OMOP – PCORnet Alignment

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Outline

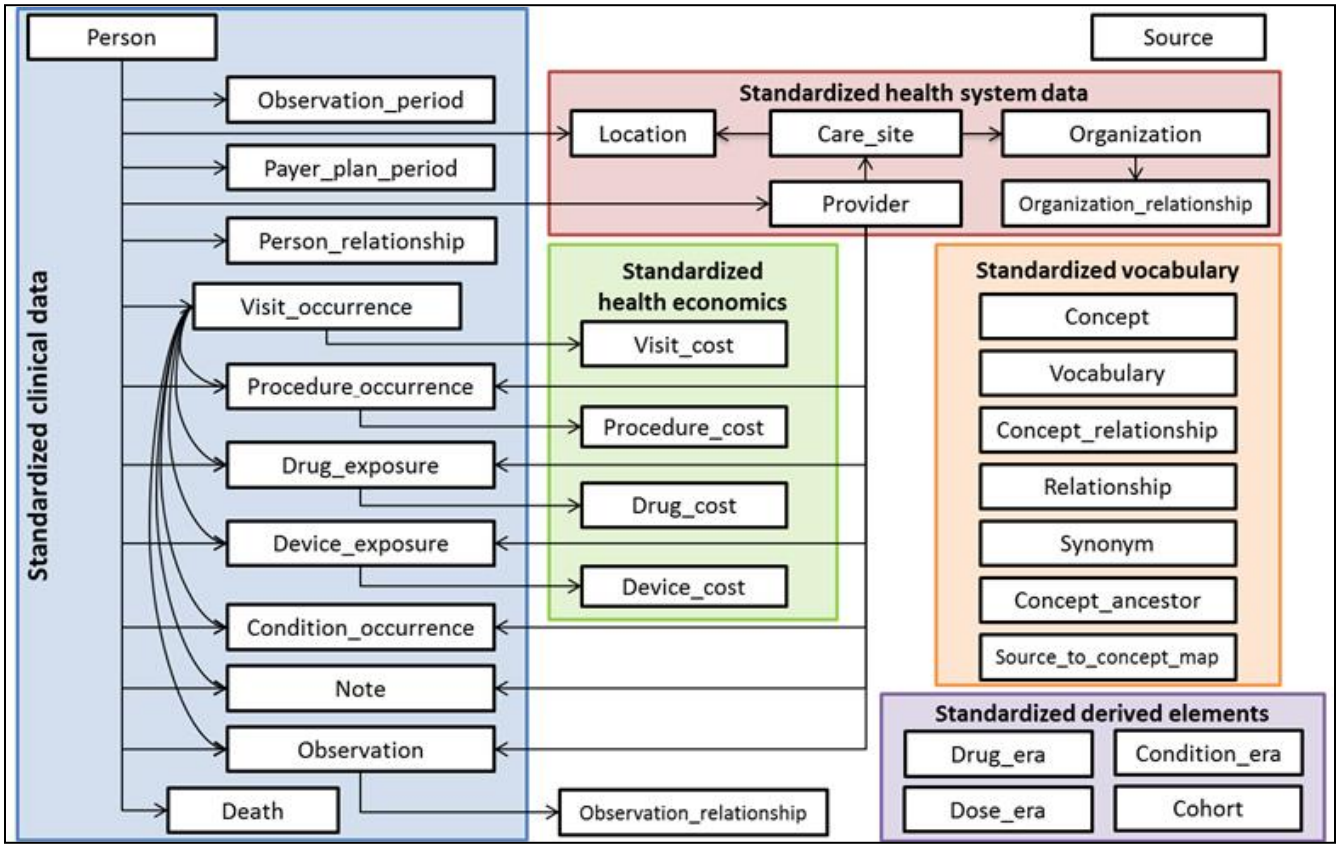
- History of OMOP adoption for CDRN
- Development of crosswalk
  - ✓Approach
  - ✓Challenges
  - ✓Outcomes
  - ✓Remaining tasks

History of OMOP adoption for CDRN

- CDRN– Clinical Data Research Network
- PCORnet - the National Patient-Centered Clinical Research Network
  - ✓ Initiated in 2014
  - ✓ Funded by the Patient-Centered Outcomes Research Institute (PCORI)
  - ✓ Integrates data from 13 networks for CER
  - ✓ PCORnet CDM is based on the Mini-Sentinel CDM
- Out of initial 11 networks
  - ✓ 7 adopted i2b2
  - ✓ 4 adopted OMOP
  - ✓ 0 adopted PCORnet

PCORNet CDM V1

OMOP CDM v4


Person
Observation_period
Payer_plan_period
Person_relationship
Visit_occurrence
Procedure_occurrence
Drug_exposure
Device_exposure
Condition_occurrence
Note
Observation
Death
Standardized clinical data
Source
Standardized health system data
Location
Care_site
Organization
Provider
Organization_relationship
Standardized health economics
Visit_cost
Procedure_cost
Drug_cost
Device_cost
Standardized vocabulary
Concept
Vocabulary
Concept_relationship
Relationship
Synonym
Concept_ancestor
Source_to_concept_map
Standardized derived elements
Drug_era
Condition_era
Dose_era
Cohort
Observation_relationship

Rationale for Choosing OMOP CDM

	C32 CCD	MiniSentinel	OMOP V5	PCORI CDM V1	SCILHS PCORI SHRINE	HARVARD SHRINE	NYC DMH QUERY HEALTH
Patient Demographics	X	X	X	X	X(HL7, ISO, CDC)	X(HL7, ISO, CDC)	X
Provider	X	X	X(NPI, DEA, Specialty(CDC))	X	O	O	X(NPI)
Encounters	X	X	X	X	X(in progress)	O	X(CPT, NQF)
Encounter cost	O	DRG	O	DRG	O	O	X
Locations	O	X	X	X	O	O	X
Care sites	O	X(3 CHAR ZIP)	X(CMS codes)	X(3 CHAR ZIP)			X
Organizations	O	X	X	O			X
Reason for encounter	O	O	X	O	O	O	X
Problem List(Condition)	X (SNOMED CT, ICD-*-CM)	O	X (SNOMED CT; MedDRA)	O	X(ICD-9-CM)	X(ICD-9-CM)	X(SNOMED CT,ICD9)
Encounter Diagnoses	X	X	X (SNOMED CT)	X			X
Principal Dx	O	X(ICD-*-CM)	X (SNOMED CT)	X(ICD-9-CM; SNOMED CT; ICD-10-CM)			O
Cause of death	O	O	X	O			O
Order diagnosis	O		X (via relevant_condition_concept_id)	O			O
Family History	PersonalRelationship:SNOMEDCT<<303071001 4 Condition:SNOMEDCT<<ClinFinding	O	X	O	O	O	X
Social History	X	O	X (SNOMED CT)	O	O	O	X
Review of systems		O	O	O	O	O	X
Alerts/Allergies	X (SNOMED CT, RxNORM)	O	X (SNOMED CT)	O	O	O	X(SNOMED CT)
Vital Signs	X	X	X (LOINC, SNOMED CT)	X	X (some, in progress)	O	X(LOINC)
Physical findings	X (SNOMED CT, LOINC)	O	X	O			X
Lab Results	X (LOINC)	X (LOINC, CPT, Specimen)	X (LOINC,UCUM)	O	X(LOINC)	X(LOINC)	X(LOINC, NQF)
Radiology results					O	O	X
Medication history	X (RxNORM)	O	X (RxNORM; NDF-RT)	O	X(RxNORM,NDF-RT)	X(RxNORM,NDF-RT)	X(NDC,NF,RXNORM)
Medications prescribed(outpt)	X	O	X	O			X
Administered	X	O	X	O			X(NDC, NQF, RXNORM)
Rx dispensed	O	X (NDC)	X	O			X
Medication costs	O	O	X	O	O	O	X(NDC)

Rationale for Choosing OMOP CDM

- **Data model -** more reflective of clinical domain, granular, better structured
- **Vocabulary -** uniformly structured and well curated
- **Information Model** - formalized connection between data model and conceptual model (vocabulary)
- **Supportive Community** of developers and researches
- **Tools** for data integration, characterization, and analysis

Development of CDM Crosswalk

Step 1. Addressing PCORnet Requirements in OMOP CDM v5

Step 2. Establishing interoperability standards

PCORnet requirements in OMOP CDM v5

- ✓ New attributes and concepts added to Person, Visit, and Observation Period domains

OBSERVATION_PERIOD

Field	Type	Required	Description
Observation_period_id	integer	Yes	A system-generate unique identifier for each observation period
person_id	integer	Yes	A foreign key identifier to the person who is experiencing the condition. The demographic details of that person are stored in the person table.
observation_period_start_date	date	Yes	The start date of the observation period for which data are available from the data source
observation_period_end_date	date	Yes	The end date of the observation period for which data are available from the source.
period_type_concept_id	**integer**	**Yes**	**A foreign key identifier to the predefined concept in the Standardized Vocabularies reflecting the source of the observation period information**
…..			

44814722	Period while enrolled in insurance'
44814723	Geography based period'
44814725	Period inferred by algorithm'
44814724	Period covering healthcare encounters'

PCORnet requirements in OMOP CDM v5

- ✓ Observations and fact relationships used as a workaround for unsupported attributes

VISIT_OCCURRENCE

Field	Value
visit_occurrence_id	555555
person_id	804860
visit_start_date	10/10/2012
visit_start_time	23:00
visit_end_date	10/14/2012
visit_end_time	14:15
provider_id	666
…..	

OBSERVATION

Field	Value	
observation_id	238923849	
visit_occurrence_id	555555	
person_id	804860	
observation_date	10/14/2012	
observation_time	14:15	
provider_id	666	
observation_concept_id	4137274	Discharge to establishment
value_as_concept_id	44814680	Residential Facility
…..		

PCORnet requirements in OMOP CDM v5

- ✓ PCORnet vocabulary created and mapped to standard vocabulary

CONCEPT_ID	CONCEPT_NAME	CONCEPT_LEVEL	CONCEPT_CLASS	VOCABULARY_ID	CONCEPT_CODE
44814649	Other	0	Generic	PCORNet	44814649-NI
44814650	No information	0	Generic	PCORNet	44814650-UN
44814653	Unknown	0	Generic	PCORNet	44814653-OT
44814647	Avaible in biobank	0	Biobank Flag	PCORNet	44814647-Y
44814648	Unavailable in biobank	0	Biobank Flag	PCORNet	44814648-N
44814651	Hispanic	0	Hispanic	PCORNet	44814651-Y
44814652	Not Hispanic	0	Hispanic	PCORNet	44814652-N
44814654	American Indian or Alaska Native	0	Race	PCORNet	44814654-01
44814655	Asian	0	Race	PCORNet	44814655-02
44814656	Black or African American	0	Race	PCORNet	44814656-03
44814657	Native Hawaiian or Other Pacific Islander	0	Race	PCORNet	44814657-04
44814658	White	0	Race	PCORNet	44814658-05
44814659	Multiple race	0	Race	PCORNet	44814659-06
44814660	Refuse to answer	0	Race	PCORNet	44814660-07
44814664	Ambiguous	0	Sex	PCORNet	44814664-A
44814665	Female	0	Sex	PCORNet	44814665-F
44814666	Male	0	Sex	PCORNet	44814666-M
44814670	Adult foster home	0	Admitting Source	PCORNet	44814670-AF
44814671	Assisted living facility	0	Admitting Source	PCORNet	44814671-AL
44814672	Ambulatory visit	0	Admitting Source	PCORNet	44814672-AV
44814673	Emergency department	0	Admitting Source	PCORNet	44814673-ED
44814674	Home health	0	Admitting Source	PCORNet	44814674-HH
44814675	Home / self care	0	Admitting Source	PCORNet	44814675-HO
44814676	Hospice	0	Admitting Source	PCORNet	44814676-HS
44814677	Other acute inpatient hospital	0	Admitting Source	PCORNet	44814677-IP

CDM Interoperability Collaborative

- Core members
  - Rimma Belenkaya
  - Rob Follett
  - Ritu Khare
  - Mark Khayter
  - Toan Ong
  - Lisa Schilling
  - Don Torok

PEDSnet A Pediatric Learning Health System — CDM v4

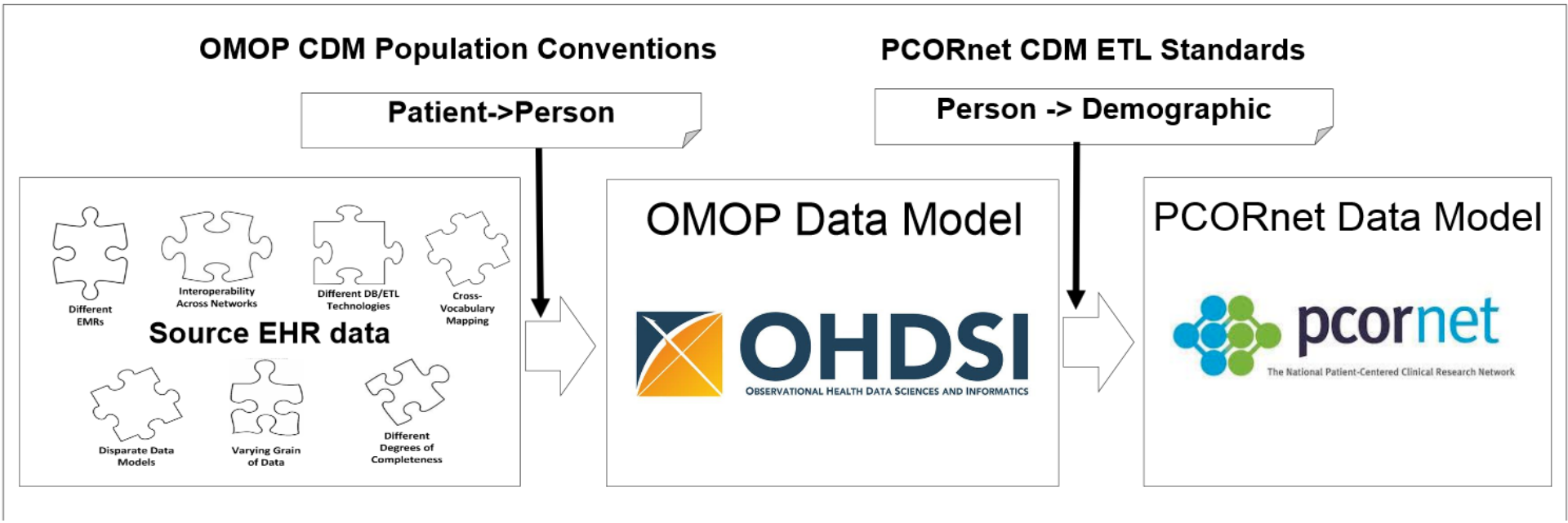
NYC-CDRN New York City Clinical Data Research Network — CDM v5

pSCANNER — CDM v4

- Weekly meetings
- Deliverables: standard specifications

Approach

Crosswalk from source – to – OMOP CDM – to – PCORNet CDM



- ✓**Satisfy PCORnet-requirements**
- ✓Preserve granularity of source data
- ✓Preserve integrity of OMOP CDM
- ✓Enforce uniformity of workarounds

Convert data in the OMOP CDM to PCORnet CDM via a set of mechanistic transformation rules

Examples

✓ Extension of OMOP vocabulary to preserve null-values

NULL - values	Defintion
0	A data field is not present in the source system
No Information	A data field is present in the source system, but the source value is null or blank
Unknown	A data field is present in the source system, but the source value explicitly denotes an unknown value
Other	A data field is present in the source system, but the source value cannot be mapped to the CDM

Examples

- ✓ Convention for enforcing PCORnet referential integrity and cardinality
- ✓ Preserving integrity of OMOP CDM
- ✓ Enforcing uniformity of workarounds

VISIT_OCCURRENCE

Field	Value
visit_occurrence_id	555555
person_id	804860
visit_start_date	10/10/2012
visit_start_time	23:00
visit_end_date	10/14/2012
visit_end_time	14:15
provider_id	666
…..	

OBSERVATION

Field	Value	
observation_id	238923849	
visit_occurrence_id	555555	
person_id	804860	
observation_date	10/14/2012	
observation_time	14:15	
provider_id	666	
observation_concept_id	4137274	Discharge to establishment
value_as_concept_id	44814680	Residential Facility
…..		

Only one record with the same observation_concept_id per visit occurrence

Examples

✓ Convention for enforcing data completeness

VISIT_OCCURRENCE

Field	Value
visit_occurrence_id	555555
person_id	804860
visit_start_date	10/10/2012
visit_start_time	23:00
visit_end_date	10/14/2012
visit_end_time	14:15
provider_id	666
visit_concep_id	**9201**
…..	

Inpatient visit

OBSERVATION

Field	Value	
observation_id	238923849	
visit_occurrence_id	555555	
person_id	804860	
observation_date	10/14/2012	
observation_time	14:15	
provider_id	666	
observation_concept_id	4137274	Discharge to establishment
value_as_concept_id	44814680	Residential Facility
…..		

Inpatient visits must have 'Discharge to establishment'

Examples

Granularity of source data preserved

- ✓More granular Race representation
- ✓Multiple encounters to the same provider on the same date
- ✓Storing diagnosis date/time different from encounter date/time

Challenges

- **Missing attributes** - workarounds, overhead in ETL
- **Missing concepts ('NULL' values)** - necessity to extend vocabulary
- **Lab mappings** – PCORnet targets not defined
- **PCORnet requirement to provide source values** – domain mismatch
- **Different versions** of OMOP and PCORnet CDM, necessity to reconcile
- **Time consuming** process of creating conventions

Outcomes

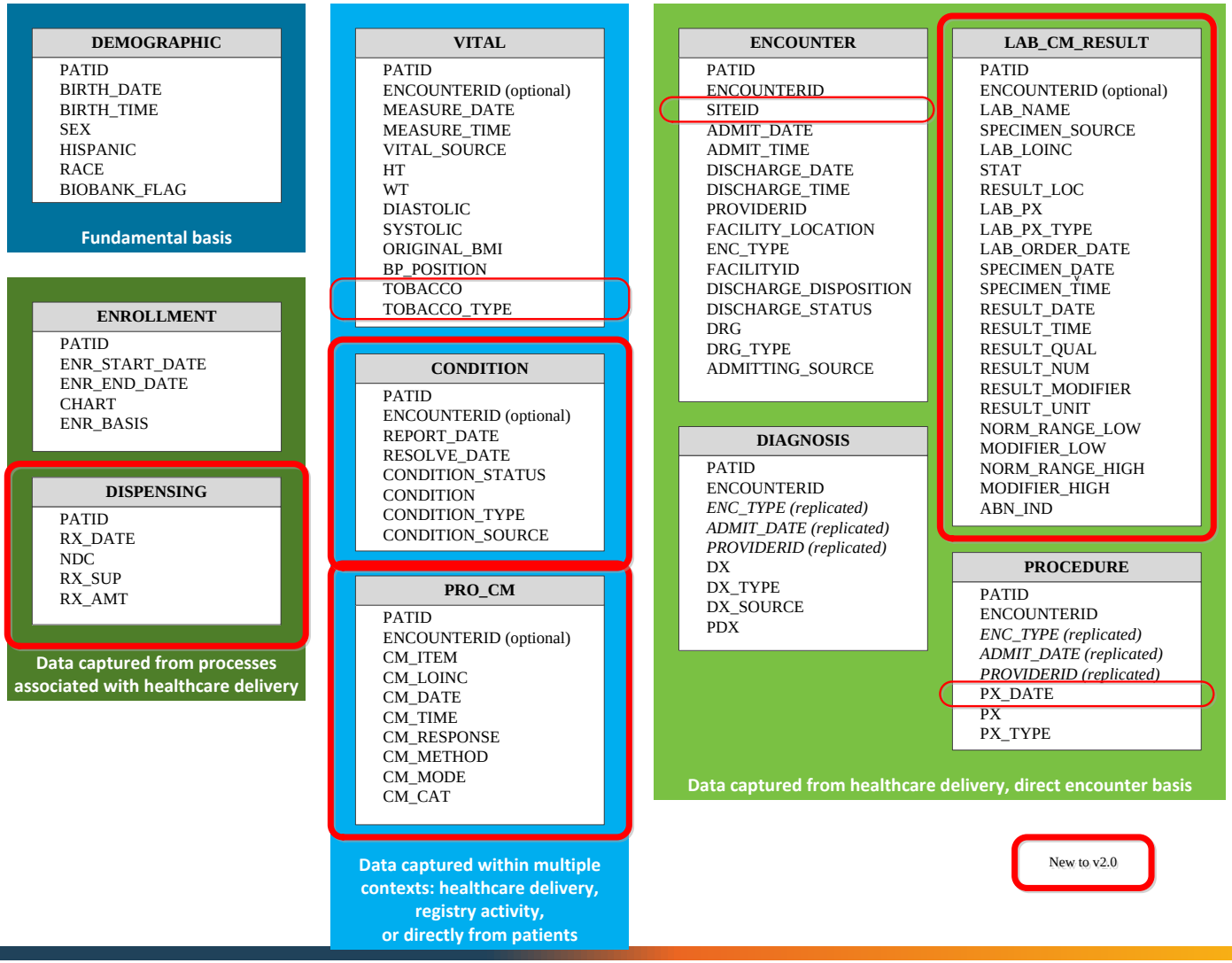
- **Interoperability standards -** from source (i.e. electronic health records) to OMOP CDM v4 (Specific to PCORI CDM) and from source to OMOP CDM v5 (specific to PCORI CDM)
- **A conventions document** - for populating the OMOP CDM, and an extract-transform-load specifications document for transforming to the PCORnet CDM v1, for both OMOP CDM v4 and OMOP CDM v5. The documents will be publicly available for the OHDSI community

- **OMOP CDM extended** – new important use cases
  - ✓ Added visit time
  - ✓ ADT – admission/discharge handling
  - ✓ Tobacco conventions – underway

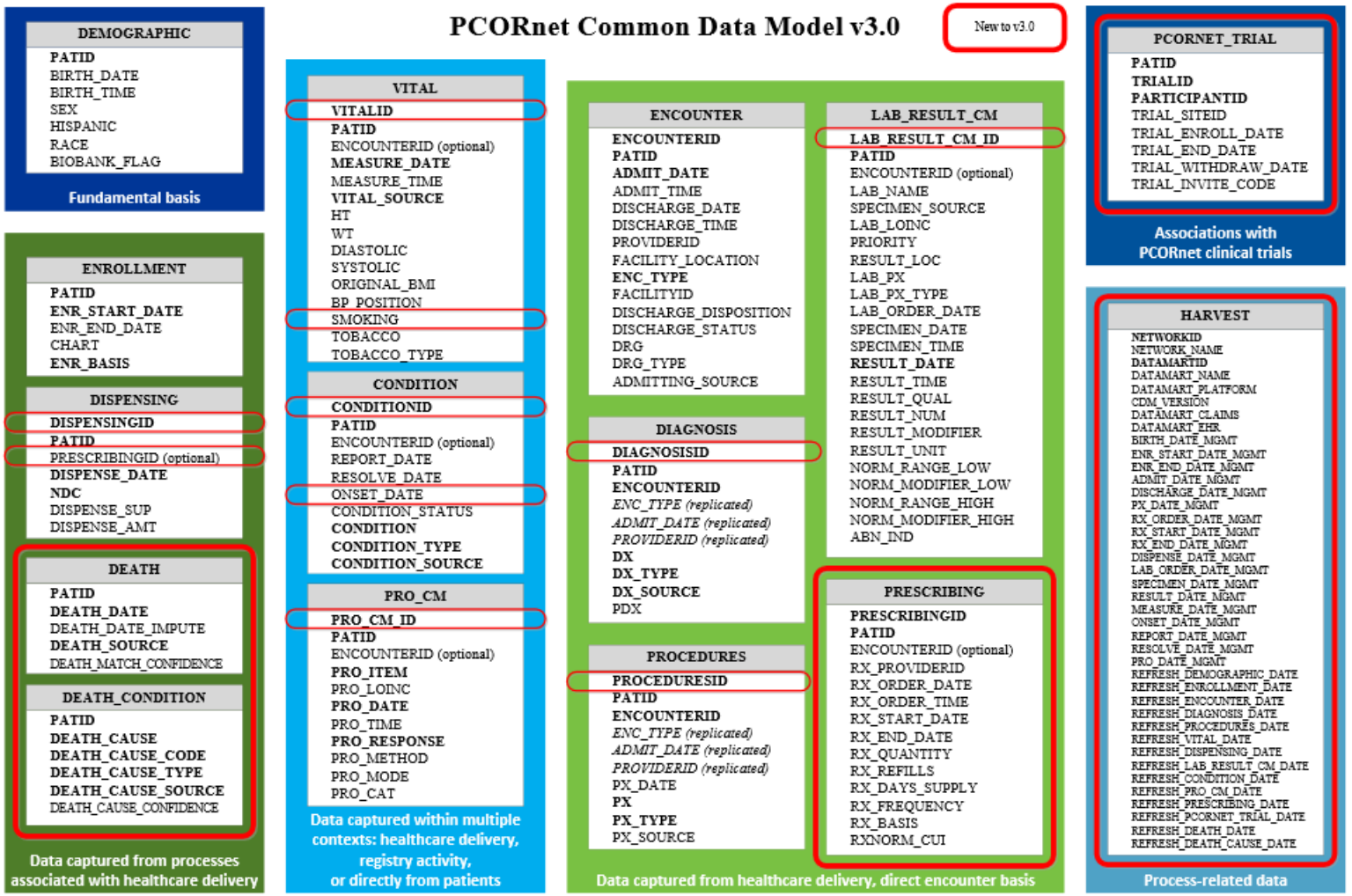
- **OMOP CDM supports CDRN phenotypes** – ADAPTABLE study

Evolution of PCORnet CDMs

PCORnet Common Data Model, Draft v2.0 Modifications



Evolution of PCORnet CDMs



Remaining Tasks

- Complete OMOP v5 to PCORnet v3 CDM standards:
  - Death
  - Reconciliation between PCORnet v1, v2, and v3
- Make ETL code available in GitHub (pSCANNER)

Conclusions

- **Greater granularity of data representation** in OMOP CDM supports
  - Preservation of source data granularity
  - Straightforward transformation to less granular PCORnet
- **OMOP CDM is extendable** without breaking the CDM structure
  - Attributes that do not exist in OMOP can be represented without altering the standard table schema but require a set of documented conventions
  - OMOP CDM can support phenotype definitions not supported in PCORnet CDM
  - Adding non-standard/local concepts cover for missing vocabulary
- **OMOP CDM is a good intermediary data representation** when converting various healthcare datasets to PCORnet CDM

Great collaborative experience

NYC-CDRN

Parsa Mirhaji
Tom Campion
Rajan Chandras
Claudia Pulgarin
Ezra Fass
Karthik Natarajan
Uday Evani
Adler Perotte
Joan Leavey
Jim Singer

OHDSI
Observational Health Data Sciences and Informatics

Patrick Ryan
Chris Reich

pSCANNER

Mark Khayter
Don Torok
Lisa Schilling
Rob Follett
Daniella Meeker

Ritu Khare
Toan Ong
Michael Kahn

pcornet
The National Patient-Centered Clinical Research Network

Shelley Rusincovitch