Feasible Medical Image Extension from **DICOM** to **OMOP CDM**

Development of Medical Imaging Data Standardization for Imaging Based Observational Research
: OMOP CDM Extension

👤 PRESENTER: **Seng Chan** You

INTRO:
- This study aims to bridge the gap between imaging research and observational research by integrating image-based measurements into OMOP CDM.
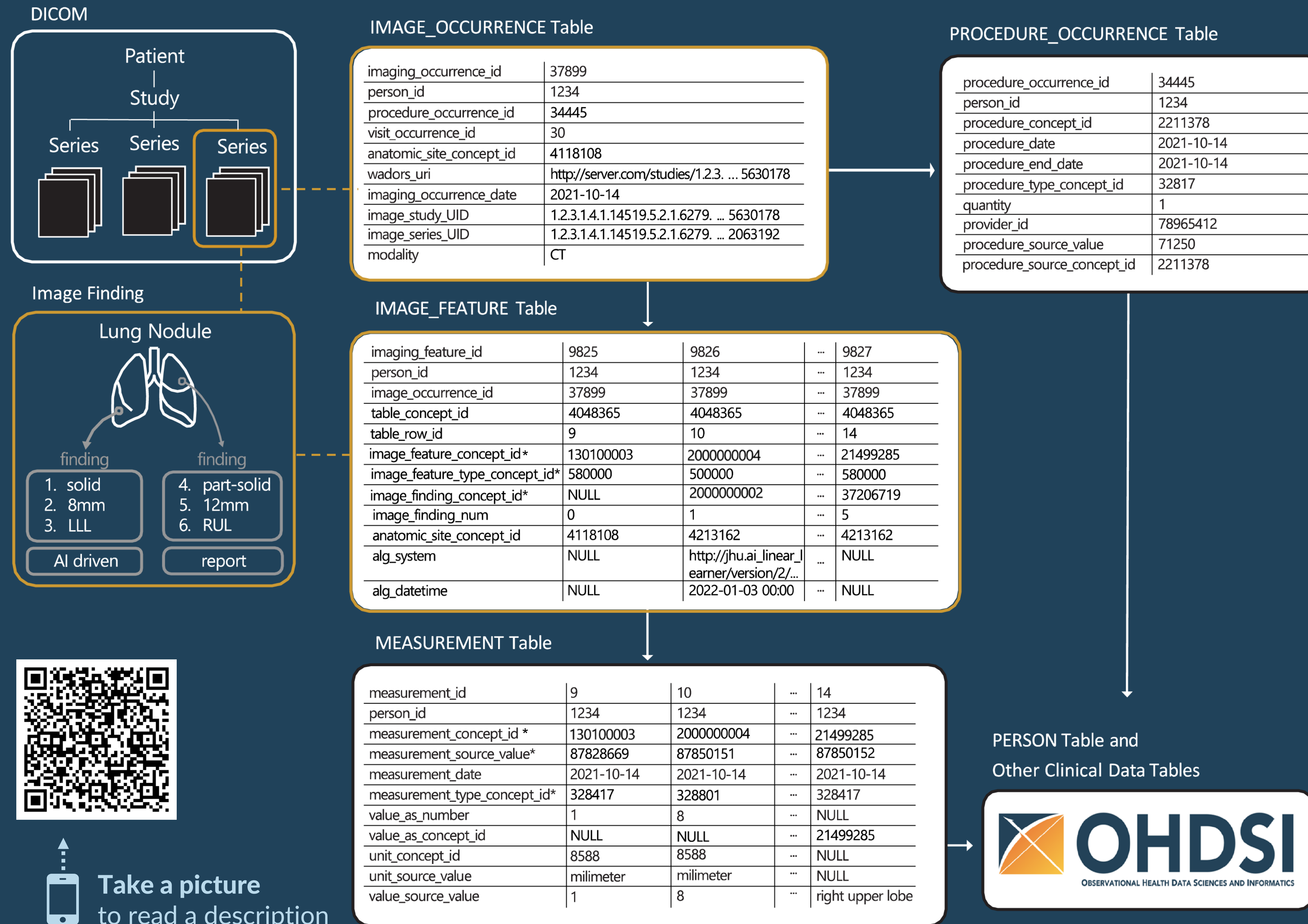
METHODS
1. The research team includes imaging researchers and observational researchers who are familiar with OMOP CDM, and researchers on various fields were consulted to gather insights.
2. This study designed new tables to encompass imaging events and features provenance, following the OMOP CDM conventions.
3. Contrary to Radiology-CDM (You et al., 2020), the proposed model incorporates a broader range of medical specialties and references more clinical domain tables from the existing OMOP CDM.

RESULTS
- We have developed two tables, **Image_occurrence** table and **Image_feature** table, for standardized representation of complex medical imaging events and features.
- We propose to incorporate widely used imaging vocabularies such as **DICOM** and **RadLex** into OMOP CDM Standard Vocabulary table.

Contact: seng.chan.you@ohdsi.org

OMOP-CDM MEDICAL IMAGE EXTENSION

DICOM

Patient
Study
Series | Series | Series

Image Finding

Lung Nodule

finding
1. solid
2. 8mm
3. LLL

finding
4. part-solid
5. 12mm
6. RUL

AI driven | report

Take a picture to read a description

IMAGE_OCCURRENCE Table

imaging_occurrence_id	37899
person_id	1234
procedure_occurrence_id	34445
visit_occurrence_id	30
anatomic_site_concept_id	4118108
wadors_uri	http://server.com/studies/1.2.3. ... 5630178
imaging_occurrence_date	2021-10-14
image_study_UID	1.2.3.1.4.1.14519.5.2.1.6279. ... 5630178
image_series_UID	1.2.3.1.4.1.14519.5.2.1.6279. ... 2063192
modality	CT

IMAGE_FEATURE Table

imaging_feature_id	9825	9826	...	9827
person_id	1234	1234	...	1234
image_occurrence_id	37899	37899	...	37899
table_concept_id	4048365	4048365	...	4048365
table_row_id	9	10	...	14
image_feature_concept_id*	130100003	2000000004	...	21499285
image_feature_type_concept_id*	580000	500000	...	580000
image_finding_concept_id*	NULL	2000000002	...	37206719
image_finding_num	0	1	...	5
anatomic_site_concept_id	4118108	4213162	...	4213162
alg_system	NULL	http://jhu.ai_linear_learner/version/2/...	...	NULL
alg_datetime	NULL	2022-01-03 00:00	...	NULL

MEASUREMENT Table

measurement_id	9	10	...	14
person_id	1234	1234	...	1234
measurement_concept_id *	130100003	2000000004	...	21499285
measurement_source_value*	87828669	87850151	...	87850152
measurement_date	2021-10-14	2021-10-14	...	2021-10-14
measurement_type_concept_id*	328417	328801	...	328417
value_as_number	1	8	...	NULL
value_as_concept_id	NULL	NULL	...	21499285
unit_concept_id	8588	8588	...	NULL
unit_source_value	milimeter	milimeter	...	NULL
value_source_value	1	8	...	right upper lobe

PROCEDURE_OCCURRENCE Table

procedure_occurrence_id	34445
person_id	1234
procedure_concept_id	2211378
procedure_date	2021-10-14
procedure_end_date	2021-10-14
procedure_type_concept_id	32817
quantity	1
provider_id	78965412
procedure_source_value	71250
procedure_source_concept_id	2211378

PERSON Table and Other Clinical Data Tables

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	Image_occurrence	**Image_feature**
Semantics	**DICOM** • Properties of image acquisition **SNOMED** • Anatomical Location & Procedures	**RadLex** • Radiological Findings absent from SNOMED **SNOMED** • Anatomical Location **LOINC** • Measurements
Structure	1. Link to the DICOM images at the study or series level 2. Link Procedure_occurrence to Image_occurrence 3. Provide provenance for Image_feature 4. Incorporate basic acquisition parameters into cohort definitions	1. Provide provenance from a clinical data table entry of a feature extracted from a medical image 2. Link to Image_occurrence to point to which images were used to create the feature at the study or series level 3. Provide a grouper to group multiple imaging features 4. Provide provenance of the algorithms and parameters used to create the Image_feature

Procedure_occurrence
↕ has
Image_occurrence
↕ has
Image_feature
↕ located_in
Clinical-Domain-Table
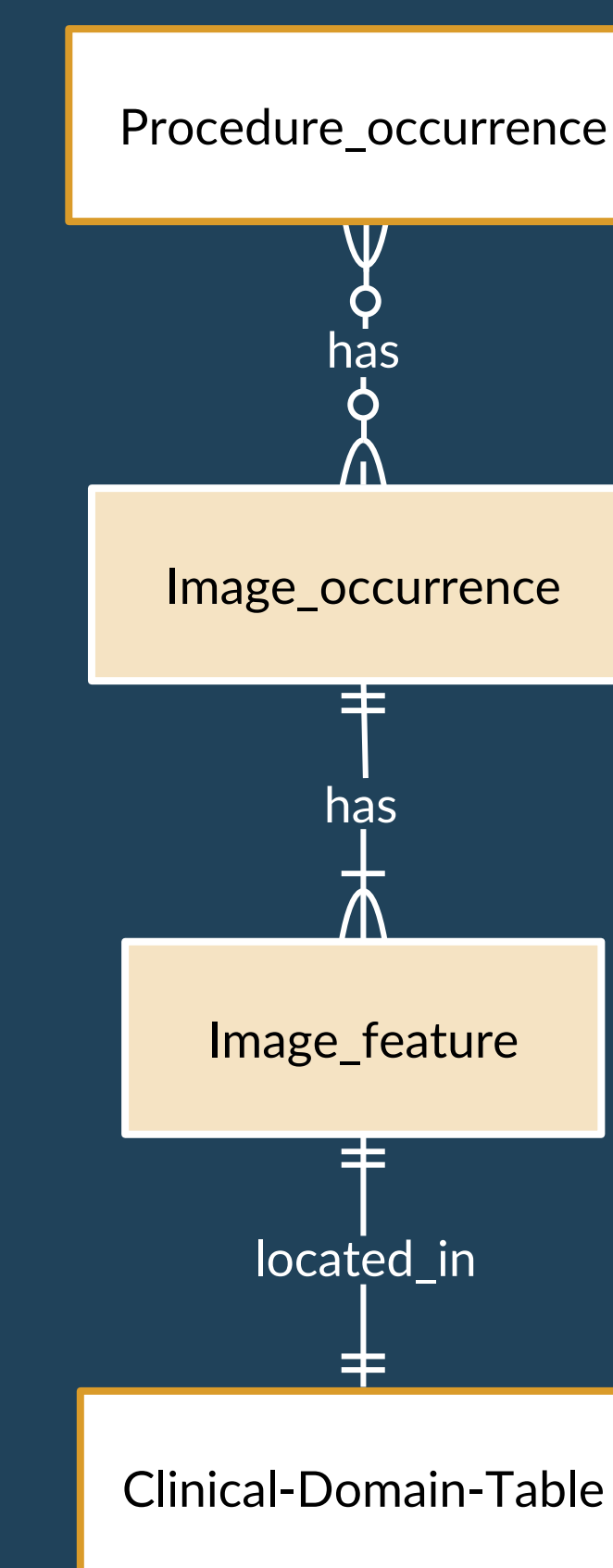
Development of medical imaging data model
- The Image_occurrence table describes imaging events and provides provenance to the imaging study stored in DICOM format on a PACS or a VNA
- The Image_feature table describes the provenance and the features of the imaging findings

Standardization in medical imaging data representation
- The Image_occurrence table use DICOM attributes and value sets as the standard vocabulary

Image_occurrence field	DICOM attribute
wadors_uri	DICOMweb URI
image_occurrence_date	(0008,0020) Study Date
image_study_UID	(0020, 000D) Study Instance UID
image_series_UID	(0020, 000E) Series Instance UID
modality	(0008, 0060) Modality; Part 16: CID 33 Modality includes Acquisition (CID 29) and Non-Acquisition (CID 32) modality

<Image_occurrence mapping from DICOM attributes>

- The Image_feature table is focused on imaging features and the values are primarily defined in DICOM Context Groups and the RadLex vocabularies

Integration with OMOP CDM
- Both tables include person_id from the Person table and they can link to the Visit_occurrence table through visit_occurrence_id
- The Image_occurrence table has a many-to-many relationship with the Procedure_occurrence table
- The Image_feature table has a one-to-many relationship with the Image_occurrence table and one-to-one with clinical data tables

👤 **Woo Yeon Park, Kyulee Jeon, Teri Sippel Schmidt, Haridimos Kondylakis, Seng Chan You, Paul Nagy**

JOHNS HOPKINS SCHOOL of MEDICINE

YONSEI UNIVERSITY

OHDSI