

Research IT Information & Exchange Series

Collaborative Opportunities and Tools in Informatics Research

April 28, 2017

Research IT Information & Exchange Series

- **Goal:** To educate pediatric researchers on the Research IT and Informatics resources and expertise available to facilitate their research and to identify areas where we can enhance IT methods to better support research.
- **Format:** One hour sessions led by subject matter experts to present information on the current services and expertise available.
- **Intended audience:** Researchers with an interest in capitalizing on Research IT tools to make their research better. Also, researchers who are interested in using Big Data and Healthcare Analytic approaches in their research.

Research IT Information & Exchange Series:

Learn about suitable collaborators and specific areas of expertise in Atlanta based institutions. We will also highlight and discuss best practices in these types of collaborations.

Research IT Information & Exchange Series

Our presenters today



- **Gari D. Clifford, PhD**, Interim Chair, Associate Professor, Biomedical Informatics, Emory University, Associate Professor, Biomedical Engineering, Georgia Institute of Technology
 - gari.clifford@bme.gatech.edu



- **Jon Duke, MD**, Director of Health Data Analytics, Georgia Tech Research Institute
 - Jon.Duke@gatech.edu

- Dr. Gari Clifford and his team presented work that is to be published and therefore cannot be shared until it is published.
- The video from today's session does NOT include this part of the presentation, but starts with the presentation by Dr. Jon Duke.
- Dr. Jon Duke's slides follow



Applying Big Data to Big Ideas: Collaborating with Georgia Tech in Health Analytics

April 28th, 2017

Jon Duke, MD, MS



(Big) Data



Analysis



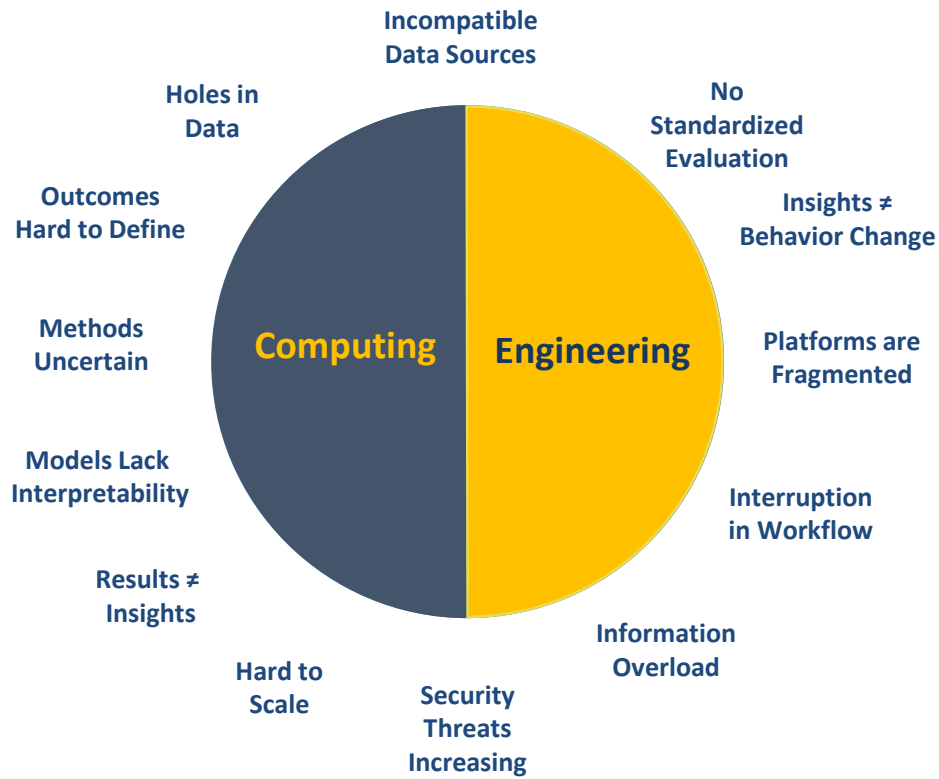
Decision Support



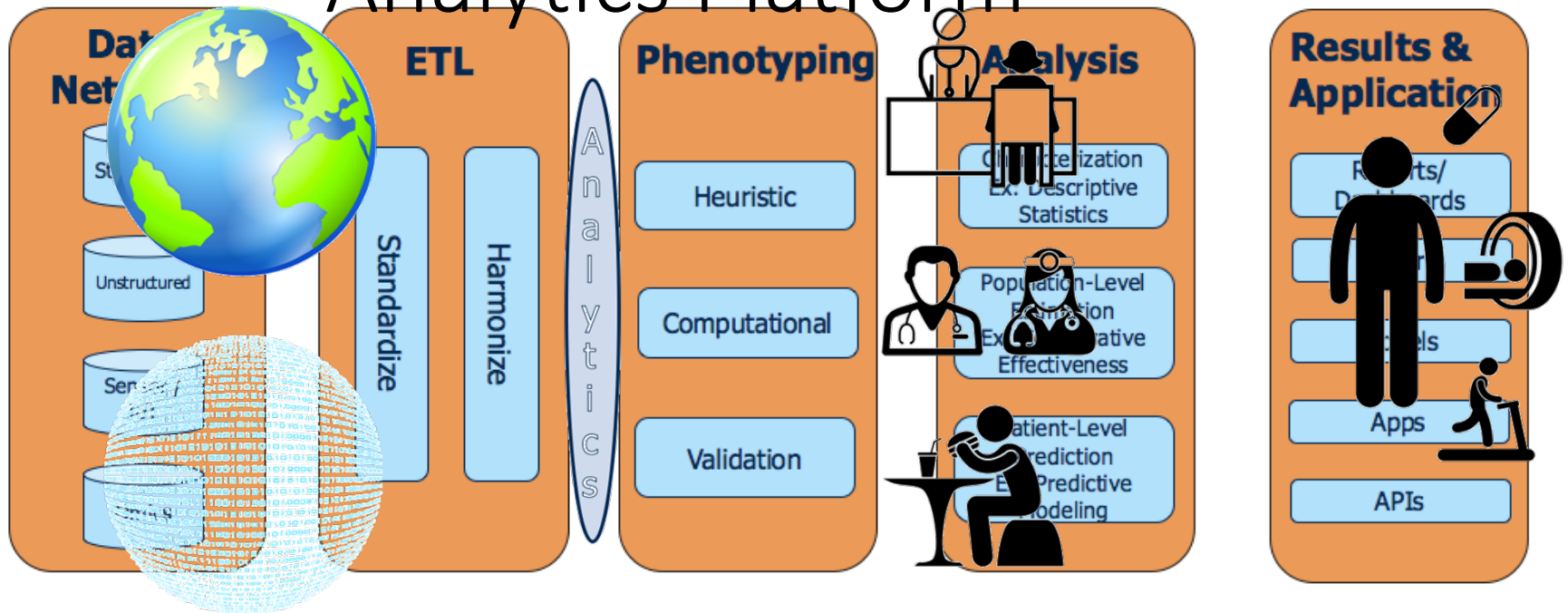
Targeted Action







GT Health Data Analytics Platform

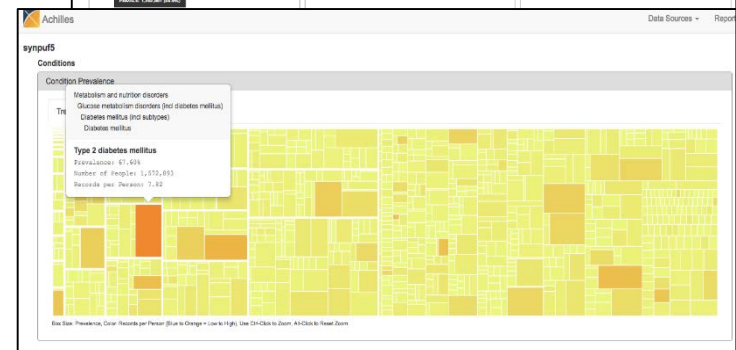
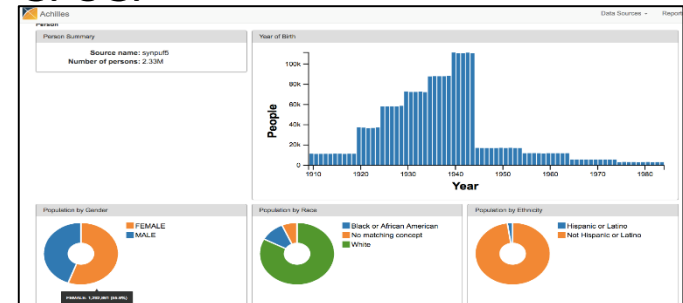
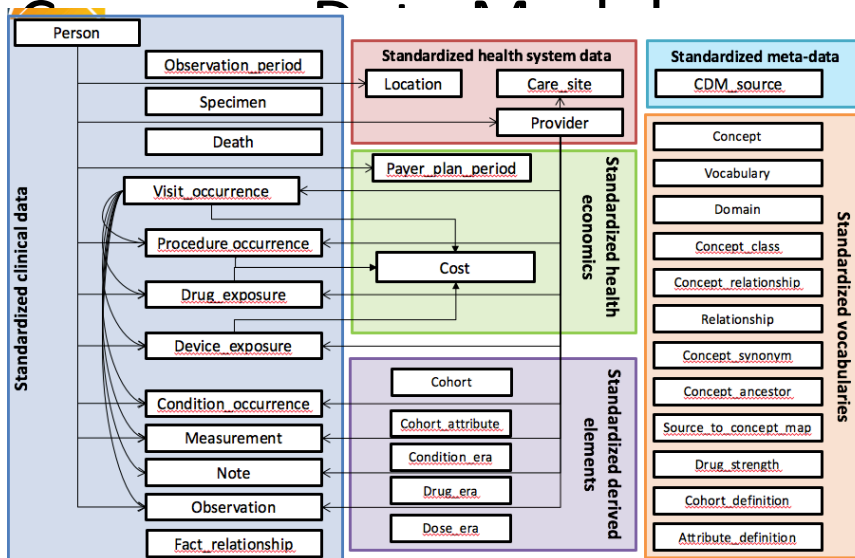


Example: C. Difficile

- *Clostridium Difficile* colitis is a hospital-borne infection associated with antibiotic use
- C. Diff costs the US Healthcare System \$4.8 billion annually and is a major target for infection control efforts nationally and internationally
- Predicting risk of C Diff infection can optimize prescribing and early detection

Step One: Harmonize Data

- Structured data is harmonized to the OMOP



ATLAS Q. Vocabulary

Search Results for Diabetes

ICD	Code	Name	Class	PG	DRD	Domains	Vocabulary
1124300	3335	Diabetes	Ingredient	244,211	493,615	Drug	RxNorm
40162859	805206	Diclofenac Sodium 75 MG Delayed Release Ora Tablet	Clinical Drug	45,031	50,287	Drug	RxNorm
40162840	803996	Diclofenac Sodium 50 MG Delayed Release Ora Tablet	Clinical Drug	49,203	44,803	Drug	RxNorm
40162842	803997	Diclofenac Sodium 75 MG Delayed Release Ora Tablet	Quant Clinical Drug	26,487	27,744	Drug	RxNorm
40162822	803942	Diclofenac Potassium 50 MG Ora Tablet	Clinical Drug	24,519	28,782	Drug	RxNorm
40162812	805636	Diclofenac Sodium 0.01 MG/MG Topical Gel (White)	Branched Drug	17,883	17,863	Drug	RxNorm
40162822	804833	Diclofenac Sodium 1 MG/MG Ophthalmic Solution (Ocular)	Branched Drug	15,386	15,386	Drug	RxNorm
40162811	803644	Diclofenac Sodium 0.03 MG/MG Topical Gel (Orange)	Branched Drug	13,405	13,405	Drug	RxNorm
42062355	8399187	Diclofenac Sodium 50 MG / Misoprostol 0.2 MG Ora Tablet (White)	Branched Drug	13,347	13,347	Drug	RxNorm
42062356	8399188	Diclofenac Sodium 75 MG / Misoprostol 0.2 MG Ora Tablet (White)	Branched Drug	12,938	12,938	Drug	RxNorm
40162801	805401	Diclofenac Sodium 1 MG/MG Ophthalmic Solution	Clinical Drug	7,058	20,745	Drug	RxNorm
40162802	805208	Diclofenac Sodium 75 MG Delayed Release Ora Tablet (Orange)	Branched Drug	6,706	6,706	Drug	RxNorm
40162335	805694	Diclofenac Sodium 25 MG Delayed Release Ora Tablet	Clinical Drug	5,122	6,200	Drug	RxNorm
40162847	803997	Diclofenac Sodium 50 MG Delayed Release Ora Tablet (Orange)	Branched Drug	4,493	4,493	Drug	RxNorm
40162338	803644	Diclofenac Potassium 50 MG Ora Tablet (Cachibol)	Branched Drug	4,263	4,263	Drug	RxNorm



OHDSI Collaborators:

- >200 researchers in academia, industry, government, health systems
- >20 countries
- Multi-disciplinary expertise: epidemiology, statistics, medical informatics, computer science, machine learning, clinical sciences

Databases converted to OMOP CDM within OHDSI Community:

- >55 databases
- >660 million patients

Step One: Harmonize Data

- Unstructured data is analyzed via NLP tools including cTakes and GT-developed open-source applications

She subsequently came to the medical floor, and then developed diffuse abdominal pain, diarrhea, and cramping, with nausea. She was given bowel rest, anti-emetics, and treated empirically for *C. difficile* colitis. One stool sample was obtained, and was negative for *C. difficile*, but given the clinical picture, the decision was made to plan an empiric 14 day course of oral metronidazole to treat this. .

Afib - rate controlled with home meds. Should not resume warfarin until at least 10 days after procedure (11/33/17-6-24**) given the bleeding that she experienced. Despite being off of warfarin, her INR remained elevated, however; this is likely due diminished po intake during the course of this illness.

Code: DNR/DNI

Medications on Admission:

Diltiazem 60
Mirtazapine 7.5 QHS:PRN
Zolpidem 5 QHS:PRN
Acetaminophen 500-1000mg PO PRN
HCTZ 37.5
Alphagan one drop daily per eye
Procrit 20,000 SQ Qwed
11/33/17 Doctor First Name 943** 60 PO daily
Zolofit 100mg PO Daily
Colace 100 PO BID
Fleet Enema 1 sup PR PRN

Discharge Medications:

1. Bisacodyl 5 mg Tablet, Delayed Release (E.C.) Sig: Two (2) Tablet, Delayed Release (E.C.) PO DAILY (Daily) as needed.
2. Senna 8.6 mg Tablet Sig: One (1) Tablet PO BID (2 times a day) as needed. 3. Diltiazem HCl 60 mg Tablet Sig: One (1) Tablet times a day). 4. Mirtazapine 15 mg Tablet Sig: 0.5 Tablet PO QHS needed for insomnia. 5. Zoloidem 5 me Tablet Sig: One (1) Tablet

```
75772 SENTENCE: Oxybutynin chloride may aggravate the symptoms of hyperthyroidism, coronary heart disease , congestive heart failure, cardiac arrhythmias, hiatal hernia
75773 NNP NN MD VB DT NNS IN NNS JJ NN NN JJ NN NN JJ NNS JJ NN
75774 Drug Procedure Finding Disorder Anatomy Anatomy Finding Disorder
75775 C080988 C0201952 C1457887 C082959 C082872 C081272 C081234 C1281578 C081872 C081872 C080311 C081927
75776
75777
75778 Drug Disorder Finding Finding Finding
75779 C0596819 C0818799 C081881 C081882 C081924
75780
75781
75782
75783 Drug Disorder Disorder
75784 C033494 C081884 C081882
75785
75786
75787 SENTENCE: Urinary Retention Oxybutynin chloride should be administered with caution to patients with clinically significant bladder outflow obstruction because of the risk
75788 JJ NN NNP NN MD VB DT NNS IN NNS JJ NN NN JJ NN NN JJ NNS JJ NN
75789 Finding Drug Drug Finding Finding Finding
75790 C0808274 C080985 C0596819 C0805682 C0828778 C1281573
75791
75792
75793 Procedure Finding
75794 C081952 C081952 C081952
75795
75796 Drug Disorder
75797 C033494 C046264
75798
75799 SENTENCE: Administration of oxybutynin chloride to patients with ulcerative colitis may suppress intestinal motility to the point of producing a paralytic ileus and
75800 NNP IN NN NN NN IN NNS IN JJ NN MD VB JJ NN IN DT NN IN VBG DT JJ NN CC
75801 Finding Drug Drug Finding Disorder Anatomy Finding Disorder
75802 C081554 C080985 C0596819 C0841582 C080359 C082185 C082835 C1518476 C081924 C1258215
75803
75804
75805 Procedure Finding Finding
75806 C1533734 C081952 C081952 C080324 C0821838 C0838446
75807
75808 Drug
75809 C033494
75810
75811 SENTENCE: Oxybutynin chloride , like other anticholinergic drugs, may decrease gastrointestinal motility and should be used with caution in patients with conditions such
75812 NN NN NN JJ JJ NNS MD VB JJ NN CC MD VB YNN IN NN IN NNS IN NNS JJ
75813 Finding Procedure Anatomy Finding Finding
75814 C080985 C0201952 C0449218 C087835 C087835 C0812634
75815
75816 Drug
75817 C1518476
75818
75819
75820
```

Line 75782, Column 123 Tab Size: 4 Plain Text

Step Two: Create Phenotypes

All Cohort Entry Criteria Cohort Exit Criteria

Initial event cohort: Events are recorded time-stamped observations for the persons, such as drug exposures, conditions, procedures, measurements and visits. All events have a start date and end date, though some events may have a start date and end date with the same value (such as procedures or measurements). The event index date is set to be equal to the event start date.

People having any of the following: [Add Initial Event...](#)

a drug era of [Add criteria attribute...](#)

with continuous observation of at least days before and days after event index date

Limit initial events to: per person.

Initial event inclusion criteria: From among the initial events, include:

People having of the following criteria: [Add New Criteria...](#)

with using all occurrences of:

a condition occurrence of [Add criteria attribute...](#)

starting between days and days event index date [and ending any time.](#)

and with using all occurrences of:

a condition occurrence of [Add criteria attribute...](#)

starting between days and days event index date [and ending any time.](#)

Limit cohort of initial events to: per person.

Step Three: Run Analyses

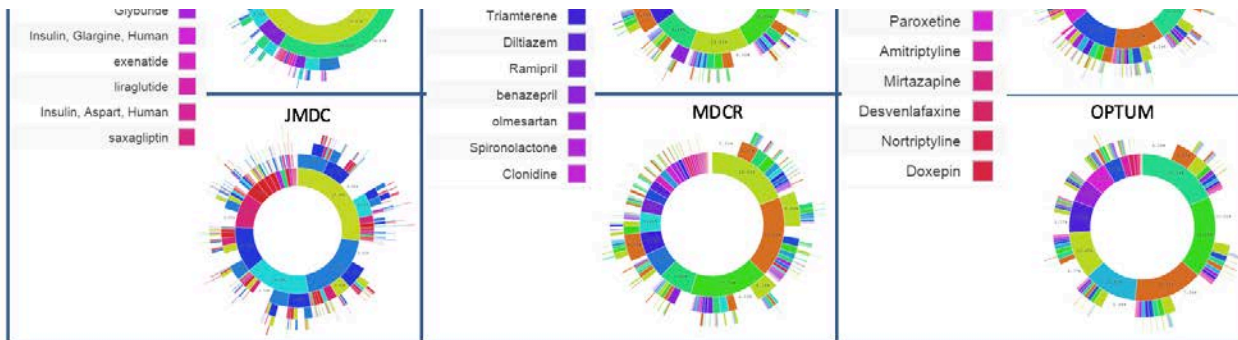
- Description



Search:

SNOMED	Person Count	Prevalence	Records per Person
Clostridium difficile infection	71,848	3.09%	1.41

s) Previous Next



Step Three: Run Analyses

- Comparison

Population Level Effect Estimation

C Difficile Risk Comparison Save Close Delete

Specification Utilities

Choose your target cohort:

C Difficile Index Group ↕ ✕

Choose your comparator cohort:

Antibiotics ↕ ✕

Choose your outcome cohort:

C Difficile Outcome Group ↕ ✕

Specify the statistical model used to estimate the risk of outcome between target and comparator cohorts:

Cox proportional hazards ⌵

Define the time-at-risk window start, relative to target/comparator cohort entry:

0 ⌵ days from cohort start date

Define the time-at-risk window end:

0 ⌵ days from cohort end date ⌵

Minimum washout period applied to target and comparator cohorts:

0 ⌵

Minimum required days at risk, applied to target and comparator cohorts:

0 ⌵

Remove patients who enter both cohorts?

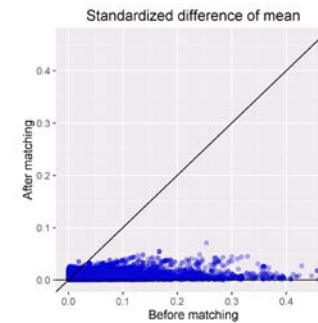
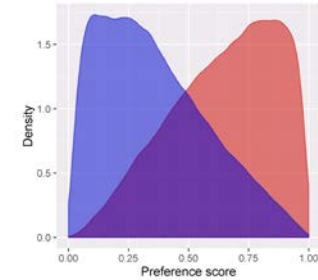
Yes ⌵

Remove patients who have observed the outcome prior to cohort entry?

Yes ⌵

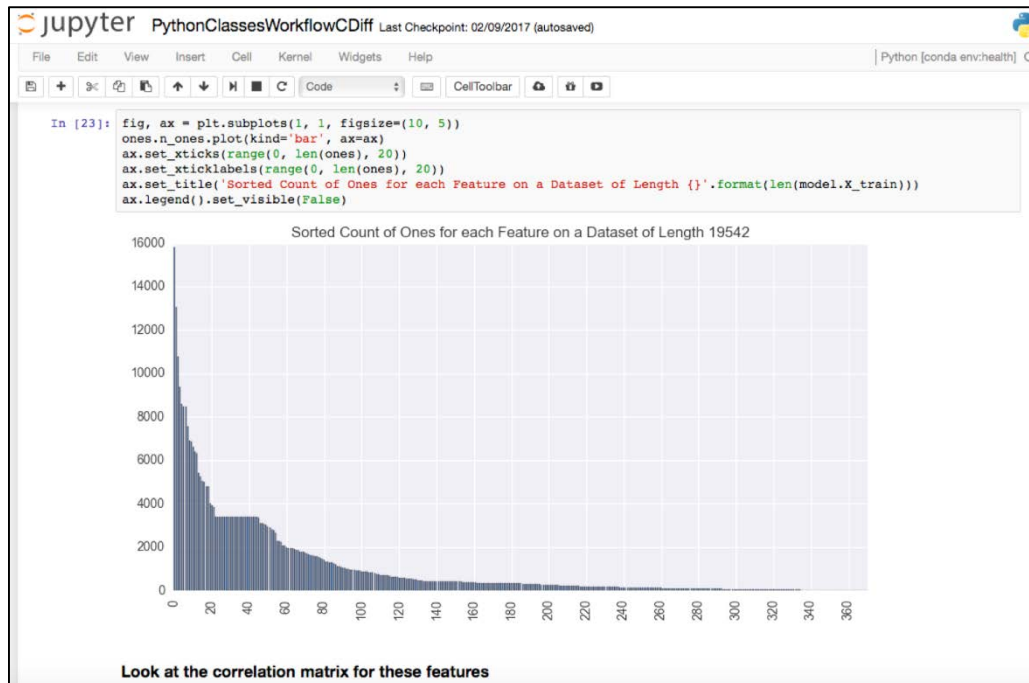
Use propensity score adjustment as a confounding adjustment strategy for baseline covariates?

Yes ⌵

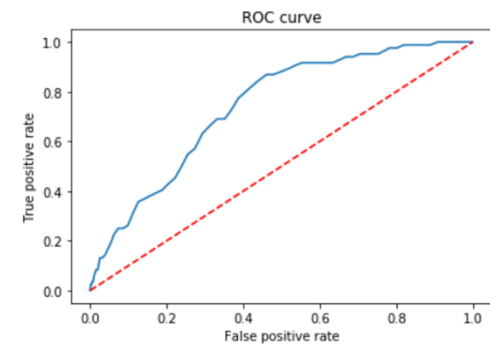


Step Three: Run Analyses

- Prediction

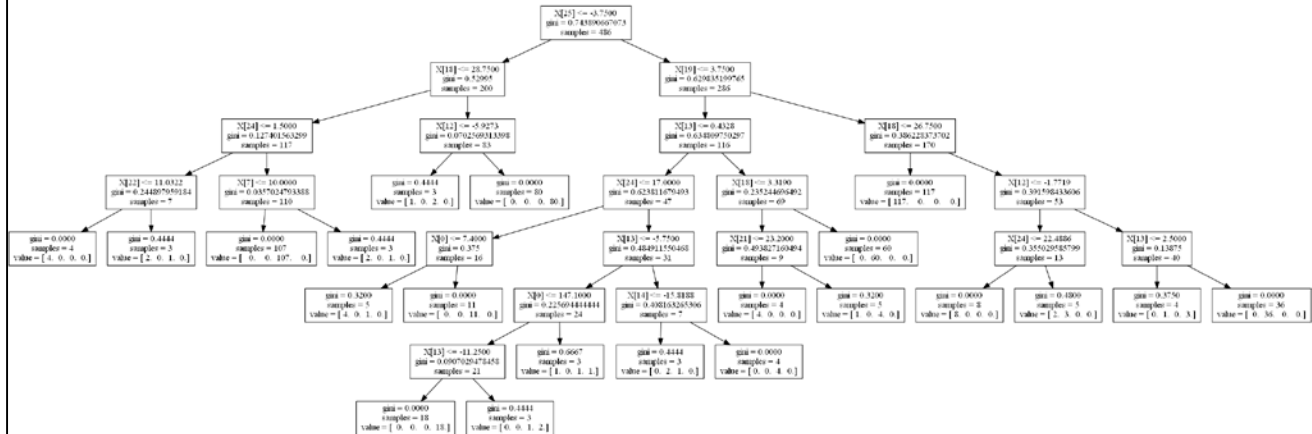


```
Accuracy
0.797697620875
Confusion matrix
[[5162 1269]
 [ 49  35]]
Normalized confusion matrix
[[ 0.80267455  0.19732545]
 [ 0.58333333  0.41666667]]
Precision
0.0268404907975
F1 score
0.0504322766571
AUC
0.740352718603
```

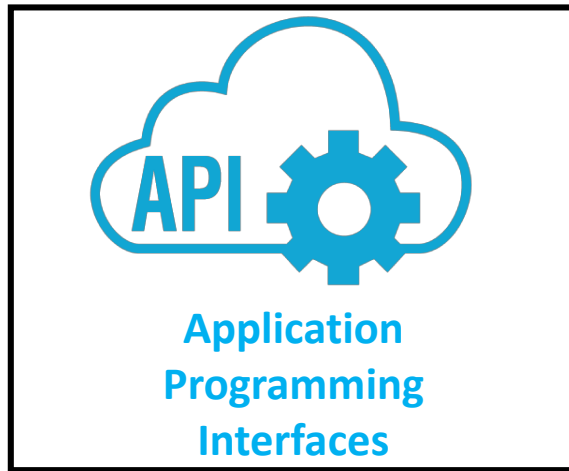


Long Way from Predictive Models to Decision Support

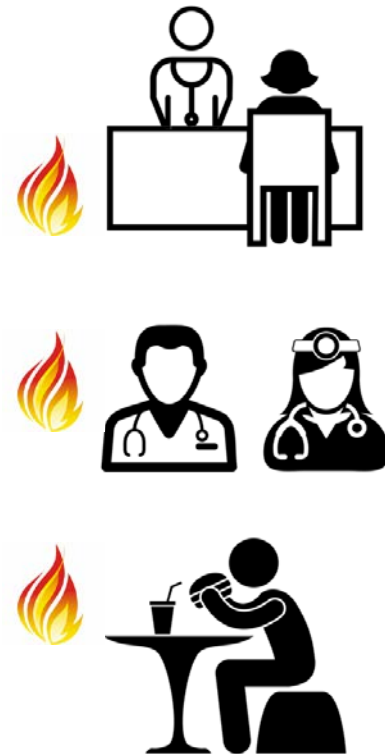
Classification Tree	P(Target)	# Inst
<root>	0.090	2071
MAX_POT <=5.050	0.050	1655
MAX_CALCIIUM <=10.150	0.048	1467
PRE_HYPERK = 0	0.038	1416
AGE <=65.500	0.032	753
AGE >65.500	0.045	663
PRE_HYPERK = 1	0.333	51
DM = 0	0.500	24
DM = 1	0.185	27
MAX_CALCIIUM >10.150	0.059	188
HTN = 0	0.167	6
HTN = 1	0.055	182
Max_CR <=3.700	0.050	179
Max_CR >3.700	0.333	3
MAX_POT >5.050	0.250	416
PRE_HYPERK = 0	0.138	327
AGE <=55.500	0.098	51
AGE >55.500	0.145	276
AGE <=65.500	0.148	88
AGE >65.500	0.144	188
PRE_HYPERK = 1	0.663	89
MAX_POT <=6.250	0.519	52
DM = 0	0.933	15
DM = 1	0.351	37
MAX_POT >6.250	0.865	37
CHF = 0	0.778	9
CHF = 1	0.893	28



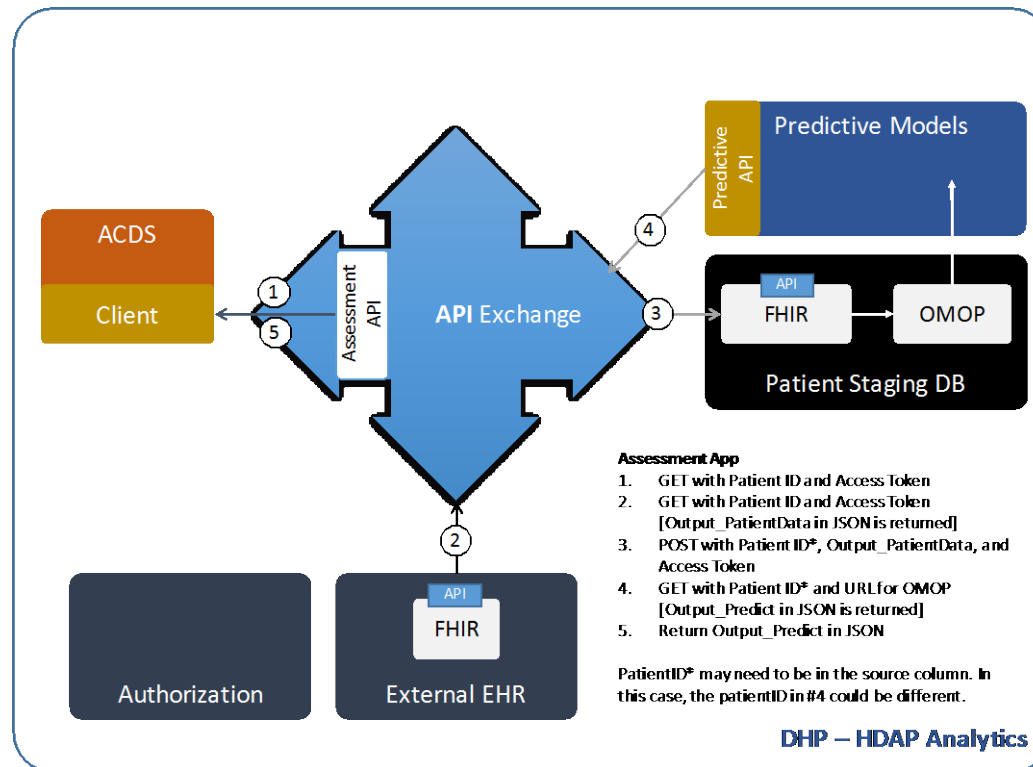
Step Four: Connect to the World with APIs



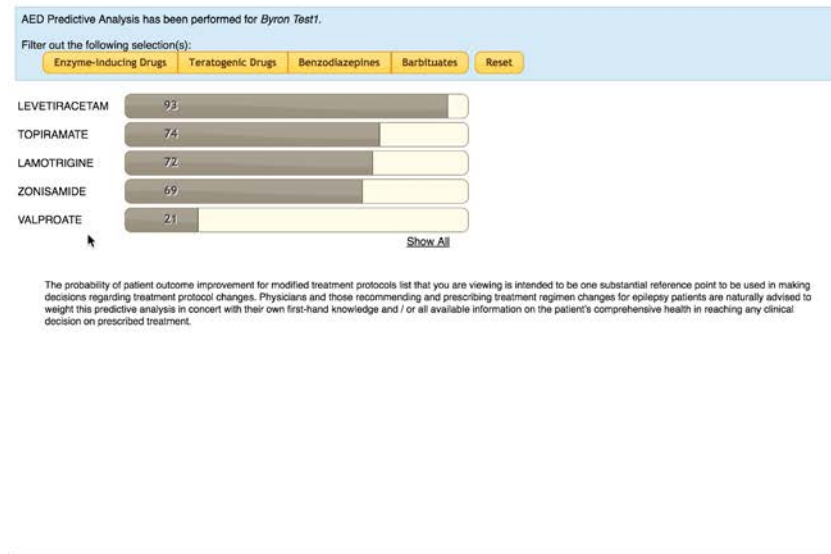
Fast Healthcare Interoperability Resources



Step Four: Connect to the World with APIs



Step Five: Build Applications



10.234.122.170 Change Password Logout

DUKE, JON DAVID at | Fast MED Center

Notifications

Personalized Epilepsy Drug Analysis

What anti-epileptic drug will work best for Byron? The **Eliminate Module** provides a personalized analysis of 15 common epilepsy medications and their likelihood of success in controlling Byron's seizures.

Relevant Orders -- Valproic Acid

[Valproate Level](#)
 CBC2
 Comprehensive Metabolic
 SGOT (AST)
[Show Order Menu](#)

Chart Search

Enter search term... [Search](#)

Filter options
[Labs, Meds, Reports](#) [Any time](#)

Dx & Complaints [Outpatient](#)
 Aug 23, 2016 17:50 — Visit Note
 Author: DUKE, JON DAVID (RESEARCH)

Primary Care Dx [Outpatient](#)
 Aug 23, 2016 17:50 — Visit Note
 Author: DUKE, JON DAVID (RESEARCH)

Visit Note [Outpatient](#)
 Aug 23, 2016 17:50

Problems manage

- Epilepsy (disorder)
- Epileptic seizure (finding)
- Insomnia (disorder)
- Pain in lower limb (finding)
- Seizure (finding)
- Tinnitus (finding)
- Traumatic brain injury (disorder)

Demonstration



Billy Bob Thornton

Search a term

ZOCOR

AMIODARONE

CEFUROXIME

LEVAQUIN

CEFPODOXIME

LOSARTAN

LASIX

TOPAMAX

LISINAPRIL

Amiodarone



Dosage

BECAUSE OF THE UNIQUE PHARMACOKINETIC PROPERTIES, DIFFICULT DOSING SCHEDULE, AND SEVERITY OF THE SIDE EFFECTS IF PATIENTS ARE IMPROPERLY MONITORED, AMIODARONE SHOULD BE ADMINISTERED ONLY BY PHYSICIANS WHO ARE EXPERIENCED IN THE TREATMENT OF

Interactions

Methotrimeprazine

Simvastatin

Vandetanib

cilostazol

Journals

[Interactions of digitalis and class-III antiarrhythmic drugs: Amiodarone versus dronedarone. International journal of cardiology, 2017 Feb 1](#)

[Acute hospital administration of amiodarone and/or lidocaine in shockable patients presenting with out-of-hospital cardiac arrest: A nationwide cohort study. International journal of cardiology, 2017 Jan 1](#)

[High-resolution sub-cellular imaging by correlative NanoSIMS and electron](#)

Warnings

Amiodarone is intended for use only in patients with the indicated life-threatening arrhythmias because its use is accompanied by substantial toxicity. Amiodarone has several potentially fatal toxicities, the most important of which is pulmonary toxicity (hypersensitivity pneumonitis or interstitial/alveolar

News

[With A-Fib Rhythms, Higher Odds of Stroke 2013-12-30](#)

[Muscle Aches From Statins? Drug Interactions May Play a Role 2013-12-04](#)

[Heart Warning Added to Label on Popular Antipsychotic Drug 2011-07-19](#)

[Fix a Health Problem or Live With It? 2009-03-17](#)

[Sanofi Drug Found Promising for Heart Ailment 2009-02-12](#)

Huge Thanks To...

- Madulekha Arun
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Questions

