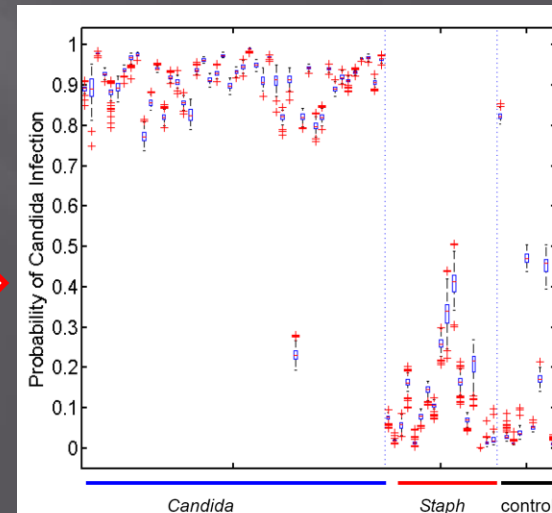
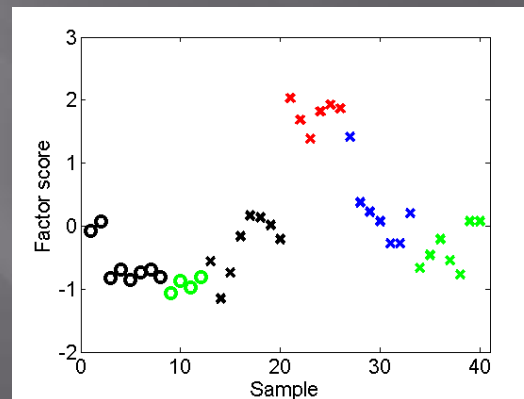
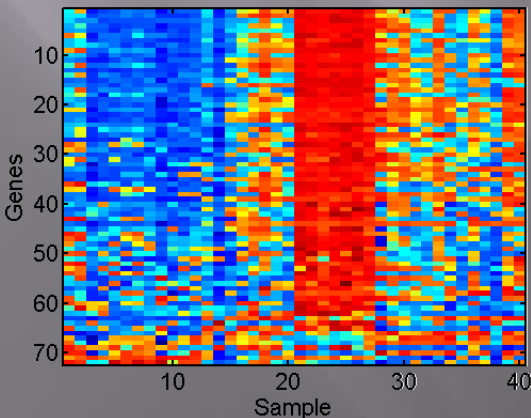


# LINKING PERSONAL AND POPULATION LEVEL HEALTH CARE

Joseph Lucas, Ph. D.

# Personalized Medicine

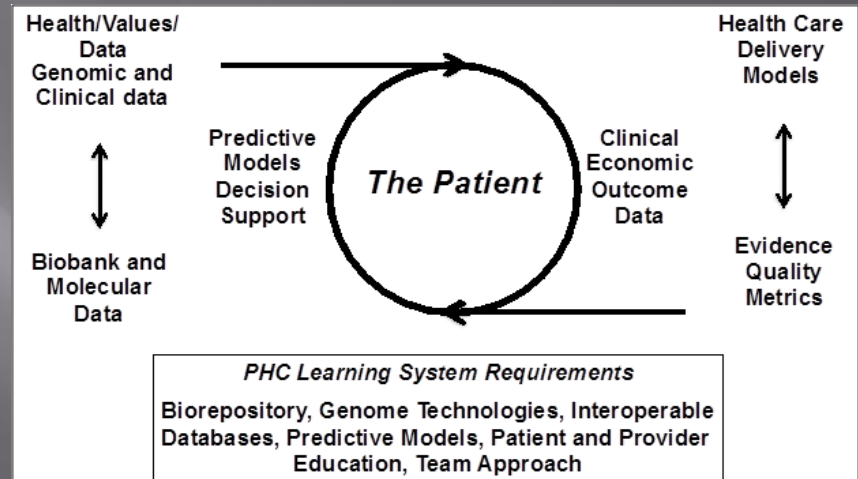
- Early initiatives
  - Know your patient
- Anything between?
- Personalized veterinary medicine



# Clinical Decision Support

- Obtain data in a usable format
  - Standardization
  - Data entry
- Database management
  - HIGHLY dynamic
  - VAST
- Predictive model
- Presentation
  - Useful
  - Don't interfere!
  - Physicians are used to integrating data
- Feedback
  - Improve modeling

## Personalized Medicine Rapid Learning Laboratory



### Data Driven

- Before presentation
  - Family history/predisposition
- At presentation
  - Diagnosis and treatment
- After presentation
  - Update CDS models with long term outcomes

# CDS Case Study

- ▣ 48 yo AAM with a past medical hx/o HTN` who presents with HA and chills. The symptoms started last night at approximately 2130. The HA is a generalized dull ache. He also c/o a cough that started today that is nonpainful and non-productive. He denies any fever` N/V/D` although it should be noted that his temperature was 99.5 at triage.

# Data

- ▣ Duke emergency department
- ▣  $\approx 50,000$  electronic medical records
- ▣ First 3 quarters, 2009
- ▣ Chief complaint
- ▣ Zip code
- ▣ Date
- ▣ Exploratory on a subset
- ▣ Moderately common chief complaints
- ▣ 6100 records
- ▣ Some distinct, some similar

# Topic Modeling

$z_i$  - group for patient  $i$

$w_{ij}$  - word  $j$  in H&P for patient  $i$

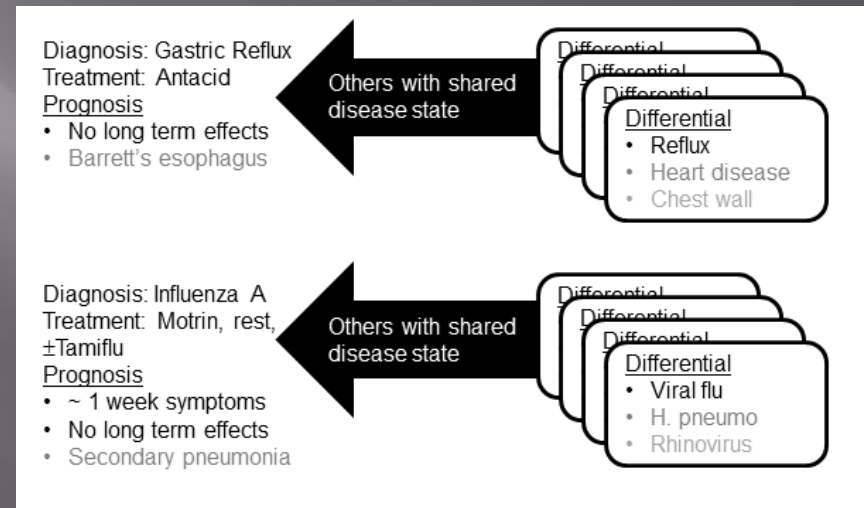
$d_{ij}$  - diagnosis  $j$  for patient  $i$

$z_i \sim \text{Multinomial}(\theta)$

$w_{ij} \sim \text{Multinomial}(\gamma_{zi})$

$d_{ij} \sim \text{Multinomial}(\eta_{zi})$

Dirichlet priors for  $\theta$ ,  $\gamma_{zi}$  and  $\eta_{zi}$



# Filtering and Data Preparation

33 yo M c/o right hand pain x 1 day. Patient reports a family member was carrying a 2x4 piece of wood and almost struck him accidentally and he blocked with his right hand. Noticed this morning that pain was worse. No other trauma. Last Tetanus: UTD.

family  
hand  
morning  
pain  
reports  
right

contusion` fracture` sprain` articular surface injury`  
neurovascular injury` tendon injury

# Results – Example group

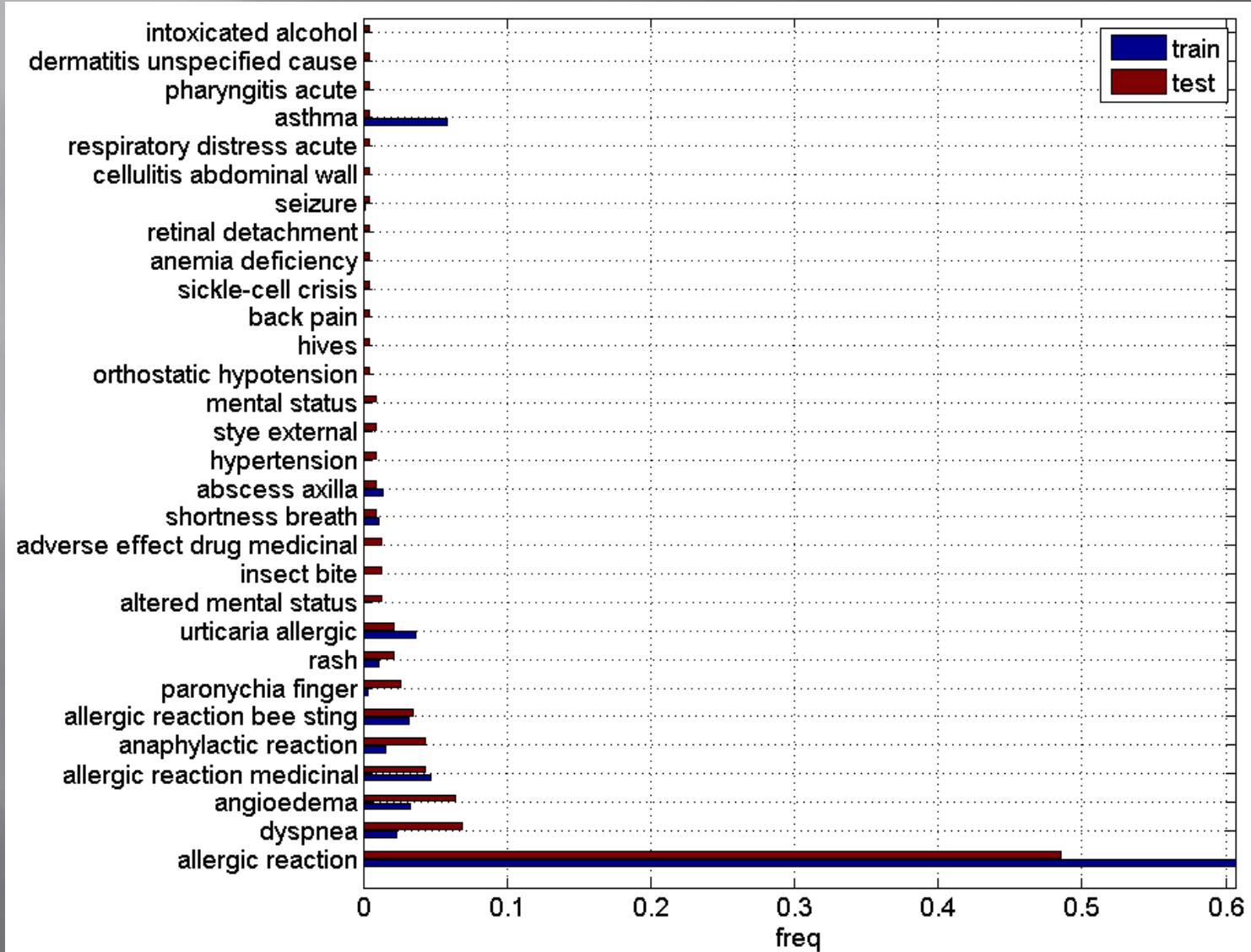
## WORDS - H&P

- ▣ 3.26 swelling
- ▣ 2.53 rash
- ▣ 2.31 prior
- ▣ 2.25 benadryl
- ▣ 2.12 problem
- ▣ 1.91 allergic
- ▣ 1.72 difficulty
- ▣ 1.70 reaction
- ▣ 1.57 tongue
- ▣ 1.49 breathing

## DIFFERENTIAL DIAGNOSIS

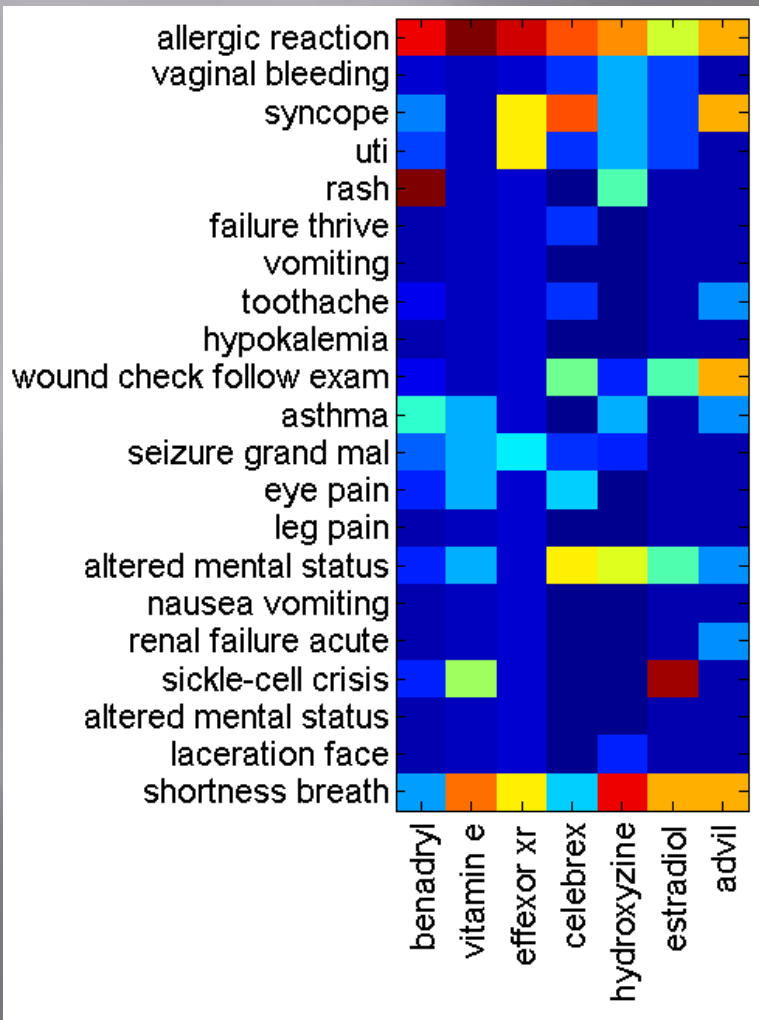
- ▣ 60.66 allergic reaction
- ▣ 5.84 dyspnea
- ▣ 4.70 angioedema
- ▣ 3.64 allergic reaction  
medicinal biological substance
- ▣ 3.31 anaphylactic reaction
- ▣ 3.22 allergic reaction bee  
sting
- ▣ 2.67 paronychia finger
- ▣ 2.30 rash
- ▣ 1.55 urticaria allergic
- ▣ 1.39 altered mental status
- ▣ 10.72 <others>

# Results - Validation



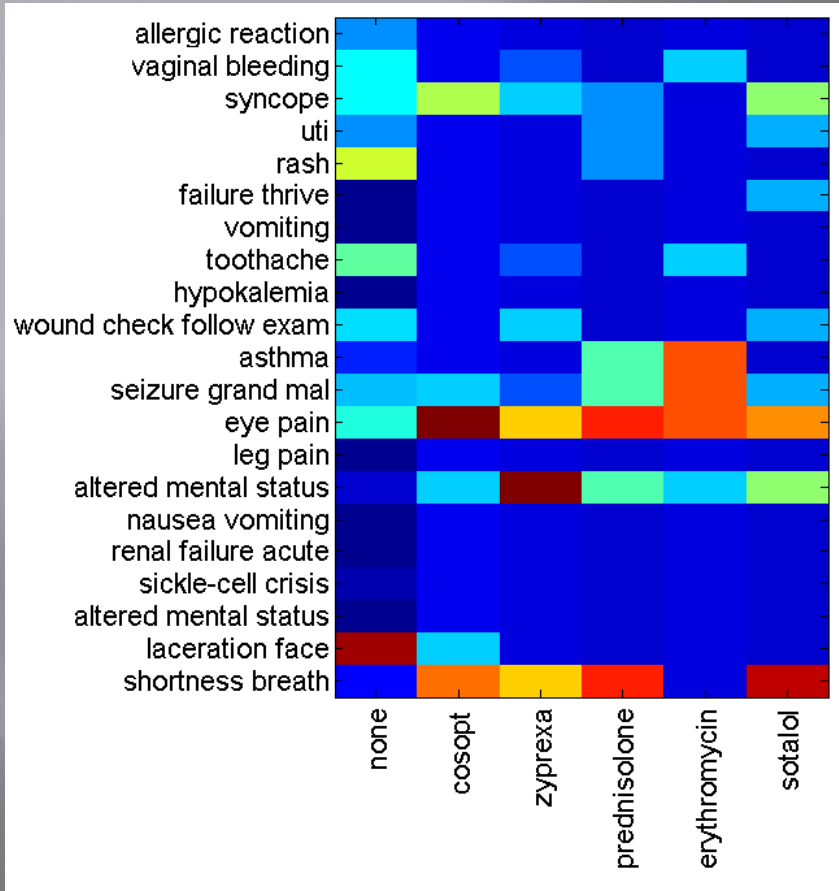
Swelling  
 Associated  
 Relief  
 Taken  
 Itching  
 Benadryl

# Allergy topic and drugs



- ❑ Benadryl, vitamin E, hydroxyzine
- ❑ Effexor XR – depression, known to cause hives
- ❑ Celebrex – treatment of rhumatoid arthritis
- ❑ Estradiol – menopause, known to cause hives
- ❑ Advil – pain medicine

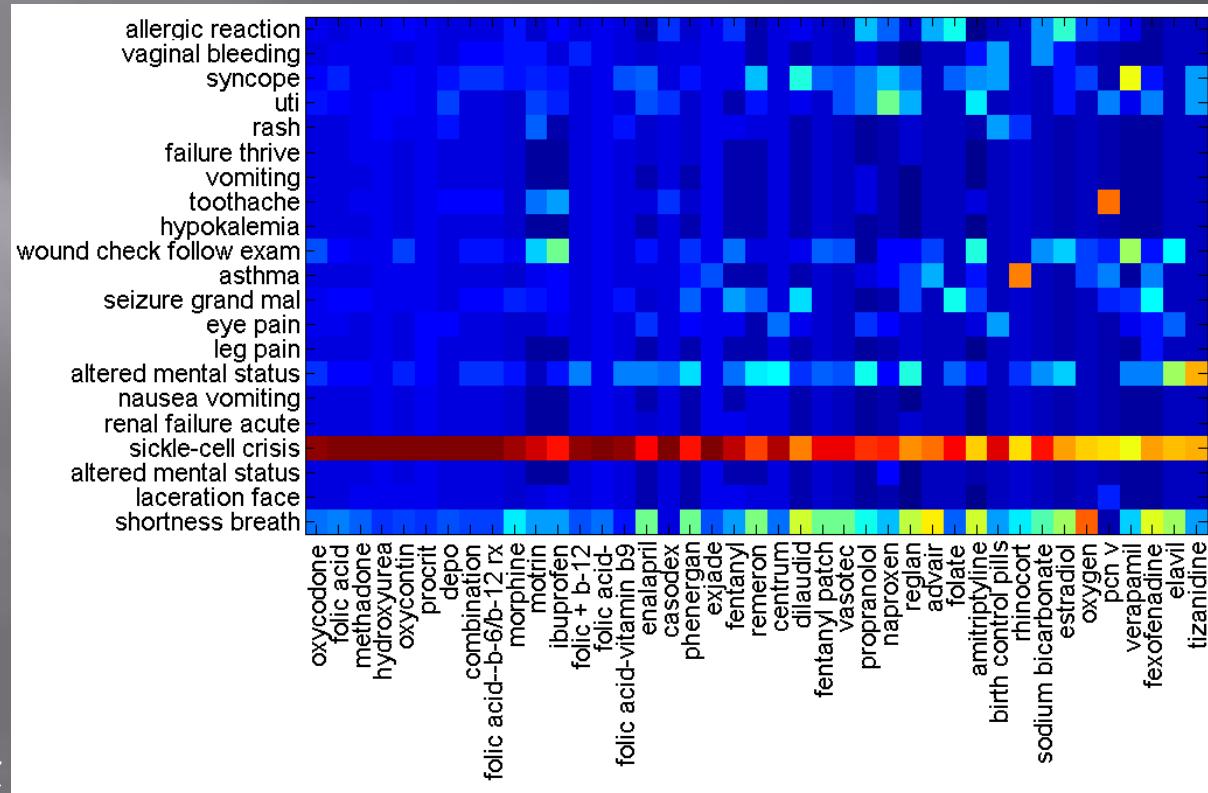
# Eye pain topic and drugs



- ▣ Cosopt, sotalol – glaucoma
- ▣ Prednisolone – anti-inflammatory eye drop
- ▣ Erythromycin – antibiotic eye drop
- ▣ Zyprexa – schizophrenia, known side effect

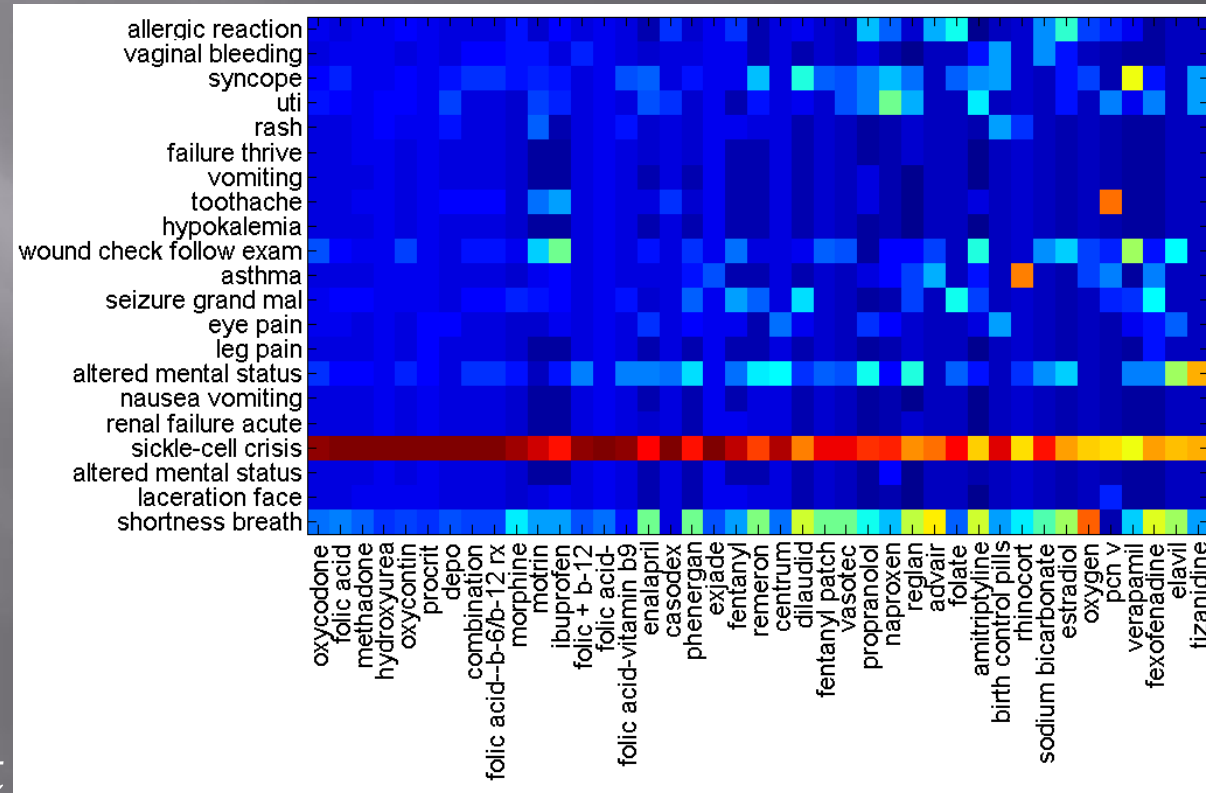
# Sickle Cell

- ▣ Pain meds,  
vitamin B,  
antidepressants
- ▣ Casodex?
  - Google search
  - Canadian  
pharmacies  
selling it without  
a perscription
  - Self medication?



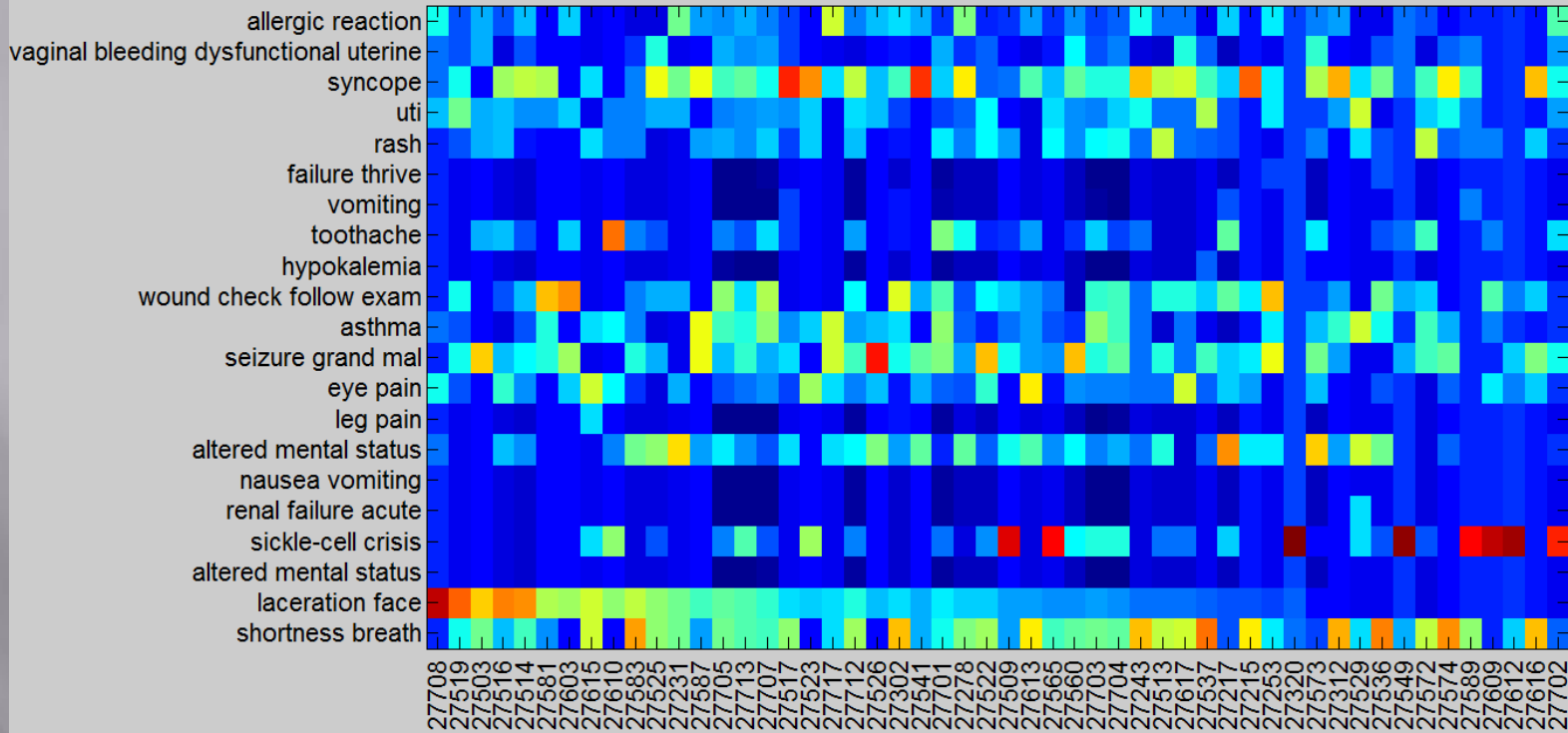
# Sickle Cell

- ▣ Pain meds, vitamin B, antidepressants
- ▣ Casodex?
  - Google search
  - Canadian pharmacies selling it without a prescription
  - Self medication?



- ▣ "Likewise, the antiandrogen bicalutamide, an inhibitor of the androgen receptor, has been reported to reduce priapism episodes in those with recurrent priapism and sickle cell anemia."
- ▣ Study in 2002 found it helped 2 patients
- ▣ All 13 sickle cell patients on casodex are men

# Laceration Topic by Location

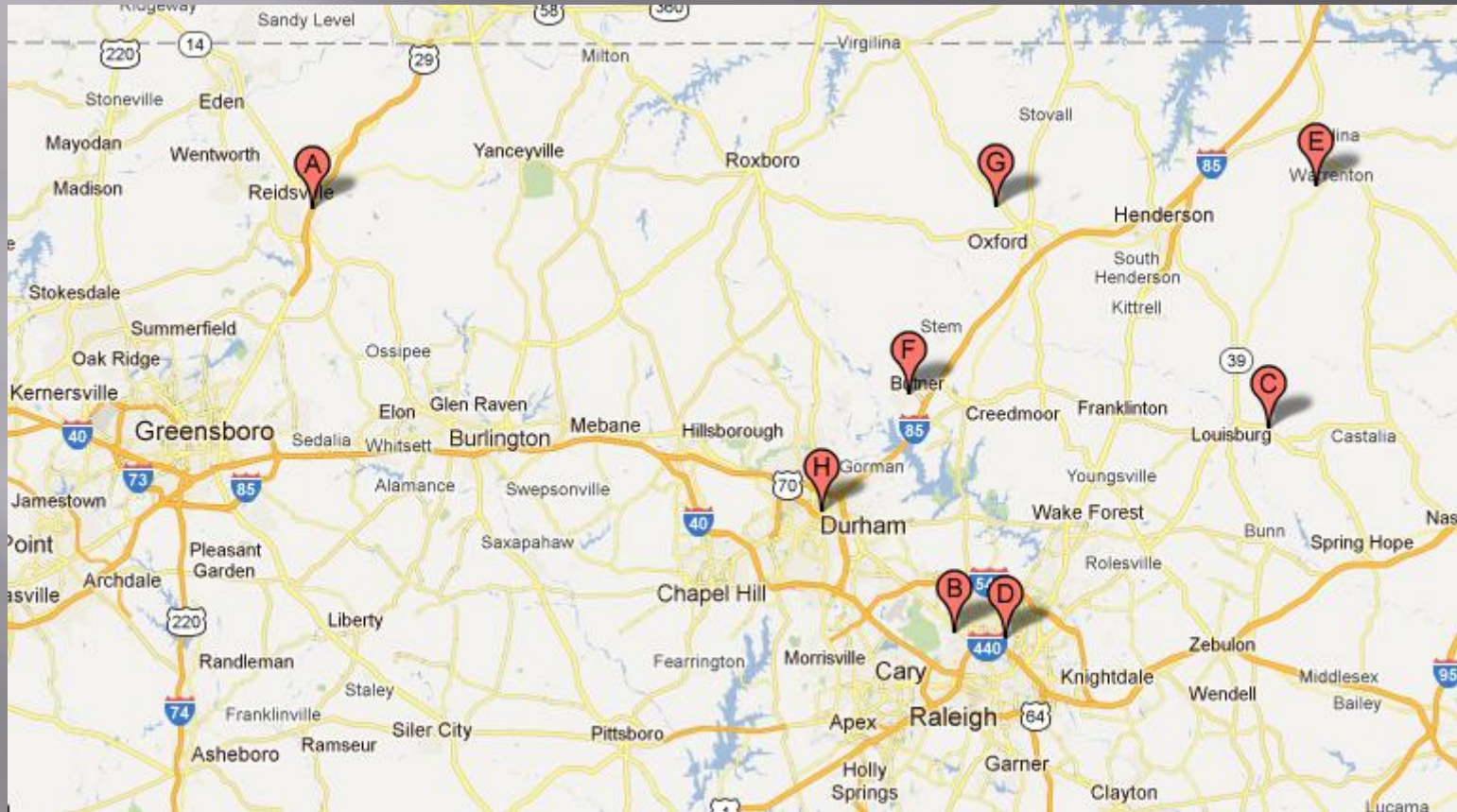


- Duke University students
- 22 patients from this zip
- 10 from this topic
- P-value =  $10^{-10}$

Alcohol?



# Where?



Should Duke consider building a new clinic?

# Future Work

## APPLICATIONS

- ▣ Predict outcomes
  - Incentivize doing better than predictions
  - Identify therapies that are better than predicted outcomes
- ▣ Differential Diagnosis
  - Clinical decision support
- ▣ Identify disease outbreaks
- ▣ Discover adverse events
- ▣ Identify regions needing local support

## MODEL

- ▣ Additional structure
- ▣ Incorporate
  - Age
  - Gender
  - Drugs
  - Review of Systems
  - Labs
  - A lot more
- ▣ Accommodate structure in the text?

# Acknowledgements

- ▣ Lawrence Carin
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- ▣ Howard Shang
  
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