

Building data capacity for PCOR: Role of NLP in data infrastructure

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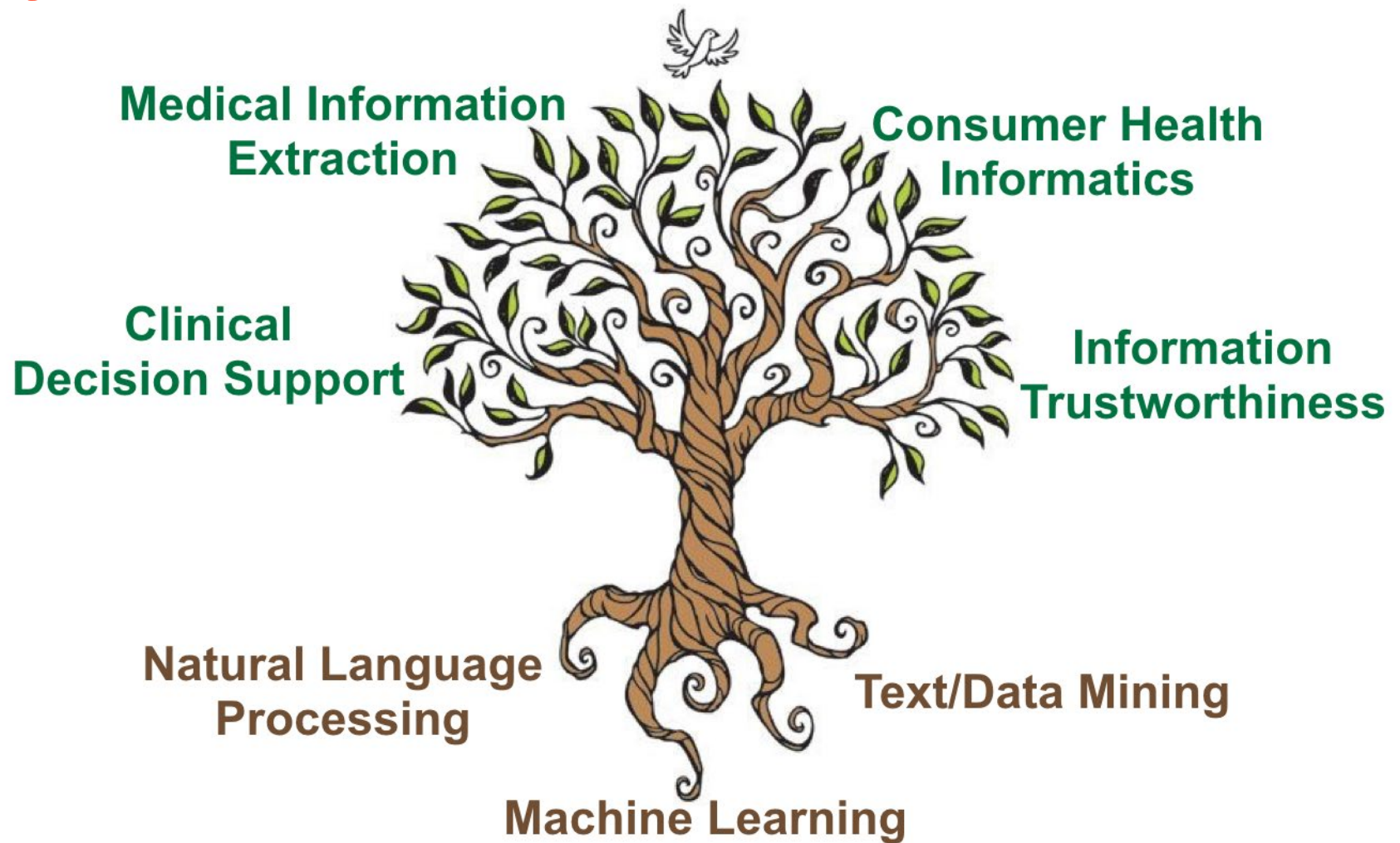
Assistant Professor of Information

May 24th, 2021

Brief Bio

- Assistant Professor ('15–'21); Associate Professor ('21–)
 - Department of Learning Health Sciences, Medical School
 - School of Information
- Ph.D. in Computer Science (2013), University of Illinois at Urbana-Champaign
- M.Tech. (2004), Indian Institute of Technology Bombay
- Member of LHSNet, a PCORI Clinical Data Research Network

My research interests



Research focuses on **transforming data into actionable knowledge** while addressing issues of context, scale, quality, and impact.

Making PCOR data infrastructure more useful for research : My two cents

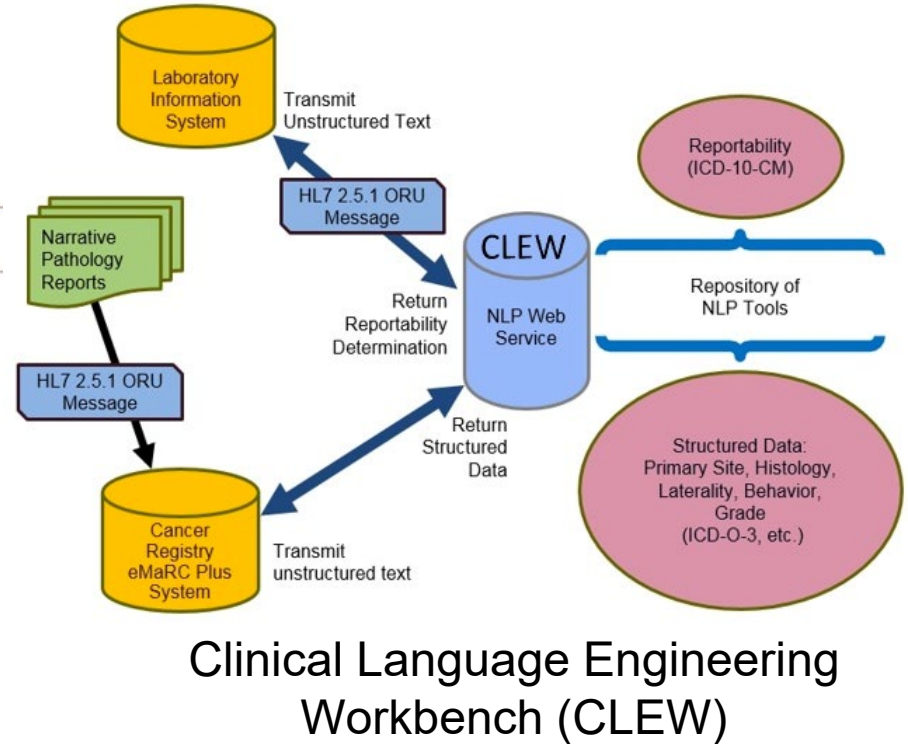
- ❑ 1. Informatics infrastructure that includes clinical notes
- ❑ 2. Computable phenotypes as knowledge objects
- ❑ 3. Looking beyond EHRs for health data

Insights from LHSNet

- ❑ Patient-Centered Network of Learning Health Systems (LHSNet)
 - ❑ PCORI-supported Clinical Data Research Network (CDRN)
 - ❑ Across nine organizations , incl. 6 health systems
- ❑ Common Data Model for structured data (demographics, lab, ...)
 - ❑ Generally successful in launching studies across multiple sites
 - ❑ Does not include text data
- ❑ **1. Informatics Infrastructure for processing textual clinical notes**
 - ❑ Extending Common Data Models to include textual components
 - ❑ Extracting clinically-relevant information from free text

Extends prior efforts

Exhibit 2. NLP Machine Learning Process



- Developed as part of CDC's National Program of Cancer Registries (NPCR)

Not only features, but also concepts & relationships between concepts

CLEW: <https://www.cdc.gov/cancer/npcr/informatics/nlp-workbench/pilot-cancer.htm>

2. Computable phenotypes as knowledge objects

OS PCORTF Vision -- First Decade

Goal: To build data capacity in HHS that supports research on patient health outcomes.

- PCOR is intended to provide decision makers with objective, scientific evidence on the effectiveness of treatments, services, and other interventions used in health care.
- This research is frequently focused on analyzing existing data to study questions and provide objective information for the purposes of informing real world health care decisions.



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RESEARCH TRUST FUND

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- ❑ Standardized definitions
- ❑ Computational tools, including clinical NLP tools for processing text
 - ❑ Knowledge objects, supporting/expanding the MCBK initiatives

Incorporating patient-reported outcomes

- ❑ Typical data elements in computable phenotypes
 - ❑ ICD-9/ICD-10 codes, CPT codes
 - ❑ medications
 - ❑ key terms and phrases, frequency of mentions
- ❑ Novel features from patient-reported outcomes
 - ❑ Symptoms, medication response, and adverse events in telephone notes
 - ❑ Medication refill requests through web portal requests
 - ❑ Care provider information, especially for patients unable to independently manage their health care needs
- ❑ Patient-reported outcomes are often in text form in EHRs

Prior work: Patient-provided text

- ❑ Self-reporting behavior about oral anticancer agent toxicity in clinical notes¹
 - ❑ Self-reported notes captured in telephone encounters, emails, and messages via portal
 - ❑ 23.5% of OAA clinical notes were telephone encounter notes
- ❑ Patient-reported outcomes in Crohn's Disease
 - ❑ Extract patient-provided information regarding Crohn's Disease symptoms, medication response, and adverse events using email and telephone notes stored in electronic medical records
 - ❑ Funded by Helmsley Foundation, 2021—2024 (PI: Vydiswaran, Stidham)

¹ Jiang Y, **Vydiswaran VGV**, Eun YL, Joo H, Zheng A, Harris MR. Feasibility of Identifying Oral Anticancer Agent

3. Looking beyond EHRs for health data

Websites

Blogs, Forums

Tweets

October 07, 2009

WebMD
Better information. Better health.

Other search tools: Symptoms | Doctors

WebMD Home > Cancer Health Center > Lung Cancer Health Center > Lung Cancer News

Lung Cancer Health Center

Erbix Helps Treat Advanced Lung Cancer

Study Shows Benefits for Patients With Non-Small-Cell Lung Cancer

Reviewed by Louise Chang, MD

By Charlene Laino
WebMD Health News

Sept. 23, 2009 (Berlin) -- Adding the targeted drug **Erbix** to standard chemotherapy drugs significantly cuts the risk of death for advanced non-small-cell lung cancer patients -- regardless of what chemotherapy combination is used.

Last year, researchers reported that patients lived five weeks longer when Erbix was added to a particular chemotherapy combination. But it wasn't clear whether the choice of chemo drugs mattered.

To find out, Jean-Louis Pujol, MD, chair of thoracic oncology at Montpelier Academic Hospital in France, and colleagues conducted a study.

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Article Talk

Myocardial infarction

From Wikipedia, the free encyclopedia Contributors

"Heart attack" redirects here. For other uses, see **Heart attack (disambiguation)**.

Not to be confused with **Cardiac arrest**.

Myocardial infarction (MI; Latin: *infarctus myocardi*) or **acute myocardial infarction** (AMI) is the medical term for an event commonly known as a **heart attack**. An MI occurs when blood stops flowing properly to a part of the heart, and the **heart muscle** is injured because it is not receiving enough oxygen. Usually this is because one of the **coronary arteries** that supplies blood to the heart develops a blockage due to an **unstable buildup of white blood cells, cholesterol and fat**. The event is called "acute" if it is sudden and serious.

A person having an acute MI usually has sudden chest pain that is felt behind the sternum and sometimes travels to the left arm or the left side of the neck. Additionally, the person may have shortness of breath, sweating, nausea, vomiting, abnormal heartbeats, and anxiety. Women experience fewer of these symptoms than men, but usually have shortness of breath, a feeling of indigestion, and fatigue.^[1] In many cases, in some estimates as high as 64%, the person does not have chest pain or other symptoms.^[2] These are called "silent" myocardial infarctions.

Important risk factors are previous cardiovascular disease, old age, tobacco smoking, high blood levels of certain lipids (low-density lipoprotein cholesterol, triglycerides) and low levels of high density lipoprotein (HDL) cholesterol, diabetes, and the use of cocaine and amphetamines.^{[3][4]} The main way to determine if a person has had a myocardial infarction are electrocardiograms (ECGs) that trace the electrical signals in the heart and testing the blood for substances associated with damage to the heart muscle. Common blood tests are troponin and creatine kinase (CK-MB). ECG testing is used to differentiate between two types of myocardial infarctions based on the shape of the tracing. An ST section of the tracing higher than the baseline is called an ST elevation MI (STEMI) which usually requires more aggressive treatment.

Immediate treatments for a suspected MI include aspirin, which prevents further blood from clotting, and sometimes nitroglycerin to treat chest pain and oxygen.^[5] STEMI is treated by restoring circulation to the heart, called reperfusion therapy, and typical methods are angioplasty, where the arteries are pushed open, and thrombolysis, where the blockage is removed using medications.^[6] Non-ST elevation myocardial infarction (NSTEMI) may be managed with medication, although angioplasty may be required if the person is considered to be at high risk.^[7] People who have had a heart attack may also be treated with bypass surgery (CABG).^{[8][9]} Ischemic heart disease, which is the most common type of heart disease, has been the leading cause of death for both men and women worldwide in 2011.^{[10][11]}

Contents [hide]

- 1 Signs and symptoms
- 2 Causes
- 2.1 Lifestyle
- 2.2 Disease

Diagram of a myocardial infarction (2) of the tip of the anterior wall of the heart (an apical infarct) after occlusion (1) of a branch of the left coronary artery (LCA). In the diagram, RCA is the right coronary artery.

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Adverse drug events in social media



- ❑ Health related communication has increased significantly online
- ❑ Laypersons share health behaviors freely on social media
 - ❑ including use of drugs and associated adverse effects

I wonder if the milk and honey thing work for heartbirn cause Tums ain't shit for me

- ❑ If understanding clinical text is hard, **consumer-generated text** is harder!
 - ❑ **Grammatical structure** might not hold, **typos** abundant
 - ❑ Not “natural” language: use of **short text language**
 - ❑ new acronyms, abbreviations ==> disambiguation challenges

Baby im ur insulin if u need ur medicine. I'll be ur prescription, come & take a dose of me. Once u get a dose of me, baby i'm ur medicine.

















“Social” determinants of health






- ❑ Exploring community health information in geo-located social media
- ❑ Analyzing social media through the lens of
 - ❑ communities: affluent vs. disadvantaged neighborhoods
 - ❑ demographics: e.g. “BlackTwitter”
 - ❑ patient cohorts: e.g. smoking cessation patient groups
- ❑ Linking patients to spatiotemporal factors
 - ❑ Environmental / spatial factors such as air pollution, neighborhood walkability, rurality, and “food deserts” affects health, exercise, and diet
 - ❑ Social media provides a non-traditional way to learn about health information exposure, sentiment, and “patient-reported” outcomes

PCOR data infrastructure for health social media

- Social media can augment information in FAERS and VAERS
- NLP to the rescue, for parsing text reports in FAERS/VAERS, and also on social media


Tweet count	Drug mentioned	Total		Mental		Sleep		Pain		Tiredness		Nausea		Sweat		Itch	
																	
133	Benadryl	3	3,1	X	X			X	X		X	X	X				
119	Adderall	6	5	X	X			X	X	X	X	X	X	X	X	X	
108	Ibuprofen	5	2,1	X	X		X	X	X	X		X				X	
74	Xanax	5	4	X	X	X	X	X	X	X	X	X					
73	Acetaminophen	5	4,2		X		X	X	X	X	X	X	X	X	X	X	
64	Vyvanse	6	5	X	X	X	X	X	X	X	X	X		X	X		
34	Codeine	6	5	X	X	X	X	X	X			X	X	X		X	X
17	Morphine	6	3	X	X	X	X	X	X			X		X		X	
16	Ambien	5	2	X	X			X	X	X		X				X	
12	Concerta	7	4	X		X	X	X	X	X	X	X	X	X		X	

 - MedlinePlus
 - Twitter



Example 1


this benadryl is making me tired



Example 2

I wish benadryl did not make me so tired

...



Example 12

apparently benadryl makes me tired

13

Key takeaways

- ❑ 1. Need for an enhanced **informatics infrastructure** for processing textual clinical notes
- ❑ 2. Treating **computable phenotypes as knowledge objects**, and incorporating patient-reported outcomes derived using NLP
- ❑ 3. **Health-related social media** can augment existing population health and SDOH efforts

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