

# AI-BASED HEALTH SIGNALS DISCOVERY ENGINE



# LEARNING OBJECTIVES

- Integrated lexicon-based data extraction
- Actionable insight from dark matter →
- Improve population health analytics



Machine Learning

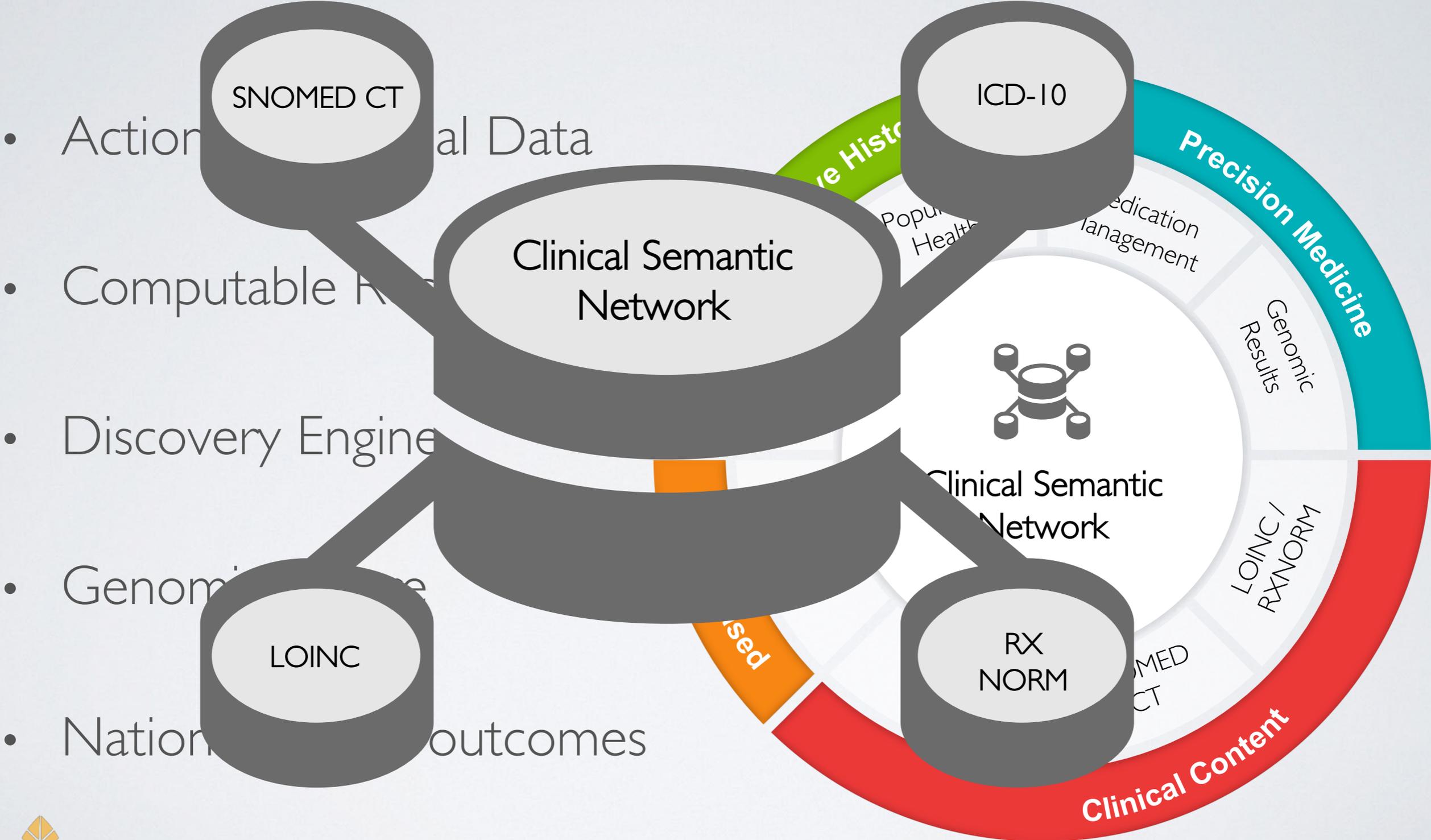


Clinical Insights



Discovery Engine

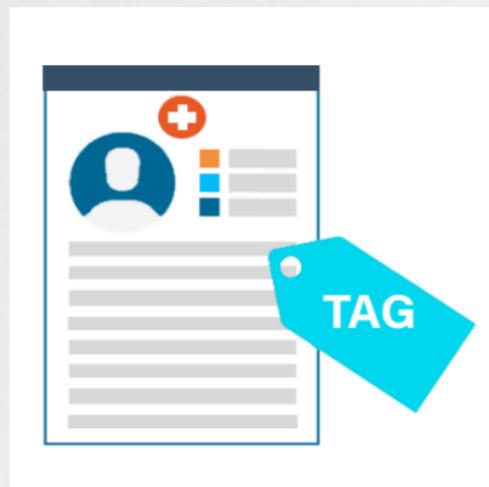
# CLINICAL SEMANTIC NETWORK



# THE VIRTUAL CSN (VCSN)



Virtualize the CSN Lexicon - integrated with industry terminologies (i.e. SNOMED CT)

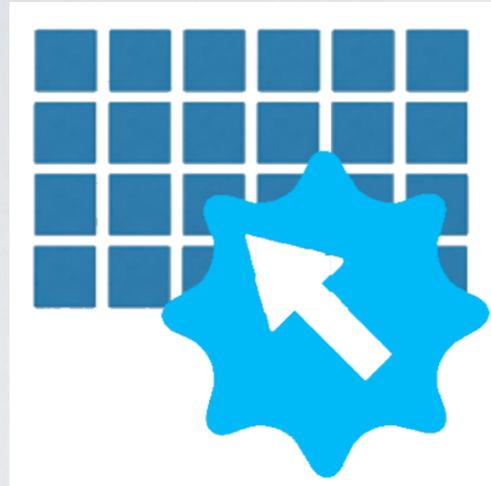


“Mark up” or “tag” unstructured healthcare records

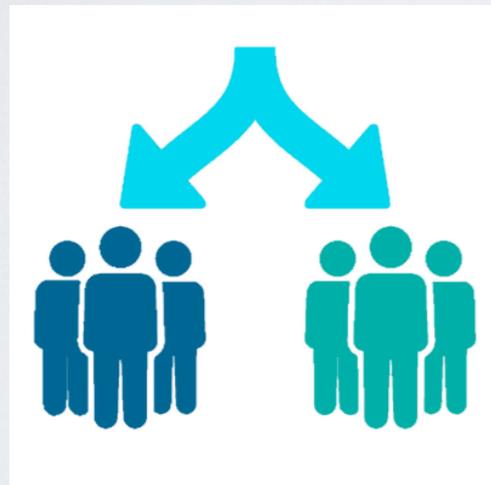


Convert the extracted terms to clinical insights

# THE VIRTUAL CSN (CONT.)

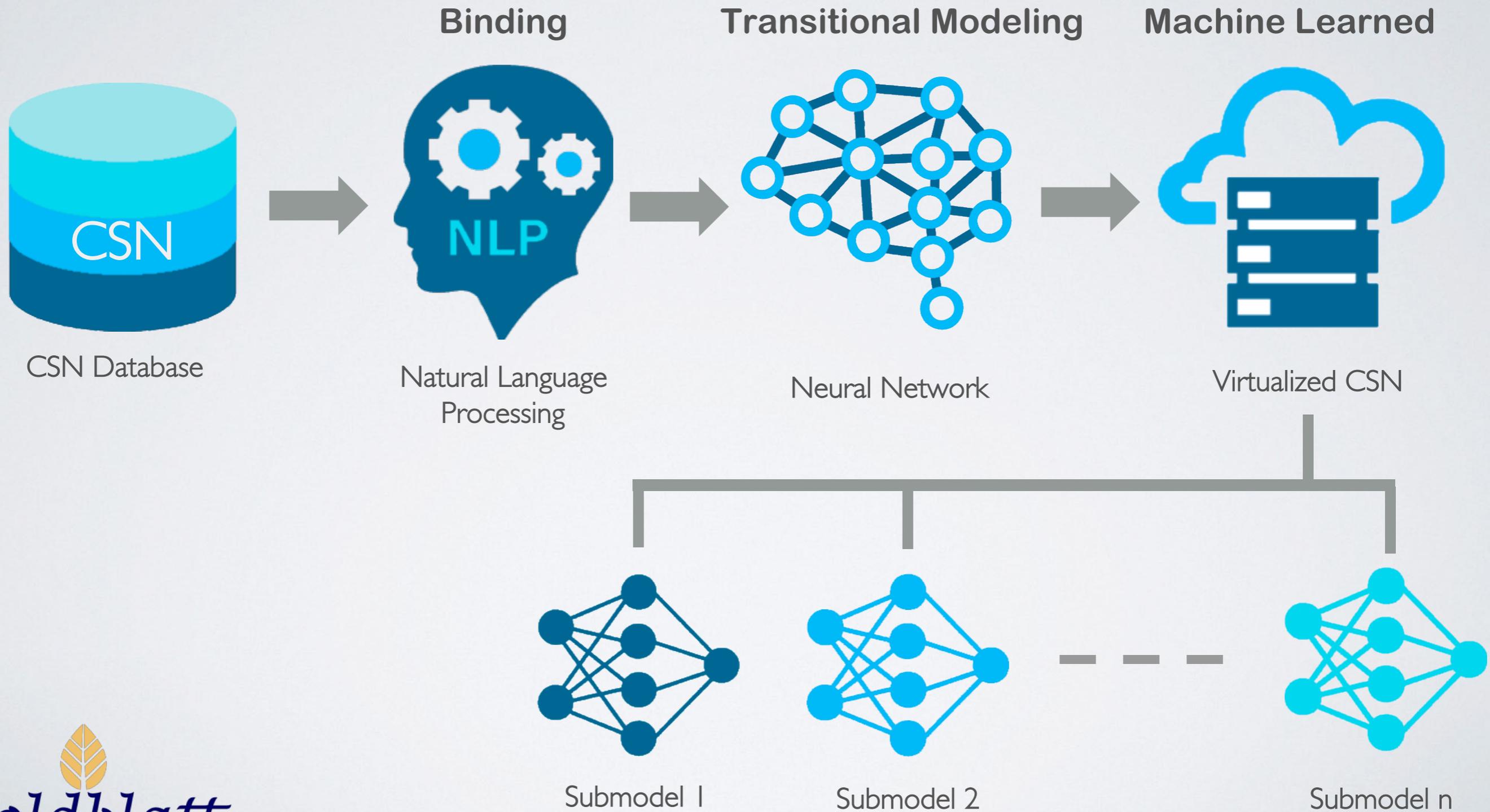


Integrate with existing structured data sets

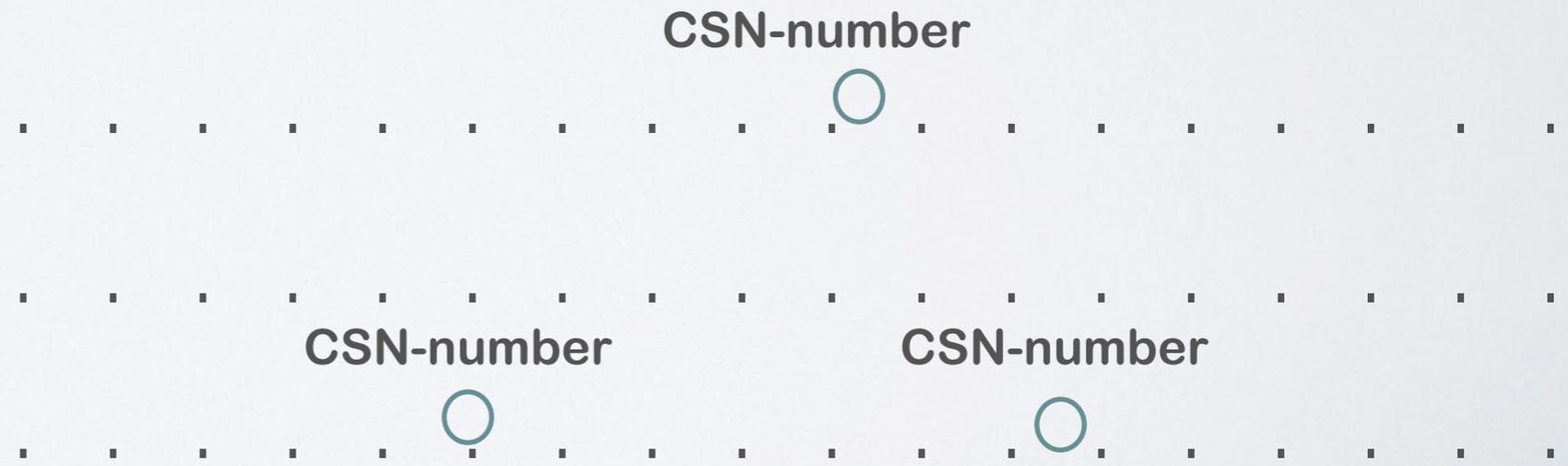
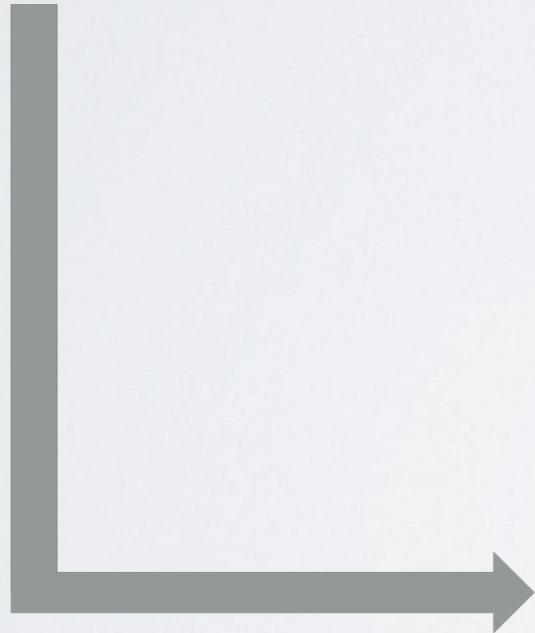
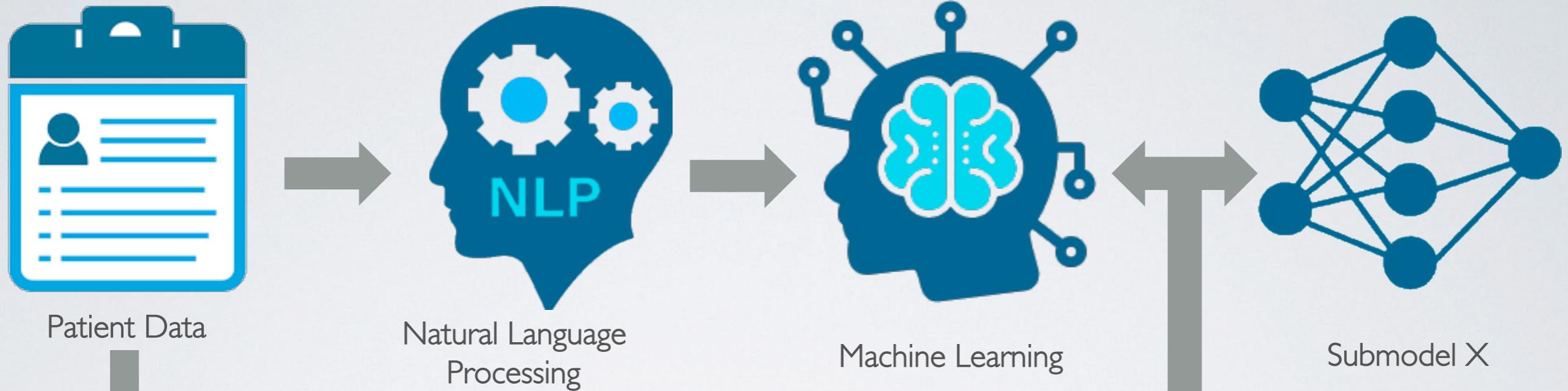


Group patients / members / consumers into cohorts

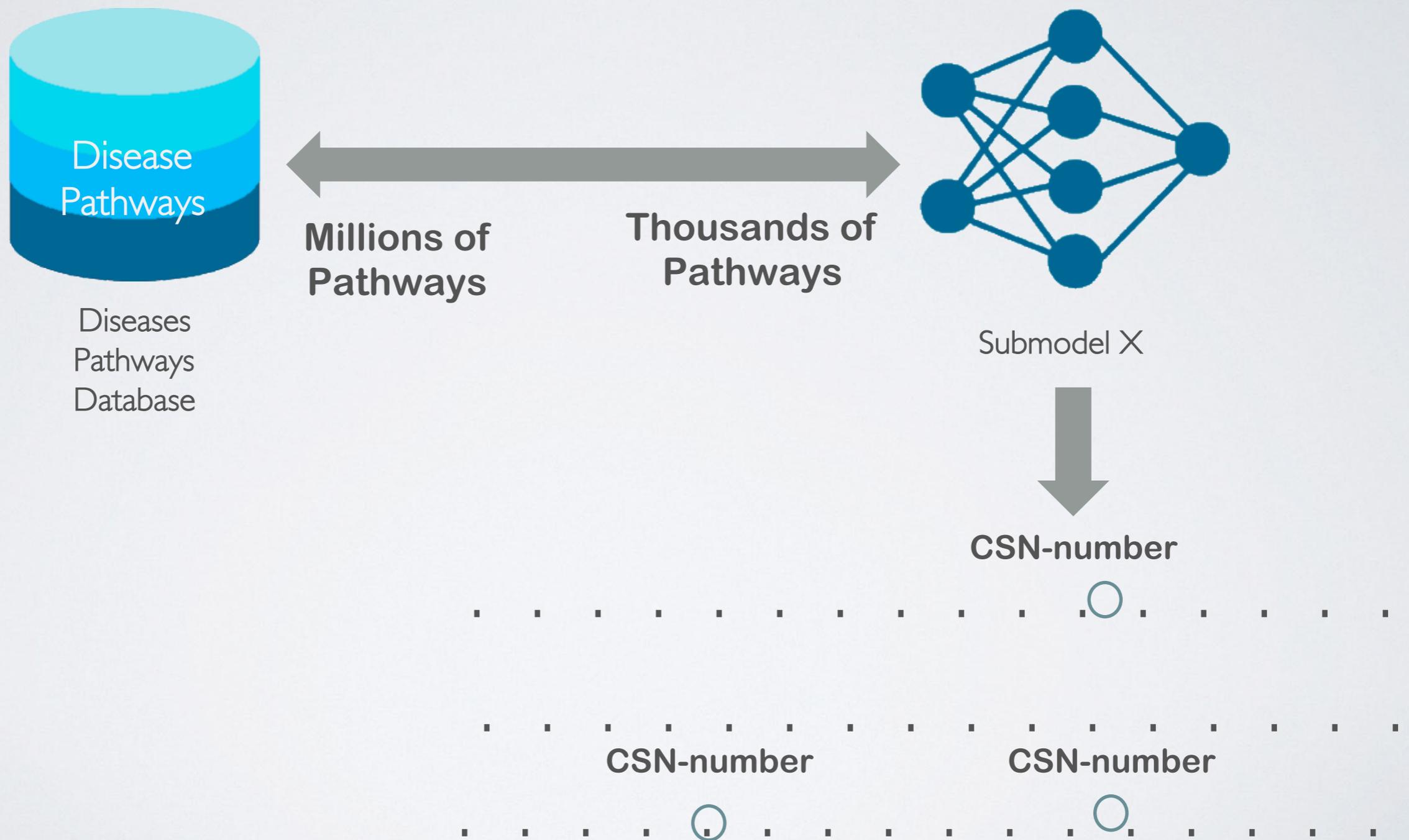
# VIRTUALIZATION OF CSN



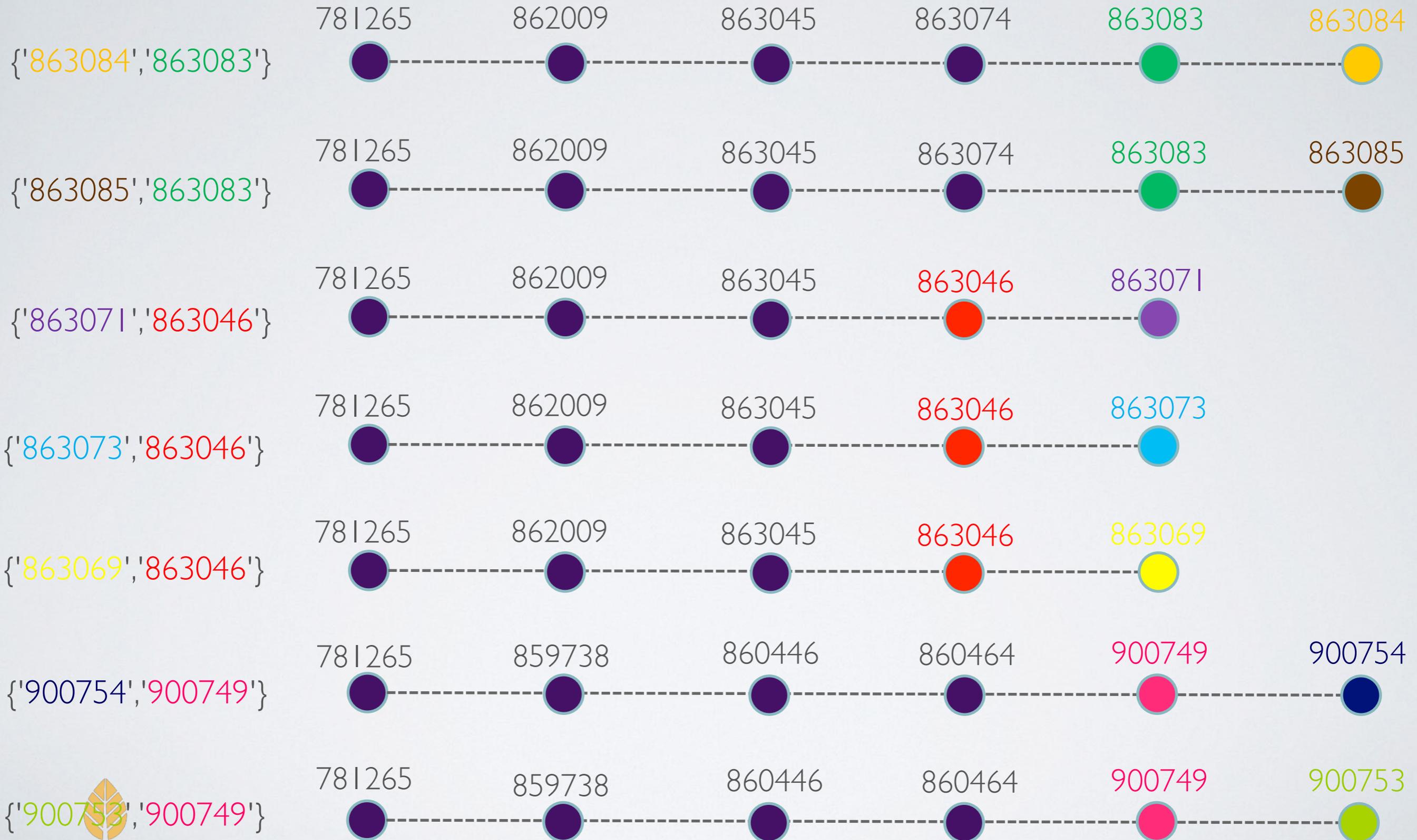
# DETAILS



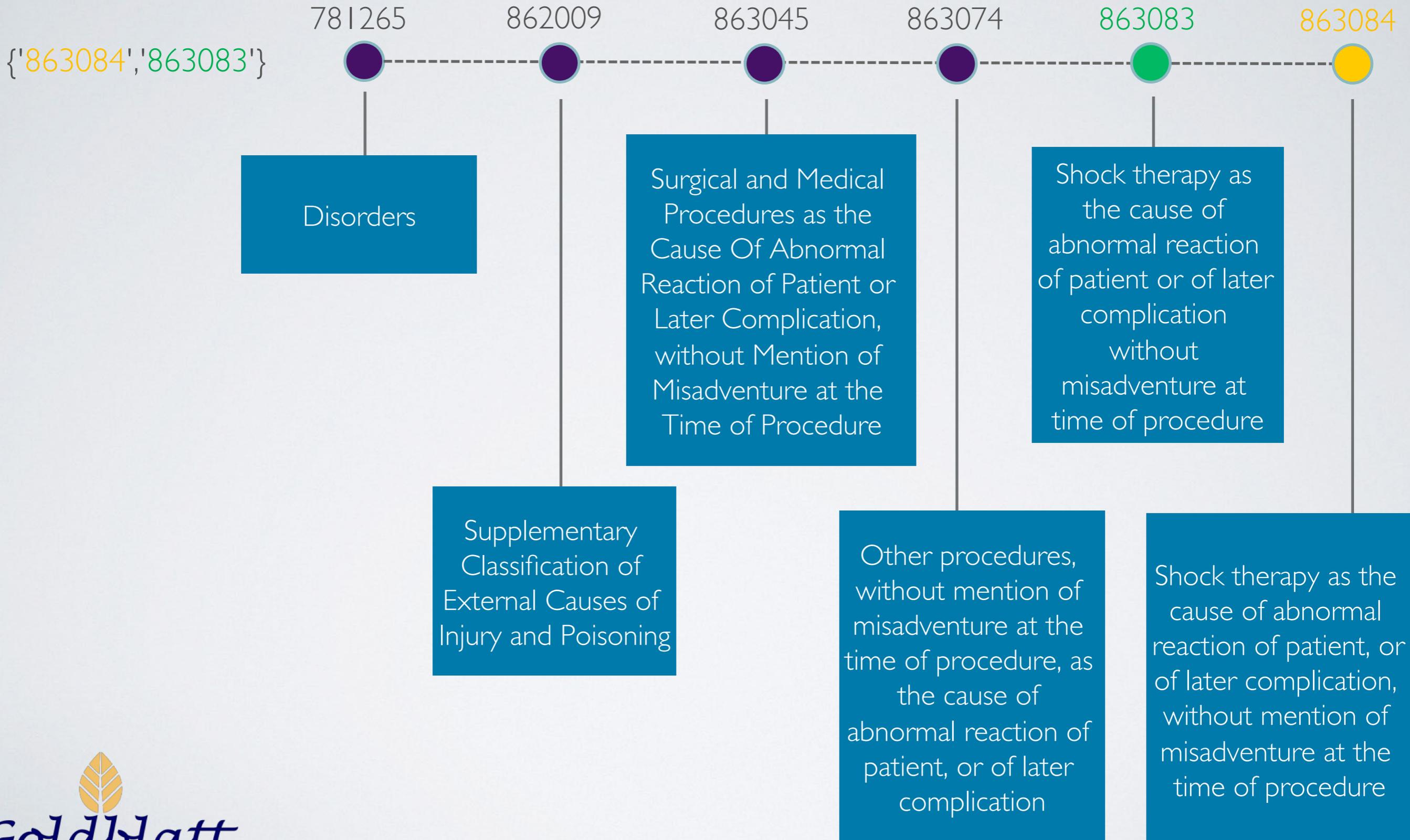
# MODELS AND SUB-MODELS



# SAMPLE RESULTS



# SAMPLE RESULTS



# INTERACTIVE OVERVIEW

[Click Here](#)

## Select Note

Note 1,953,483

Note 1,953,485

Note 1,953,487

Note 1,953,484

## Patient 194,779 &gt; Encounter 125,654 &gt; Note 1,953,483

HISTORY AND PHYSICAL  
LOCATION OF PATIENT:

Room:

DATE OF ADMISSION:

02/11/2015

CRT:

KQH 2/12/15

PRIMARY CARE PHYSICIAN:

## ASSESSMENT:

1. Increased shortness of breath from baseline, particularly with reported paroxysmal nocturnal dyspnea in a patient with elevated NT-proBNP.

She also has underlying chronic obstructive pulmonary disease with no evidence of pneumonia.

2. End-stage renal disease, on Monday, Wednesday, and Friday regimen.

3. Anemia of chronic disease.

4. Chronic obstructive pulmonary disease on home O2.

5. Medical conditions listed.

## RECOMMENDATIONS:

The patient will be admitted for at least overnight monitoring.

Dr. \_\_\_\_\_ has been consulted.

The patient is not a candidate for dialysis to see urgently, but may require supplemental dialysis tomorrow at the discretion of the consultant.

There may be multifactorial component to her presentation, she does have an underlying COPD,

and she has had a history of acute on chronic diastolic heart failure in the past with the last echocardiogram being in August with the EF was 65% at that time.

We will go ahead and repeat the 2D echocardiogram, while we have her.

We will repeat the cardiac enzymes in the morning as well, those are atypical for an MI presentation.

Keep her on supplemental O2.

Give DuoNeb treatments via respiratory.

Encourage incentive spirometry.

Her blood gases reasonable tonight.

In the past, she has been much higher CO2 retainer as high as 69.

We will keep the head of the bed elevated.

She may benefit from BiPAP for nocturnal dyspnea, at the moment she seems stable.

The plan of care has been reviewed in detail with Dr. \_\_\_\_\_ who was also examined the patient.

The patient is lucid enough to confirm that she wishes to be regarded as a FULL CODE.

## CHIEF COMPLAINT:

Shortness of breath, particularly at nighttime.

## NLP

Entity

Clinical Words

Merged Entity

Clinical Entity

Complex Phrases

NLP Phrases

Combined Phrases

## Matched CSN Numbers

## Pathways

Identify

Select Note

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Note 1,953,487

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Patient 194,779 > Encounter 125,654 > Note 1,953,483

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1040559 - Other Medical conditions

1041696 - Chronic obstructive pulmonary disease

609997 - Myocardial infarction

70938 - Tinnitus occurred in the past only

738599 - Tends to plan ahead

79763 - Injury detail

Pathways

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Note 1,953,485

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47939 - Cardiac enzymes normal

83221 - FH: MI

875390 - Anemia of chronic disease

875392 - Anemia in end-stage renal disease

876882 - Incentive spirometry

8919 - Shortness of breath

Pathways

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8919 - Shortness of breath

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Pathways



CSN #	CSN Pathways	Expanded Pathways	Description
8919	633 634 635 1260 8916 8919	GS findings HISTORY of PRESENT ILLNESS Symptom specific HPIs HPI resources Admits to symptoms of panic disorder Shortness of breath	Shortness of breath
47939	633 634 635 47638 47639 47797 47930 47931 47932 47939	GS findings HISTORY of PRESENT ILLNESS Symptom specific HPIs SHARED HPIs Assessment for somatization disorder vis a' vis DSM IV TR criteria C1. Examination reveals no organic or substance-related pathologic diagnosis Normal laboratory findings Normal biochemistry findings Normal biochemistry findings 1 Cardiac enzymes normal	Cardiac enzymes normal
83221	633 634 635 81774 83212 83216 83220 83221	GS findings HISTORY of PRESENT ILLNESS Symptom specific HPIs Cardio-Pulmonary symptoms HPI Problem-specific FH FH: cardiovascular disease FH: myocardial infarction FH: MI	FH: MI
875390	633 237412 237697 238320 238331 875361 875390	GS findings REVIEW OF SYSTEMS ADMINISTRATIVE OFFICE VISIT Consultation Hematology consultation Other and unspecified anemias Anemia of chronic disease	Anemia of chronic disease
875392	633 237412 237697 238320 238331 875361 875390 875391 875392	GS findings REVIEW OF SYSTEMS ADMINISTRATIVE OFFICE VISIT Consultation Hematology consultation Other and unspecified anemias Anemia of chronic disease Anemia in chronic kidney disease Anemia in end-stage renal disease	Anemia in end-stage renal disease
876882	633 152834 152876 876439 876854 876882	GS findings PAST MEDICAL HISTORY Current medical treatment Physical therapy Physiotherapy of chest Incentive spirometry	Incentive spirometry
1041696	633 357508 721234 1037820 1037821 1041644 1041645 1041693 1041694 1041696	GS findings PHYSICAL EXAMINATION PSYCHOLOGIC DSM-5 [Structured Diagnosis] SUBSTANCE-RELATED DISORDERS Tobacco-Related Disorders Tobacco Use Disorder common Comorbidities Medical comorbidities Chronic obstructive pulmonary disease	Chronic obstructive pulmonary disease

The patient is lucid enough to confirm that she wishes to be regarded as a FULL CODE.  
 CHIEF COMPLAINT:  
 Shortness of breath, particularly at nighttime.

Select Note

- Note 1,953,483
- Note 1,953,485
- Note 1,953,487
- Note 1,953,484

Patient 194,779 > Encounter 125,654 > Note 1,953,483

HISTORY AND PHYSICAL

LOCATION OF PATIENT:

Room: SCPH-3C5 - Sentara Careplex Hospital

DATE OF ADMISSION:

02/11/2015

CRT:

KQH 2/12/15

PRIMARY CARE PHYSICIAN:

Nequita Dowling, MD.

ASSESSMENT:

1. Increased shortness of breath from baseline, particularly with reported paroxysmal nocturnal dyspnea in a patient with

She also has underlying chronic obstructive pulmonary disease with no evidence of pneumonia.

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3. Anemia of chronic disease.

4. Chronic obstructive pulmonary disease on home O2.

5. Medical conditions listed.

RECOMMENDATIONS:

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Dr. Semret has been consulted.

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We will keep the head of the bed elevated.

She may benefit from BiPAP for nocturnal dyspnea, at the moment she seems stable.

The plan of care has been reviewed in detail with Dr. Amo-Mensah, who was also examined the patient.

The patient is lucid enough to confirm that she wishes to be regarded as a FULL CODE.

CHIEF COMPLAINT:

Shortness of breath, particularly at nighttime.

NLP



Matched CSN Numbers

1041696 - Chronic obstructive pulmonary disease

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Pathways ✕

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## Diseases ID

Concept ID	GS Disease Number	SNOMED ID	ICD9 Code	ICD10 Code
838402	DS-57924	267036007	786.05	R06.00,R06.02

## Snomed Descriptions

Term	Concept ID	Description ID
Dyspnea	267036007	397885013
Dyspnoea	267036007	397886014
Breathless	267036007	397887017
Breathlessness	267036007	397888010
SOB - Shortness of breath	267036007	397889019
Shortness of breath	267036007	397890011
Dyspnea (finding)	267036007	659603012

Breathlessness	267036007	397888010
SOB - Shortness of breath	267036007	397889019
Shortness of breath	267036007	397890011
Dyspnea (finding)	267036007	659603012

### Relationships

Term	Concept ID	Relationship ID
Difficulty breathing (finding)	230145002	3900536021
Respiratory system subdivision (body structure)	118969007	594803029
Ease of respiration (observable entity)	248546008	594804024
Respiratory function (observable entity)	78064003	2257261021
Structure of respiratory system (body structure)	20139000	2780652025

# SNOMED CT JSON DESCRIPTIONS

```
▼ descriptions:
  ▼ 0:
    descriptionId:      "397885013"
    conceptId:          "267036007"
    ▼ type:
      conceptId:        "900000000000013009"
      preferredTerm:    "Synonym (core metadata concept)"
      languageCode:    "en"
      term:              "Dyspnea"
      length:           7
    ▼ caseSignificance:
      conceptId:        "900000000000020002"
      ▼ preferredTerm:  "Only initial character case insensitive (core metadata concept)"
    ▶ acceptability:    [...]
    active:             true
    effectiveTime:     "20020131"
    ▼ module:
      conceptId:        "9000000000000207008"
      preferredTerm:    "SNOMED CT core module (core metadata concept)"
```

# SNOMED CT JSON RELATIONSHIPS

```
▼ relationships:
  ▼ 0:
    relationshipId: "3900536021"
    ▼ type:
      conceptId: "116680003"
      preferredTerm: "Is a (attribute)"
    ▼ destination:
      conceptId: "230145002"
      preferredTerm: "Difficulty breathing (finding)"
      fullySpecifiedName: "Difficulty breathing (finding)"
    ▼ definitionStatus:
      conceptId: "900000000000074008"
      ▼ preferredTerm: "Necessary but not sufficient concept definition status (core metadata concept)"
      statedDescendants: 66
      inferredDescendants: 67
      active: true
      effectiveTime: "20020131"
    ▼ module:
      conceptId: "900000000000207008"
      preferredTerm: "SNOMED CT core module (core metadata concept)"
    sourceId: "267036007"
    relationshipGroup: 0
    ▶ characteristicType: {...}
    ▶ modifier: {...}
    active: true
```



Judy is actively being treated for her Type 2 Diabetes.

Insights from her records using the vCSN indicated emerging risks of major depressive disorder and lactic acidosis ...

... prioritizing her for new interventions, multi-modal engagement, medication review, trigger alerts in Provider offices, etc.

Come visit us at  
Booth #7