



Association for
Veterinary Informatics

TRanslational ANimal Shared CoLaboraTive Observational Research (*TRANSLATOR*)

CTSA OneHealth Alliance (COHA) standards based common data model platform for collaborative observational research from cohort discovery to enrollment

Acknowledgements: COHA Team

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- ²Cummings School of Veterinary Medicine, Tufts University, North Grafton, MA, USA
- ³Animal Bioscience Inc, Boston, MA, USA
- ⁴Sackler School of Graduate Biomedical Sciences, Tufts University, Boston, MA, USA
- ⁵Colorado State University College of Veterinary Medicine and Biological Sciences, Ft Collins, CO, USA
- ⁶UC Davis School of Veterinary Medicine, Davis, CA, USA
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About the Presenter

Manlik Kwong BSEE, BSCS

- Engineer/Scientist – Tufts Medical Center’s Institute for Clinical Research and Health Policy Studies (ICRHPS)
- Sr IT Advisor – Tufts Clinical Translational Science Institute (CTSI)
- 11+ yrs Electrocardiograph Algorithm and Device Development
- 20+ yrs Clinical Research System design and implementation (human)

Dr. Virginia Rentko VMD, DACVIM

- Board-certified internal medicine –small animal
- Clinical Associate Professor – Tufts Cummings School of Veterinary Medicine
- Chief Veterinary Medical Officer – Animal Bioscience Inc
- 10+ yrs Hospital Director academic teaching hospital
- 19+ yrs Animal models for drug development

Presentation Agenda

- What is **COHA**
 - Clinical Translational Science Award One Health Alliance (www.ctsaonehealthalliance.org)
- What is **OHDSI, OMOP, and CDMs**
 - Observational Health Data Sciences and Informatics (ohdsi.org)
 - Observational Medical Outcomes Partnership (**OMOP**) Common Data Model (**CDM**)
 - OMOPv5+ CDM
- What is **TRANSLATOR**
 - TRanslational ANimal Shared CoLaboraTive Observational Research

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CTSA One Health Alliance



Clinical and Translational Science Award One Health Alliance

- Formed in 2016
- 15 Veterinary Colleges that have partnered with Medical Colleges on a CTSA
- URL: ctsaonehealthalliance.org

COHA Members



COHA Mission and Approach

- COHA Mission
 - Advance our understanding of diseases shared by humans and animals
 - Leverage the expertise of physicians, research scientists, veterinarians, and other professionals to find solutions for medical problems and to address the well-being of humans, animals, and the environment
- Informatics Strategy to the COHA Mission
 - Common Data Model for human and veterinary data
 - Collaboration with national registries and networks
 - Public/Private registries
 - NCI Cancer Data Commons – Integrated Canine Data Commons

Sadie's Nonhealing Wound Post-op



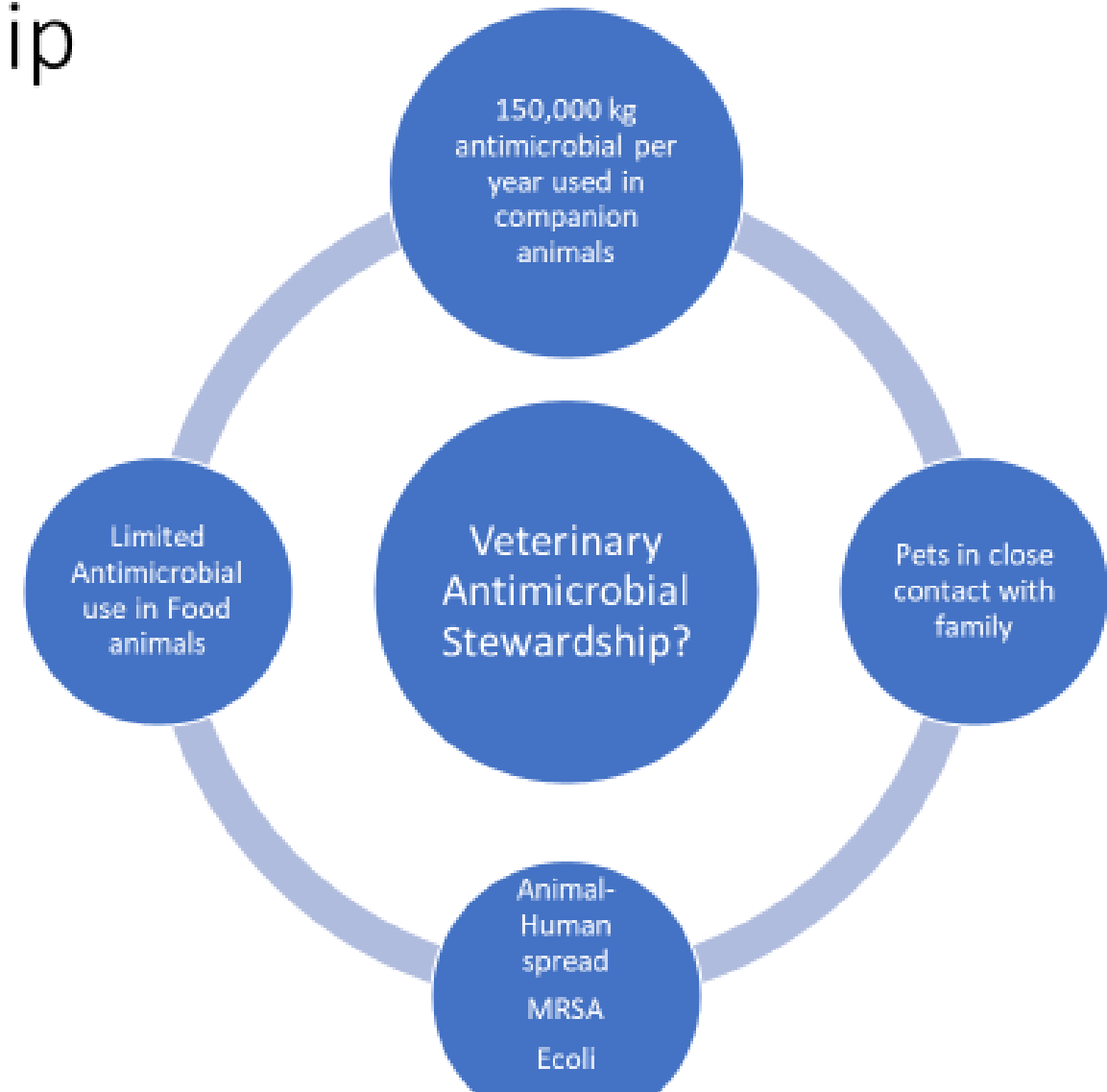
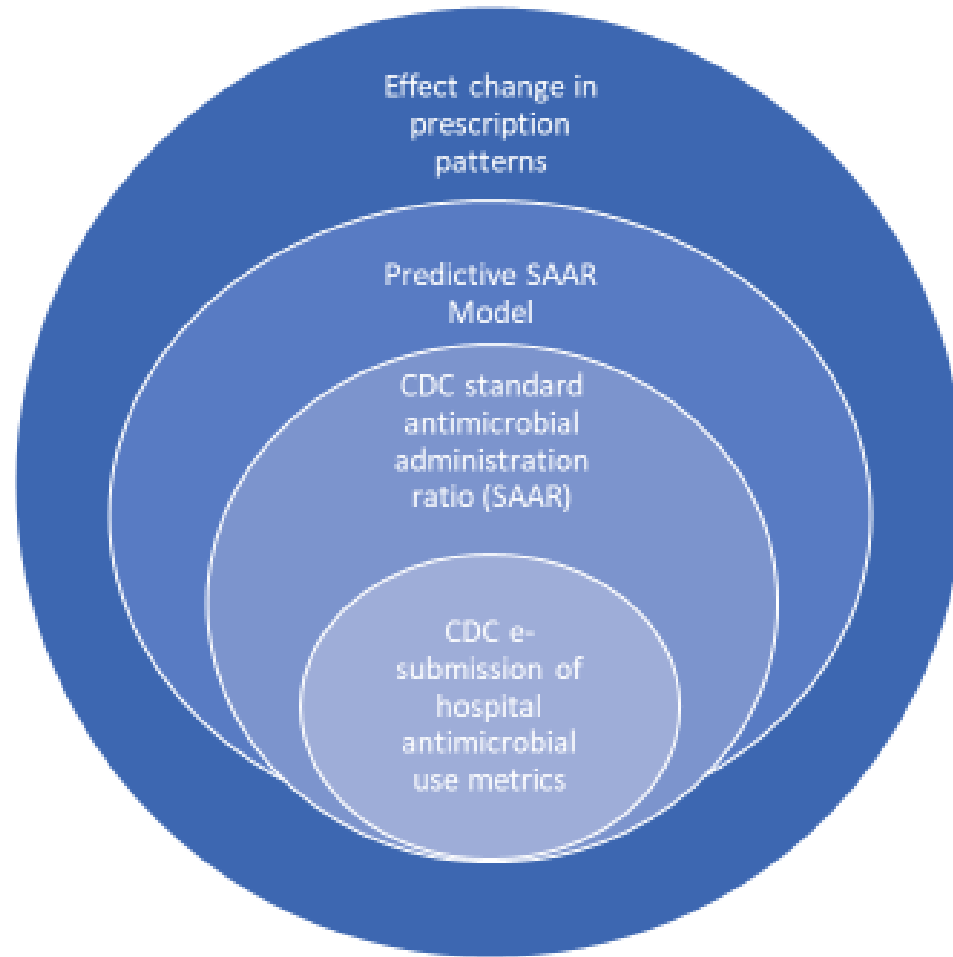
Draining tract
4 wks post op

2nd surgery
to remove
ortho plates

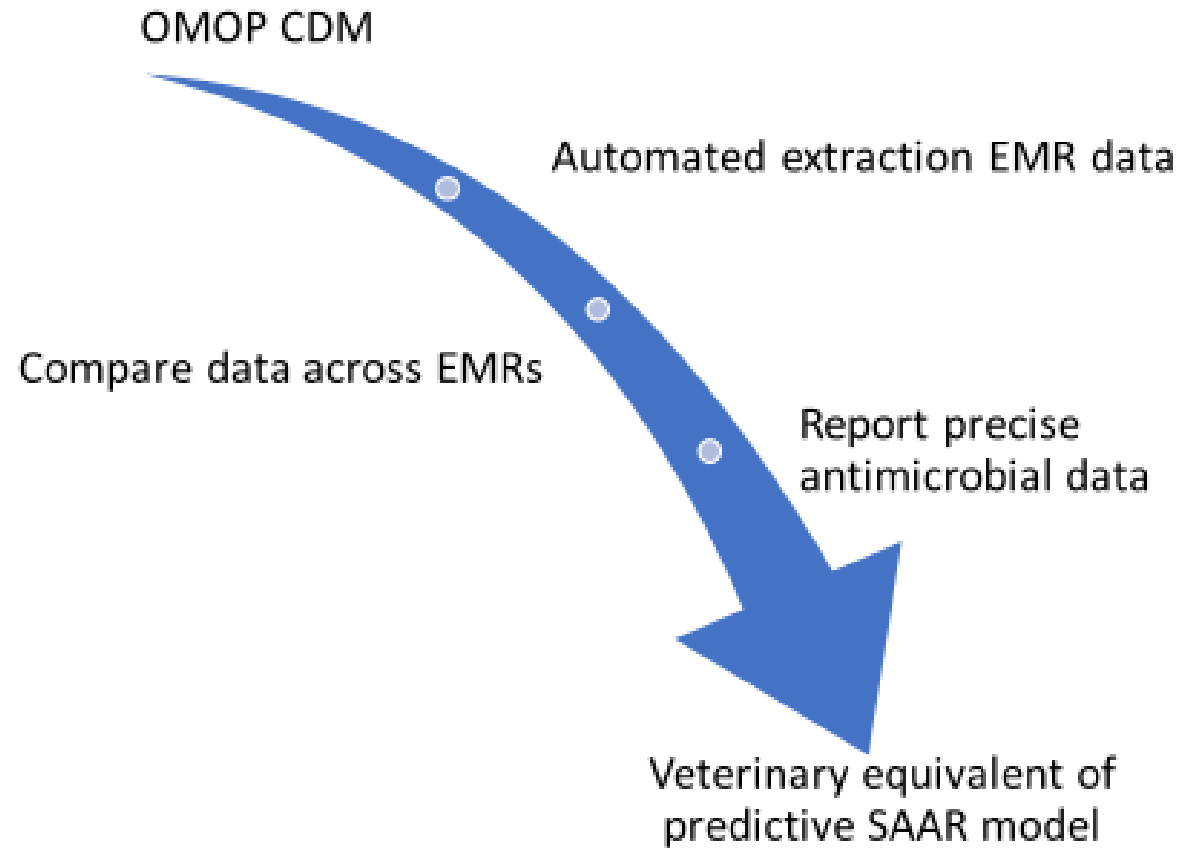
Cultured
Methicillin
resistant Staph

Sadie's human
is a nurse

Antimicrobial Stewardship



One Health Implications



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OHDSI Background

- Observational Health Data Sciences and Informatics (**OHDSI** – ohdsi.org)
- **Mission:** Improving health by empowering a community to collaboratively generate evidence that promotes better health decisions and better care
- **Vision:** Creating a world in which observational research produces a comprehensive understanding of health and disease
- **Values:** Innovation, Reproducibility, Community, Collaboration, Openness, Beneficence

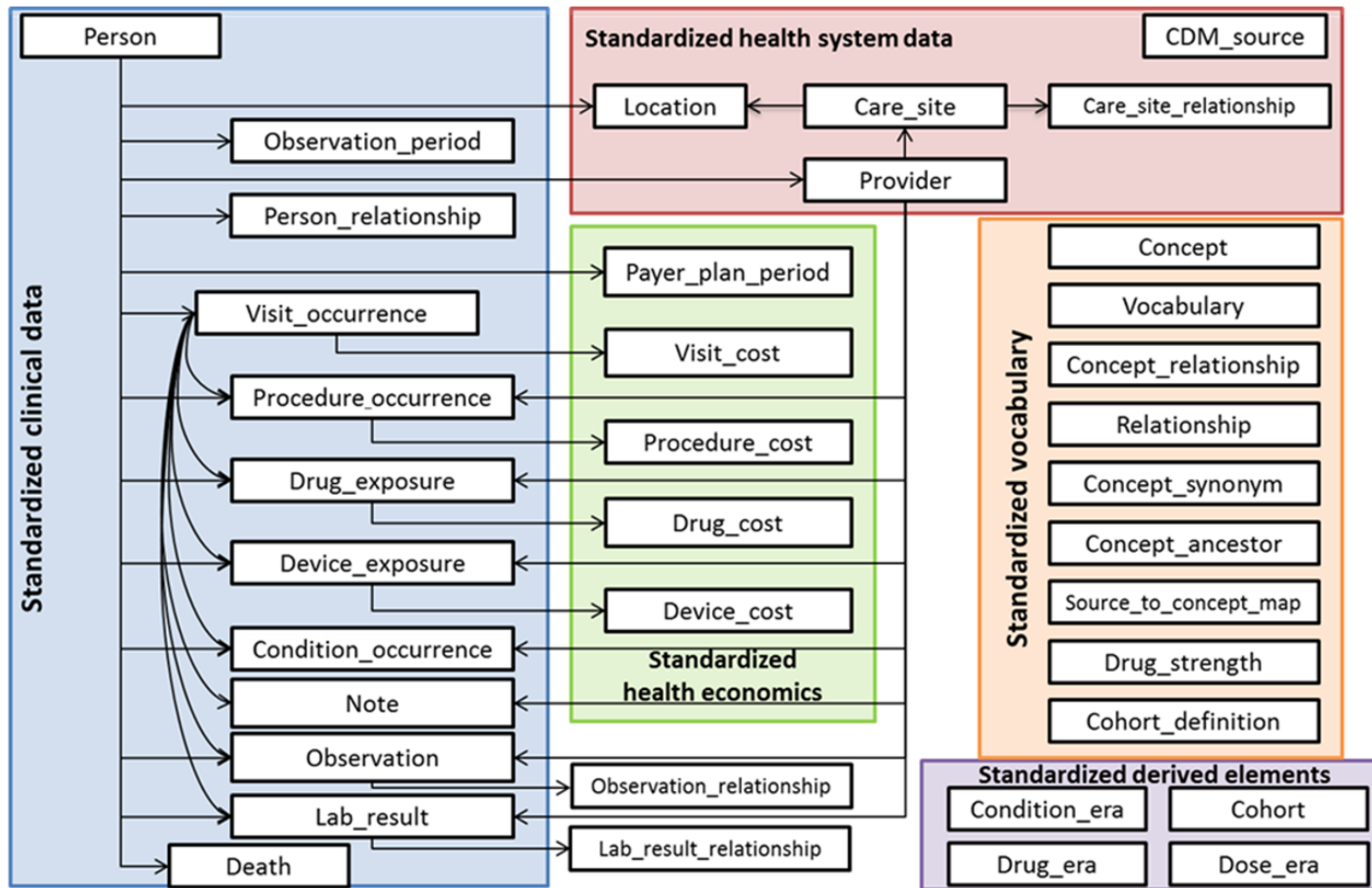
OHDSI Background

- “A multi-stakeholder, interdisciplinary collaborative to bring out the value of health data through large-scale analytics”
- An International Open Source OHDSI Community
 - 2500+ distinct users across
 - 19 countries across 6 continents
 - 100+ different databases
 - 500M+ patient records
 - Central coordinating center at Columbia University
- Annual symposium - www.ohdsi.org/2020-symposium-registration

OMOP Common Data Model (CDM)

- **Observational Medical Outcomes Partnership (**OMOP**) Common Data Model (**CDM**)**
- The OMOP is a public–private partnership that is an initiative of the Foundation for the National Institutes of Health, a 501(c)(3) organization.
- Focused on human care data
- Patient Centric Design
- ***Tufts CTSI's Human OMOP Research Data Warehouse (RDW) went live in Fall 2016***
- Serves Tufts CTSI and affiliates
- Cohort Discovery
- Retrospective studies
- Updated Weekly

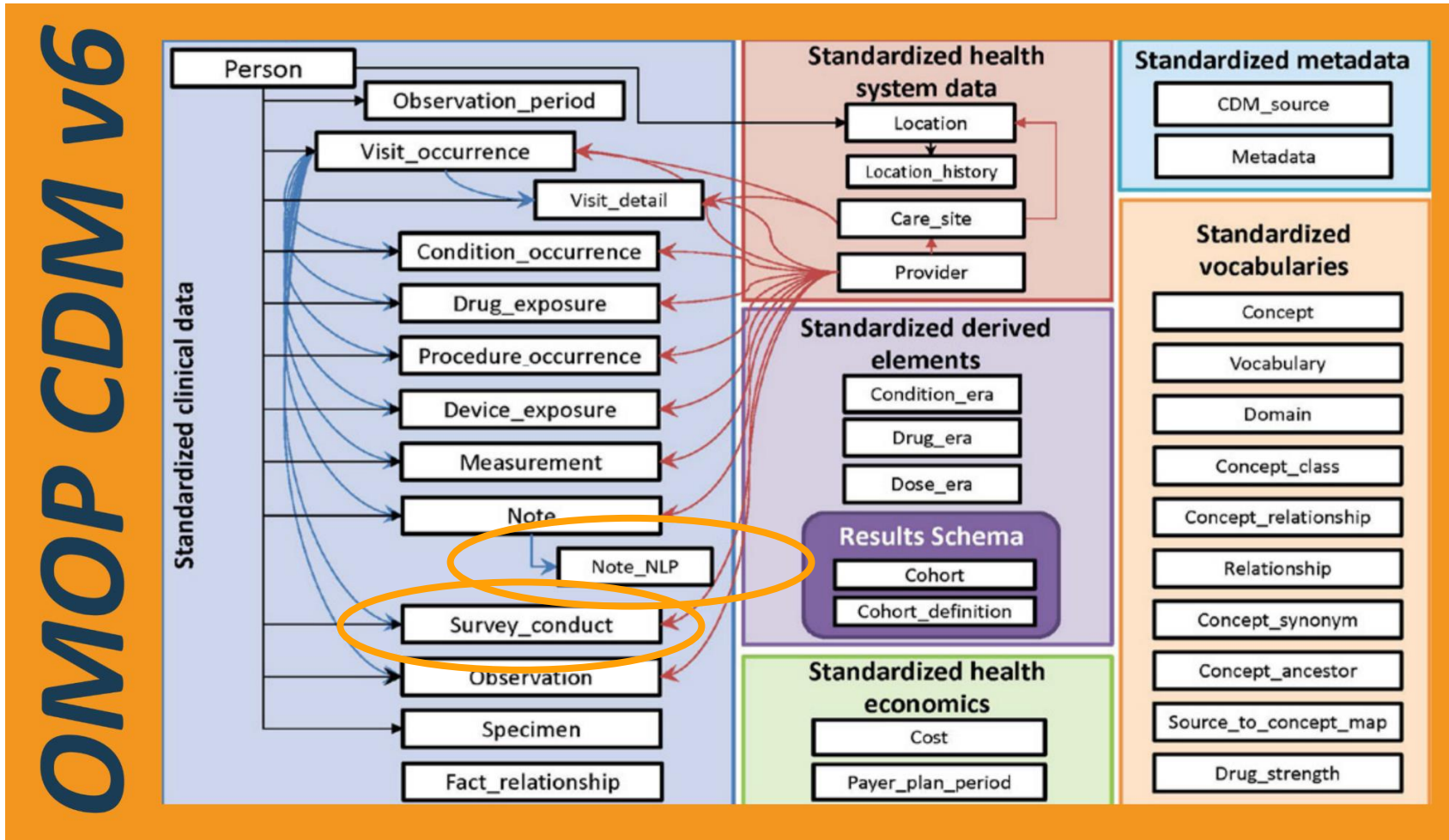
OMOP Common Data Model (CDM)



OMOP CDM Version 5.x

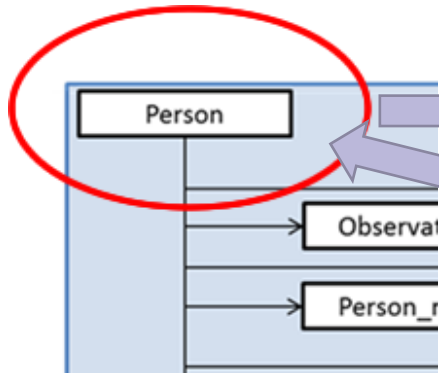
- Patient Centric
- Hospitalization Focus

OMOP Common Data Model (CDM)



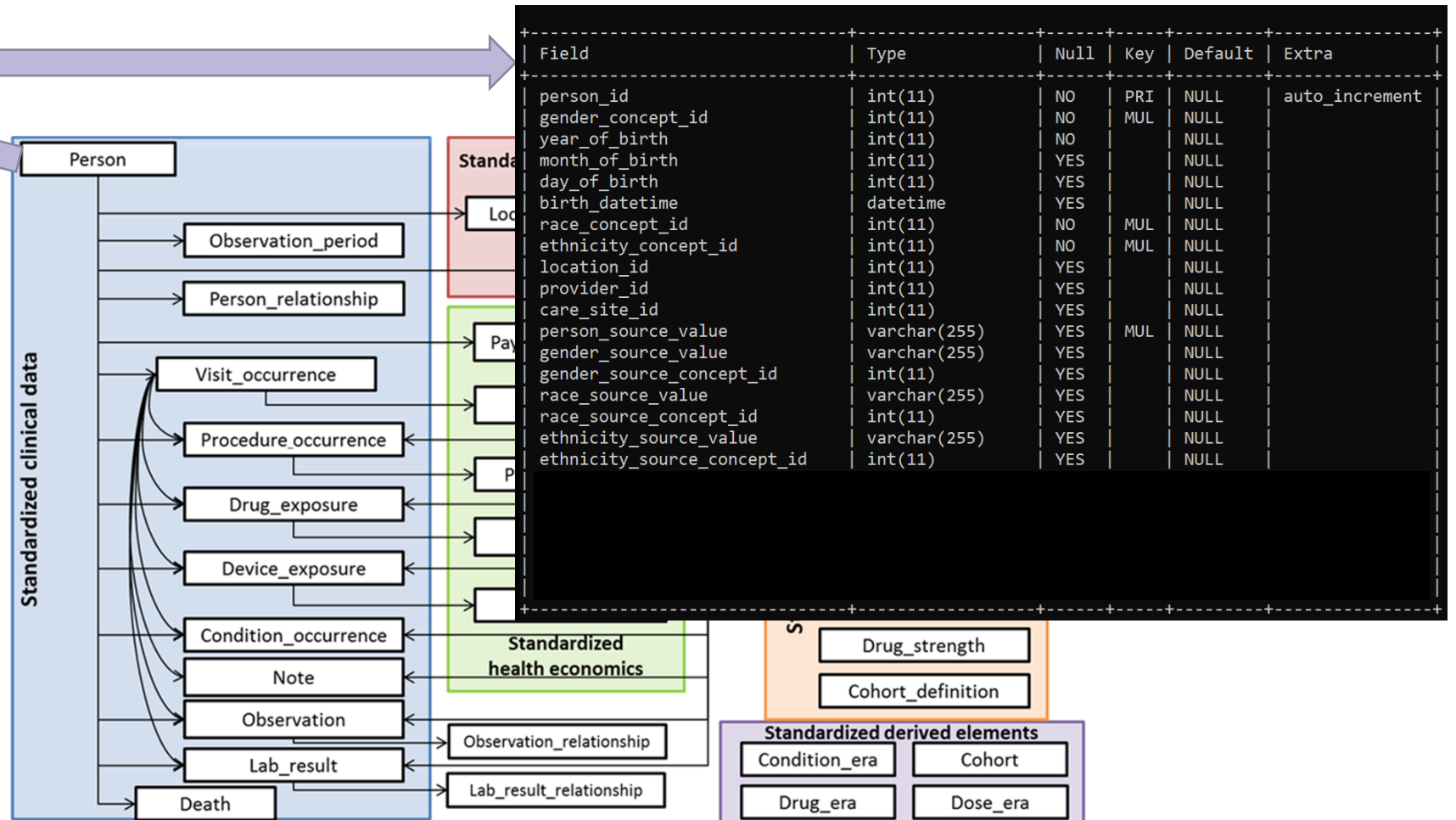
OMOP CDM
Version 6 (2020)

OMOP v5 and v6 Extensions – Veterinary Support

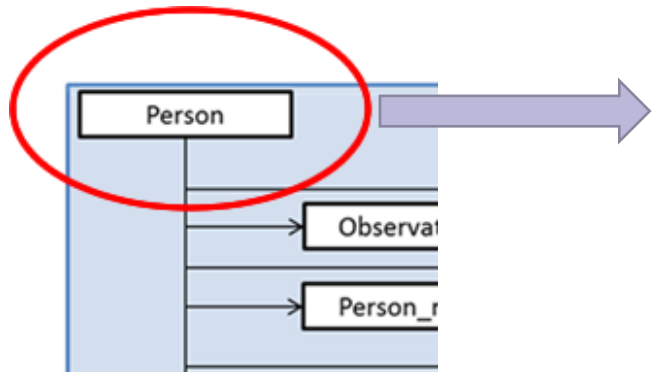


Design Approach

- Retain existing table names
- Only add new field names
- Only add new tables
- Do not eliminate any existing tables

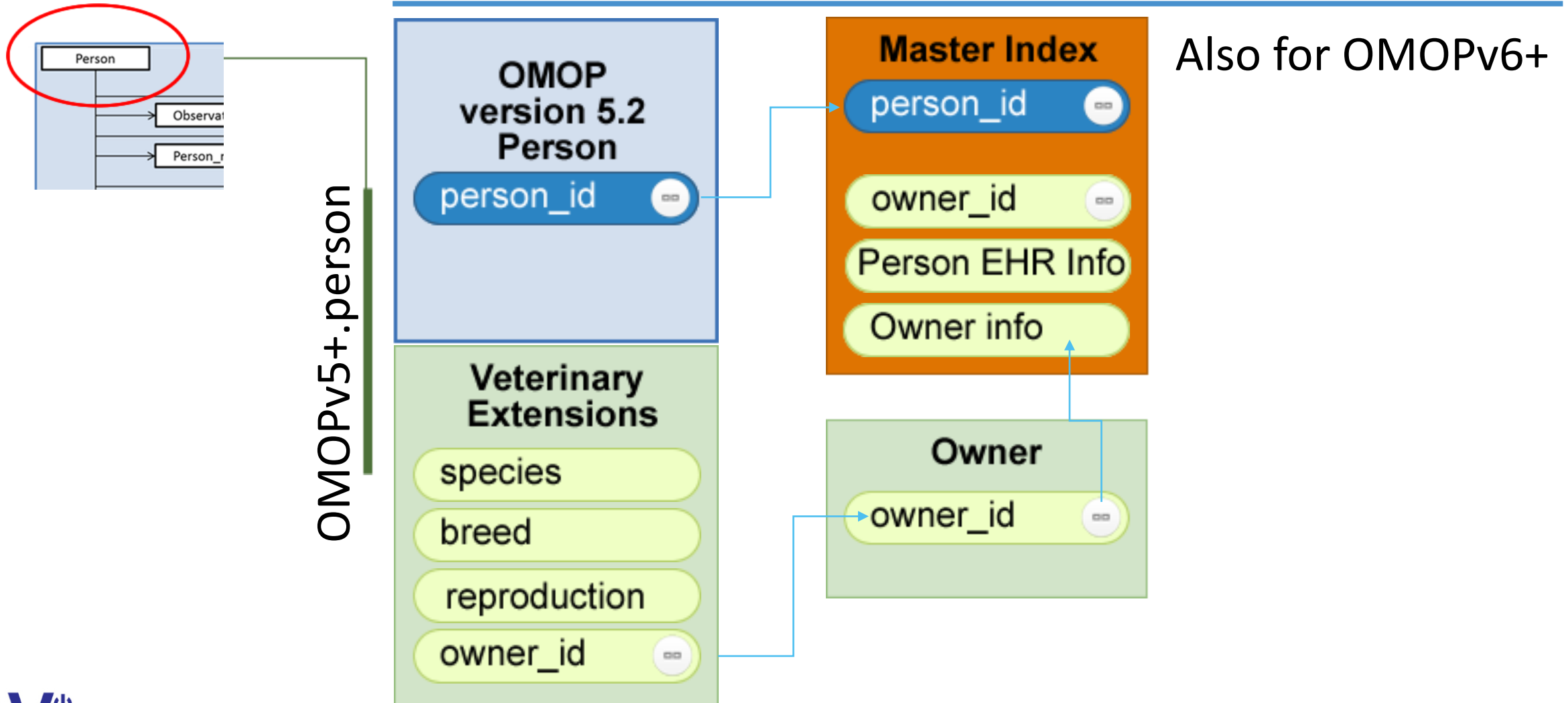


OMOP v5 and v6 Extensions – Veterinary Support

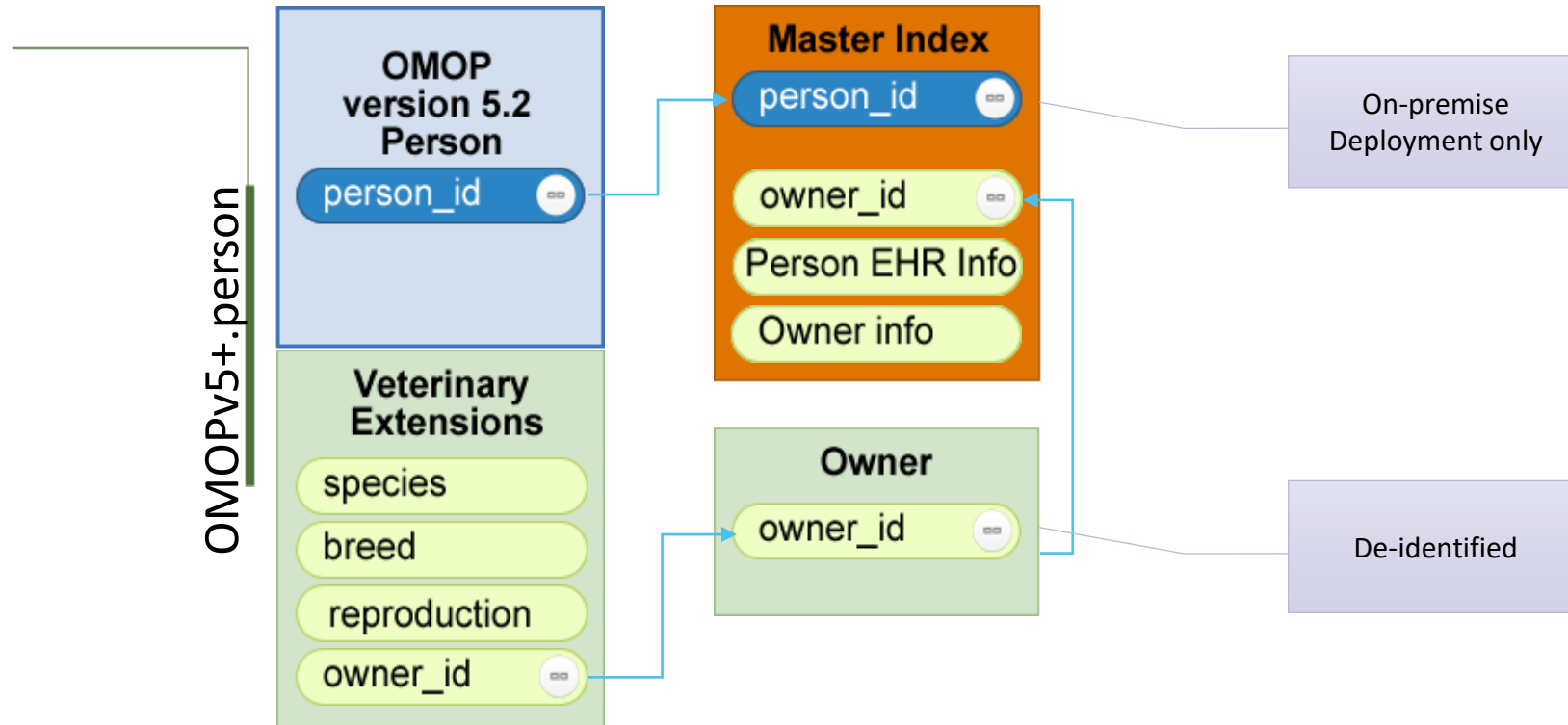


Field	Type	Null	Key	Default	Extra
person_id	int(11)	NO	PRI	NULL	auto_increment
gender_concept_id	int(11)	NO	MUL	NULL	
year_of_birth	int(11)	NO		NULL	
month_of_birth	int(11)	YES		NULL	
day_of_birth	int(11)	YES		NULL	
birth_datetime	datetime	YES		NULL	
race_concept_id	int(11)	NO	MUL	NULL	
ethnicity_concept_id	int(11)	NO	MUL	NULL	
location_id	int(11)	YES		NULL	
provider_id	int(11)	YES		NULL	
care_site_id	int(11)	YES		NULL	
person_source_value	varchar(255)	YES	MUL	NULL	
gender_source_value	varchar(255)	YES		NULL	
gender_source_concept_id	int(11)	YES		NULL	
race_source_value	varchar(255)	YES		NULL	
race_source_concept_id	int(11)	YES		NULL	
ethnicity_source_value	varchar(255)	YES		NULL	
ethnicity_source_concept_id	int(11)	YES		NULL	
species_concept_id	int(10) unsigned	YES		NULL	
species_source_concept_id	int(10) unsigned	YES		NULL	

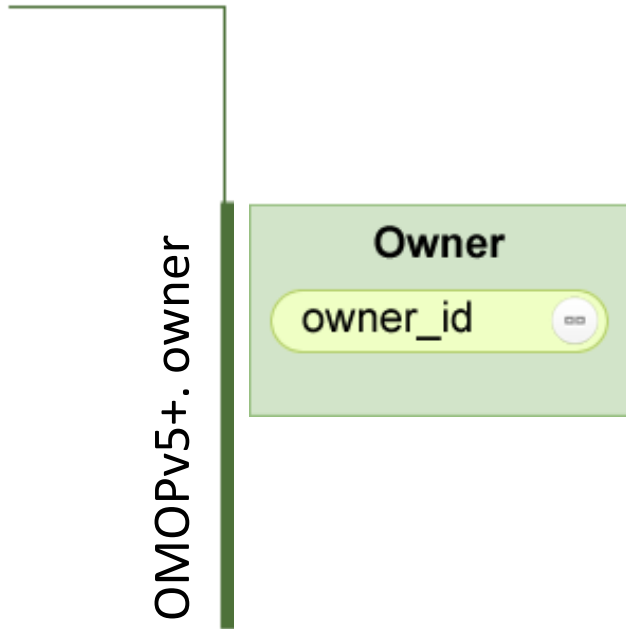
OMOP v5 and v6 Extensions – Veterinary Support



OMOPv5+ Patient Health Information Protection



OMOPv5+ and OMOPv6+ Extensions – Owner Table



Field	Type	Null	Key	Default	Extra
owner_id	int(11)	NO	PRI	NULL	auto_increment
gender_concept_id	int(11)	NO	MUL	NULL	
year_of_birth	int(11)	NO		NULL	
month_of_birth	int(11)	YES		NULL	
race_concept_id	int(11)	NO		NULL	
ethnicity_concept_id	int(11)	NO		NULL	
location_id	int(11)	YES		NULL	
person_source_value	varchar(255)	YES	MUL	NULL	
gender_source_value	varchar(255)	YES		NULL	
gender_source_concept_id	int(11)	YES		NULL	
race_source_value	varchar(255)	YES		NULL	
race_source_concept_id	int(11)	YES		NULL	
ethnicity_source_value	varchar(255)	YES		NULL	
ethnicity_source_concept_id	int(11)	YES		NULL	

OMOPv5+ and OMOPv6+ Extensions – Master Index Table

OMOPv5+.master_index

Master Index

- person_id
- owner_id
- Person EHR Info
- Owner info

Field	Type	Null	Key	Default	Extra
person_id	int(11)	NO	PRI	NULL	
mrn_id	varchar(255)	NO	MUL	NULL	
encounter_id	mediumtext	YES	MUL	NULL	
first_name	varchar(255)	YES		NULL	
last_name	varchar(255)	YES		NULL	
owner_first_name	varchar(255)	YES		NULL	
owner_last_name	varchar(255)	YES		NULL	
owner_id	int(11)	YES		NULL	

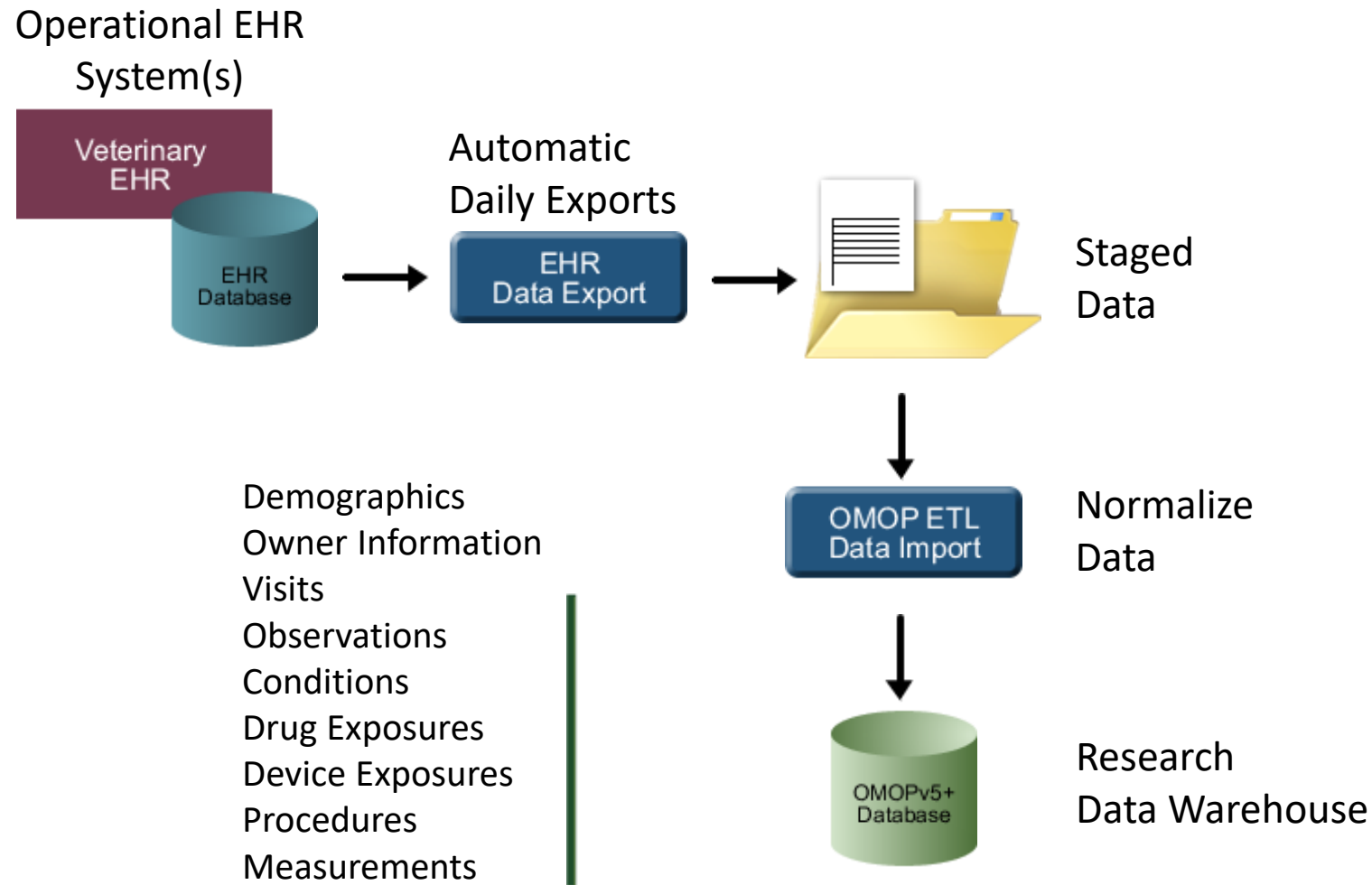
Electronic Health Record to OMOP CDM

- Heterogeneous Electronic Health Records
 - System level – Electronic Medical Record, Radiology, Laboratory, devices
 - Documentation level – local practices, semantics, drop-downs vs free text
- Multi-institution collaboration
- Veterinary registries and repositories
- Data sharing

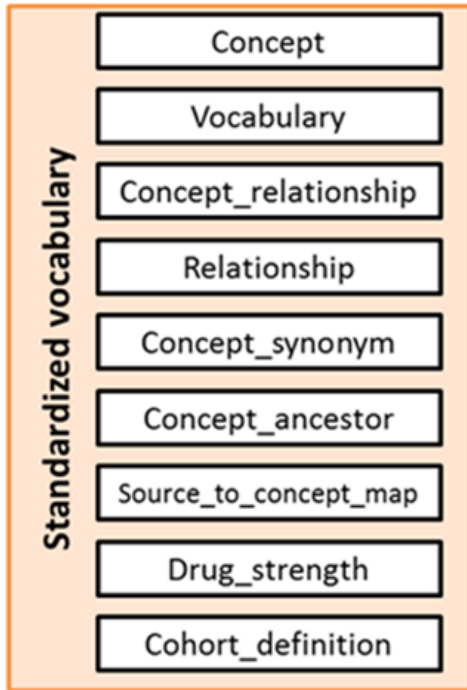
Electronic Health Record to OMOP CDM

- Extract/Transform/Load (ETL) Software
 - Organizes and converts local documentation practices and semantics to a common vocabulary and concepts
 - Also referred to as “Normalization”
- Example: Gender
 - “M”, “Male”, “1”, “COLT”
 - Mapped or Normalized to SNOMED.8507 “MALE”
- ETL Software is also a multi-stage, multi-step process
 - Handles different clinical data sources
 - Invoices, Labs, devices, admissions/discharges, etc
 - Implemented using various languages – SQL, Java, Python, C#/C++, etc

Electronic Health Record to OMOP CDM

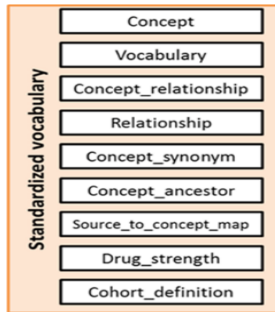


OMOP Vocabularies and Concepts



- What are OMOP Vocabularies?
- Over 140 vocabularies available
 - [SNOMED] Systematic Nomenclature of Medicine - Clinical Terms (IHTSDO)
 - [LOINC] Logical Observation Identifiers Names and Codes (Regenstrief Institute)
 - RxNorm (NLM)
- Concepts - codes and descriptive
 - SNOMED.8507 “MALE”
- All EHR data are mapped to a vocabulary and concept

OMOP Vocabularies and Concepts



Tufts CTSI (Human and Veterinary) Vocabularies

- [SNOMED] Systematic Nomenclature of Medicine - Clinical Terms (IHTSDO)
- [LOINC] Logical Observation Identifiers Names and Codes (Regenstrief Institute)
- RxNorm (NLM)
- Use of standard vocabularies enable federated multi-institution collaborative studies
- Shared queries – federated cohort discovery
- Common semantic between veterinary institutions
- Common semantic between human and veterinary collaboration – One Health studies

OMOP Vocabularies and Concepts - Exceptions

- Not all Veterinary care can be mapped to SNOMED, LOINC, RxNORM
- Example Invoice items:
 - “ACVIM STAGE C, CHRONIC VALVULAR HEART DISEASE”
 - “ADVANTAGE MULTI FOR DOGS (20.1 TO 55 LB)”
 - ” HILLS K9 K/D LAMB”
 - ” HEARTGARD FELINE TABLET”
 - ” HAY PER BALE”
 - Large animal/Large dose medications
- OMOP CDM Support Custom Vocabularies and Concepts
- Work within OHDSI to adopt/extend supported vocabularies and concepts for veterinary medicine

Tufts OMOPv5+ Status

- Tufts COHA Research Data Warehouse (2014 – Jan 2020)
 - Patients (>257,000), Owners (>134K)
 - Visits (>745,000)
 - Treatments (Drugs, Devices, Procedures)
 - Invoiced Items (Drugs, Devices, Procedures, Admissions)
 - Vitals (Measurements)
 - Laboratory results (Measurements, Observations)
 - Cardiology Appointments (Observations/Conditions, Echo Measurements)
 - *Internal Medicine Appointments (Observations/Conditions)
- PubMed Veterinary Publications
 - >745,000 – from 2000-2019 for dogs, cats, horses, pigs
 - > 3.2M mapped concepts (SNOMED, MeSH), > 16,000 unique concepts
 - Additionally > 258K unique search terms (unmapped)
 - [TODO] 12M animal publications from 2000-2020

Current Activities using Tufts OMOPv5+

- Prospective study to identify candidate patients for a cardiac cachexia in dogs
- Retrospective study (2018) on Infection Control and Antimicrobial Stewardship Project funded through Tufts CTSI's Pilot Studies Program
- Integration of Patient Care Reports (REDCap) and genomics data into OMOP – a proof of concept use case
- Tufts/CSU/UC Davis Proof of Concept Use Case demonstrations (Q4-2020)

COHA Resources

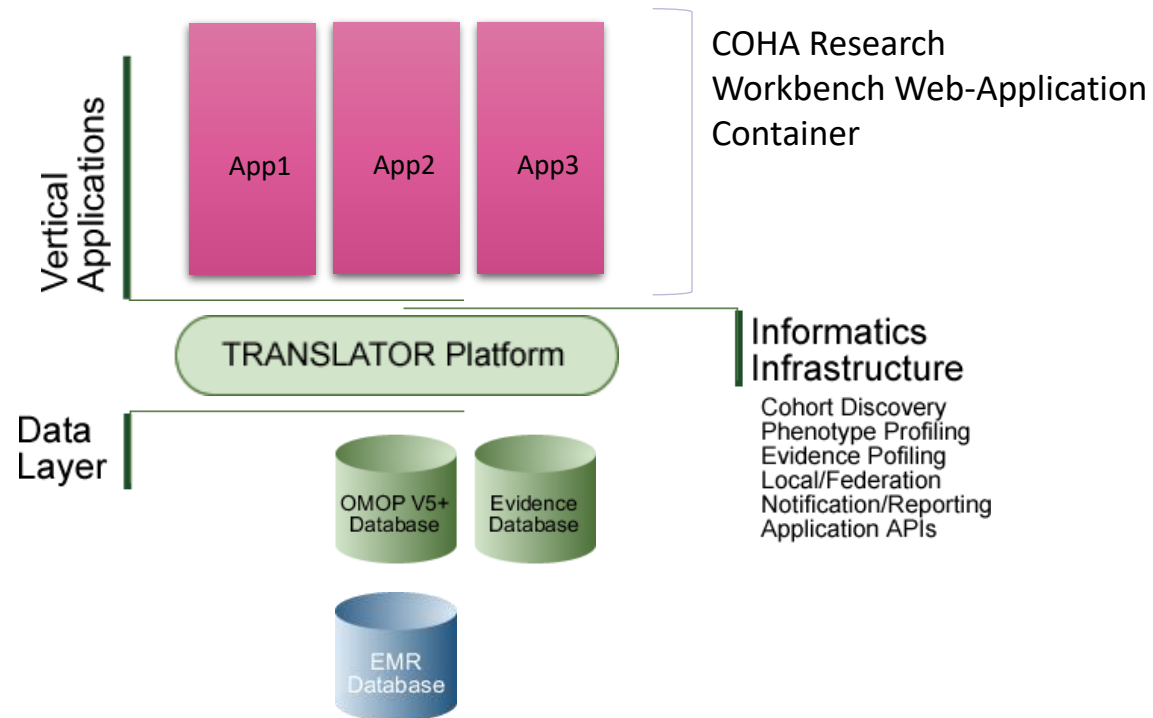
- **COHA Public Website** <https://ctsaonehealthalliance.org/>
 - One Health information
 - Grants and funding opportunity announcements
 - Biorepository
 - Animal Model Repository
- **COHA Research Workbench (CTSA Supplement 2018-2019)**
 - Configurable web-based application – On-Premise, Federated, and Centralized
 - Preparatory to Research tools that are fully OMOP V5+ Aware
 - User Interface designed for Clinicians in mind
 - Includes Research Warehouse for evidence-base generation (PubMed veterinary publication search using OMOP standard vocabularies and concepts)

Presentation Agenda

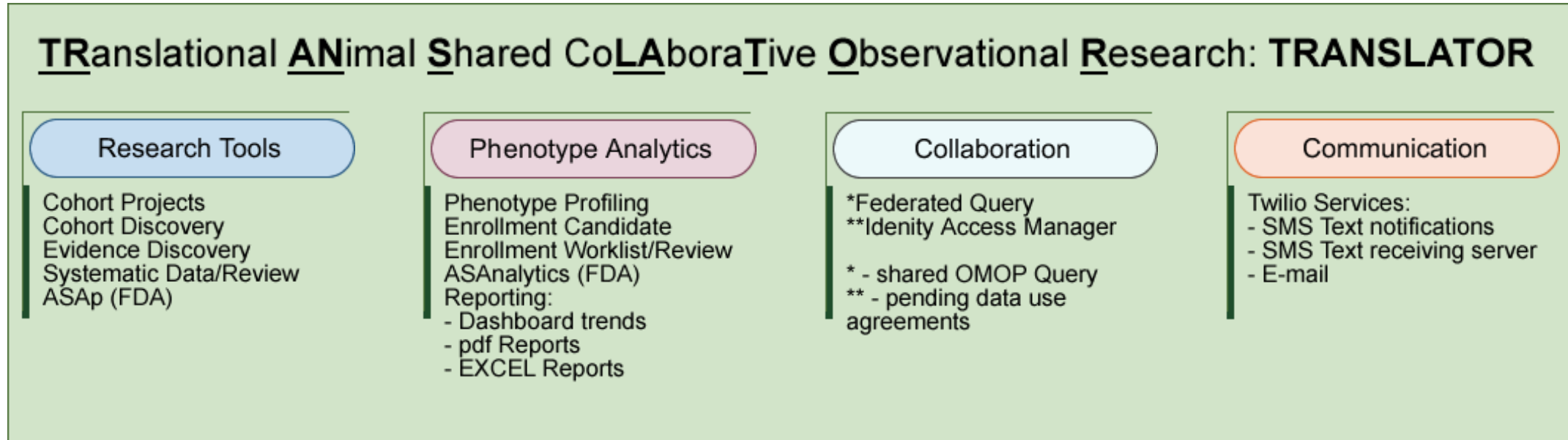
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COHA TRANSLATOR

- **T**ranslational **A**nimal **S**hared Co**L**abora**T**ive **O**bservational **R**esearch (**TRANSLATOR**)
- A Technology Platform
- A Middleware Layer



TRANSLATOR Components

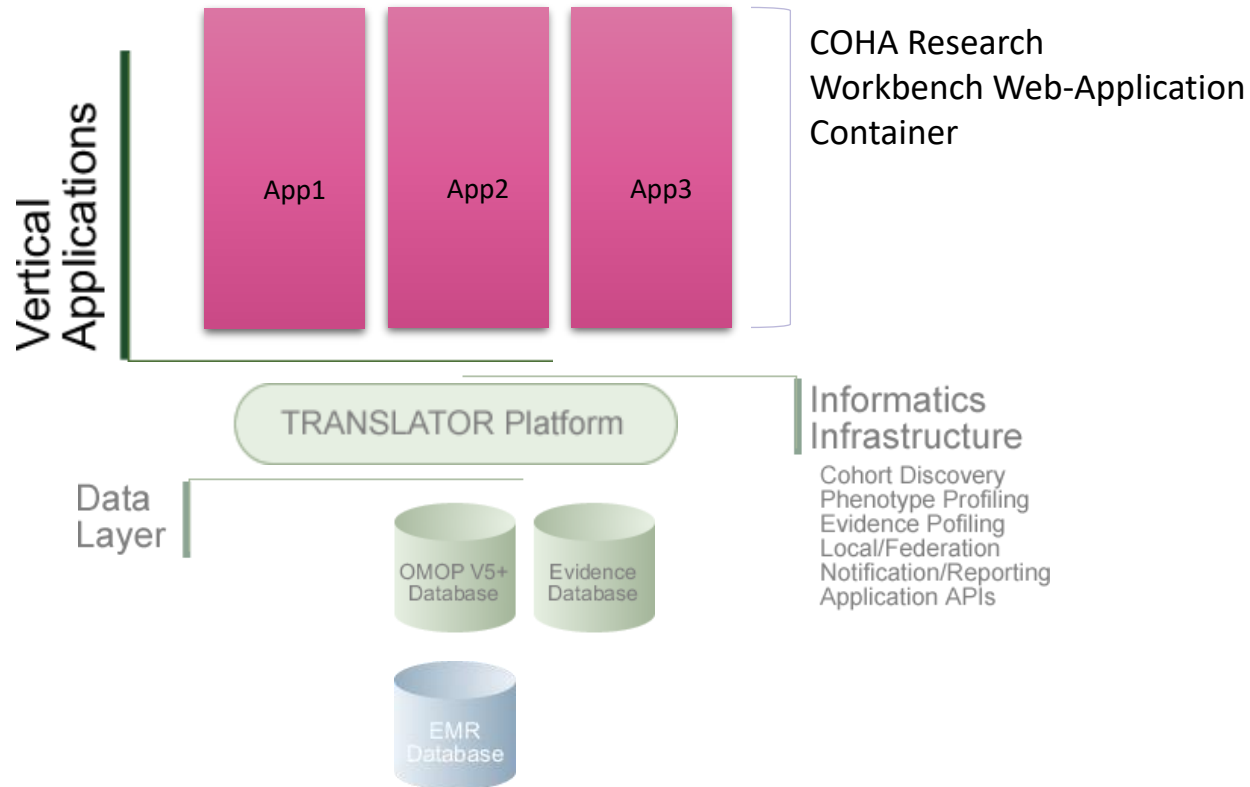


TRANSLATOR Technologies

- Standard/Open Source Technologies
 - Java Programming Language J2SE 1.8
 - Apache.org POI – the Java API for Microsoft Documents
 - Apache.org XML
 - Apache.org PDFBox – A Java PDF Library
- Twilio Communication - SMS Text message for Java library
- Oracle MySQL database drivers and client applications
- iMedical Solutions LLC – Database and Systematic Review System libraries
- Tufts CTSI Research Technologies
 - Extraction/Transform/Load – ETL
 - EHR Data Handler
 - OMOP Maps and Analysis development tools

COHA Research Workbench Application

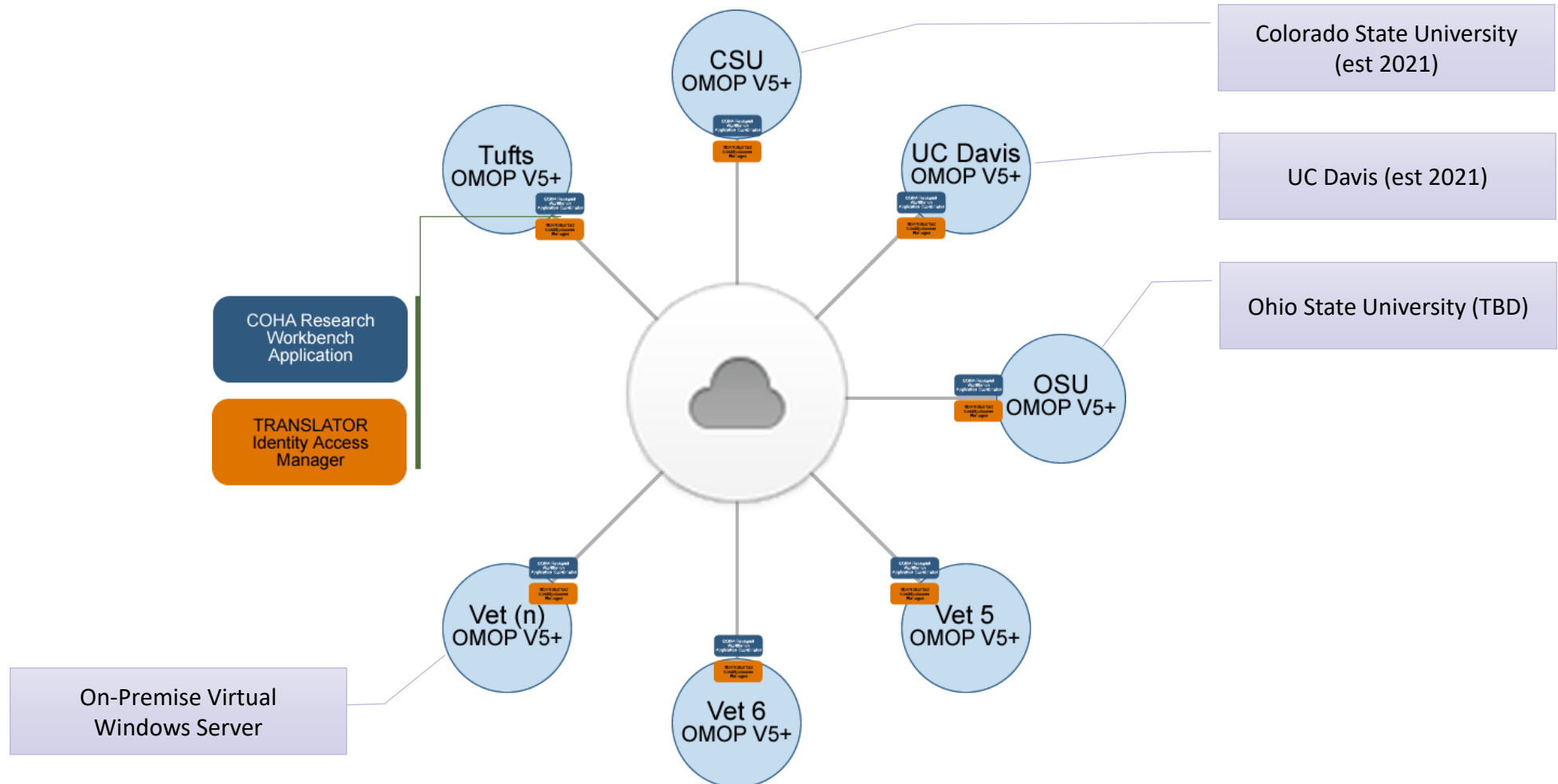
- Application Layer



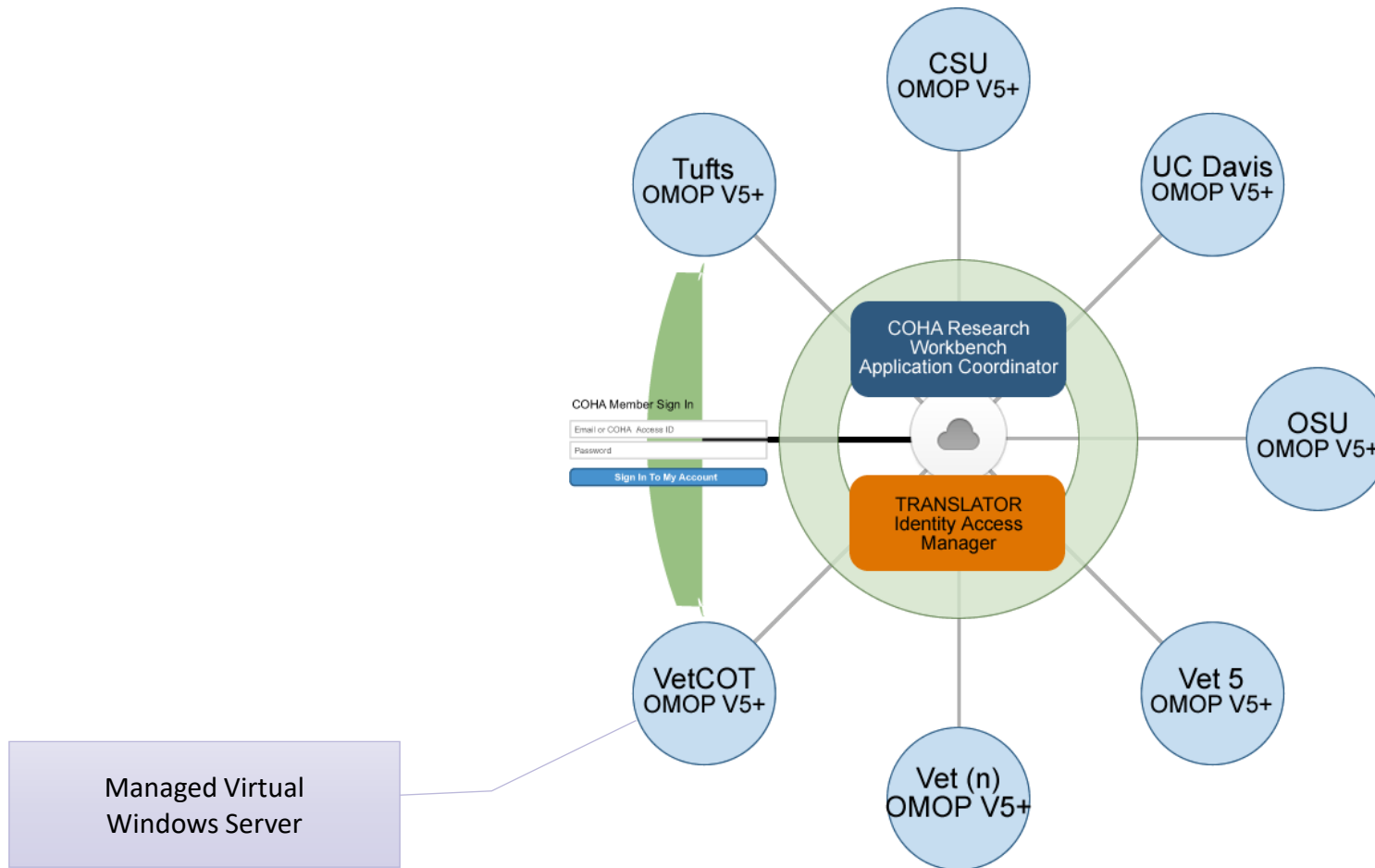
COHA Research Workbench Status

- COHA Research Workbench Tools
 - Preparatory to Research toolset
 - Evidence Generation – 2000 – 2019 PubMed abstracts
 - Electronic Patient Records – local OMOP V5+ Aware
 - Federated Cohort Discovery – generates SQL command for export
 - Patient Identification/Enrollment – Twilio SMS text
 - Cohort/Project Management

TRANSLATOR Network Topology - Federated



TRANSLATOR Network Topology - Centralized



Thank You

Manlik Kwong
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Questions & Answers



#BetterDataSavesPets

Education Opportunities:



Annual Talbot Symposium

VMX 2021

Virtual Education, TBA

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#Talbot20



#BetterDataSavesPets

Extra Slides

Clinical Translational Science Award (CTSA)

- What is a **C**linical **T**ranslational **S**cience **A**ward Hub?
 - **N**ational **C**enter for **A**dvancing **T**ranslational **S**ciences (**NCATS**) funded program that supports a national network of medical research institutions (human focus) – called “CTSA Hubs”
- 50+ CTSA Hubs across the US competitive 5 year funding cycle
- \$559M in funded activities (2019)
- Multi-disciplinary, multi-site collaborative research
- Focus on system-wide scientific and operational problems in clinical and translational research
- CTSA Hubs are also called Clinical Translational Science Institutes – CTSI
- See ncats.nih.gov/ctsa/about

CTSA Program

- Activities to test and develop innovative approaches to barriers in clinical research
 - Investigator Training and Career Development
 - Patient and community engagement
 - Underserved populations
 - Advance use of Informatics in clinical studies
- Trial Innovation Network
 - Trial Innovation Centers
 - Recruitment Innovation Center
 - CTSI Program hubs
- Streamlined, Multisite, Accelerated Resource for Trials (SMART)
 - Single-IRB reliance platform for multi-site clinical studies