UC San Diego
SCHOOL OF MEDICINE

Department of
BioMedical Informatics

Using Natural Language Processing for Vancomycin Induced Nephrotoxicity

By Joshua Fuller

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About Me

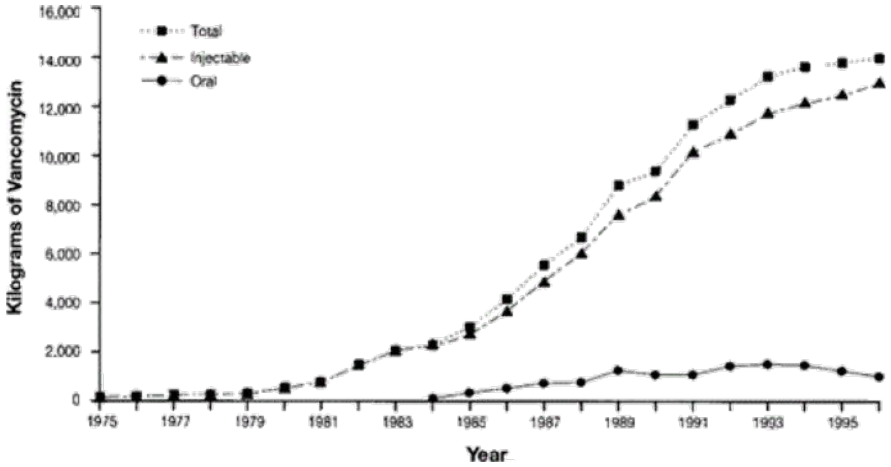
COLUMBIA | ENGINEERING
The Fu Foundation School of Engineering and Applied Science

- Second Year at Columbia University
- Studying Biomedical Engineering

- This is my first Informatics internship

Why does this matter

- Vancomycin is an antibiotic
- The use of Vancomycin has increased sharply
- 100-Fold increase since the 80s



- "...aggressive drug dosing aimed at curbing the trend of reducing microbial sensitivity is associated with higher incidence of AKI."
- "...10-20 % and 30-40 % of patients following conventional and high doses of vancomycin therapy, respectively."

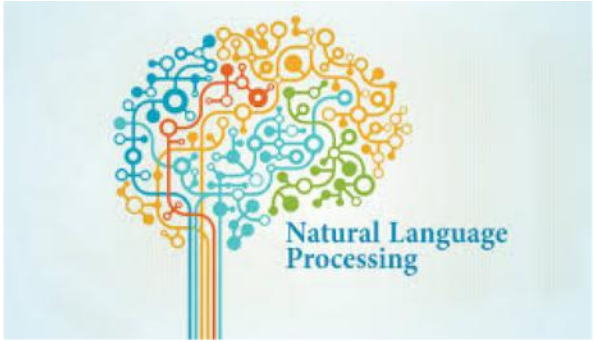
How to find the people

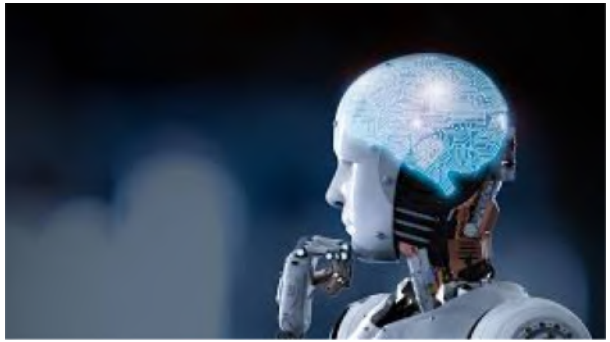
- There are models
  - But they use structured data
  - But that's not where the data is..

- If we find them
  - Different antibiotic

The Solution: NLP

- Info Extraction
  - Words to data
- Machine learning to identify
  - Parts of speech
  - Sentence structure
  - Meaning of the information?





The Difficulty

- Why not do a keyword search?
  - Not that easy
- A Diagnosis of elimination, spanning multiple days and clinician notes
- Muddy data because of patients
  - Severe Infection?
  - Diabetic?

Dehydrated?

Heart Failure?

Vasculitis?

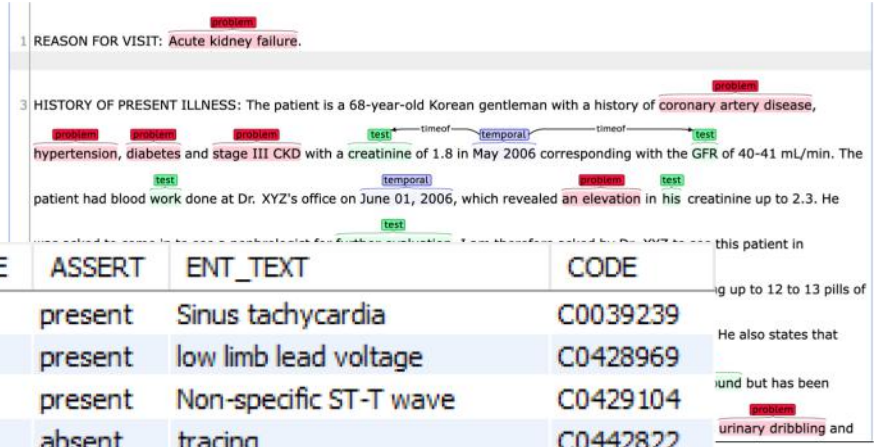
Enlarged Prostate?

Tumor?

NSAID?

The Tools

- Clinical Language Annotation and Modeling Pipeline
  - CLAMP
  - Keywords
  - Temporal relation
  - Negation
  - Discern tests and their values
  - Export all of that into a mySQL database



	ID	DOC_ID	START_POS	END_POS	SEM_TYPE	ASSERT	ENT_TEXT	CODE
▶	1	4	0	17	problem	present	Sinus tachycardia	C0039239
	2	4	30	51	problem	present	low limb lead voltage	C0428969
	3	4	53	75	problem	present	Non-specific ST-T wave	C0429104
	4	4	100	107	test	absent	tracing	C0442822

The Tools Cont

- Two Flavors:
  - Total Dictionary
  - Expert Derived
- Unified Language Medical System (UMLS)

REASON FOR VISIT: Acute kidney failure.

HISTORY OF PRESENT ILLNESS: The patient is a 68-year-old Korean gentleman with a history of coronary artery disease, hypertension, diabetes and stage III CKD with a creatinine of 1.8 in May 2006 corresponding with the GFR of 40-41 mL/min. The patient had blood work done at Dr. XYZ's office on June 01, 2006, which revealed an elevation in his creatinine up to 2.3. He was asked to come in to see a nephrologist for further evaluation. I am therefore asked by Dr. XYZ to see this patient in consultation for evaluation of acute on chronic kidney failure. The patient states that he was actually taking up to 12 to 13 pills of Chinese herbs and dietary supplements for the past year. He only stopped about two or three weeks ago. He also states that TriCor was added about one or two months ago but he is not sure of

3 HISTORY OF PRESENT ILLNESS: The patient is a 68-year-old Korean gentleman with a history of coronary artery disease, hypertension, diabetes and stage III CKD with a creatinine (Test) of 1.8 in May 2006 corresponding with the GFR of 40-41 mL/min. The patient had blood work done at Dr. XYZ's office on June 01, 2006, which revealed an elevation in his creatinine (Test) up to 2.3. He was asked to come in to see a nephrologist for further evaluation. I am therefore asked by Dr. XYZ to see this patient in consultation for evaluation of acute on chronic kidney failure (Kidney Damage). The patient states that he was actually taking up to 12 to 13 pills of Chinese herbs and dietary supplements for the past year. He only stopped about two or three weeks ago. He also states that TriCor was added about one or two months ago but he is not sure of the date. He has not had an ultrasound but has been diagnosed with prostatic hypertrophy by his primary care doctor and placed on Flomax. He states that his urinary dribbling and weak stream had not improved since doing this. For the past couple of weeks, he has had dizziness in the morning. This is then associated with low glucose. However the patient's blood glucose (Test) this morning was 123 and he still was dizzy. This was worse on standing. He states that he has been checking his blood pressure regularly at home because he has felt so bad and that he has gotten under 100/60 on several occasions. His pulses remained in the 60s.

5 ALLERGIES: None.

7 MEDICATIONS: Imdur 20 mg two to three times daily, nitroglycerin p.r.n., insulin 70/30 40/45 units daily, Zetia 10 mg daily, ? Triglide

AKI Kidney Damage
acute interstitial nephritis Kidney Damage
Acute Kidney Injury Kidney Damage
acute tubular necrosis Kidney Damage
AIN Kidney Damage
ATN Kidney Damage
hypoperfusion Kidney Damage
hypovolemia Kidney Damage
nephrotoxic Kidney Damage
nephrotoxicity Kidney Damage
oliguria Kidney Damage
azotemia Kidney Damage
kidney failure Kidney Damage
hyperkalemia Kidney Damage
hypernatremia Kidney Damage

nephrology Kidney
nephrology consult Kidney
renal output Kidney
pre-renal Kidney
kidney Kidney

blood loss comorbidity
cardiogenic shock comorbidity
hypotension comorbidity
UTI comorbidity
septic shock comorbidity
sepsis comorbidity
shock comorbidity
urinary track infection comorbidity
volume loss comorbidity
hyperglycemia comorbidity

The Tools Cont.

- Literal Petabytes
- PHI
- Amazon workspaces remote desktop

- Scalability
- EC2

A Little Comparison

- My Mac
  - 2.3 GHz Intel Core i7 Processor
  - 16 GB of memory
- Amazon
  - 3.6 GHz Intel Xeon Scalable Processors
  - 96 of them…
  - 192 GB of memory

Part 2: Creation of the Cohort

- Model require efficacy tests
- Me, MIMIC, and Many Tables

SUBJECT_ID	HADM_ID	ADMITTIME	DISCHTIME	Pre-Admit Creatinine time
Pre-Admit Creatinine Levels	First_Creatinine_Test_Time	First_Creatinine_Test_Value	Min_Creatinine_Time	
Min_Creatinine_Value	Max_Creatinine_Time	Max_Creatinine_Value	Avg_Creatinine_Value	

Future Steps

- Narrow and Confirm the Cohort
- Run CLAMP on the EC2 Server
- Create a comprehensive list of those affected

- Far Future Steps
  - DNA Tests
  - Patient interviews
  - Other...

What did I learn

- So, so, so much
- The eternal joy of de-bugging code I didn't write
- mySQL, database Java
- The minutiae of comp-sci

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Questions?

Thank you to Dr. Jejo Koola, Dr. Zaid Yousif, and the National Library of Medicine