i2b2 and tranSMART 2017:

first experiences of interoperability

Mauro Bucalo
Matteo Gabetta
BIOMERIS

Ward Weistra
Jan Kanis
Jarno Van Erp
THE HYVE

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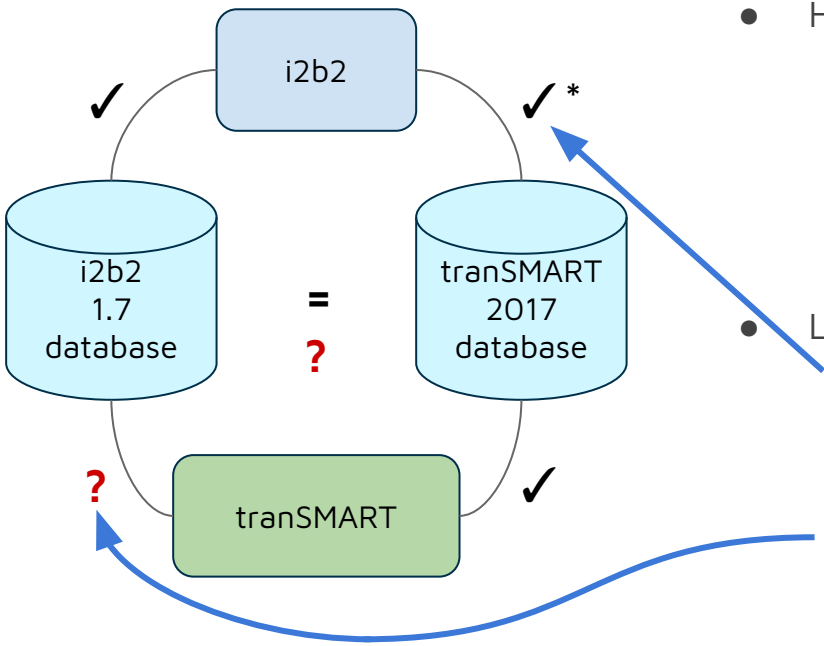
Basic Idea

allow **i2b2** and **tranSMART**
to work on the same database
with opportune modifications

The idea

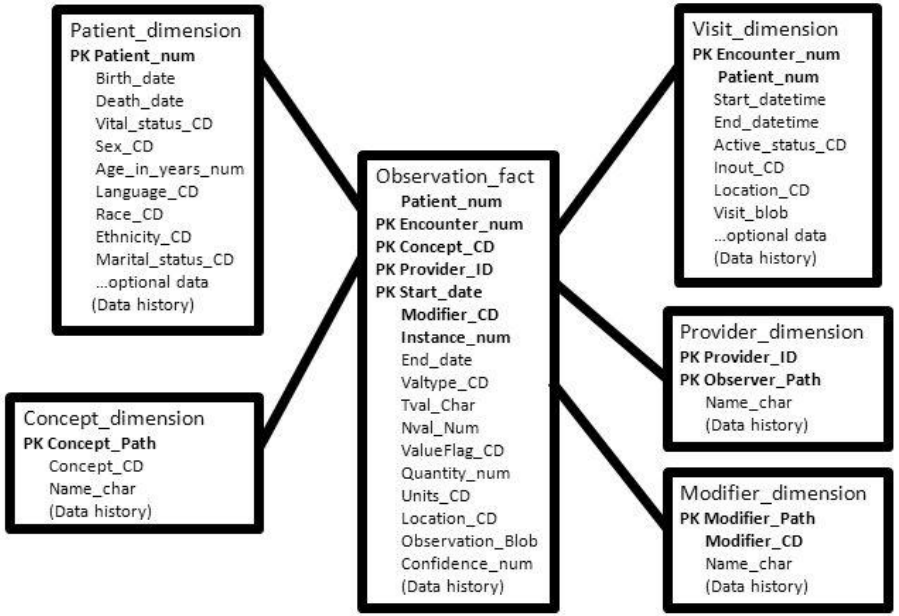


- History
  - **tranSMART** was built on top of **i2b2** with the same database, but diverted over time
  - **tranSMART 17.1 project** restored i2b2 star schema
- Let's test how similar they really are!
  - In Harvard (June) we showed that **i2b2** runs (with minor changes) on **tranSMART 2017 database**
  - Next up: Does **tranSMART 2017** run on an **i2b2 database**?

i2b2 1.7 database

The i2b2 clinical data model is pictured below.

- The ***visits***, ***dates*** on observations and ***modifiers*** allow for modelling time series and samples.
- The visit dimension has ***patient_num*** in its primary key. Hence these visits can only be linked to one patient.

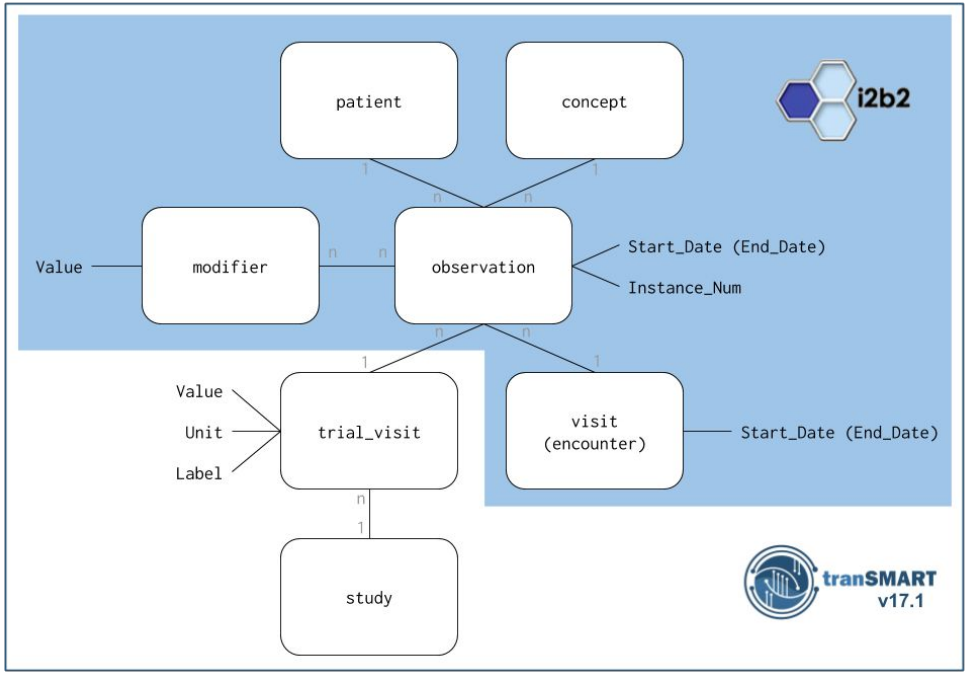


i2b2 Design Document; Data Repository (CRC) Cell; Partners Healthcare System, 1.7.1
-image created by Jim Campbell, Dan Connolly, PCORI/GPC Standard Data Model

tranSMART 17.1 database

The effective clinical data model in tranSMART 17.1 data model is pictured on the right.

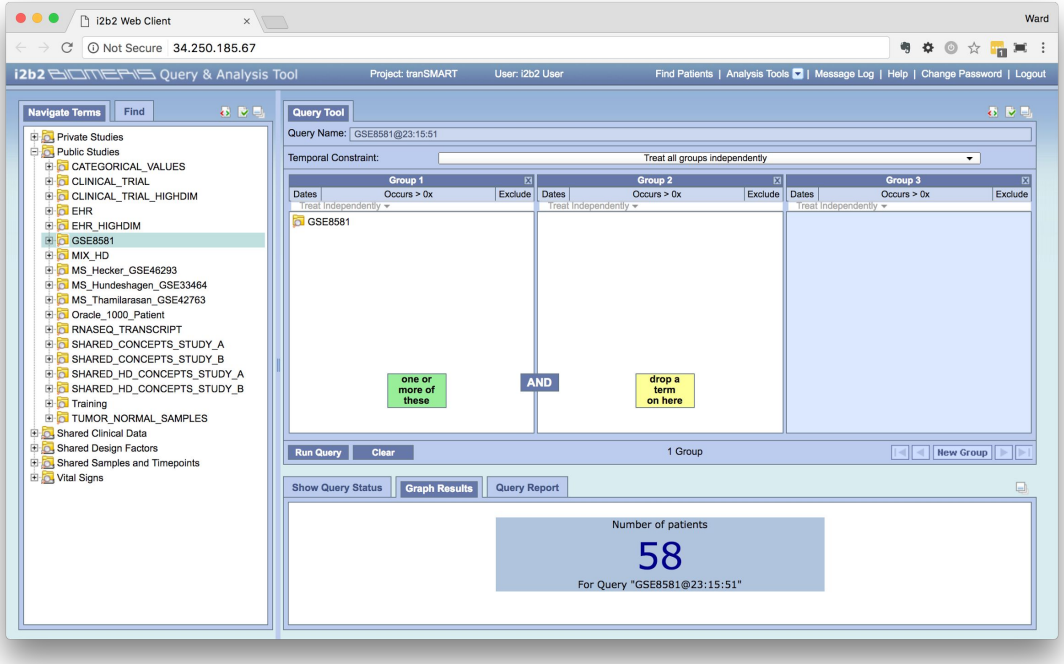
- Reinstatement of the **full i2b2 star schema dimensions** allows for modelling time series and samples.
- The link with **studies** is made explicit. It is made on observation level instead of concept level, to allow for cross-study concepts.
- **Trial visits** are introduced to model visits shared among patients (Baseline, Week 1, ...).



tranSMART 17.1 project: Removed differences in tranSMART compared to i2b2

- Dimensions
  - Restored the usage the i2b2 dimension columns and tables:
    start_date, **end_date** on observations, **visit/encounter**, **modifier_cd**, **instance_num**.
  - Restored **observation_fact** primary key and nullability by re-adding **encounter_num**, **start_date** and **instance_num**.
- High dimensional data linking
  - Deprecating **observation_fact.sample_cd** column. Link to high dimensional data is now made with a modifier instead of a tranSMART-specific column.
- Study linking
  - Deprecating **observation_fact.sourcesystem_cd** for storing the tranSMART study ID.

Flashback to June: i2b2 on tranSMART 2017 database

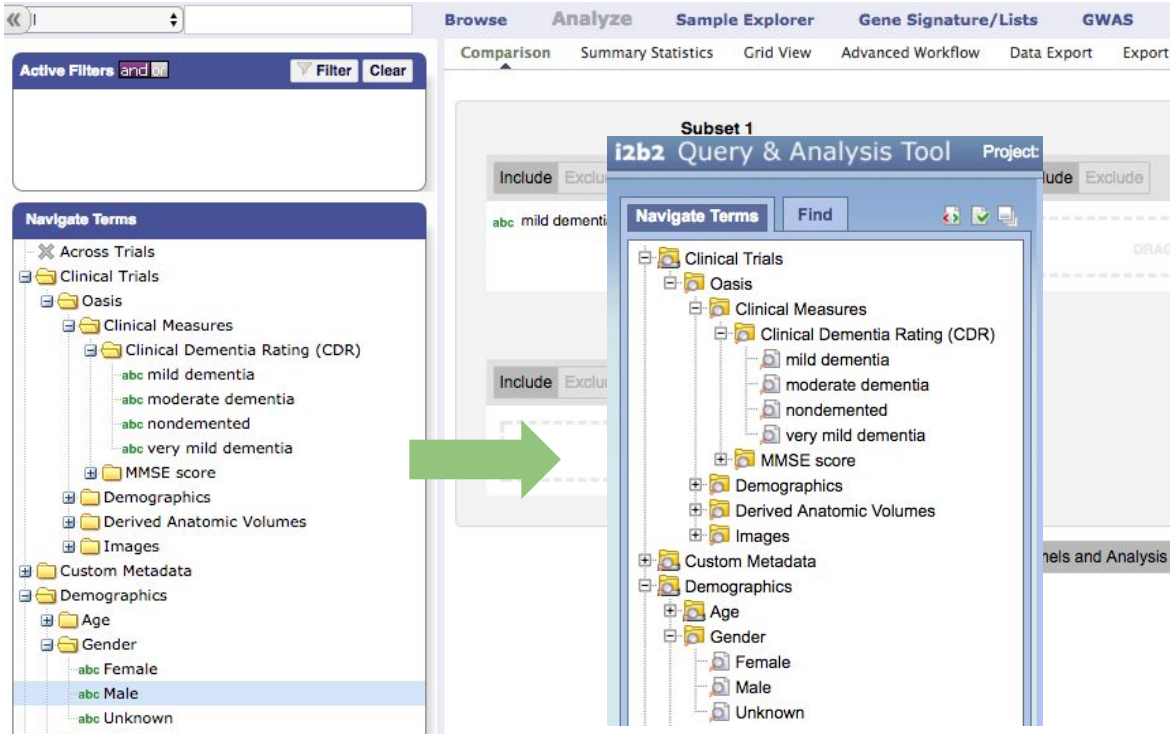


Works on a tranSMART 2017 database!
(sequence names need to be aligned)

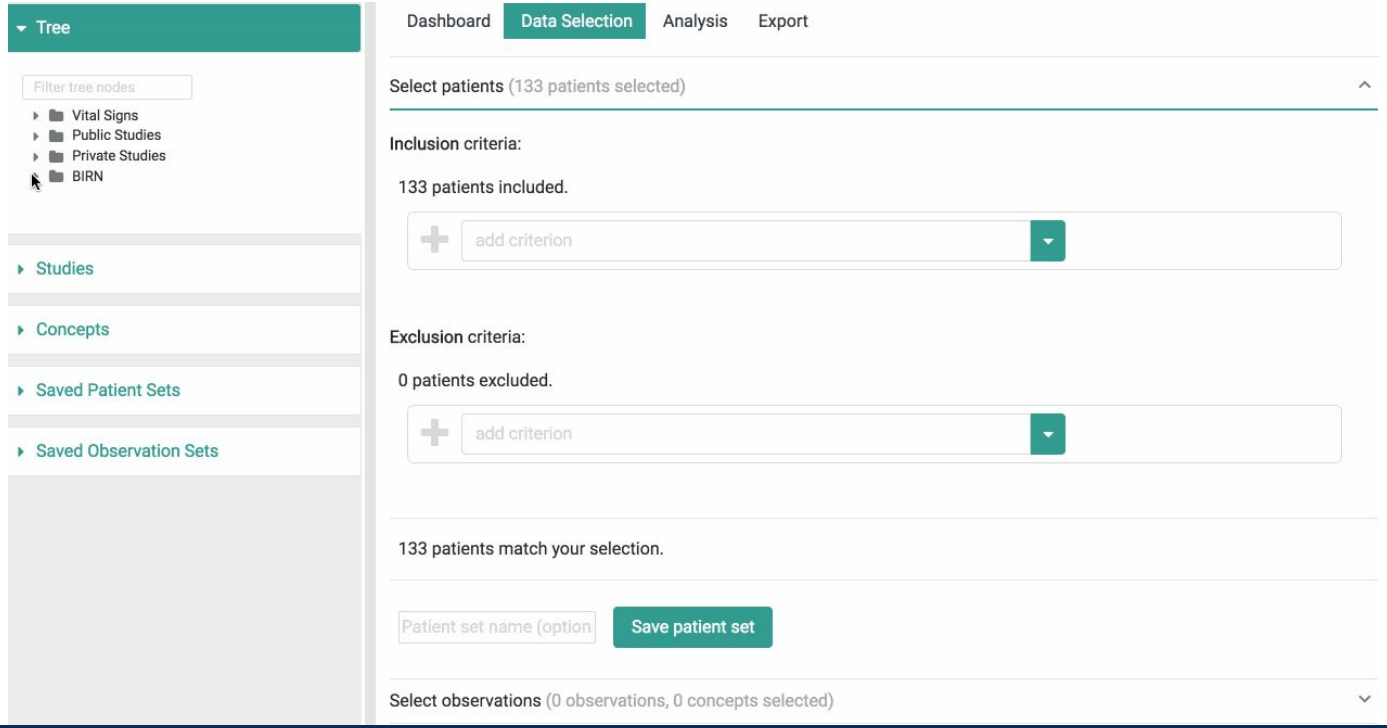
The steps make tranSMART run on i2b2 database

1. Take a clean tranSMART database and drop i2b2 tables
2. Add i2b2 **demodata** and **metadata** tables from i2b2 database:
   a. Change table format
      - Convert type **integer** to **numeric**
      - Add **trial_visit_num** to **observation_fact**
   b. Adjust metadata for all studies
      - Add **birn** entries to **i2b2_secure**
      - Add study OASIS to study table in **i2b2demodata** and a trial visit for this study
   c. Change visual attribute in **i2b2metadata**
      - tranSMART visually differentiates between categorical, numerical and high dimensional nodes (LA to LAN in numeric and LA to LAC in categorical)
   d. Satisfy tranSMART security model
      - Add one trial visit to each observation, and one study to the trial visit
   e. Adjust i2b2 data for tranSMART limitations
      - Convert date observations to text
      - Convert less than and greater than to exact number

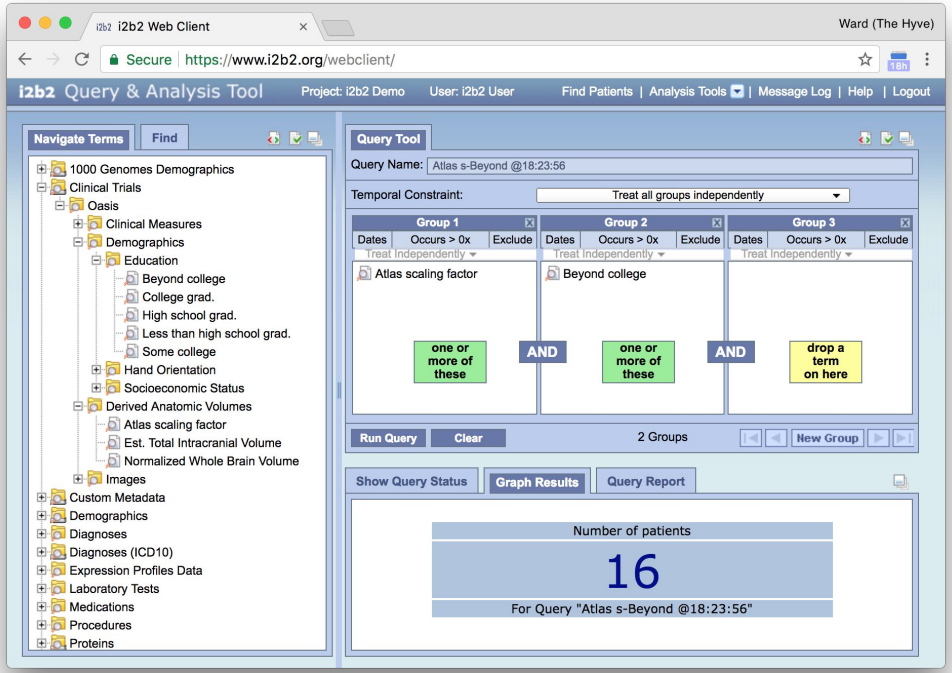
transmartApp UI on i2b2 database



Glowing Bear cohort builder on i2b2 1.7 database



The same query on all



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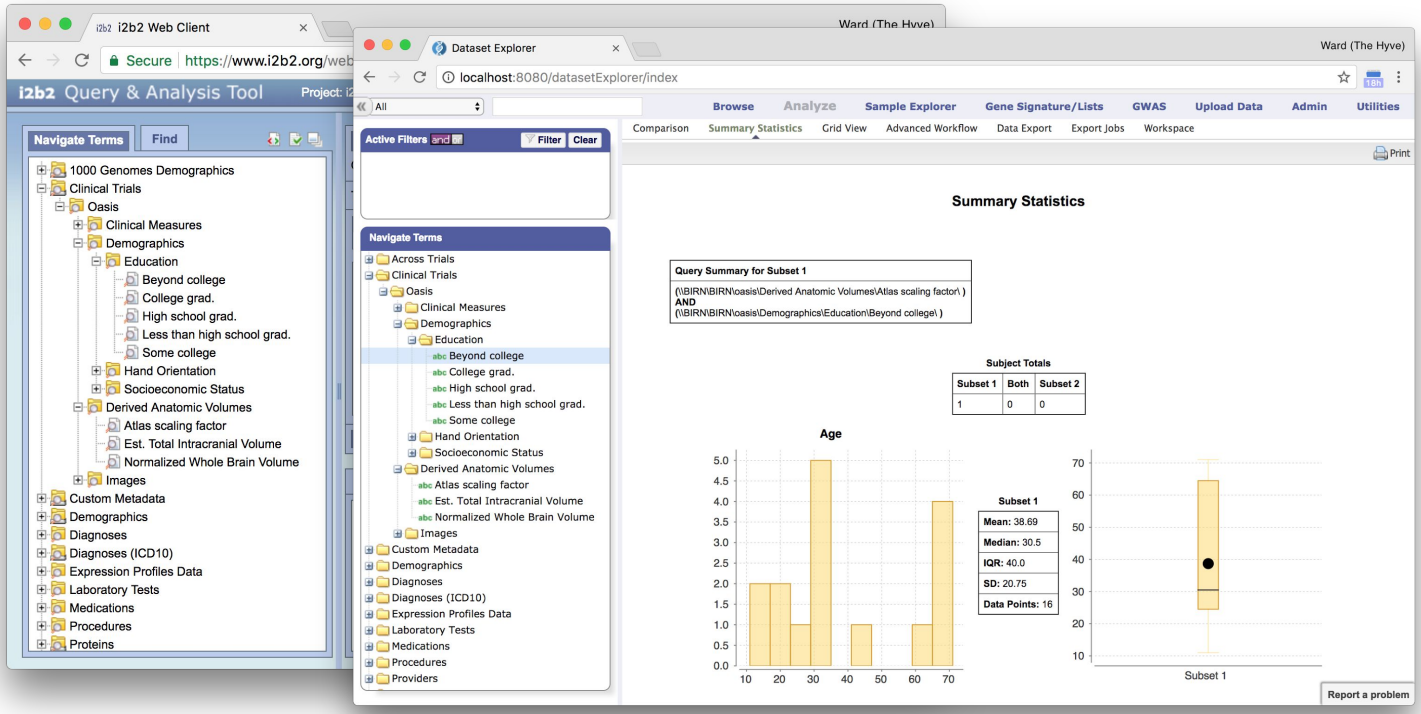
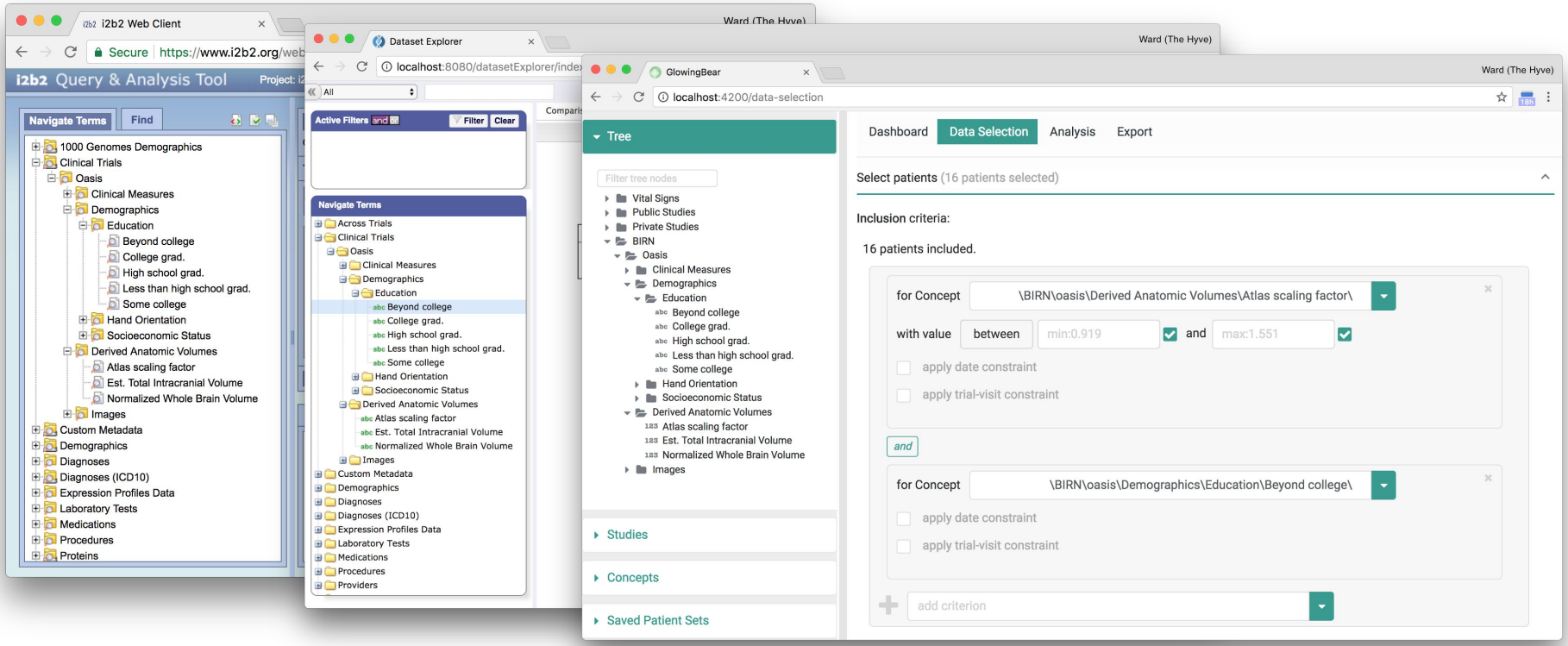


The same query on all



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Other remaining differences

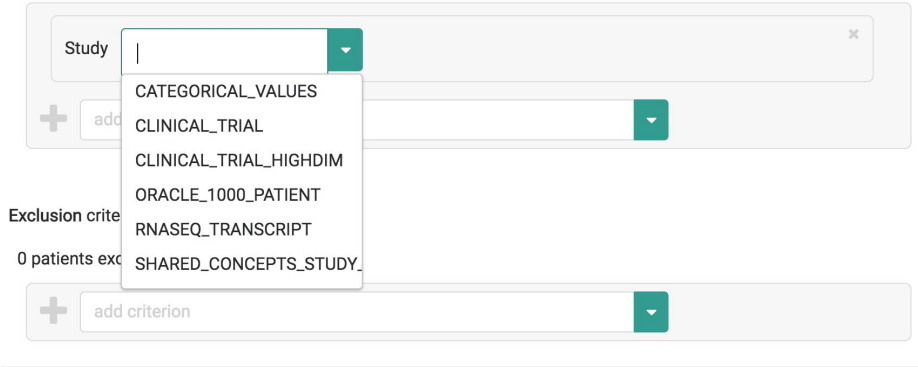
- Study tree nodes
    - tranSMART Ontology tree has study dimension tree nodes. Could work in i2b2 if corresponding tables are added.
- Sequence names
    - Sequence names in i2b2 different between Oracle and Postgres. tranSMART currently uses Oracle sequence names (as presented at Harvard meeting)

Projects in i2b2

- In i2b2 a user can access to different projects
- The data behind each project are stored in different schema or in different database (we use materialized views to simplify ETL procedures)
- User permission are granted using the PM cell

Studies and trial visits in tranSMART

- Both are essential for modelling clinical trials and tranSMART security
- The data behind each study are stored in the same database
- User permission are granted on a observation level using the added **trial_visit** column
    - Corresponding **study** and **trial_visit_dimensions** tables were added to **i2b2demodata**.
    - Studies are linked to observations via **trial visits**, such as to limit the number of additional columns in **observation_fact**.



Going forward to a shared database

- The **i2b2 PMC** is already considering:
  - Inclusion of the **trial_visit_num** column in the **i2b2demodata.observation_fact** table.
  - Inclusion of the study and **trial_visit_dimensions** tables to **i2b2demodata**.
- The **tranSMART PMC** is already considering:
  - Migration of the tables related to study dimensions and large scale file storage to non-i2b2 schema.
- The Foundation is planning a **database working group** to think further about alignment (and optimalization)
  - We hope this working group will consider our lessons learned and bring the community to **one shared i2b2 tranSMART database**!

Credits

- The Hyve's Team
  - Ward Weistra
  - Jan Kanis
  - Jarno Van Erp
- Biomeris Team
  - Mauro Bucalo
  - Matteo Gabetta