I2b2 User Guide

October 5, 2015

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Introduction

i2b2 is a web-based clinical research exploration tool, that enables on researchers to refine and define a patient or concept population quickly using a drag-and-drop interface. The software is widely used at other institutions and is based on a common framework. However, the Regenstrief deployment offers several unique advantages specifically in terms of depth and breadth of information. Unlike other deployments of i2b2, the Regenstrief deployment allows researchers the opportunity explore clinical data for Indiana University Health and Eskenazi health. At this time the two institutions are not searched simultaneously. However, this need will be met with an upcoming service called, ACT.

To gain access to the system, researchers will require creating an account with Indiana University: CTSI: <u>https://beta.indianactsi.org/regenstrief/i2b2-account-request</u>. Once you do this, you will create a JIRA ticket through the CTSI portal. Once you have completed the form you should receive an email letting you know that the ticket has been submitted. Once the account has been created, i2b2 can be accessed at <u>https://i2b2ctsi.regenstrief.org/</u>. From there you will log into system using your home institution credentials.

There are several caveats you should be aware of while using i2b2: the deidentified nature of the data, and the structure of the data; different sources of data can be different both qualitatively and quantitatively; . First, any data with less than 10 persons has been removed from the interface. This is to remain HIPPA compliant and generally does not affect the quality of a query. Secondly, the data is modeled after the Regenstrief concept tree. This means that individuals familiar with Careweb or G3 will recognize many of the hierarchies, whereas individuals who have not spent much time with Careweb or G3 may need to spend some time to familiarize themselves with the structure. Fortunately, for either case we'll quickly show you how to kick-start that learning curve.

Let's explore together four quick hypothetical searches in Eskenazi: first patients seen at a site, second finding labs, third patients discharged with medications, and finally patients with a diagnosis or complaint.

Then we will explore some queries in the IUH silo: Metabolic diseases, Long QT, and Testicular cancer.

Task 1: Encounters

Let's see what kind of patients we can find whom have gone to the ER at Eskenazi. We'll then refine the query to see the number by gender, then by age.

The first thing you should do is go to the ENCOUNTER DATA directory. Click on the plus to expand the tree. There you'll see all of the concepts related to encounters, such as clinic data, DX lists (diagnoses), and hospital abstracts. We are interested in the clinic data, so expand the *clinic data* folder. Your screen should look like the image below.



Next you'll drag and drop the icon that says, *Encounter Site* to the Group 1 window. Your screen should like the images below—in that order.

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You'll get a pop-up that asks you what search text you want to use. First let's use no value to see the total number of patients with data in that concept. So select *No Value*. Your screen should look like the image below; if it does, then click ok.

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When you click *Run Query* you'll get another pop-up. This will ask you how you'd like your data broken up. For now we are only interested in total number of patients. So just select *OK*. Your screen should look like the image below.

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After a few seconds you should get the results at the bottom of the page, a number over 745,000. Your screen should look something like the image below.

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Now we are focused on refining the query to look for ER patients. *Right click* on the concept you dragged over earlier in *Group 1*, then *Set Value...*; you'll see the same window when you dragged the concept over the first time. This time we'll enter "ER" in the field.

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You'll notice now the *Group 1* concept has changed to include "*Contains: ER*". If you mouse over the field you'll see the directory-path for the concept. This can be helpful if you are building more complex

queries. Go ahead and run this query. You'll see your patient count at the bottom—about 25,000 patients. Let's expand on this and now break it down by gender, and age.

Click on *Run Query* again. This time select the *Gender patient breakdown* and *Age patient breakdown*. Your results will be slightly different than before. This time you'll be able choose seeing the data either as bar graphs or tables. The two tabs called *Graph Results* and *Show Query Status* will let you choose how you'd like to display the data.



Section two: Labs

Now that we've played with encounters, let's deal with some lab values, in particular systolic blood pressure while sitting or *BP Sys Sitting*. You can clear the previous work by using the *Clear* button to the right of the *Run Query* button. This time you're not exactly sure where we'd store systolic blood pressure so we'll use the *Find* function—which is located to the top left. We can search for "bp sys" then drag and drop the *BP Sys Sitting* concept to the *Group 1* terms column. Here you'll have a chance to explore the operators: *Greater than, Greater than or Equal to, Between, Less than, Less than or equal to,* and *Equal.* You should be familiar with all but the between. The between operates as any integer that is between and including the values you are providing. So if you want to find a normal BP you'll search for 120 and 139. You should get a number around 106,000 or more.

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If you were interested in finding similar tests you can mouse over the concept and you'll see its directory path, like the area circled in red below:

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VITALS\VITALS CLINIC\BP Sys Sitting. This will tell you how to find or how a particular lab is classed. In this case we see that it's housed in the VITALS CLINIC which also contains several other tests (see image below). We use this to verify we have the right kind of blood pressure test. You'll see that there are many kinds available so take some time to explore the tests.



Assuming we have selected the correct test let's see if we can understand the 106,00 better by seeing how many of those patients have been to Eskenazi in the past 2 years. So select, *Dates* from the *Group 1* box and enter the date range you're interested in making sure you follow MM/DD/YYYY format like I have below. Then click *OK*.



We are also interested in seeing the number of patients who do not have a record of death. So in the *Run Query* select *Vital Status*; then click *Run*. This query may take a few minutes—if it does you'll be prompted and the query will run in the background. To see the results we'll use another feature of i2b2, which is reloading previous queries. The bottom most panel on the left contains all of your previous queries. You can drag and drop the query you built into the *Query Name* section at the very top (circled in red).

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You'll see that you got a number around 8000, and when you scroll through the results you'll see the number of patients with and without a record of death.

Task 3: Medications

In this section we'll cover the AND and OR functions while finding meds specifically *Acetaminophen* and *Antihistamines*.



It is important to know that i2b2 stores meds in three ways: drug class, ingredient, and RXNORM. Drug class is broken into categories like, "Antihistamines"; the ingredient tab is an alphabetical ordering of generic drug names; finally, RXNORM then provides specific information about drugs including dosage strength. Each system has will have its own merits and pitfalls, so it is a good idea to explore these classing systems. So let's start with finding *antihistamines*.



Expand the *MEDICATIONS\DRUG CLASS* concept tree. You'll see antihistamines near the top. Since we want the entire group and not any of the sub-classes, we'll just drag and drop the whole *antihistamine* tree.

izbz Query & Analysis Tool		User Nate Ring	Message Log Help Log
Naviosito Terms Find	Query Test		5.2 h
	Oserv Name		
	Temporal Constraint	Treat all groups independently	2.20
2 S CHONNORC STODES	Crown 1	al from 2	Group 3
R CEF and OTHER EI URD (COLINITS and CHEM)	Dates Occurs > 0x	Exclude Dates Occurs + 0x Exclude Dates	Occurs > 0x Exclude
	Treat independently	Treat transportmenty .	intantly .
B DIAGNOSIS NON-CODED			
9-19 ENCOUNTER DATA			
8 SEVE and EAR STUDIES			
# CASTROENTEROLOGY STUDIES			
9 SHEMATOLOGY STUDIES			
R S Hospital Quality Management			
9 S MED DOSES SUPPLIES WACC SKIN TST			
R S MEDICATIONS			
R CRUC CLASS - 543403	and the second se		
B ANTIDOTES DETERBENTS AND POISON CONTROL - 7244	ANTIHISTAMINES - 10055		
B ANTHISTAMINES . 100568			
H 2 ANTIMICROBIALS - 368425			
R ANTINEOPI ASTICS - 5825			
H-S ANTIPARASITICS - 18263			
R ANTISEPTICS/DISINFECTANTS - 24			
FIST ALTONOMIC MEDICATIONS - 35315			
IS ST BLOOD PRODUCTSMODIFIERSNOLUME EVENDERS - 24082			
R-15 CARDIONASCULAR MEDICATIONS - 183264			
F CENTRAL NERVOUS SYSTEM MEDICATIONS - 351347			
2 DENTAL AND ORAL AGENTS TOPICAL - 19368			
R DERMATOLOGICAL AGENTS - 148930			
E DIAGNOSTIC AGENTS - 1			
# 3 GASTROINTESTINAL MEDICATIONS - 143110			
IF GENITOURINARY MEDICATIONS - 29934			
B 5 HORMONES/SYNTHETICS/MODIFIERS - 149606			
12 3 IMMUNOLOGICAL AGENTS - 3205			
B S IRRIGATION/DIALYSIS SOLUTIONS - 14163			
B S MISCELLANEOUS AGENTS - 5785			
E S MUSCULOSKELETAL MEDICATIONS - 208797	drop a		
H 🔁 NASAL AND THROAT AGENTS TOPICAL - 62567	onhere		
8 3 OPHTHALMIC AGENTS - 56561			
H 🔂 OTIC AGENTS - 35686			
IE C PHARMACEUTICAL AIDS/REAGENTS - 5648	STATISTICS IN TAXABLE PARTY AND ADDRESS OF TAXABLE PARTY.	D Omuna	
# D RECTALLOCAL - 8320	Ran Query Clear Print Query	U Groups	Hew Group
B C RESPIRATORY TRACT MEDICATIONS - 108057			
B D THERAPEUTIC NUTRIENTSMINERAL SELECTROLYTES - 57893	Show Query Status Graph Results		100
I VITAMINS - 25104			
E DINOREDIENT - 543403			
IE 🔂 RONORM OTHER - 138737			
-D MEDICATIONS NON-CODED			
* 3 MICROBIOLOGY STUDIES:			
B C NEUROLOGY STUDIES			
8 50 OBIGYNIPERINATAL			
8 B OTHER			
A REPRESENTING CARE			

If we run the query now we should get a number over 100,000 patients. Now because we want a second drug, we can ask many different questions: one OR the other; one AND the other, one AND NOT the other, etc. We'll start with one OR the other then look to see who had both.

z Query & Analysis Tool	Project Estenad	User: Nate Ring	Message Log Help
monto Terms	D D Guery Tool		6.6
En mospilar labarg management	Query Name ANTHISTAMINESID1227.41		
MED DOSES-SUPPLIES-VACC-SKIN TST			
OF MEDICATIONS	Temporal Constraint	Treat all groups independently	•
DRUG CLASS - 543403	Provide B.		Crows B.
E 3 INGREDIENT - 543403	Course Courses of the	Territor Dates	Contract of Contra
E D A DRUGS - 398466	Treat independently, T	Trait mine	endertik T
A AMINOBENZOATE - 4	ANTILISTANNES . 100569		
B 54 6-AMINOCAPROIC ACID - 68	Press and a second seco		
H D ABACAAR - 123			
ACAMPROSATE - 54			
E C ACARBOSE - 208			
R ACEBUTOLOL - 95			
C C ACETAMINOPHEN - 278210			
R ACETAZOLAMIDE - 1261			
E S ACETIC ACID - 3066			
ACETYLCYSTEINE - 656			
E CALIFRETIN - 29	E .3		
ACYCLOVIR - 16284			
E T ADAPALENE - 277			
R E ADEFOVIR - 2			
E S AL PLITEROL - 53335			
R SALCI OMETASONE - 130			
N S 4 EU208IN - 136			
E DI ALLOF DRUAL - 1750			
STOCALIEPLASE - 10			
C DI ALUMINUM CHLORODE - 35			
B DI ALUMINUM HYDROXIDE - 415			
DI AMANIALINE - 1/81			
III DI AMCINONIDE - 74			
B DI AMPOSTINE - 1			
() DI AMIKACIN - 11			
DI AMILORIDE - 355	one or	AND drop a	
I DI AMINOPHYLLINE - 97	more of	term	
I DI AMIODARONE - 2448	UIC SE	Cil liefe	
AMITRIPTYLINE - 30597			
G DI AMLODIPINE - 41198		and the second sec	
I AMOXAPINE - 6	Run Query Clear Print Que	1 Group	New Group
AMOXOCILLIN - 169969 AMOXOCILLIN - 169969			
AMPHETAMINE - 5114	Cheep Cheany Status		
AMPHOTERICIN B - 16	Banna General Science and Construction		
AMPICILLIN - 5424			
AMYL NITRITE - 25		Number of patients	
AMYLASES - 267			
ANAGRELIDE - 23		100560	
III DAASTROZOLE - 973		100200	
3 ANTIPYRINE - 8312			
APRACLONIDINE - 8		For Query "ANTIHISTAMINES@12:27:41"	

Because *acetaminophen* is an ingredient we'll look there, then ADD it to the same group as *antihistamines*. This will perform an "OR" function.

zbz. Query & Analysis Tool	Project Estenan	User: Nate Ring	Message Log Help L
Navigate Terms Find	Query Tool		e 14
* 5 GASTROENTEROLOGY STUDIES	Quary Nama		
HEMATOLOGY STUDIES:	and interest		
1 Hospital Quality Management	Temporal Constraint	Treat all groups indepen	idenDy 👻
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B D MEDICATIONS	Detroit Contraction	Group z	Control Dates Annual Control Dates
1 DRUG CLASS - 543403	Treat Interventienty +	Treat Polenesciantly +	Trail Inference + 0k
R R INGREDIENT - 543403	C ANTILICTAMINE 9 . 100569		
B A DRUGS - 398466	En secta no some no s to con		
1 CH 4-4MINOBENZOATE - 4			
R 53 6-MINOCAPROIC ACID - 68			
B BACAVIR - 123			
E ACAMPROSATE - 54			
R TACARBOSE - 208			
B ACEBUTOLOL - 95			
ACETAMNOPHEN - 270210			
E S ACETAZOLAMIDE - 1261	*		
R R ACETIC ACID - 3066		201171 2702	
A PO ACETO CVSTEINE - 655	DI ALLE TAMIN	OPPEN-2/82	
E ACITECTIN 29			
R CACYCLOVER - 16294			
a Dapati ENE - 277			
2.5 ADECOND. 2			
R R ALBUTTEROL - 52236			
E ALCONETADONE - 530			
9 10 ALE (2020) 100			
B DI ALPRAZOLANI - 23009			
BID ALIEPLASE - 10 GIN ALIEPLASE - 10			
B C ALCHING CHLORODE 35			
IS TO ALLOWING WE HORONDE - 415			
		days a	
IS CLAMPOSITIVE - 1	more of	AND term	
	these	on here	
B DI AMEURIDE / 305	Anne and An		
IN THE AMERICAN PROPERTY OF A			
IS CI AMIOLAKONE - 2448	Discourse and the classical print print	1 Oroug	The State Course of the
E DI AMITRIPTYUNE - 30597	num query Clear Print Query	1 Gloup	I A I A NEW Group
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e DI AMOXICILLIN - 169959			
COLOR AMPTERIAMINE - 5114			
AMPROLINGIN B - 15			
a Di Americal Lini - 5424			
(1) CH AMYL NITRITE - 25			
AIMLASES - 267			
B DI ANAGRELIDE - 23			
I ANASTROZOLE - 973			
I ANTIPYRONE + 8312			

You should get about 300,000 patients. To see who has had both medications we *delete* the *acetaminophen* concept from the first group then drag it to the second group window.

i2b2 Query & Analysis Tool	Project Enkeniszi	User Nate Ring	Message Log Help Lo
Navigate Terms Tind	Quary Tool		a 81
GASTROENTEROLOGY STUDIES	Query Name		
B B HEMATOLOGY STUDIES:			
So Hospital Quality Management	Temporal Constraint	Treat all proups independ	Serdy 🔻
B MED DOSES-SUPPLIES-VACC-SKIN TST	Group 1	Crown 2	Fil Group 3
E C MEDICATIONS	Dates October 100	Evolution Dates Design a De	Evolution Dates
10 G DRUG CLASS - 543403	Treat independently: *	Trial tolevenderity	Treat transmitty *
- 1 INGREDIENT - 543403	C ANTINESTAMINES 100568		
E 🚼 A DRUGS - 398466	Printing in the second		
H 34 4-MINORENZOATE - 4			
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+ 3 ABACA/IR - 123			
# ACAMPROSATE - 54			
E ACARBOSE 208			
H ACEBUTOLOL - 95			
ACETAMINOPHEN - 278210		and the second se	
R ACETAZOLAMIDE - 1261		ACETAMINOPHEN - 2782	
E ACETIC ACID - 2055			
A CETVI CVSTEINE . 666			
E RACITECTIN 20			
E SACYCLOVE - 16284			
E SADARA ENE 277			
H ADEEOVIR - 2			
R 🔂 ALBUTEROL - 53335			
P. SA CLOMETASONE 139			
H R ALENDRONG AGD - 5851			
8 17 ALFUZOSIN - 139			
R R ALLOPURING - 7730			
R ALPRAZOLAM - 23008			
B ALPROSTADIL - 7			
N ALTEPLASE - 10			
B ALUMINUM CHLORIDE - 35			
R ALUMINUM HYDROXDE - 415			
E AMANTADINE - 1781			
E AMCINONIDE - 74			
B AMFOSTINE - 1	one or	drop a	
E AMKACIN - 11	more of	term	
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E AMINOPHYLLINE - 97			
E AMIODARONE - 2448			
AMITRIPTYLINE - 30597	Run Query Clear Print Query	1 Group	New Group
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H C AMOXAPINE - 6	Show Down Status		
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B AMPICILLIN - 5424			
B 🔂 AMYL NITRITE - 25			
B AMYLASES - 287			
# ANAGRELIDE - 23			
E ANASTROZOLE - 973			
6 ANTIPYRINE - 0312 -			
(Designed of the second of the	1		

You should get a number around 70,000. You can expand these types of searches to include many more drugs or concepts. We'll expand on this idea in task 4.

Task 4: Diagnoses

By now you should understand most of the interface functions and the drag-and-drop nature of query mechanism. However, many preliminary searches focus on a diagnosis and presence of some other thing. So let's look for an *E.R. Chief Complaint* of *pain*.

Rather than searching for a concept, *pain* or an icd-9 code of pain we have to look for the type of diagnosis. To illustrate see the image below:



CAVEAT: It is important to point out, some of these concepts will let you enter terms as text, icd-9, or is just a diagnosis type class, you should explore these to find which works best for the project at hand.

Pull over E.R. Chief Complaint to the first group. Here we'll enter: pain. That is it!

i2b2 Query & Analysis Tool		Project Eskenan		User Nate Ring		Ue	ssage Log Help Lo
Navigate Terms Find	🚯 🗟 🔍 🛛 Guery	Tool					6 P I
B BLOOD BANK	Query N	ame: ER Chief Comp@13.51.55					
CARDIOLOGY STUDIES				A particular and the second			
CHEMISTRY STUDIES	Tempor	al Constraint		Treat al groups indeper	derby		-
CHROMOSOME and MOLECULAR PATHOLOGY	and the second se	Group 1		Group 2		Group 3	
CSF and OTHER FLUID (COUNTS and CHEM)	Dates	Occurs > 0x	Exclude Dates	Occurs + 0x	Exclude Dates	Occurs > 0x	Exclud
E DEMOGRAPHICS	Treat	(vorgecarray)*	1/64	independently *	- Trial V	hdepandently *	17.702.024
DIAGNOSIS NON-CODED	DER	Chief Complaint [Contains: pain]					
ENCOUNTER DATA							
B Clinic data - 858192							
D Clinic Site - 86257							
DrID - 5763							
Encounter Site - 745617							
- D MD Care Here 1-4 - 17827							
5 Missed Visit - 186841							
- D Total Clinic Charge - 681229							
C D 11979 - 1005317							
E 5 Problems - 1005317							
B Clinic Billion Diannosis - 769123							
Doub Alleroles - 466908							
Ding sing sing is 400000							
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BER Criter Comprant - 200832							
Di Lace De 179570							
Riprimary Care Dr. 200624	-						
in the second second second							
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B GASIROENIEROLOGI STODIES							
E D HEMRIOLOGY STODIES.							
Di Hospital Quality Management							
IS DI MEDI DUGES-SUPPLIES-INDU-SKIN TST							
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D QUESTIONNAIRES	T. and the second	and a second sec					
RADIOLOGY and NUCLEAR MEDICINE	Shows	auery status Graph Results					
E DI REFERRAL LAB							
SEROLOGY STUDIES:			1	Number of nationts			
SURGICAL PATHOLOGY and CYTOLOGY				muniper or patients			
SYMPTOMS and FINDINGS:				11220			
TDM and TOXICOLOGY STUDIES				1//9			
TEXT REPOT							
TRANSPLANT/ STEM CELL LEUKEMIA			8	For Query "E.R. Chief Comp@13:51	:55"		
TREE POSITION NOT ESTABLISHED							
R ST LIBITLA VSIS							

We can then add in the previous query where we searched for *acetaminophen* from the previous query history.

izbz Query & Analysis Tool	Project Esk	ienazi			User Nate Ring			Messa	ge Log Help Logou
Previous Queries Find	Query Tool								
0 🖶 ACETAMINOPHEN@13:53:15 (9-9-2015) [naring]	Query Name								
E.R. Chief Comp@13:51:55 (9-9-2015) [naring] E.R. Hosp ICD9 Dx@13:49:29 (9-9-2015) [naring]	Temporal Constraint	C			Treat all groups independent	ny.			•
🖲 😓 Hosp ICD9 Dx@13:49:14 (9-9-2015) [naring]		Group 1	ġ.		Group 2		1	Group 3	.X
Hosp ICD9 Dx@13:46:59 [9-9-2015] [naring] E.B. Chief Come@12:56:49 [9-9-2015] [naring]	Trest Independently -	Occurs > 0x	Exclude	Dates Treat independently +	Occurs > 0x	Exclude	Treat Interpendently -	Occurs > 0x	Exclude
Bit Chr. Curror Did (12:54:40 (P-2015) [namid] Bit Heap (COD Did (12:54:40 (P-2015) [namid] Bit Heap (COD Did (12:54:40 (P-2015) [namid] Bit Anterior Diagna (12:54:20 (P-2015) [namid] Bit Profile Diagna (12:54:20 (P-2015) [namid] Bit Contact Extends (10:00 (P-2015) [namid] Bit Contact Extends (10:00 (P-2015) [namid] Bit Contact Extends (10	ER. Chief Complair	n (Cootains: pain)			ER ACETMINOPHENB	13.5			
		one or more of these	A	ND	drop a berm on here				
	Run Query Clear	Print Query			1 Group		<i>.</i>		New Group > >
	Show Query Status	Graph Results							
B	1 <u>0</u>								

Now you should be well on your way to building exciting and new queries!

Two final points if you are not interested in moving forward with the IUH section of the materials: First, this data is based on clinical data. Which means that there may be a great deal of variation in how data are stored or where it is located in terms of the concept tree or the type of information you're looking for; second; if data looks very unusual it may not be what you're querying rather something related to how the data is stored. If you find these cases, contact <u>i2b2ctsi@iupui.edu</u>

IU Health Data

At this point you have decided to explore the data from Indiana University Health. There are several distinctions between IUH and ESK data. First, there are many more patients in this *silo*. This is because IUH is a network of hospitals across the state of Indiana. Second, IUH does not send as much data to the INPC as Eskenazi. So, this silo is somewhat more specialized and selective in its use for feasibility. For example, IUH data is very strong in LABS, CARDIO, report types, and ICD-9's. It is not very good at medications, procedures (unless identified by ICD-9), or *local concepts*. Therefore it is generally a good idea to test in BOTH silos or submit a feasibility request to the Regenstrief Data Core.

Unlike the previous walk-through, since we learned much about the interface and searching we'll focus on expanding queries. For this section, we'll rely on pre-built queries and reading the results.



Here you'll need to log in to the IUH warehouse.

After you've selected IUH, we'll focus on the window of *Shared* folder, which you'll see in the screenshot below.

Workplace	8 Q 🗆
SHARED Period (Diabetes Control) Period (Prolonged QT) Period (Testicular cancer related hearing loss) Training Period Training Period Regenstrief Data Core Demos (Imler) Period Demo3 (Testicular cancer related hearing loss) Period Regenstrief Data Core Demos (Imler) Period Regenstrief Data Core Demo3 (Regenstrief Regenstrief Regenstri	

I've already drilled down on the Regenstrief Data Core demo's for you and the Data Core as built the queries.

Let's explore the first, Diabetes control.

Task 1: Diabetic Retinopathy

We are looking for patients taking metformin and have an uncontrolled diabetic event. So to start we'll look at patients taking Metformin.

Q	wery Tool								8 💌 🗆
QL	Jery Name: METFORMIN@	208:29:44							
Те	mporal Constraint:				Treat all groups indep	pendently			•
		Group 1	X		Group 2	X		Group 3	X
	ates	Occurs > 0x	Exclude	Dates Treat Independently -	Occurs > 0x	Exclude	Dates Treat Indepen	Occurs > 0x dently -	Exclude
	METFORMIN								
		one or more of these	А	ND	drop a term on here				
F	Run Query Clear	Print Query			1 Group			I Nev	v Group
S	how Query Status	Graph Results							-
									^
					Number of patients				
				C	93036				
				For Oue	ry "METEORMIN@08-29-	44''			
				1 of Que	,				•

If you click on the printer icon on the bottom right, you'll see the demographic break down of patients taking Metformin (see below).

Query Name: No Query Name is currently p Temporal Constraint: Treat all groups inde	rovided. pendently	
Group 1		
Date From: none Date To: none Excluded? failse Independently	• Occurs X times: >0 Relevance %:	100 Temporal Constraint: Treat
Path	Concept/Term	Other Information
Medication/Ingredient/M Drugs/METFORMIN	METFORMIN	

Finished Query: "METFORMIN@08:29:44"

[22 secs]

Number of patients for "METFORMIN@08:29:44" patient_count: 93036

Gender patient breakdown for "METFORMIN@08:29:44"

Female: 50671 Male: 42176 Transgender: 0 Unknown: 5

Race patient breakdown for "METFORMIN@08:29:44"

American Indian or Alaska Native: 65 Asian: 837 Black or African American: 12568 Hispanic or Latino: 251 Unknown or Other: 1772 White: 76104

Age patient breakdown for "METFORMIN@08:29:44"

0-9 years old: 6 10-17 years old: 208 18-34 years old: 3984 35-44 years old: 6934 45-54 years old: 13500 55-64 years old: 23078 65-74 years old: 26334 75-84 years old: 14493 >= 65 years old: 45142 >= 85 years old: 4515 Not recorded: 0

Here there are a few things to pay attention to: cohort design, concept paths, patient counts, and demographics. First, you'll see at the very top, we've specified no date restrictions, no exclusion criteria, no required number of occurrences, and no temporal constraints. Put in other words, this grabs all patients with a record of having Metformin as found in the MEDICATIONS section of i2b2. If you were to add additional *METFORMIN* concepts, they too would be listed here and likely the numbers would increase across the board.

Now we want to find the number of patients with an A1C over 7%. So drag over the "Number of patients on metformin with HgbA1c >=7" folder to the query name section of i2b2. Your results should look like the image below.

12b2 Query & Analysis Tool	Project K	Houlth		User: Nate Ring:		Messag	LOD Help LODO
Westplace	Query Tool						
B SHARED	Query Name: Inunces of	f patients on methodes with H	pA1c == 7				
Regenstrief Data Core Demos (Imler)	Temporal Constraint			Treat al groups indep	erdently		
- Number of patients on mettormin		Group 1	0	Group 2	0	Group 3	0
Number of patients on methormin with HgbA1C x=7 with creatinine x= 1.5 Number of patients on methormin with HgbA1C x=7 with divibition attracts	Dates	Occurs > Bx	Exclude Dates	Occurs > 0x	Exclusie Dates	Occurs > 0x	Dickide
Control of a particular of moduline and inglicity, 4-2 in the database tetral particular Control of the database of t	ER METFORMA		E Har arc bia	0n HPLC 7 % Hgb			
		one or more of these	AND	one or more of these	AND	drop a term on bere	
	Run Query Clev	e Print Query		2 Groups		101 101 10	w Group
	Show Query Status	Graph Results					-
				the second second second second			1
				number or patients			1.00
				22338			
			For O	ery "Number of patients on	met		
			- Police	any manual of province on	inter.		
							•

Notice that we've simply added a lab constraint to the cohort as we've done before, however the output is somewhat more complex:

Query Name: No Query Name is currently p Temporal Constraint: Treat all groups indep	rovided. Sendently	
Group 1		
Date From: none Date To: none Excluded? failse Independently	• Occurs X times: > 0 Relevance %:	100 Temporal Constraint: Treat
Path	Concept/Term	Other Information
Medication/Ingredient/M Drugs/METFORMIN	METFORMIN	

Finished Query: "METFORMIN@08:29:44"

[22 secs]

Number of patients for "METFORMIN@08:29:44" patient_count: 93036

Gender patient breakdown for "METFORMIN@08:29:44"

Female: 50671 Male: 42176 Transgender: 0 Unknown: 5

Race patient breakdown for "METFORMIN@08:29:44"

American Indian or Alaska Native: 65 Asian: 837 Black or African American: 12568 Hispanic or Latino: 251 Unknown or Other: 1772 White: 76104

Age patient breakdown for "METFORMIN@08:29:44"

0-9 years old: 6 10-17 years old: 208 18-34 years old: 3984 35-44 years old: 6934 45-54 years old: 13500 55-64 years old: 23078 65-74 years old: 26334 75-84 years old: 14493 >= 65 years old: 45142 >= 85 years old: 4315 Not recorded: 0

Query Name: No Query Name is currently provided. Temporal Constraint: Treat all groups independently

Group	1

croup i		
Date From: none Date To: none Excluded? false Independently	e Occurs X times: >0 Relevance %:	100 Temporal Constraint: Treat
Path	Concept/Term	Other Information
Medication\Ingredient\M Drugs\METFORMIN	METFORMIN	
Group 2		
Date From: none Date To: none Excluded? false Independently	• Occurs X times: > 0 Relevance %:	100 Temporal Constraint: Treat
Path	Concept/Term	Other Information
CHEMISTRY STUDIES\CARBOHYDRATE/DIABETES STUDIES:\GLYCOSYLATED HGB TESTS\Hgb A1C Bld	Hgb A1C Bld Qn HPLC ≻= 7 % Hgb	GE : 7 % Hgb

Finished Query: "Number of patients on metformin with HgbAlc >=7"

[73 secs]

Ctnd Below:

Finished Query: "Number of patients on metformin with HgbAlc >=7" [73 secs] Number of patients for "Number of patients on metformin with HgbAlc >=7" patient count: 22338 Gender patient breakdown for "Number of patients on metformin with HgbAlc >=7" Female: 11022 Male: 11253 Transgender: 0 Unknown: 0 Race patient breakdown for "Number of patients on metformin with HgbAlc >=7" American Indian or Alaska Native: 20 Asian: 243 Black or African American: 4131 Hispanic or Latino: 31 Unknown or Other: 269 White: 17564 Age patient breakdown for "Number of patients on metformin with HgbAlc >=7" 0-9 years old: 0 10-17 years old: 6 18-34 years old: 310 35-44 years old: 1221 45-54 years old: 3303 55-64 years old: 6056 65-74 years old: 6557 75-84 years old: 3664 >= 65 years old: 11379 >= 85 years old: 1158 Not recorded: 0

Here you'll see the progressive break-down of the cohort: First patients taking Metformin (Group 1), then of those patients who has had an HgbA1C >=7. This can be a fairly powerful function to see determine where potential relationships between concepts exist. If we were to reverse this cohort, placing hgb A1C in the first group then Metformin in the second box we'd see the number of patients with an A1C >=7, then who has taken Metformin. This output function is consistent as the number of group's increases so it may be worth exploring.

We now want to explore patients who may have diabetic retinopathy; we can do this in two ways. First we can look for patients who have the icd-9 code, then we can look for those who have creatinine levels greater than 1.5 mg/dL; however we can learn a great deal more if we *Combine* those queries.

First, let's evaluate the diabetic retinopathy query. After dragging the concept over to the *Query Name* section as we've done in the past, your screen should look like the image below.



Here you'll notice that we've just extended the previous query and added the icd-9 for *Diabetic Retinopathy* and your count should be 717 patients. It is important to remember you can evaluate the step-wise breakdown of this query by changing the order of group selection.

Now let's evaluate the second method, diabetic retinopathy via creatinine levels. After dragging the concept over to the *Query Name* section as we've done in the past, your screen should look like the image below.



Here we see there are 5557 patients that meet our criteria, but now we want to combine the results and see who meets one or the other condition. Since we have already cued up the results we can show that we find an additional 357 patients by combining the queries, as we see below.



It is important to point out, some queries you can build can take quite a while to run. While we address performance issues, it may be helpful to notice when queries have finished. You can do this by expanding your previous queries and expanding the specific query you ran. For example see the image below:

i2b2 Query & Analysis Tool	
Previous Queries Find	0 🖻 🗆
 Number of patie@10:35:25 [9-30-2015] [naring] Results of Number of patie@10:35:25 [9-30-2015] [naring] - INCOMPLETE Number of patientsPROCESSING - PROCESSING Hosp Service@14:22:29 [9-28-2015] [naring] Hosp Service@14:20:58 [9-28-2015] [naring] Miscellaneous T@12:59:45 [9-28-2015] [naring] Miscellaneous T@12:56:29 [9-28-2015] [naring] Miscellaneous T@12:56:29 [9-28-2015] [naring] Abortions@11:20:16 [9-25-2015] [naring] Deceased@10:59:56 [9-25-2015] [naring] Deceased@10:59:56 [9-25-2015] [naring] Deceased@10:59:22 [9-25-2015] [naring] Decease@10:59:22 [9-25-2015] [naring] Weight Metric@10:55:51 [9-25-2015] [naring] Weight Metric@10:55:12 [9-25-2015] [naring] Weight Metric@10:55:45 [9-25-2015] [naring] Weight Metric@10:54:48 [9-25-2015] [naring] Weight Metric@10:54:48 [9-25-2015] [naring] Weight Metric@10:54:48 [9-25-2015] [naring] Weight Lbs@10:53:45 [9-25-2015] [naring] Weight Lbs@10:53:45 [9-25-2015] [naring] MetrFORM-Hgb A1CMETFORMHb A1C @10:31:37 [9-25-2015] [naring] 	

Here you'll notice it tells you that it's still processing and that the query is *incomplete*. You can hit the refresh button I've circled in RED to update this window. At this time there is no progress bar or alert system to let you know when complex queries have finished.

roup 1		
Date From: none Date To: none Excluded? ndependently	? false Occurs X times: > 0 Rele	vance %: 100 Temporal Constraint: Treat
Path	Concept/Term	Other Information
Medication\Ingredient\M Drugs\METFORMIN	METFORMIN	
inished Query: "METFORMIN@08 Jumber of patients for "METFORM	3:29:44" IN@08:29:44"	
Sender patient breakdown for "MET Female: 50671 Male: 42176 Transgender: 0 Unknown: 5	FORMIN@08:29:44''	
Race patient breakdown for "METFO American Indian or Alaska Native: 65 Asian: 837 Black or African American: 12568 Hispanic or Latino: 251 Unknown or Other: 1772 White: 76104	DRMIN@08:29:44''	
an antiont breakdown for "METEO)	DMIN/209.10.449	
0-9 years old: 6 10-17 years old: 208 18-34 years old: 3984 35-44 years old: 6934 45-54 years old: 13500 55-64 years old: 23078 65-74 years old: 26334 75-84 years old: 14493 >= 65 years old: 45142 >= 85 years old: 4315 Not recorded: 0	FTATTA (@08:23:44	
0-9 years old: 6 10-17 years old: 208 18-34 years old: 3984 35-44 years old: 3984 45-54 years old: 6934 45-54 years old: 23078 65-74 years old: 23078 65-74 years old: 26334 75-84 years old: 14493 >= 65 years old: 45142 >= 85 years old: 4315 Not recorded: 0 Query Name: No Query Name is current Temporal Constraint: Treat all groups	ntly provided. independently	
0-9 years old: 6 10-17 years old: 208 18-34 years old: 3984 35-44 years old: 6934 45-54 years old: 13500 55-64 years old: 23078 65-74 years old: 26334 75-84 years old: 14493 >= 65 years old: 45142 >= 85 years old: 4315 Not recorded: 0 Query Name: No Query Name is current Temporal Constraint: Treat all groups Group 1	ntly provided. independently	
0-9 years old: 6 10-17 years old: 208 18-34 years old: 3984 35-44 years old: 6934 45-54 years old: 23078 65-74 years old: 26334 75-84 years old: 14493 >= 65 years old: 45142 >= 85 years old: 4315 Not recorded: 0 Query Name: No Query Name is current Temporal Constraint: Treat all groups Group 1 Date From: none Date To: none	ntly provided. independently ? false Occurs X times: >0 Rele	vance %: 100 Temporal Constraint: Treat
0-9 years old: 6 0-17 years old: 208 18-34 years old: 3984 35-44 years old: 6934 45-54 years old: 13500 55-64 years old: 23078 65-74 years old: 2334 75-84 years old: 4493 >= 65 years old: 45142 >= 85 years old: 4315 Not recorded: 0 Query Name: No Query Name is currer Temporal Constraint: Treat all groups Group 1 Date From: none Date From: none Path	ntly provided. independently ? false Occurs X times: >0 Rele Concept/Term	vance %: 100 Temporal Constraint: Treat Other Information
0-9 years old: 6 0-17 years old: 208 18-34 years old: 3984 35-44 years old: 6934 45-54 years old: 13500 55-64 years old: 23078 65-74 years old: 23078 65-74 years old: 23078 65-74 years old: 4493 >= 65 years old: 45142 >= 85 years old: 4315 Not recorded: 0 Query Name: No Query Name is current Temporal Constraint: Treat all groups Group 1 Date From: none Date To: none Excluded 3 Independently Path Medication/ingredientW Drugs/WETFORMIN	htty provided. independently ? false Occurs X times: >0 Rele Concept/Term METFORMIN	vance %: 100 Temporal Constraint: Treat Other Information
0-9 years old: 6 0.10-17 years old: 208 10-17 years old: 208 18-34 years old: 3984 35-44 years old: 6934 45-54 years old: 13500 55-64 years old: 23078 65-74 years old: 24534 65-74 years old: 45142 >= >= 65 years old: 45142 >= >= 85 years old: 4315 Not recorded: 0 Query Name: No Query Name is current Temporal Constraint: Treat all groups Group 1 Date From: none Date To: none Excluded3 Independently Path Medication\ingredient\W Drugs\WETFORMIN	Interpretation (a)	vance %: 100 Temporal Constraint: Treat Other Information
0-9 years old: 6 0-17 years old: 208 18-34 years old: 3984 35-44 years old: 6934 45-54 years old: 13500 55-64 years old: 23078 65-74 years old: 246334 75-84 years old: 441493 >= 65 years old: 45142 >= 85 years old: 4315 Not recorded: 0 Query Name: No Query Name is current Temporal Constraint: Treat all groups Group 1 Date From: none Date To: none Excluded3 Independently Path Medication\ingredient\W Drugs\WETFORMIN Group 2 Date From: none Date To: none Excluded3 Independently	ntly provided. independently ? false Occurs X times: >0 Rele Concept/Term METFORMIN ? false Occurs X times: >0 Rele	vance %: 100 Temporal Constraint: Treat Other Information Under Information Vance %: 100 Temporal Constraint: Treat
0-9 years old: 6 0-17 years old: 208 10-17 years old: 208 18-34 years old: 3984 35-44 years old: 6934 45-54 years old: 23078 65-74 years old: 23078 65-74 years old: 26334 75-84 years old: 45142 >= 85 years old: 45142 >= 85 years old: 4315 Not recorded: 0 Query Name: No Query Name is current Temporal Constraint: Treat all groups Group 1 Date From: none Date To: none Excluded 3 Independently Path Medication/Ingredient/W Drugs/WETFORMIN Group 2 Date From: none Date To: none Excluded 3 Independently	ntly provided. independently ? false Occurs X times: > 0 Reference Concept/Term METFORMIN ? false Occurs X times: > 0 Reference Concept/Term METFORMIN ? false Occurs X times: > 0 Reference Concept/Term	vance %: 100 Temporal Constraint: Treat Other Information vance %: 100 Temporal Constraint: Treat Other Information

Finished Query: "Number of patients on metformin with HgbA1c >=7"

[73 secs]

ecs]

Continued Below

Number of patients for "Number of patient patient_count: 22338 Gender patient breakdown for "Number of Female: 11022 Male: 11253 Transgender: 0 Unknown: 0	ts on metformin with HgbA1c > F patients on metformin with Hg	=7" bAlc>=7"	
Race patient breakdown for "Number of p American Indian or Alaska Native: 20 Asian: 243 Black or African American: 4131 Hispanic or Latino: 31 Unknown or Other: 269 White: 17564	atients on metformin with Hgb&	Alc >=7"	
Age patient breakdown for "Number of pa 0-9 years old: 0 10-17 years old: 6 18-34 years old: 310 35-44 years old: 1221 45-54 years old: 3303 55-64 years old: 6056 65-74 years old: 6557 75-84 years old: 6557 75-84 years old: 3664 >= 65 years old: 11379 >= 85 years old: 1158 Not recorded: 0	tients on metformin with HgbAl	lc >=7"	
Query Name: No Query Name is currently p Temporal Constraint: Treat all groups indep	rovided. vendently		
Group 1			
Date From: none Date To: none Excluded? false Independently	Occurs X times: > 0 Relevance %:	100 Temporal Constraint: Treat	
Path	Concept/Term	Other Information	
undefined	undefined		
undefined	undefined		
Finished Query: "Number of patie@10:35	:25"		[1482 secs]

Number of patients for "Number of patie@10:35:25" patient_count: 5914

Here I want to point your attention to two important things. First, the cohort design; second, the time required to run.

First, you'll see that it combines the *Structure* of each query. This means that since we kept *Metformin* and A1C constant, but varied the third group (creatinine OR icd-9), i2b2 runs the query as those queries as we've previously done however adds the OR status for the creatinine and icd-9 conditions. Because we chose to combine our query in this manner, we must shift our attention to the resultant time: 1482 seconds. Now, you may assume that it takes less time to just make the addition by adding a second OR to the final group, however it in fact can slow down results because i2b2 will need to search for new concepts. For example see the output below.

Query Name: No Query Name is currently provided. Temporal Constraint: Treat all groups independently							
Group 1							
Date From: none Date To: none Excluded? false Occurs X times: > 0 Relevance %: 100 Temporal Constraint: Treat Independently							
Path	Concept/Term	Other Information					
Medication/Ingredient/M Drugs/METFORMIN	METFORMIN						

Finished Query: "METFORMIN@08:29:44"

[22 secs]

Number of patients for "METFORMIN@08:29:44" patient_count: 93036

Gender patient breakdown for "METFORMIN@08:29:44"

Female: 50671 Male: 42176 Transgender: 0 Unknown: 5

Race patient breakdown for "METFORMIN@08:29:44"

American Indian or Alaska Native: 65 Asian: 837 Black or African American: 12568 Hispanic or Latino: 251 Unknown or Other: 1772 White: 76104

Age patient breakdown for "METFORMIN@08:29:44"

0-9 years old: 6 10-17 years old: 208 18-34 years old: 3984 35-44 years old: 6934 45-54 years old: 13500 55-64 years old: 23078 65-74 years old: 26334 75-84 years old: 14493 >= 65 years old: 45142 >= 85 years old: 4315 Not recorded: 0

Query Name: No Query Name is currently provided. Temporal Constraint: Treat all groups independently							
Group 1							
Date From: none Date To: none Excluded? false Occurs X times: > 0 Relevance %: 100 Temporal Constraint: Treat Independently							
Path	Concept/Term	Other Information					
Medication\Ingredient\M Drugs\METFORMIN	METFORMIN						
Group 2							
Date From: none Date To: none Excluded? false Independently	e Occurs X times: >0 Relevance %:	100 Temporal Constraint: Treat					
Path	Concept/Term	Other Information					
CHEMISTRY STUDIES/CARBOHYDRATE/DIABETES STUDIES: /GLYCOSYLATED HGB TESTS/Hgb A1C Bid On HPLC	Hgb A1C Bld Qn HPLC >= 7 % Hgb	GE : 7 % Hgb					

Finished Query: "Number of patients on metformin with HgbAlc >=7"

[73 secs]

Finished Query: "Number of patients on metformin with HgbAlc >=7"

[73 secs]

Number of patients for "Number of patients on metformin with HgbAlc >=7" patient_count: 22338

Gender patient breakdown for "Number of patients on metformin with HgbAlc >=7"

Female: 11022 Male: 11253 Transgender: 0 Unknown: 0

Race patient breakdown for "Number of patients on metformin with HgbAlc >=7"

American Indian or Alaska Native: 20 Asian: 243 Black or African American: 4131 Hispanic or Latino: 31 Unknown or Other: 269 White: 17564

Age patient breakdown for "Number of patients on metformin with HgbAlc >=7"

```
0-9 years old: 0

10-17 years old: 0

18-34 years old: 310

35-44 years old: 1221

45-54 years old: 6056

65-74 years old: 6557

75-84 years old: 6557

75-84 years old: 3664

>= 65 years old: 11379

>= 85 years old: 1158

Not recorded: 0
```

Query Name: No Query Name is currently provided. Temporal Constraint: Treat all groups independently								
Group 1								
Date From: none Date To: none Excluded? failse Independently	• Occurs X times: > 0 Relevance %:	100 Temporal Constraint: Treat						
Path	Concept/Term	Other Information						
undefined	undefined							
undefined	undefined							

Finished Query: "Number of patie@10:35:25"

[1482 secs]

Number of patients for "Number of patie@10:35:25" patient count: 5914

Query Name: No Query Name is currently provided. Temporal Constraint: Treat all groups independently						
Group 1						
Date From: none Date To: none Excluded? false Independently	e Occurs X times: >0 Relevance %:	100 Temporal Constraint: Treat				
Path	Concept/Term	Other Information				
Medication\Ingredient\M Drugs\METFORMIN	METFORMIN					
Group 2						
Date From: none Date To: none Excluded? faise Independently	e Occurs X times: >0 Relevance %:	100 Temporal Constraint: Treat				
Path	Concept/Term	Other Information				
CHEMISTRY STUDIES\CARBOHYDRATE/DIABETES STUDIES:\GLYCOSYLATED HGB TESTS\Hgb A1C Bid Qn HPLC	Hgb A1C Bld Qn HPLC >= 7 % Hgb	GE : 7 % Hgb				
Group 3						
Date From: none Date To: none Excluded? failse Independently	e Occurs X times: > 0 Relevance %:	100 Temporal Constraint: Treat				
Path	Concept/Term	Other Information				
CHEMISTRY STUDIES'ROUTINE SER-PLAS CHEM TESTS: \CREATININE TESTS\Creatinine SerPI Qn	Creatinine SerPl Qn ≻= 1.5 mg/dL	GE : 1.5 mg/dL				
Diseases of the nervous system and sense organs \ Disorders of the eye and adnexa \ Other retinal disorders \ Diabetic retinopathy	ICD9:362.0 Diabetic retinopathy					

Finished Query: "METFO-Hgb A-Creat@11:20:19"

[1009 secs]

Number of patients for "METFO-Hgb A-Creat@11:20:19" patient_count: 5914

Here you see that the overall time was increased by 1009 seconds. Which brings up a caveat about the i2b2 program. Some times it's easier to build on previously run queries as the results are cached rather than extending the existing query.

Now that we have learned about some of the more advanced features, lets explore a different topic.

Task 2: Long QT

Here we are interested in individuals who have taken a medication and then develop a long QT. We will explore the event-ordered function of i2b2.

Pull over the previously run query: "Number of patients with QTC >= 480", your screen should look like the following image.



Given that we now know our base-rate of patients (77518) we want to explore the number of patients who have ever been prescribed azithromycin. Here we pull over the second query in the demo, "Number of patients with QTc >= 480 and on azithromycin ever". Your screen should look as follows:



However, what if we want to know who has had a long QT following the prescription to azithromycin? We use the *Temporal Constraint* function at the top center of the interface, circled in red.

Once you click on that field you should see the following then you'll select Define sequence of Events.

Query Tool Query Name: (t) AZITHROMYCING	NT Corrected@08:26:04								
Temporal Constraint:					Define sequence of E	Events			
Treat all groups independently Selected groups occur in the same fir Define sequence of Events			nancial e	ncounter	its occur Group 2	X			• Ne
Dates Occ	urs > 0x	Exclude	Dates		Occurs > 0x	Exclude	Dates		0
Treat Independently -			Treat	Independer	tly 👻		Treat Ir	ndependently 🔻	

Next you'll change the query from a *population in which events occur* and start adding the events of interest.

Temporal Constraint:	Define sequence of Events							
Davidellas is utilationaria accura		pulation in	which events occur			New Event		
Population in which events occur	×		Group 2	X		Group 3		
Event 2	Exclude	Dates	Occurs > 0x	Exclude	Dates	Occurs > 0x	Exclu	
Define order of events		Treat l	ndependently 👻		Trea	t Independently 👻		

You'll notice the option for *Define order of events* option. Once you have each event defined like you've done in the past with a simple query, you'll decide how you want to order events. I've skipped over the events space since it looks and behaves exactly like the environment you've seen in the past, you're just simply defining the criteria of each event.

Now in the *Define order of events* interface you'll see some new options. Your screen should look as the one below.



Here you'll see that we've said that persons falling into the first event (Event 1) will happen before (we defined this as patients with azithromycin) will be followed by the second event (Event 2) *BY*at least 60 days. You can choose to not include these kinds of restrictions, but for the sake of clinical interest we've included the restriction that patients should have a prescription of azithromycin at least 60 days prior to a QTC >= 480.

Two important points about this query: we did not define a cut-off date, nor have we defined start-date. This means that we could find patients who have azithromycin prescribed any time before the long QTC and while it may seem natural to expand on your query at this point, it may push i2b2 beyond its intended purpose. Thus you may end up with very small results. To do these kinds of examinations, it would be best to contact the Regenstrief Data Core for these kinds of queries. Second, many investigators are interested in the outcomes of something due to an epoch effect—e.g., azithromycin was really popular in XXXX. This would also be a question best explored with the Regenstrief Data Core.

Now that we have explored the *Define sequence of events*function, let's review the output of this query. You'll notice that the query has already been generated as, "Number of patients with QTC >= 480 within 60 days after being on azithromycin". Once you pull this query over, your screen should look as the image below:

Query Tool		8 🖬 🗐							
Query Name: (t) AZITHROMYCINQT Corrected@08:26:04									
Temporal Constraint: Define sequence of Events									
Population in which events occur									
Anchoring Observation	Group 2	Group 3 🛛 🖾							
Dates Occurs > 0x Exclue Treat Independently	Dates Occurs > 0x Exclude Treat Independently	Treat Independently							
drop a term on here									
Run Query Clear Print Query	1 Group	New Group							
Show Query Status Graph Results									
	Number of patients 201 For Query "(t) AZITHROMYCINQT Corrected@08:26:04"								

You'll notice that the pre-defined query here does not show you any concepts in any grouping. This is because you'll have to select which *Event* you're looking at. So for example, if we select Event 1 from the *Population in which occurs* bar at the top, you'll see the events. Select event 1, your screen should look like the image below:

Query Tool		8 V Q								
UUEY NAME: (1) AZITHROMYCINGT Corrected@08/26/04										
Temporal Constraint Define sequence of Events 🔹										
	Event 1 New Event 1									
Anchoring Observation	Group 2	Group 3 🛛 🖂								
Items Instance will be the same	Treat Independently -	Treat Independently -								
AZITHROMYCIN One or more of these	ND drop a term on here									
Run Query Clear Print Query	1 Group	New Group								
Show Query Status Graph Results										

Event two will look very similar, but will specify the conditions for Long QTC.

It is important to point out at this time, that time-series queries in i2b2 can be some of the most computationally intensive queries you can run therefore it is best to build on the previous methods if at all possible.

At this point let's explore a final IUH query, that is unexpected correlations.

Task 3: Hearling loss and Testicular Cancer

In demo section 3, you'l only see two queries: "Number of patients with testicular cancer", and "number of patients with testicular cancer and hearing loss". This is one of the principle use cases for i2b2 capability because it is an unexpected result to those not familiar with the phenomenon and it demonstrates that while some small-population research is not best conducted through i2b2. In the first query, we are looking for the testicular cancer icd-9's. As before, drag over the first concept labeled, "Number of patients with testicular cancer (ICD9)", your screen should look like the image below:

Query Tool							8 🕅
Query Name: ICD9:186 Mai	ign@08:15:20						
Temporal Constraint:				Treat Independent	у		•
	Group 1	X		Group 2	X	Grou	ıp 3
Dates	Occurs > 0x	Exclude	Dates	Occurs > 0x	Exclude Dates	Occur odependently 💌	s > 0x Exclud
🔀 ICD9:186 Malignant n	eoplasm of testis						
	ana az			dran a			
	more of	A	ND	term			
	ulese			Unitere			
Run Query Clear	Print Query			1 Group			New Group
Show Query Status	Graph Results						d
		_					
			Nur	nber of patients			
			3	3956			
			For Quoru "IC	D0:186 Malian@00:15:	20"		
			For Query IC	09.100 Maliyn@08:15:	20		

However when we combine testicular cancer with the icd-9 for *hearing loss* (the second query), we find the image below:

Query Tool										ð 🕅 🗐
Very Name. Index new based good no.+2										
remperar constraint.										
Dates	Group 1 Occurs > 0x	Exclude	Dates	G	roup 2 curs > 0y	Exclude	Dates		Group 3 Occurs > 0x	Exclude
Treat Independently -	000013 2 02	Exclude	Treat	Independently -	.curs > 0x	Exclusion	Treat	Independently 👻	Occurs 7 0x	Exclude
CD9:186 Malignant i	neoplasm of testis		C ICC	19:389 Hearing loss						
	000.07				000.05				drop a	
	more of these	A	ND		more of these		AND		term on here	
Run Query Clear	Print Query				2 Groups					New Group
Show Query Status	Graph Results									
										<u>^</u>
				Number	of patients					
					E 2					
					53					
				E 0		16.40				
				For Query "ICD9:1	8-ICDA:38@08:	16:42"				
										•

This suggests that IUH has seen at least 153 patients who have had testicular cancer AND have had a diagnosis of hearing loss—suggestive of hearing loss because of Cisplatin—however, this is an illustrative point where investigators should reach out to the Regenstrief Data Core. The Regenstrief Data Core can confirm feasibility of patient populations using the INPC (Indiana Network for Patient Care) and other tools which search text documents not stored otherwise.

Version Guide

Version Number	Author	Date
1	Nate Ring	9-30-2015