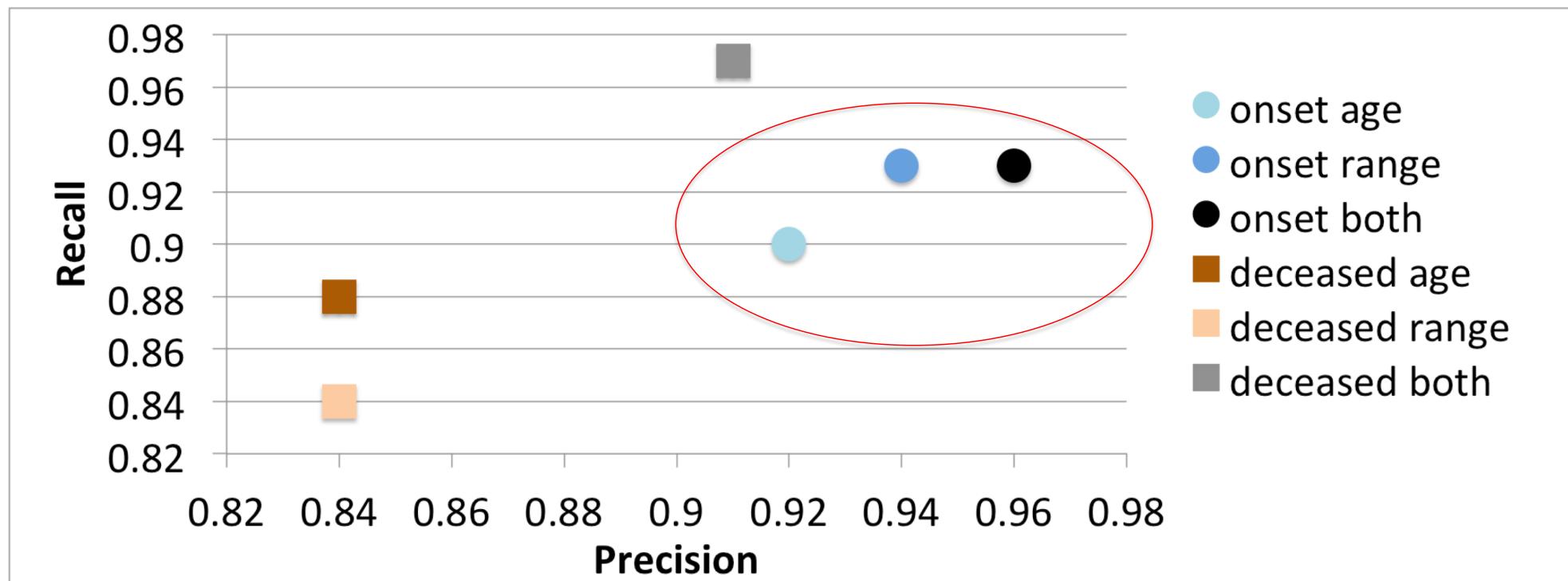
Decision Support

FLAG PATIENTS IN EMR WITH FAMILY HISTORY OF BREAST/COLORECTAL CANCER

Danielle Mowery, Subhadeep Nag,
Guilherme Del Fiol, Ken Kawamoto

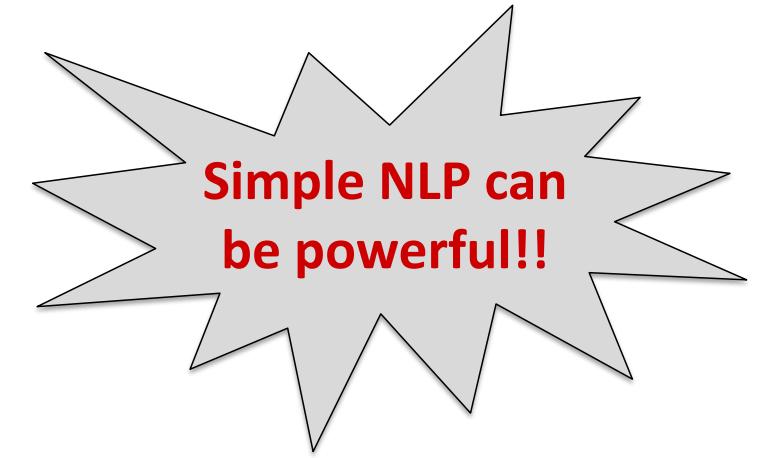
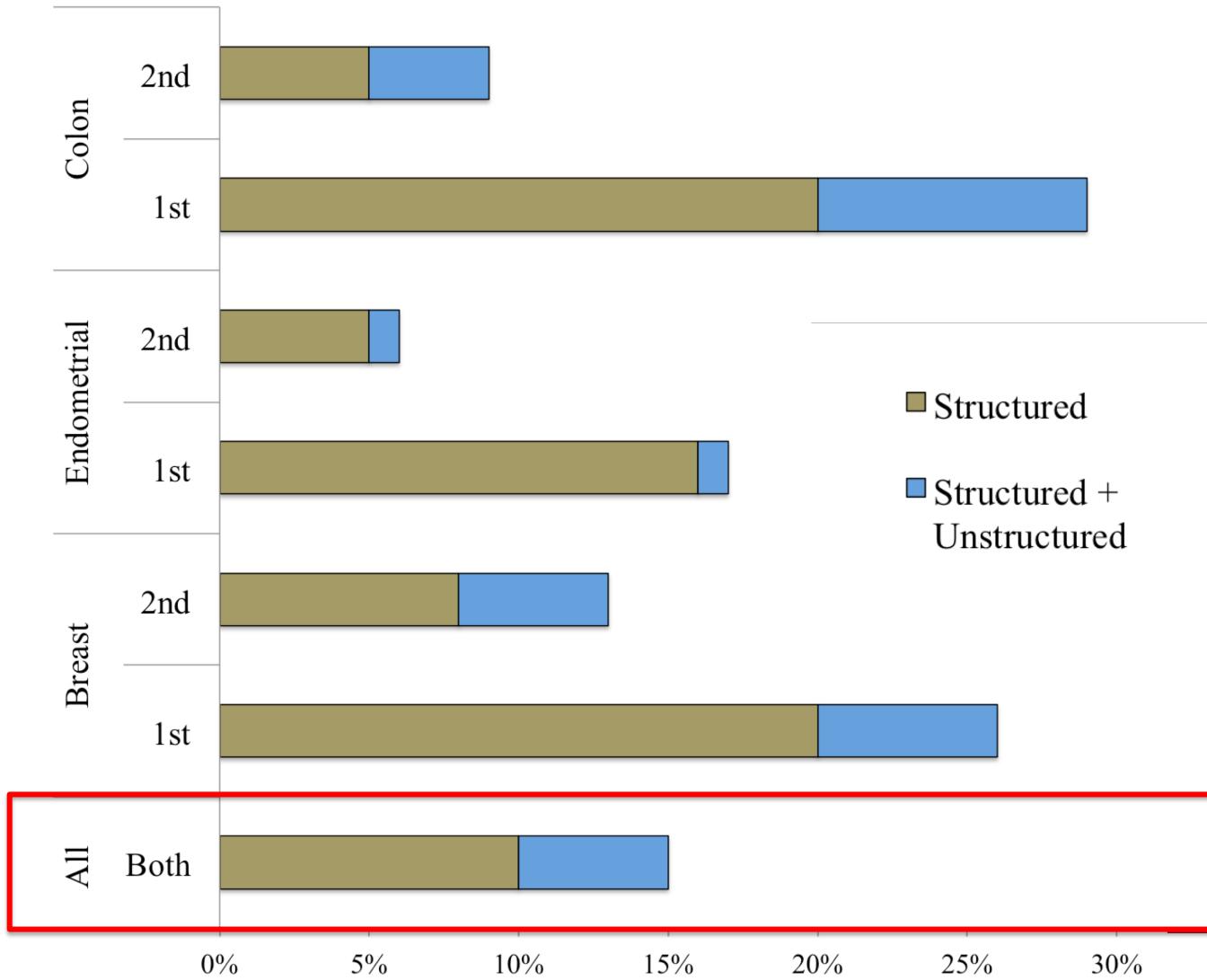


EXTRACTING AGE USING PYCONTEXT



Onset age and range can be extracted with high precision and recall

NLP WITH STRUCTURED AGE OF ONSET ENTRIES





High Hanging Fruit

Low Hanging Fruit

High Hanging Fruit

Requires Inference

- “Brother at bedside” = Has_Social_Support

High Hanging Fruit

Requires Inference

- “Brother at bedside” = Has_Social_Support

Ambiguous Vocabulary

- “**Brother** died from MI”
- “Stood at **bedside**”

High Hanging Fruit

Requires Inference

- “Brother at bedside” = Has_Social_Support

Ambiguous Vocabulary

- “**Brother** died from MI”
- “Stood at **bedside**”

Semantic Roles Matter

- “**Wife** helps **patient** with meds”
- “**Patient** helps **wife** with meds”

Example

Social Risk Factors to help
predict readmission

Using NLP to Extract High Fruit

Dementia

Depression

Activities of Daily Living

- Bath, Eat, Walk

F-score 75-98%

Social Support

Housing Situation

Language Barrier

Medical Condition Leading to Impairment

Medication Compliance

Conclusion

By the way...

Amazon just released a clinical NLP tool

- Get a feel for what clinical NLP tools do

Many other tools

- Contextual information
- Classification

Opportunities Abound for Using NLP in Health Care



1. Identify information from text
 - Many tools available
 - A lot of low hanging fruit
2. Create apps using NLP output
3. Integrate into workflow

Challenge as Opportunity



Q&A

Thank You!