SNOMED International

Delivering SNOMED CT

Data Analytics with SNOMED CT

SNOMED CT in Germany

March 19th, 2024

Anne Højen and Kai Kewley
SNOMED International

snomed.org @snomedct linkedin.com/company/ihtsdo/

Outline

(Friday)
March 24

- **Introduction**
  - Clinical data analytics
  - Meaning-based retrieval with SNOMED CT
- **Analytics scenarios**
  - Population health monitoring
  - Designing preventative measures
  - Assessing treatments
- **Interpreting the Results**

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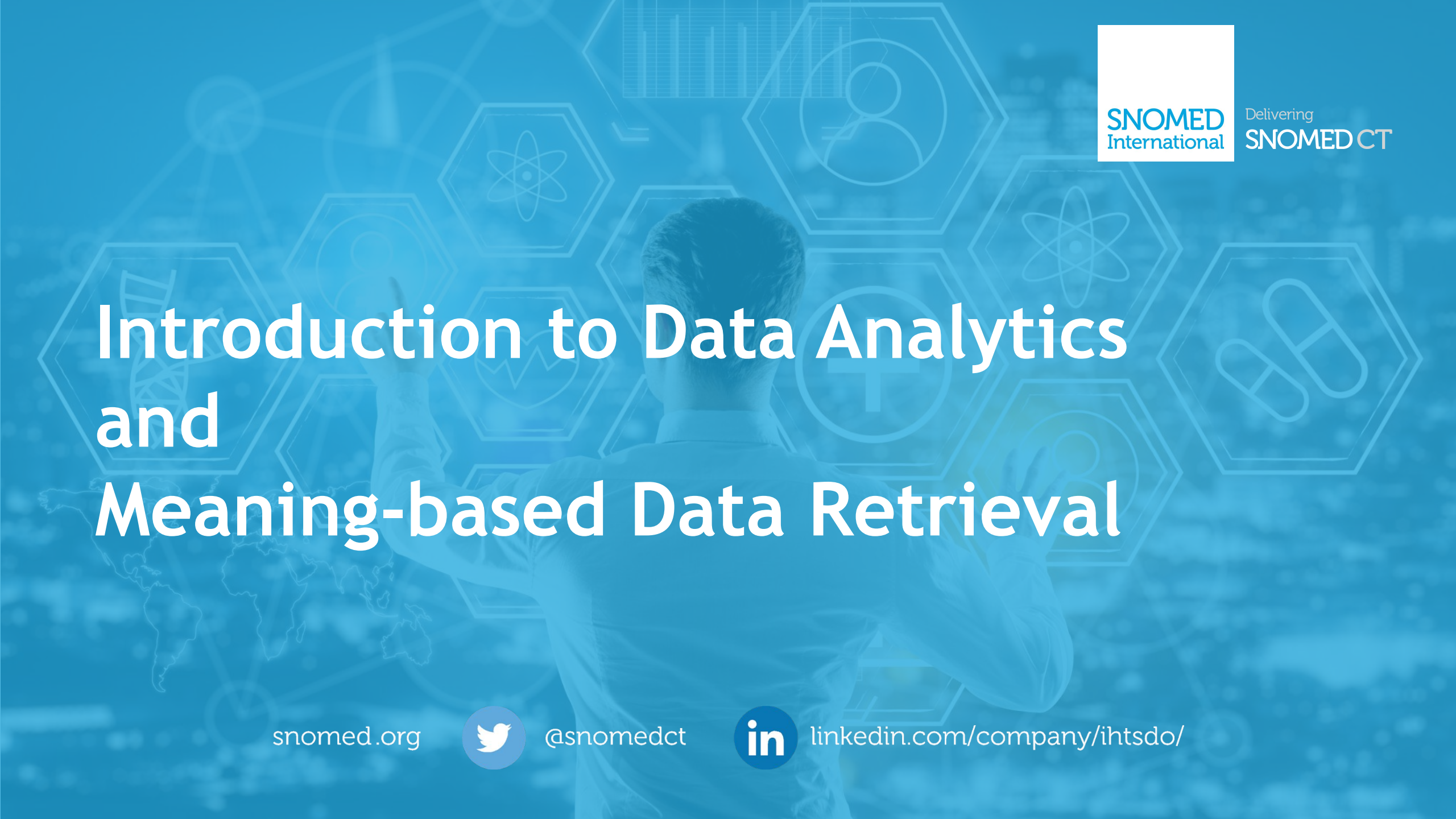

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Introduction to Data Analytics and Meaning-based Data Retrieval

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Data Analytics

“The discovery and communication of meaningful patterns in data”

Data Analytics

Population health monitoring
What are the trends?

Patient care and treatment

Population health

Research

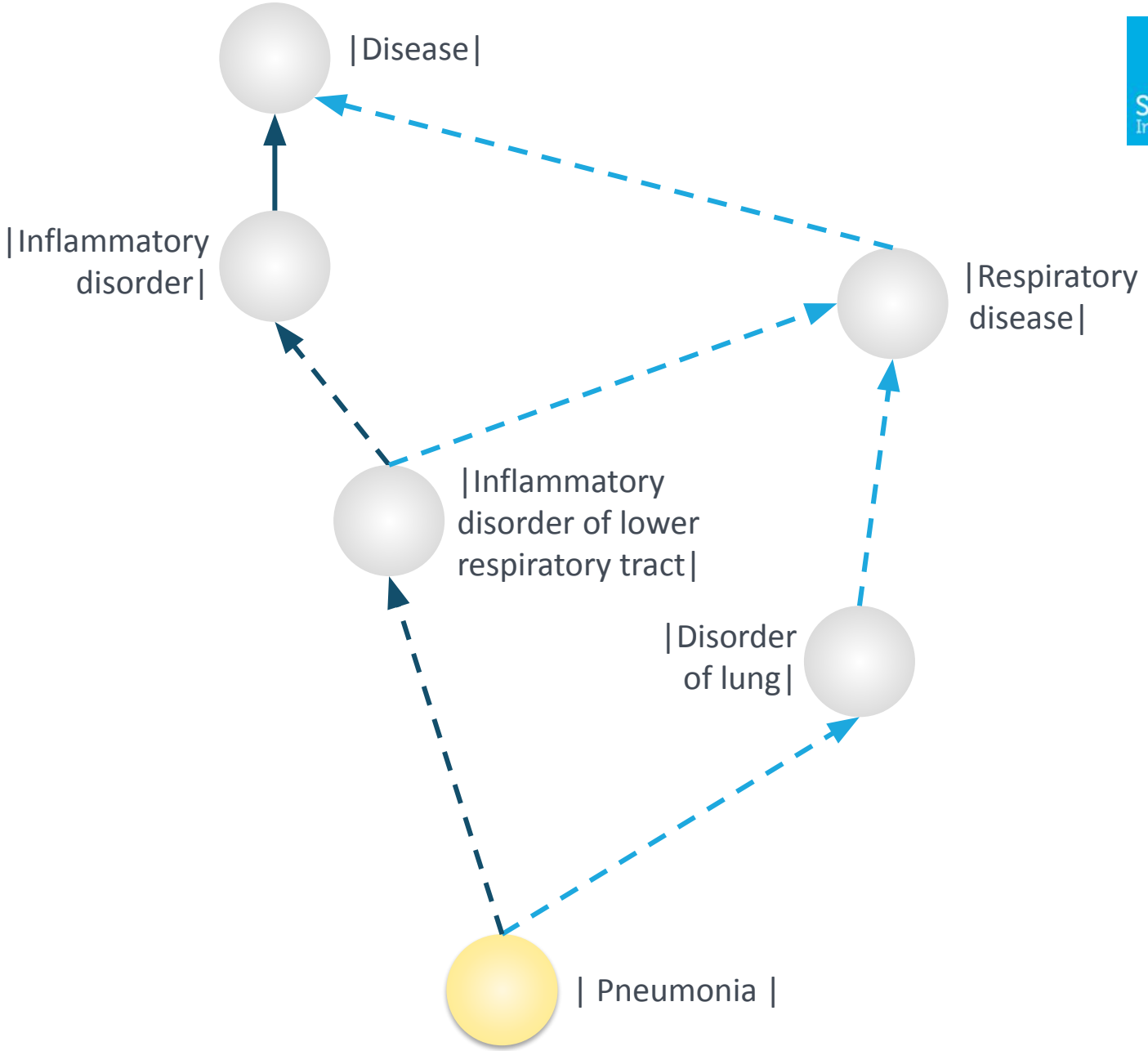
Assessing treatments
What will happen to me?

Improving the quality and efficiency of care
What are the causal effects?

… A Semantic Network of Clinical Meanings

Supports effective and consistent entry of data

Flexible retrieval of clinical information



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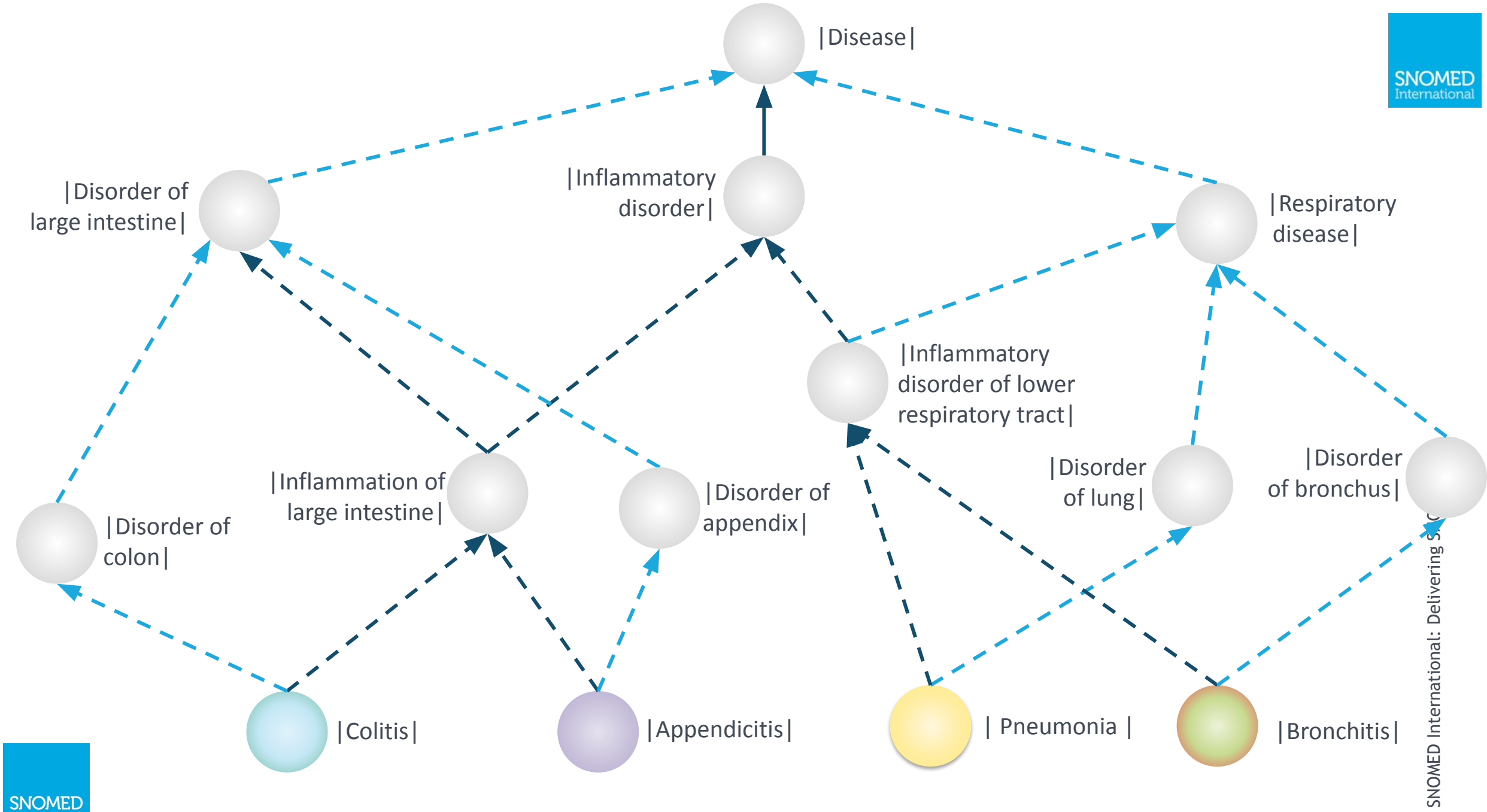

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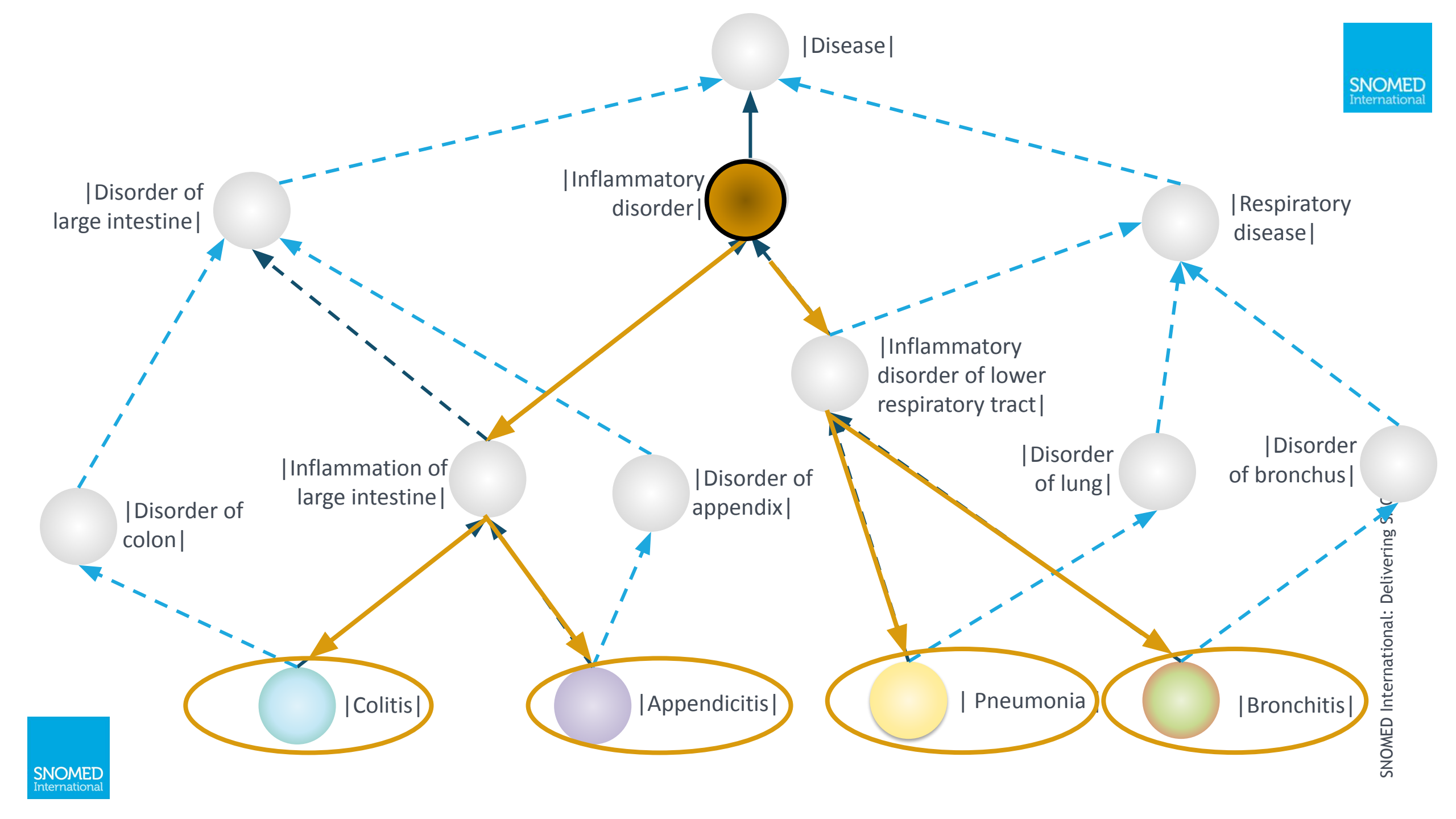
|Disease|
|Disorder of large intestine|
|Inflammatory disorder|
|Respiratory disease|
|Inflammatory disorder of lower respiratory tract|
|Inflammation of large intestine|
|Disorder of appendix|
|Disorder of colon|
|Disorder of lung|
|Disorder of bronchus|
|Colitis|
|Appendicitis|
| Pneumonia
|Bronchitis|
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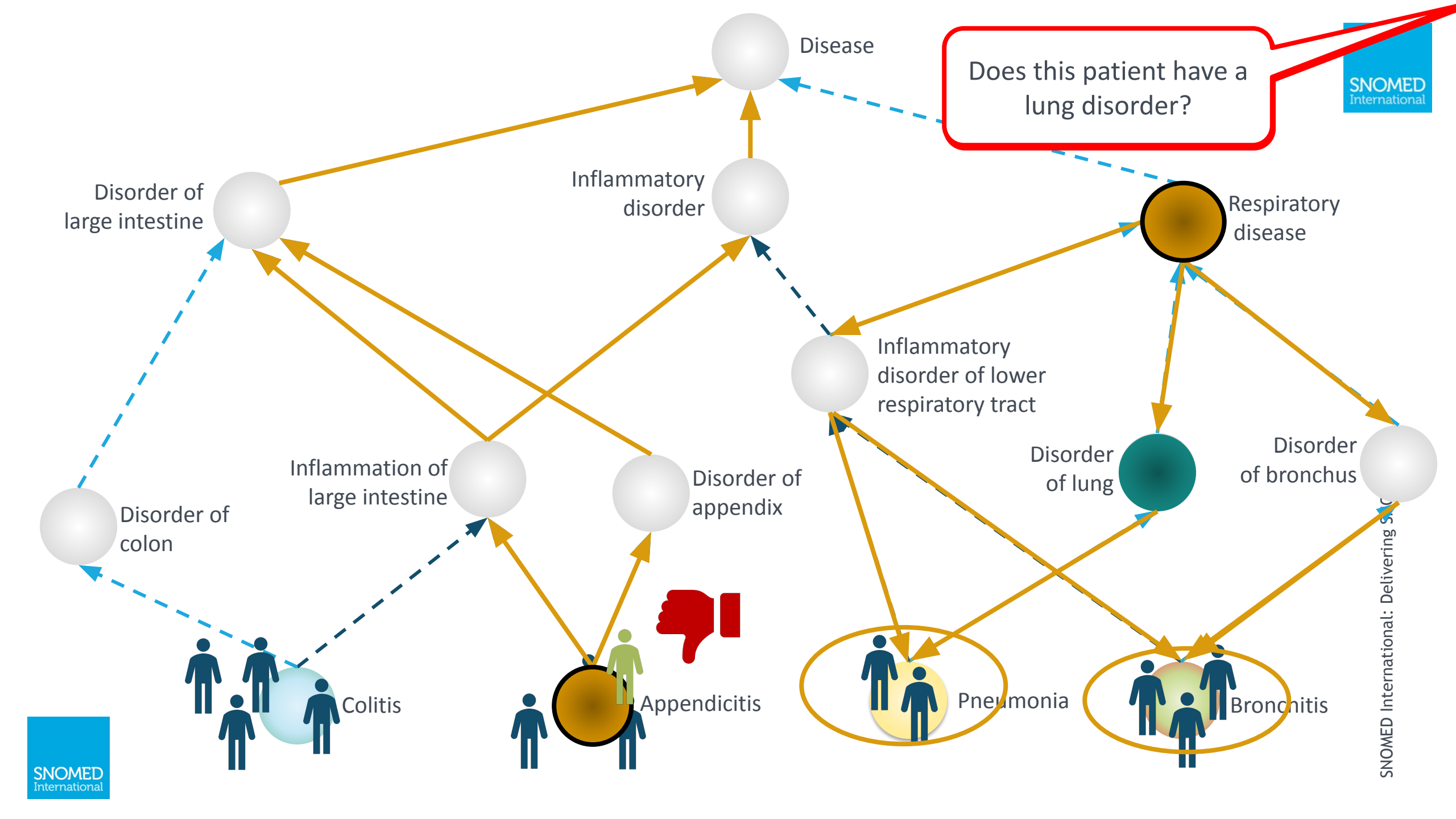
Disease
Does this patient have a lung disorder?
Disorder of large intestine
Inflammatory disorder
Respiratory disease
Inflammatory disorder of lower respiratory tract
Inflammation of large intestine
Disorder of appendix
Disorder of lung
Disorder of bronchus
Disorder of colon
Colitis
Appendicitis
Pneumonia
Bronchitis
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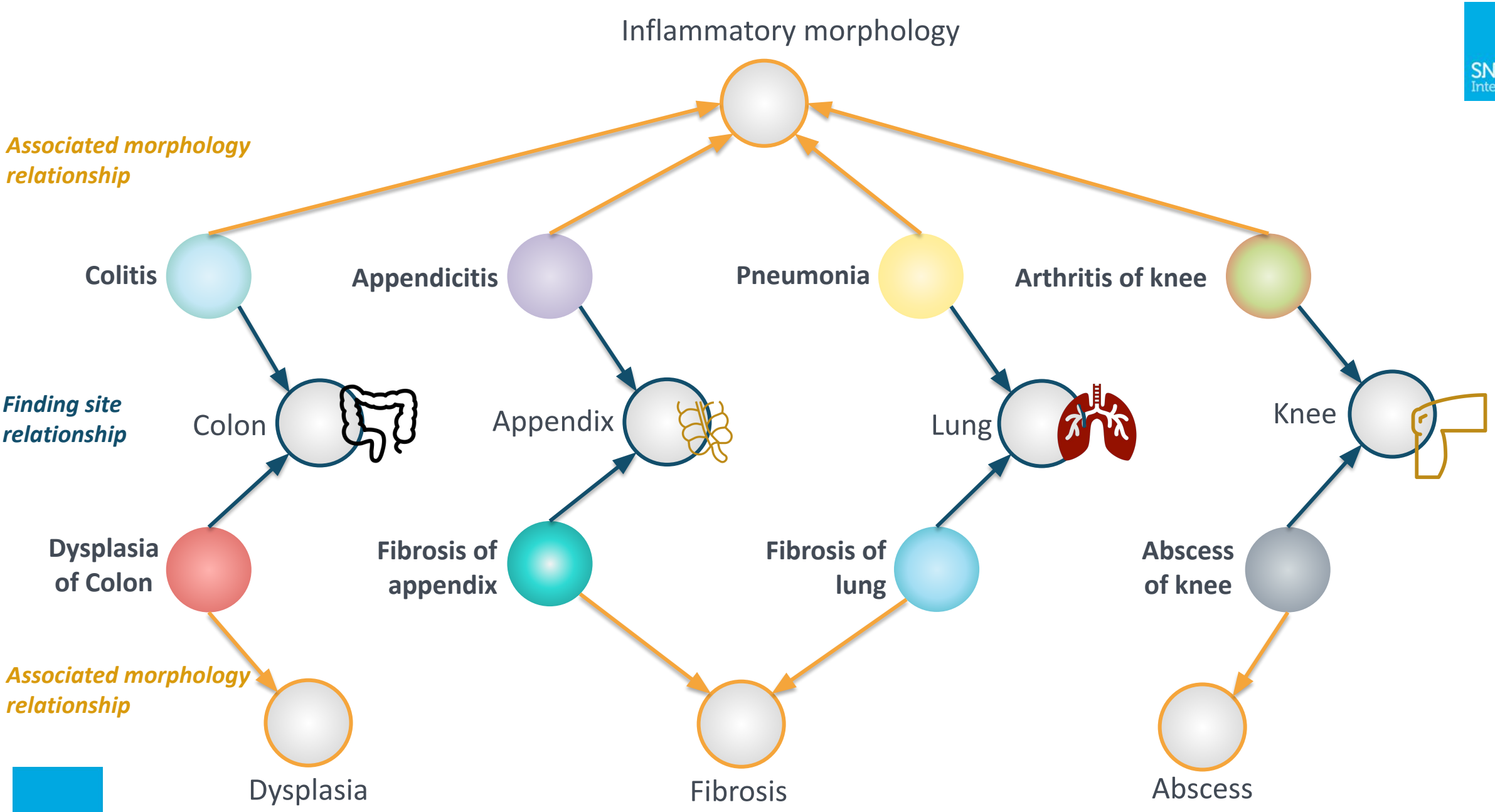

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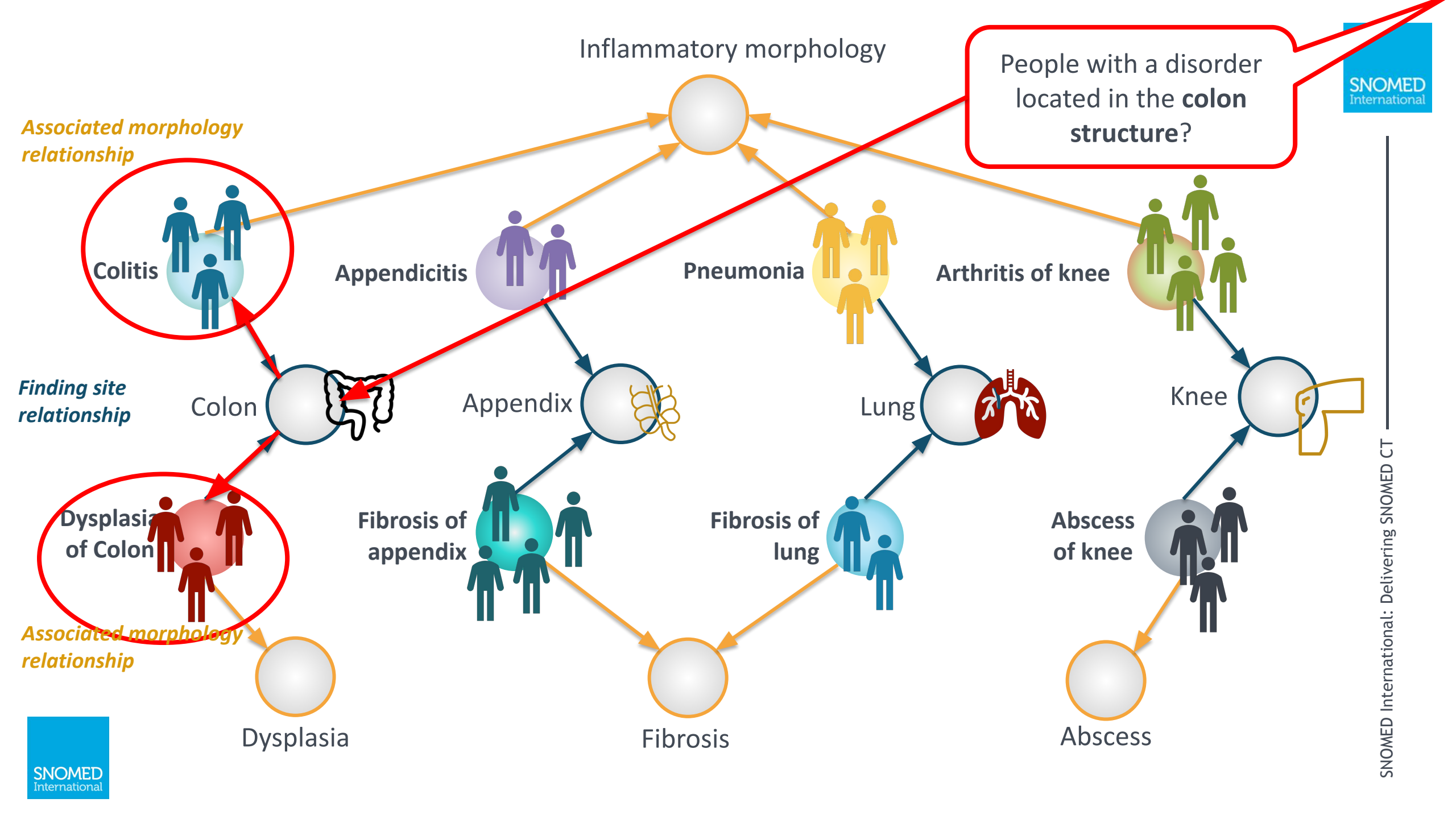
Inflammatory morphology
People with a disorder located in the **colon structure**?
Associated morphology relationship
Colitis
Appendicitis
Pneumonia
Arthritis of knee
Finding site relationship
Colon
Appendix
Lung
Knee
Dysplasia of Colon
Fibrosis of appendix
Fibrosis of lung
Abscess of knee
Associated morphology relationship
Dysplasia
Fibrosis
Abscess
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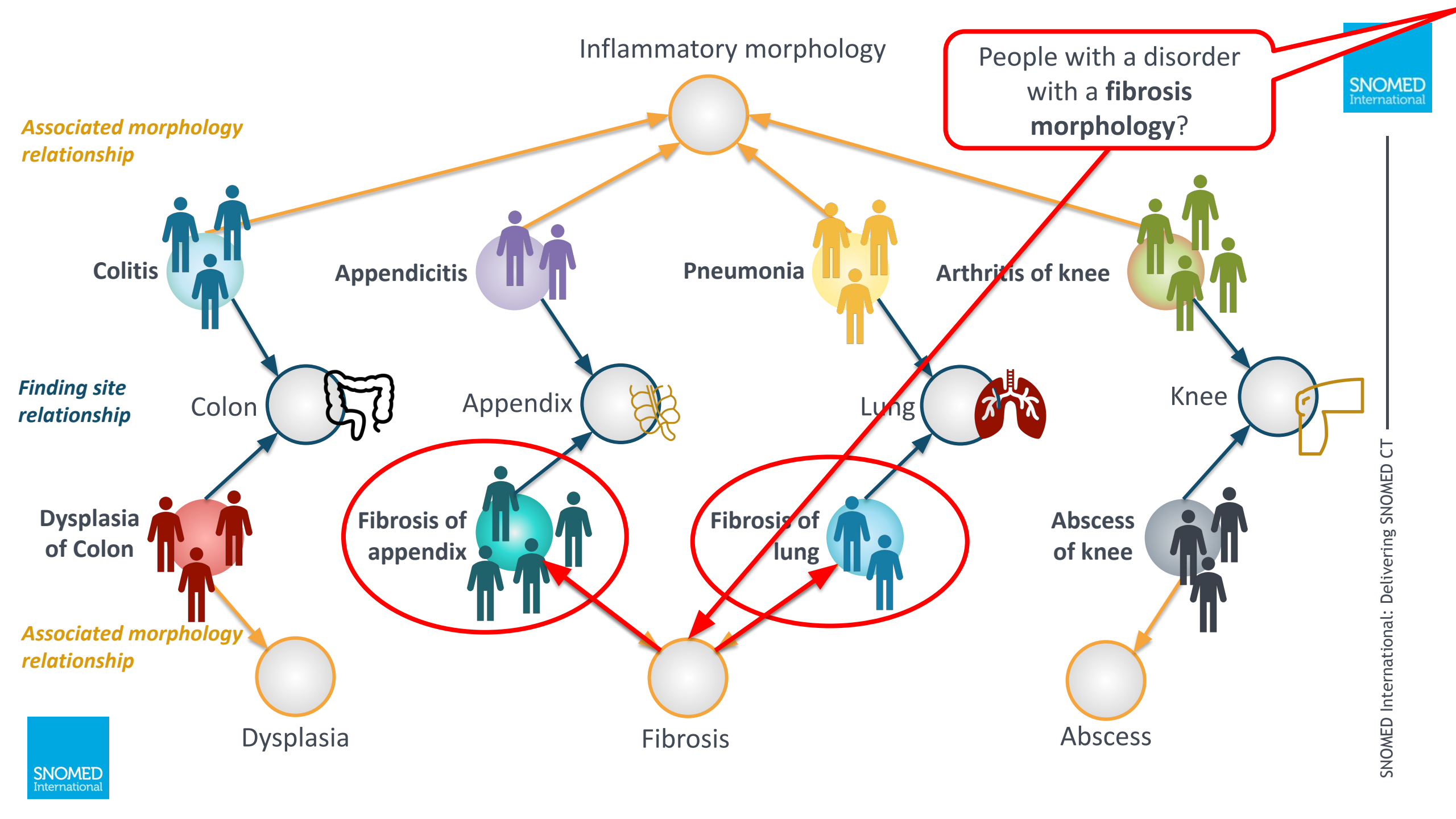
Inflammatory morphology
People with a disorder with a **fibrosis morphology**?
Associated morphology relationship
Colitis
Appendicitis
Pneumonia
Arthritis of knee
Finding site relationship
Colon
Appendix
Lung
Knee
Dysplasia of Colon
Fibrosis of appendix
Fibrosis of lung
Abscess of knee
Associated morphology relationship
Dysplasia
Fibrosis
Abscess
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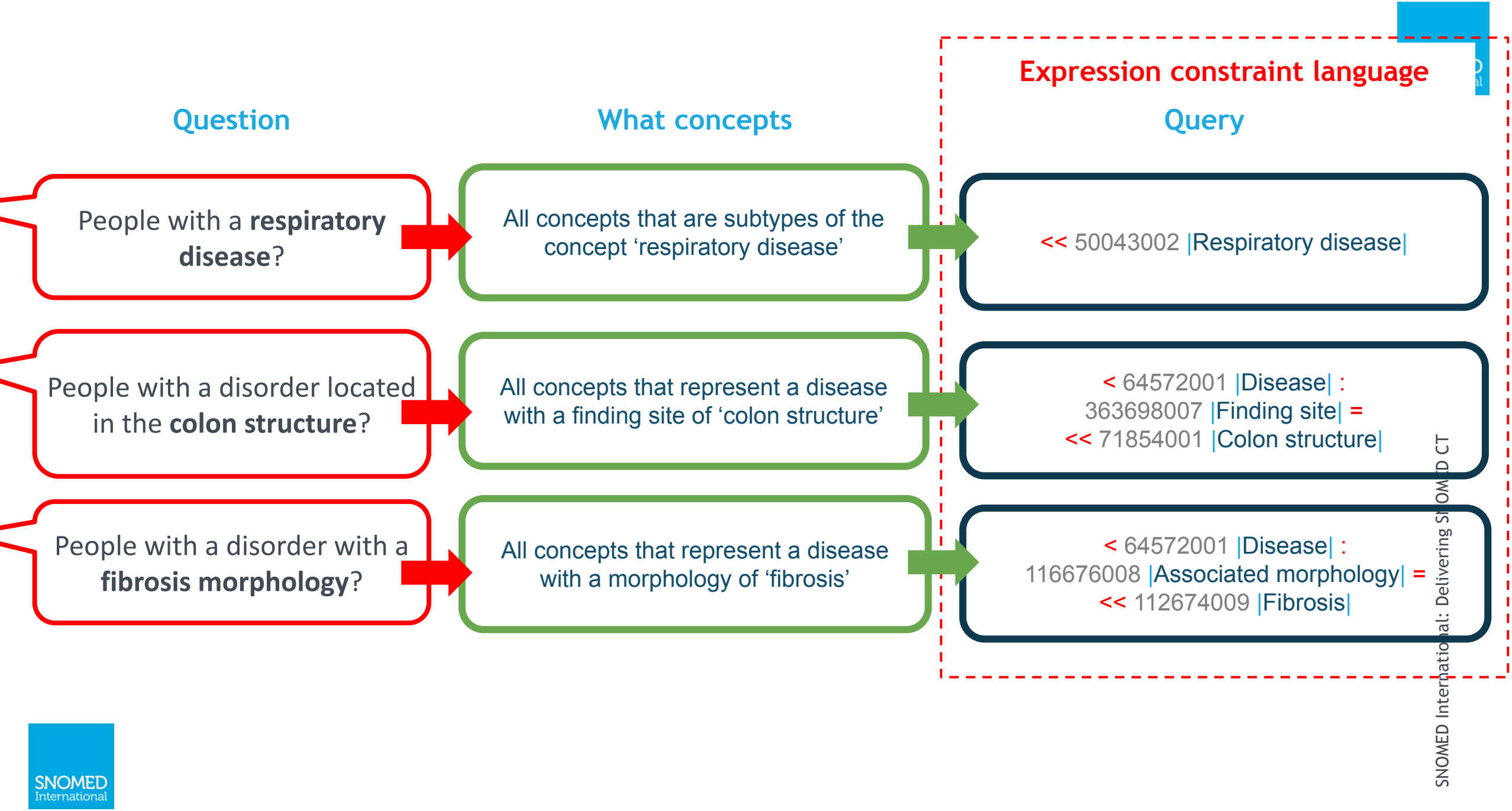

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Symbol	Name
<	Descendant of
<<	Descendant or self of
>	Ancestor of
>>	Ancestor or self of
<!	Child of
^	Member of
^ [x,y]	Member of with field selection
*	Any
:	Refinement
AND	Conjunction
OR	Disjunction
MINUS	Exclusion
[x..y]	Cardinality
R	Reverse attribute
.	Dotted attribute
{{ D }}	Description filter
{{ C }}	Concept filter
{{ M }}	Member filter
{{ +HISTORY }}	History supplement

Expression constraint language

Query

<< 50043002 |Respiratory disease|

< 64572001 |Disease| :
363698007 |Finding site| =
<< 71854001 |Colon structure|

< 64572001 |Disease| :
116676008 |Associated morphology| =
<< 112674009 |Fibrosis|

To learn more visit:
http://snomed.org/ecl

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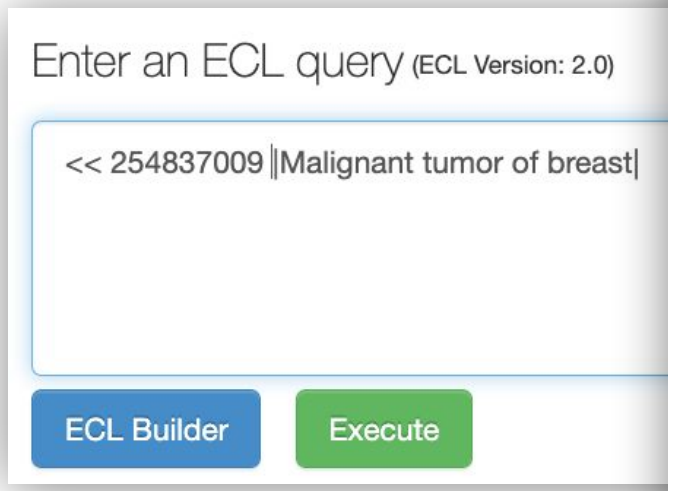
Expression Constraint Language

<< 254837009 |Malignant tumor of breast|



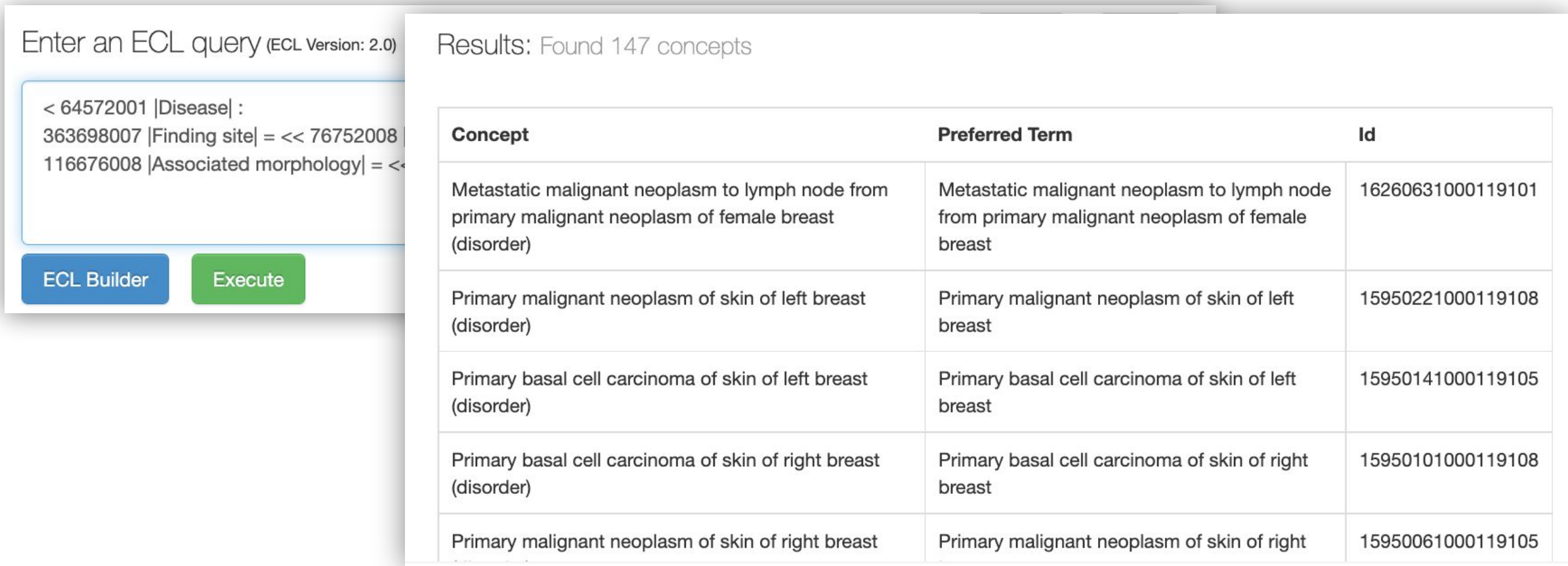
Results: Found 147 concepts

Concept	Preferred Term	Id
Metastatic malignant neoplasm to lymph node from primary malignant neoplasm of female breast (disorder)	Metastatic malignant neoplasm to lymph node from primary malignant neoplasm of female breast	1626063100011910
Primary malignant neoplasm of skin of left breast (disorder)	Primary malignant neoplasm of skin of left breast	1595022100011910
Primary basal cell carcinoma of skin of left breast (disorder)	Primary basal cell carcinoma of skin of left breast	1595014100011910
Primary basal cell carcinoma of skin of right breast (disorder)	Primary basal cell carcinoma of skin of right breast	1595010100011910

Expression Constraint Language

Refinements

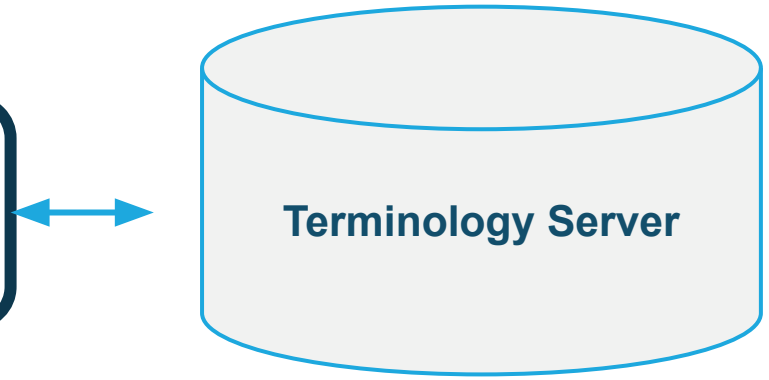
< 64572001 |Disease| :
363698007 |Finding site| = << 76752008 |Breast structure|,
116676008 |Associated morphology| = << 367651003 |Malignant Neoplasm (Morphology)|



Concept	Preferred Term	Id
Metastatic malignant neoplasm to lymph node from primary malignant neoplasm of female breast (disorder)	Metastatic malignant neoplasm to lymph node from primary malignant neoplasm of female breast	16260631000119101
Primary malignant neoplasm of skin of left breast (disorder)	Primary malignant neoplasm of skin of left breast	15950221000119108
Primary basal cell carcinoma of skin of left breast (disorder)	Primary basal cell carcinoma of skin of left breast	15950141000119105
Primary basal cell carcinoma of skin of right breast (disorder)	Primary basal cell carcinoma of skin of right breast	15950101000119108
Primary malignant neoplasm of skin of right breast	Primary malignant neoplasm of skin of right	15950061000119105

Technique: Patient Data Analytics

<< 254837009 |Malignant tumor of breast|



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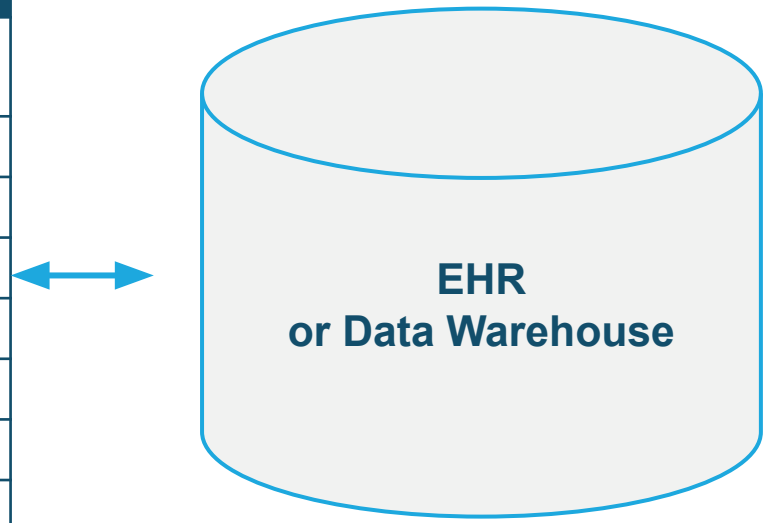

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Population Health Monitoring

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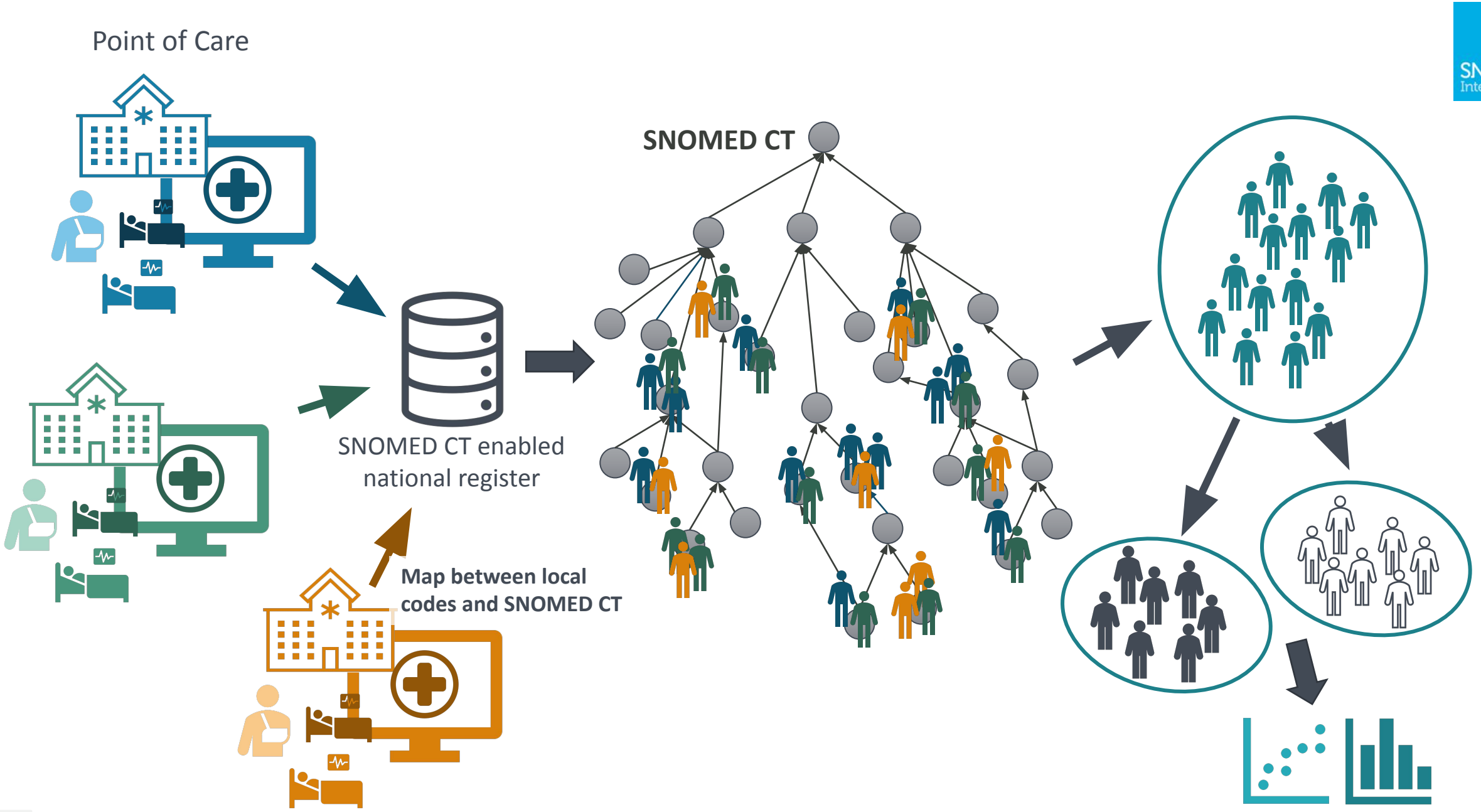

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Data Analytics - Scenario 1

Population health

Population health monitoring

What are the trends?

Data Analytics - Scenario 1

Summarize and aggregate health-related information

Identify health trends and patterns across a population

Monitor the incidence and prevalence of diseases

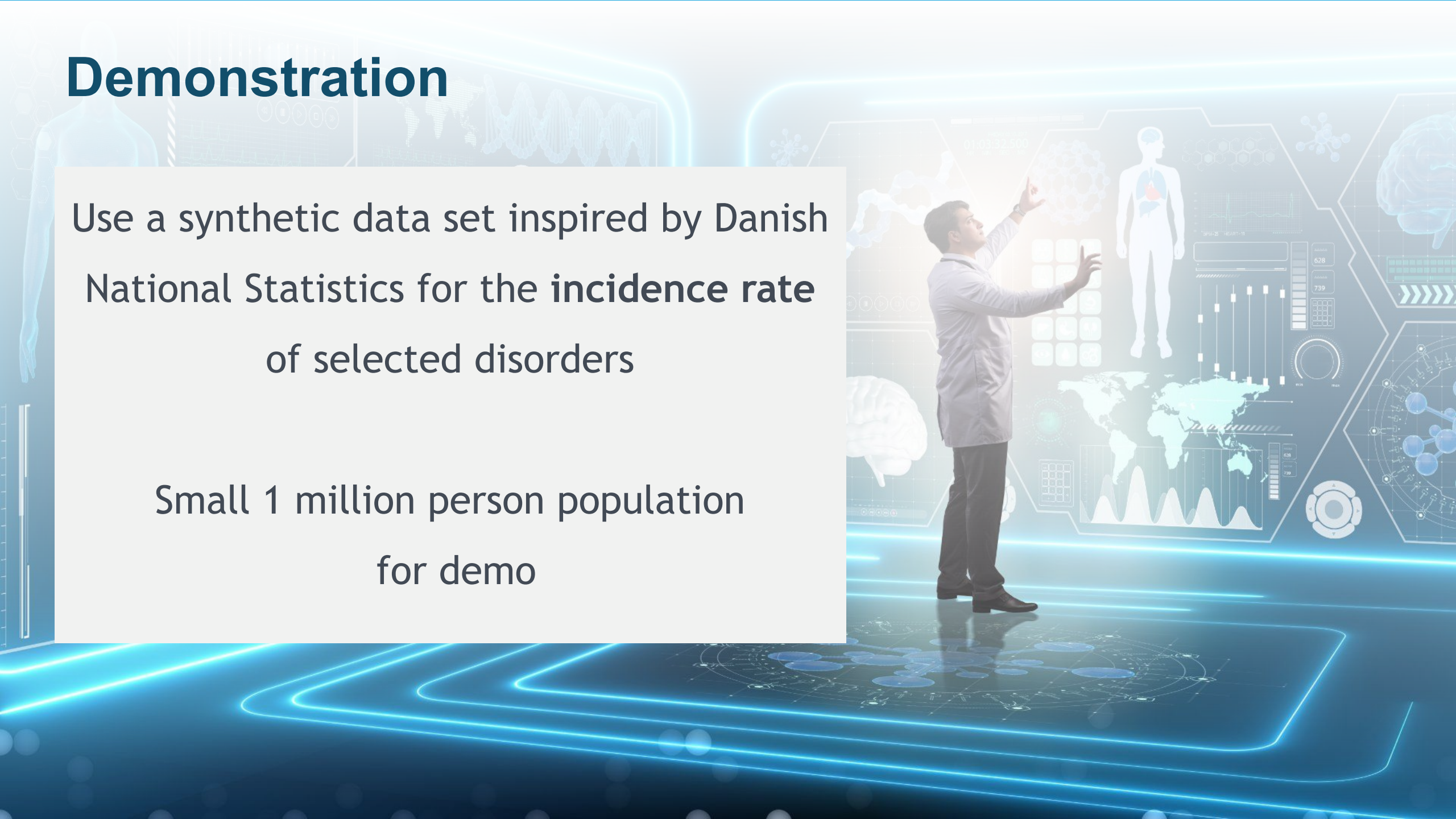
Monitor effect of national programmes and initiatives

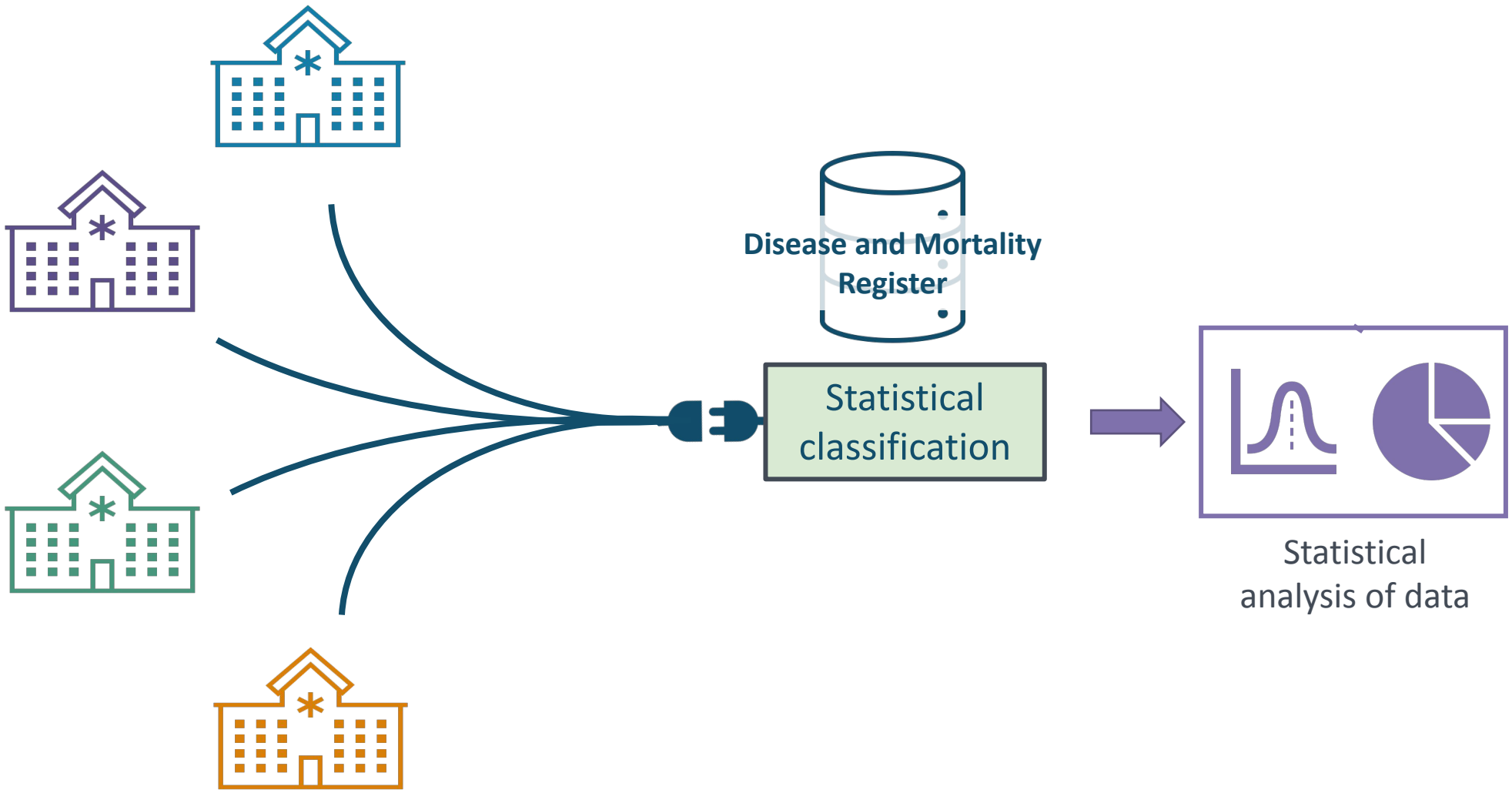
Balance and prioritize healthcare related costs

Demonstration

Use a synthetic data set inspired by Danish National Statistics for the **incidence rate** of selected disorders

Small 1 million person population for demo



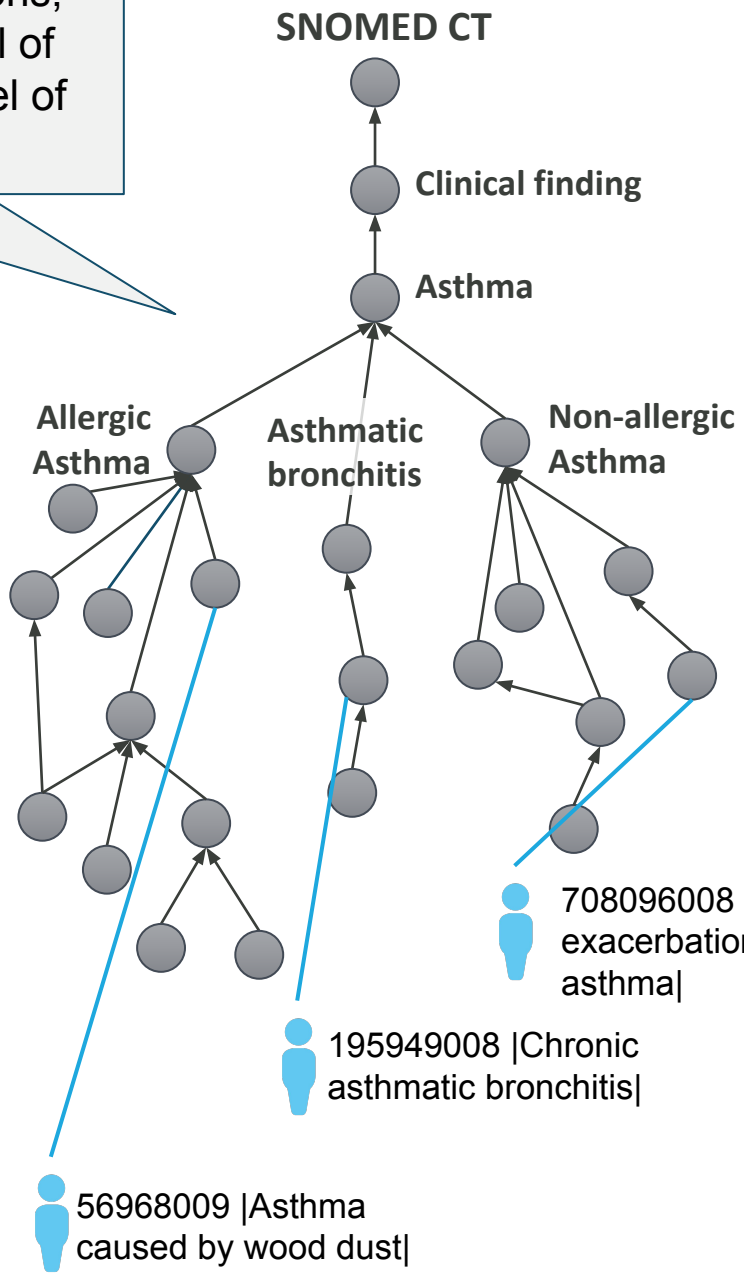

Disease and Mortality Register
Statistical classification
Statistical analysis of data

Compared to statistical classifications, SNOMED CT provides a high level of flexibility when determining the level of aggregation

Disease and Mortality Register

SNOMED CT

Selective and explorative analysis of data



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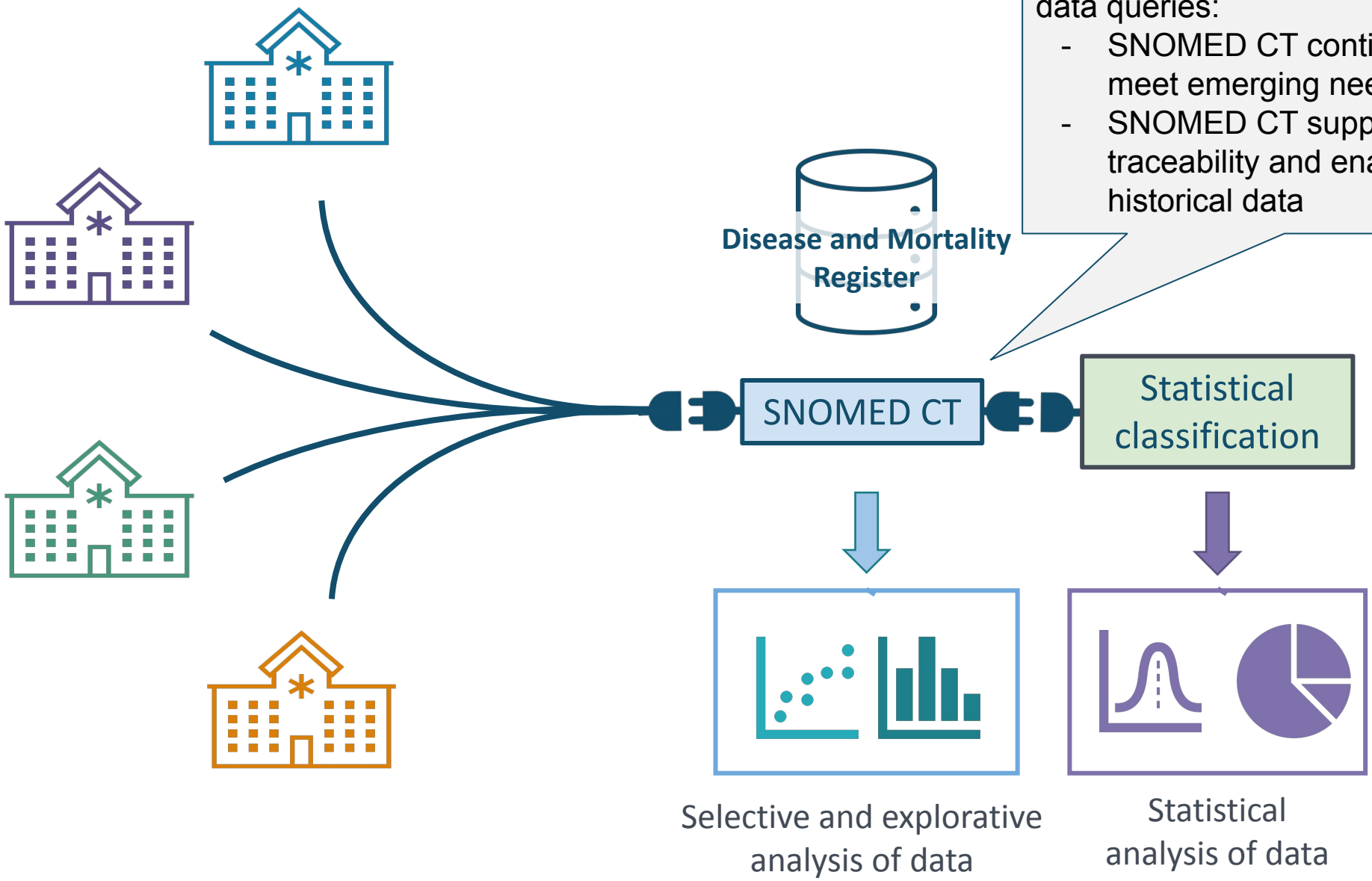
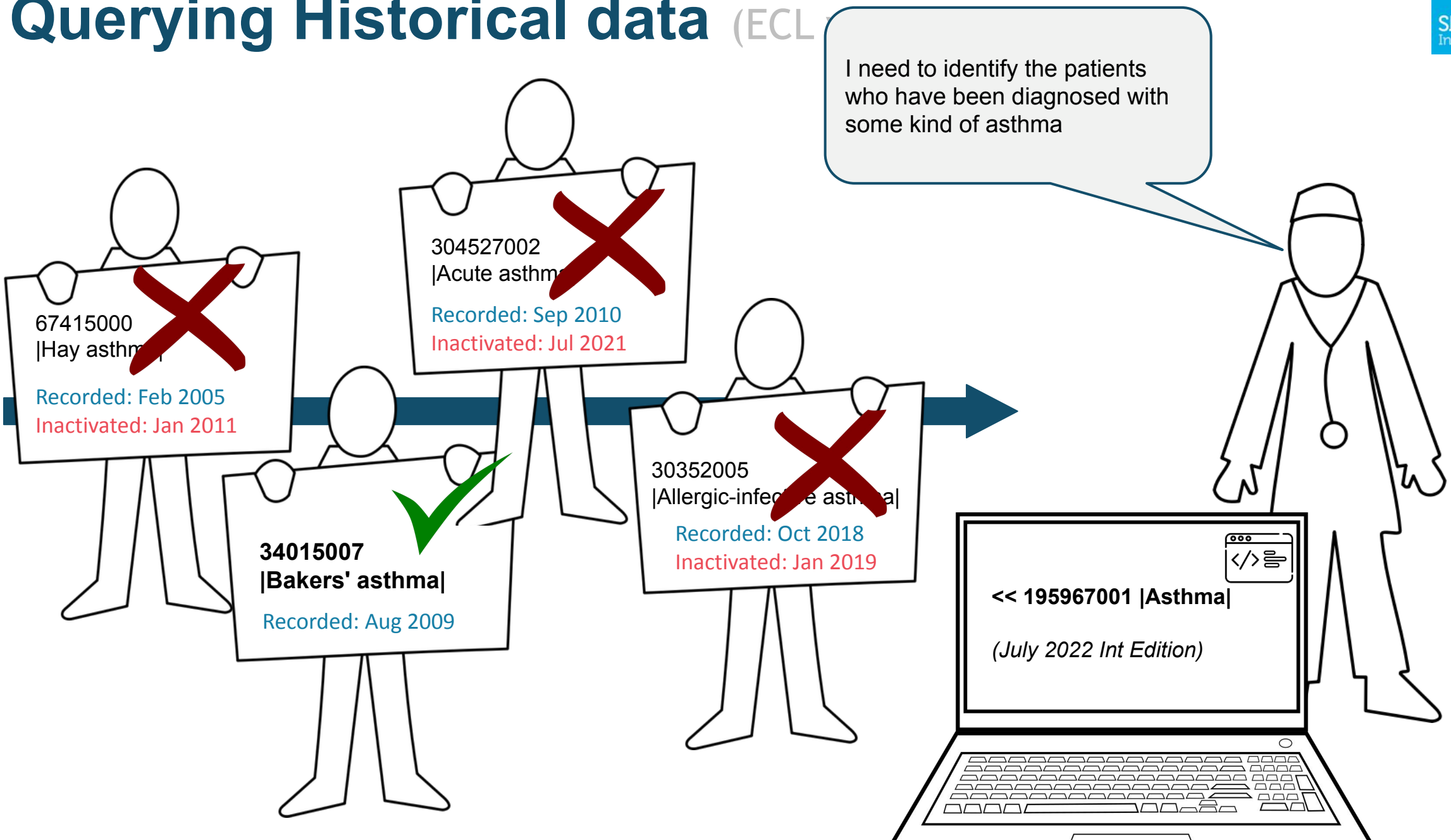
Using SNOMED CT as the core terminology is beneficial for longitudinal data queries:

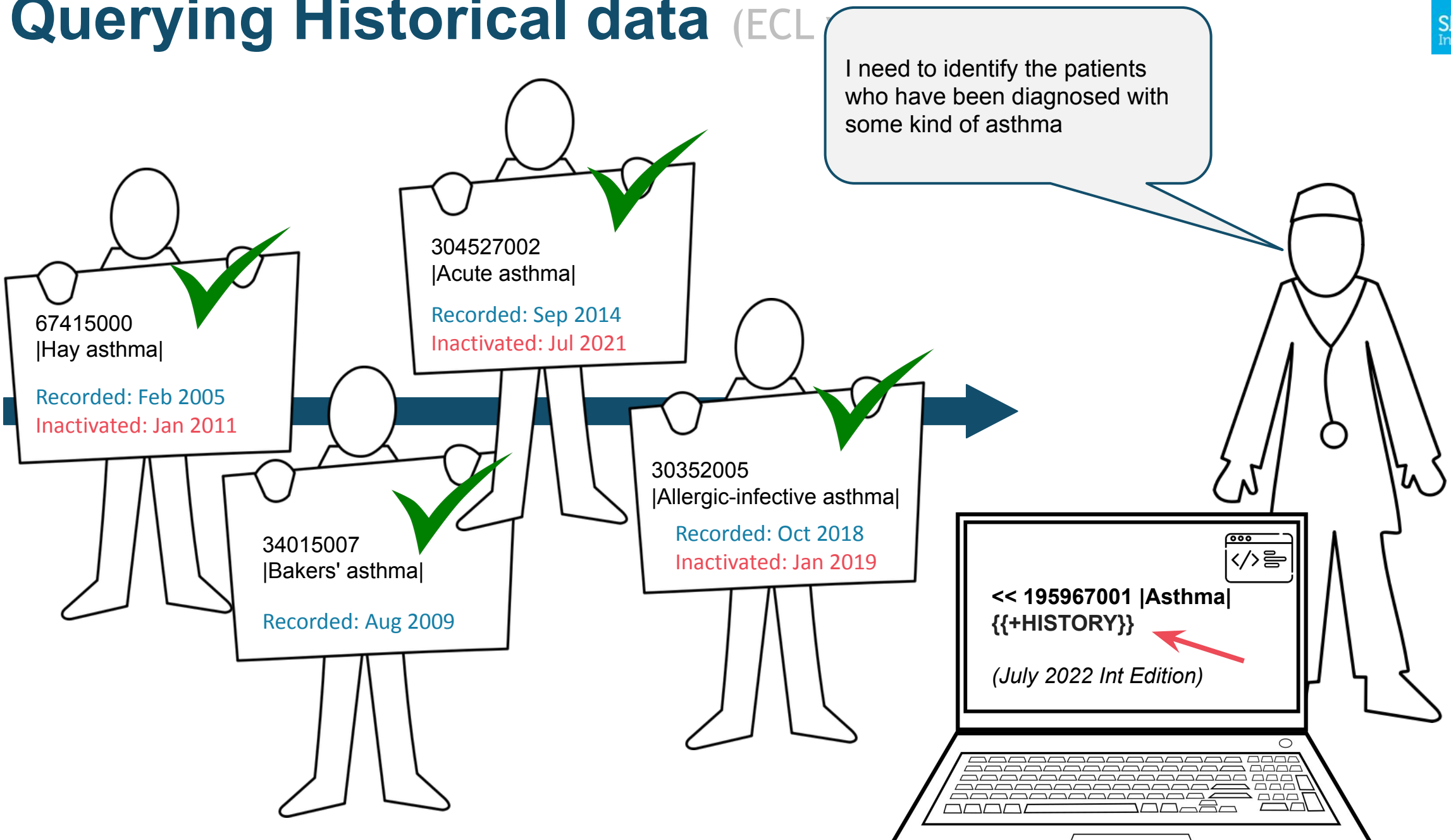
- SNOMED CT continuously evolve to meet emerging needs
- SNOMED CT supports full traceability and enables queries over historical data



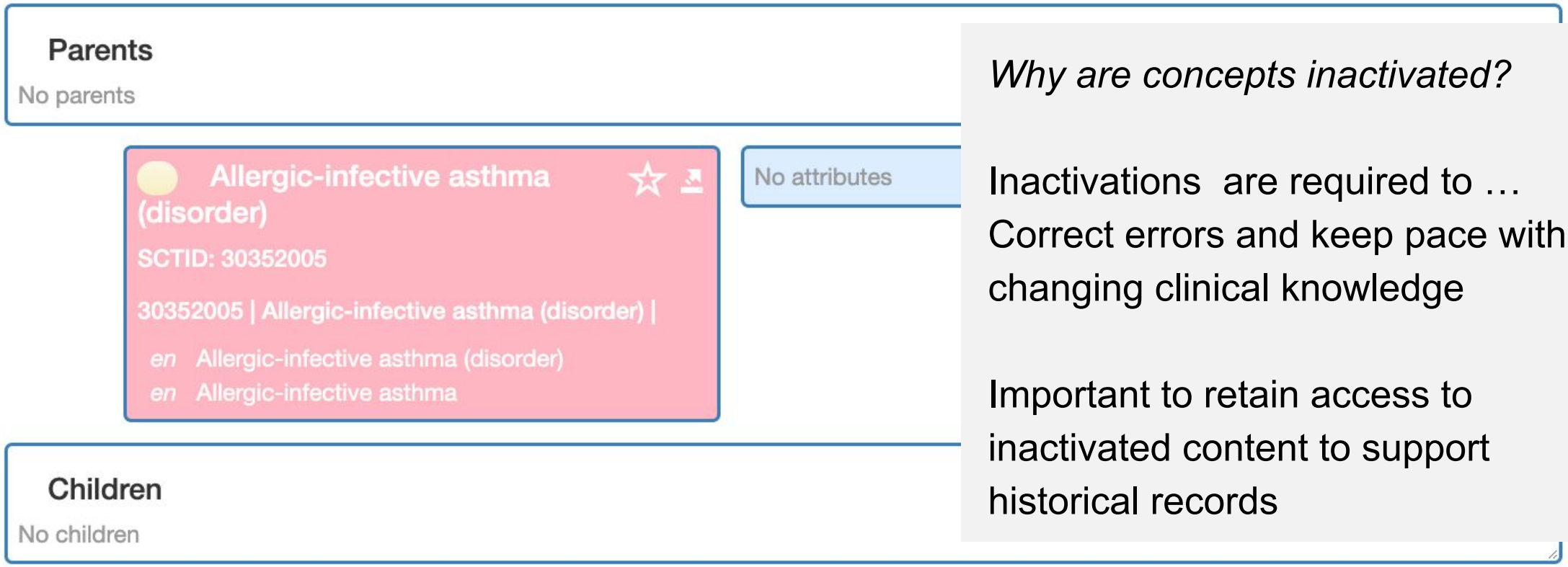
Querying Historical data (ECL



Querying Historical data (ECL



History Supplements (ECL v2.0)

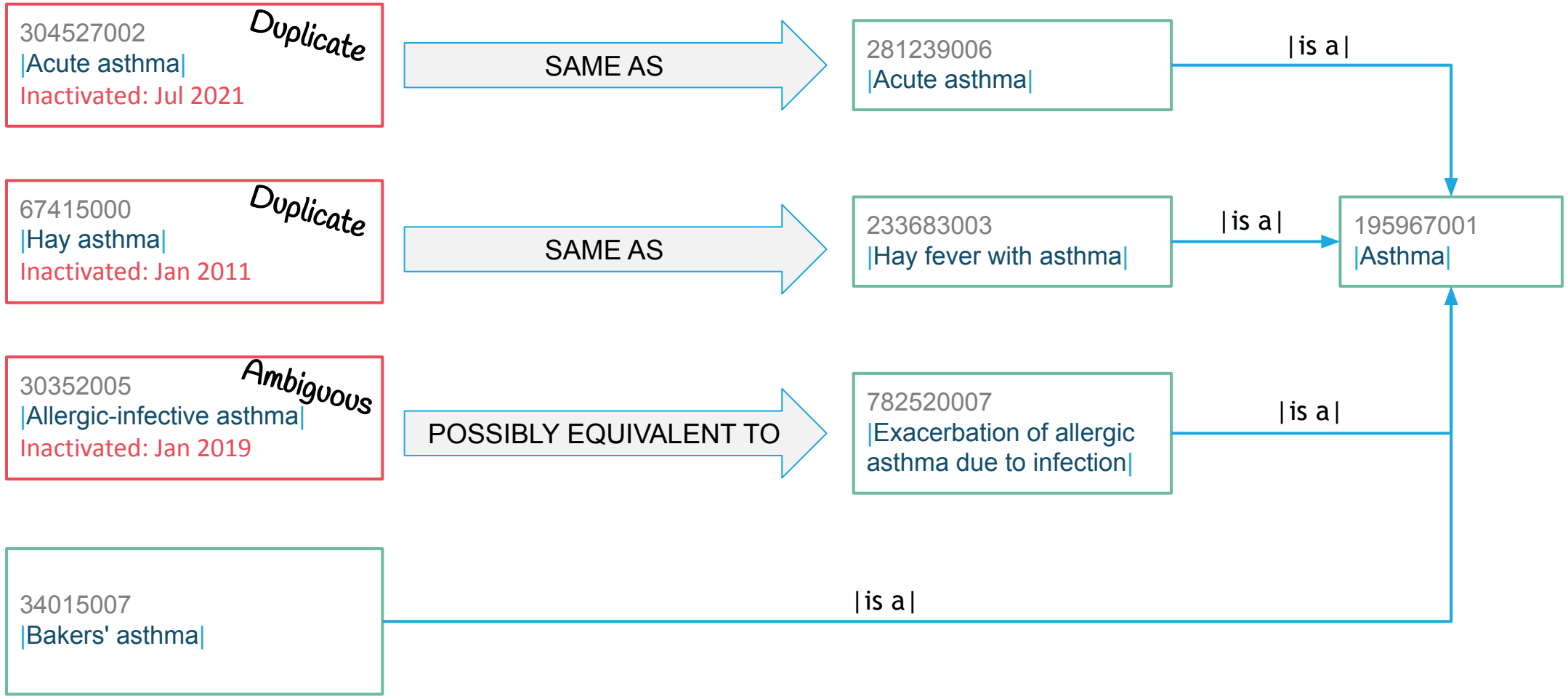


Why are concepts inactivated?

Inactivations are required to … Correct errors and keep pace with changing clinical knowledge

Important to retain access to inactivated content to support historical records

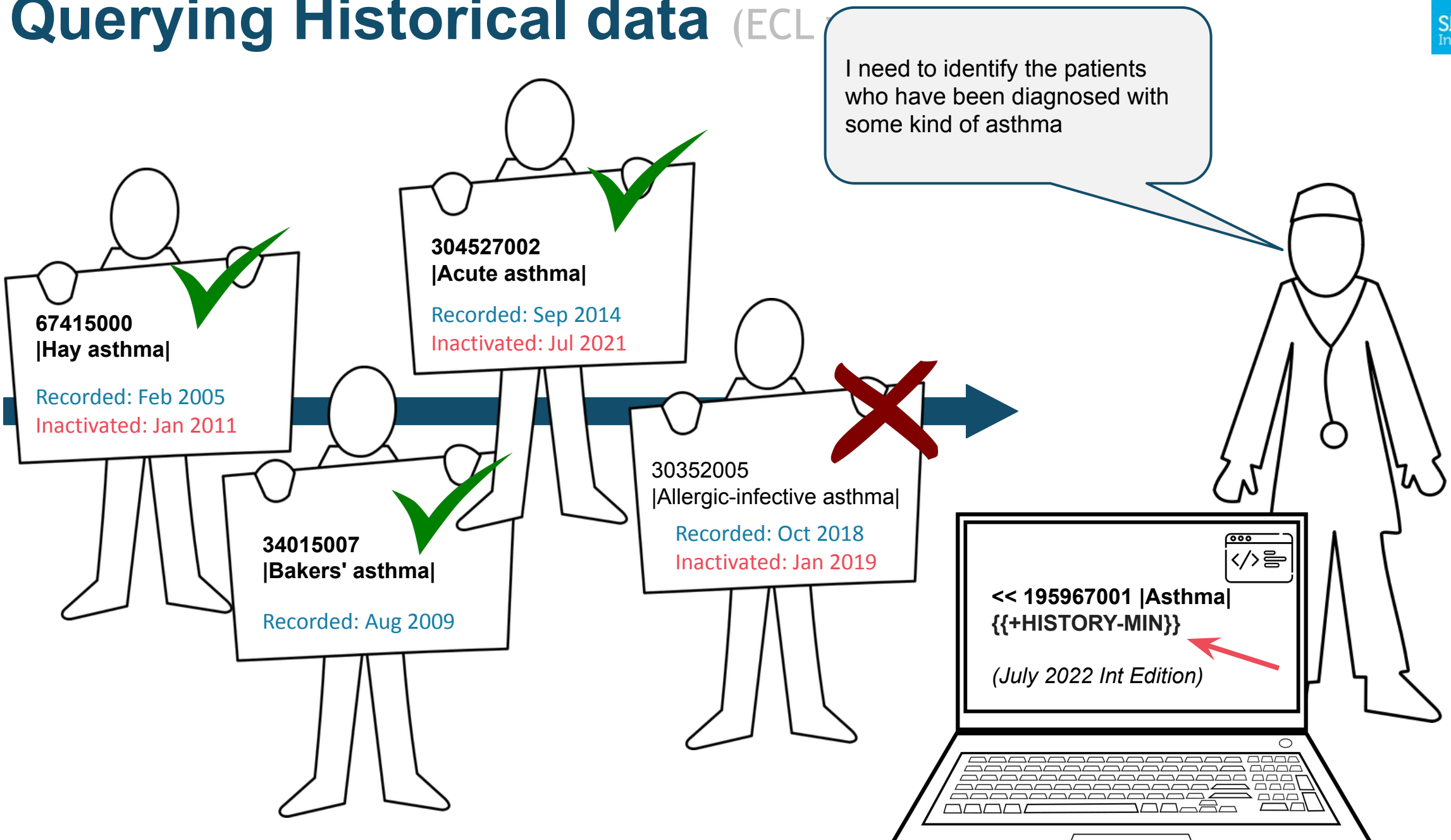
History Supplements (ECL v2.0)



History Supplements (ECL v2.0)

History Profile	Historical Association Reference Sets
HISTORY-MIN	• 900000000000527005 |SAME AS association reference set|
HISTORY-MOD	• 900000000000527005 |SAME AS association reference set| • 900000000000526001 |REPLACED BY association reference set| • 900000000000528000 |WAS A association reference set| • 1186924009 |PARTIALLY EQUIVALENT TO association reference set|
HISTORY-MAX HISTORY (*)	• < 900000000000522004 |Historical association reference set|

Querying Historical data (ECL



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Enabling Preventive Care Measures

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Data Analytics - Scenario 2

Research

Improving the quality and efficiency of care

Which groups are most at risk?
Consider preventative measures?

Data Analytics - Scenario 2

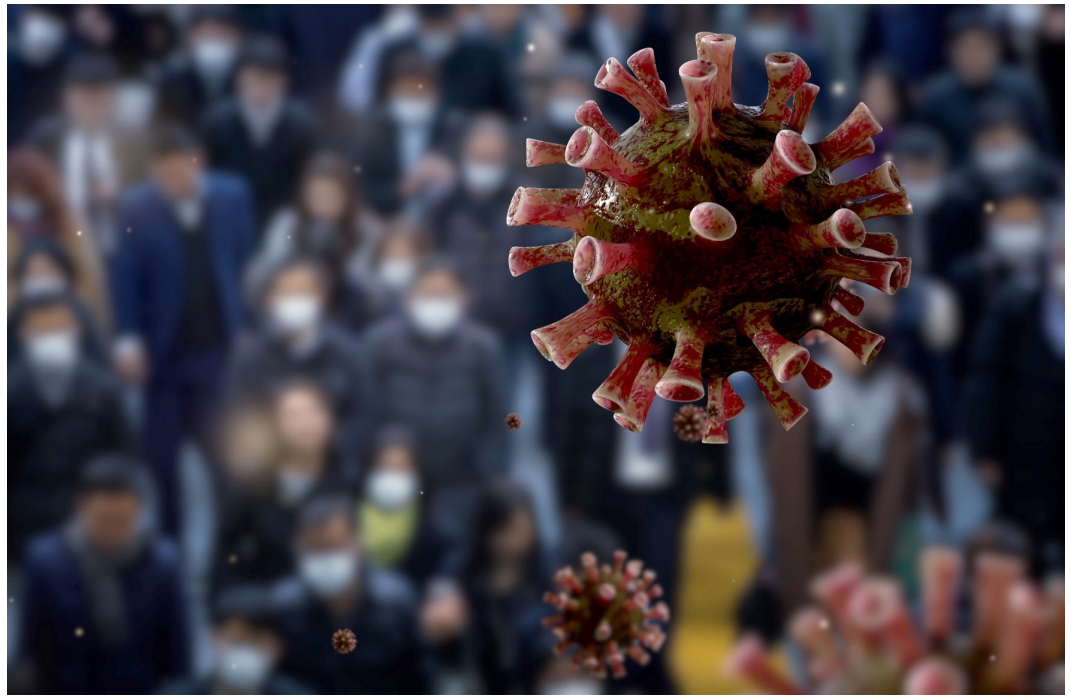
Patient group

People with COVID-19
(any variant)

Outcomes

People with pneumonia due to COVID-19

People died



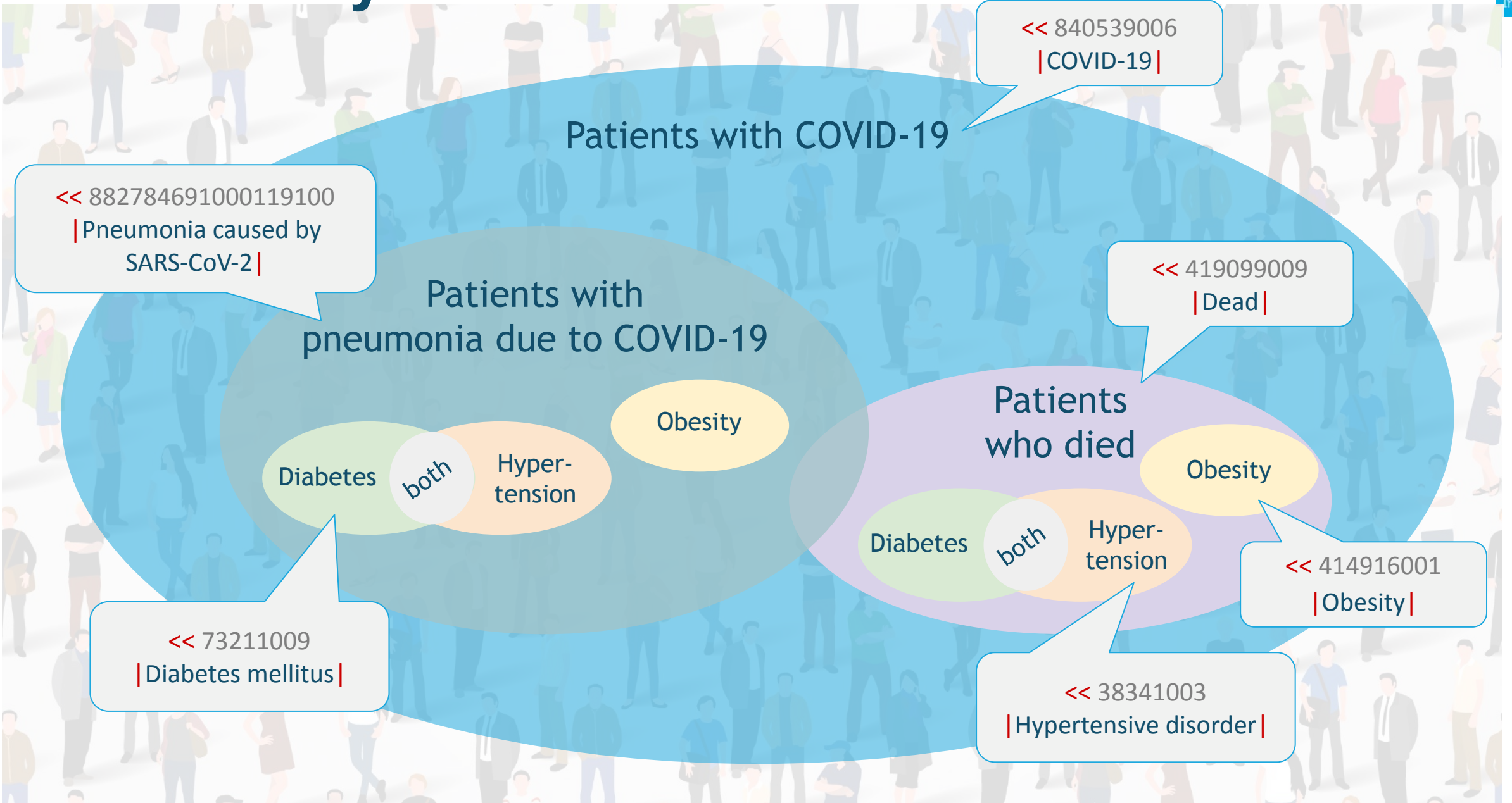
Risk factors

Obesity

Diabetes

Hypertension

Data Analytics - Scenario 2



Demonstration

Data Analytics - Scenario 3

Assessing treatments

How effective is each treatment option?

Data Analytics - Scenario 3

Patient cohort

BRCA1 gene mutation

Increased risk of breast cancer

Treatment

Drug prevention available

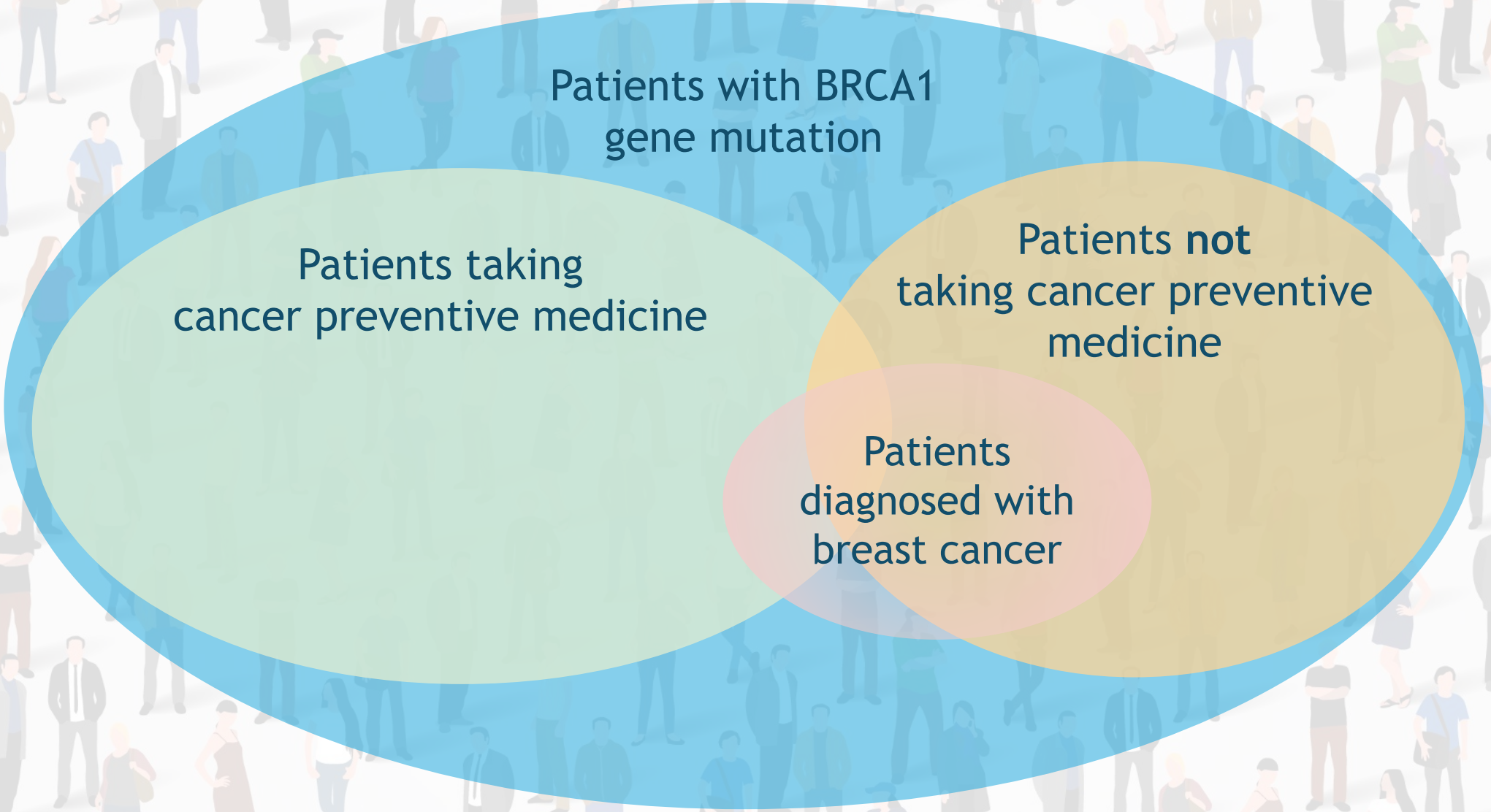
Risk of severe side effects

Question

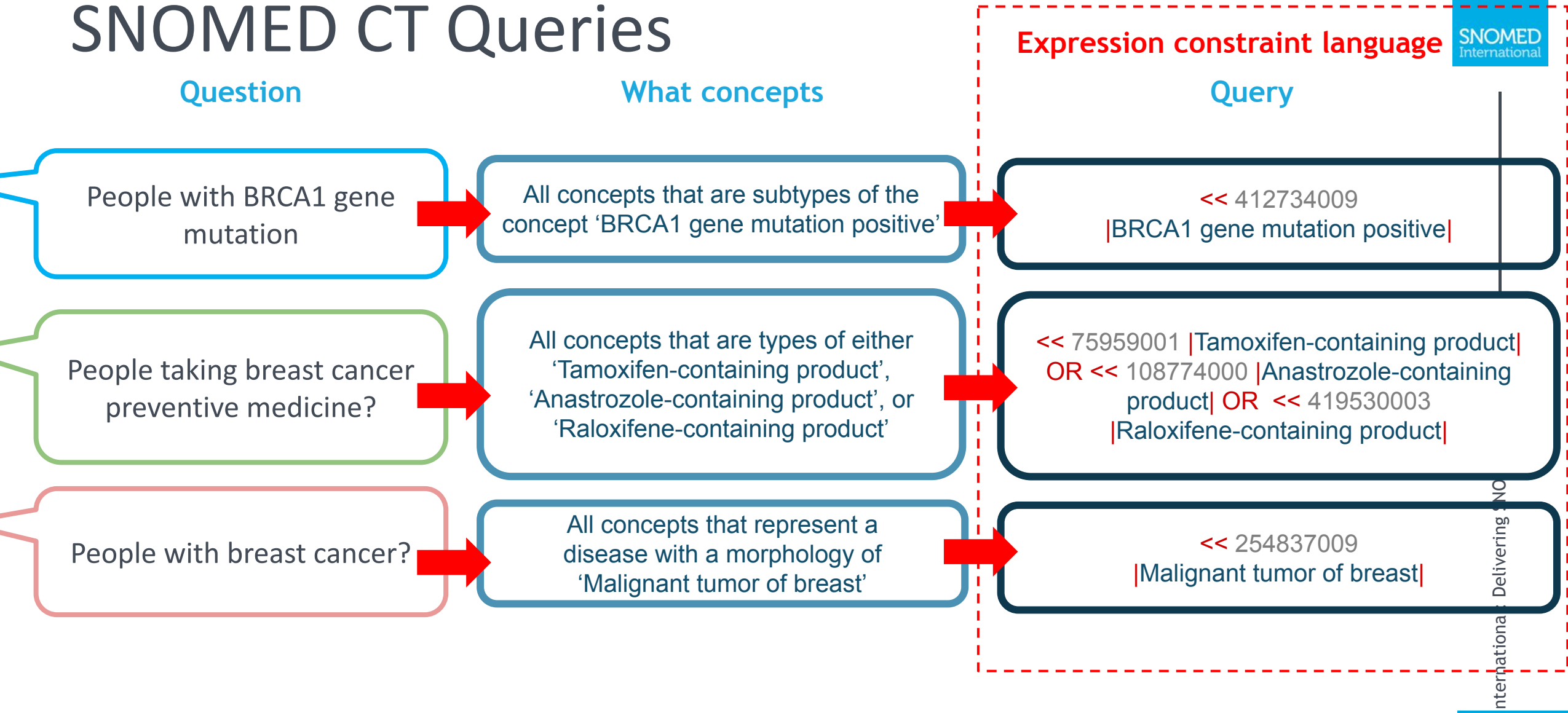
Does the medication significantly reduce the risk of cancer?

Data Analytics - Scenario 3

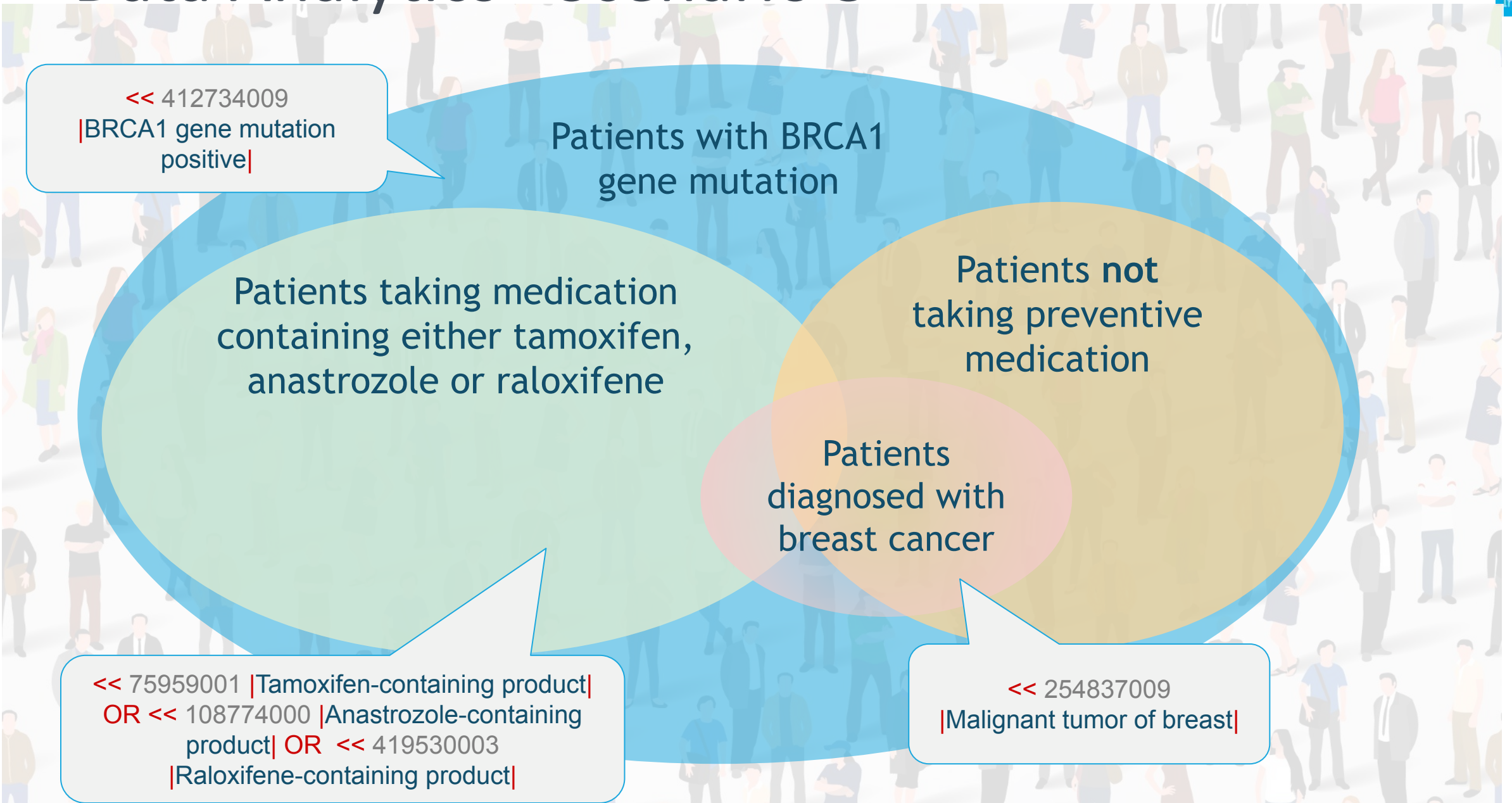
Data Analytics - Scenario 3



SNOMED CT Queries

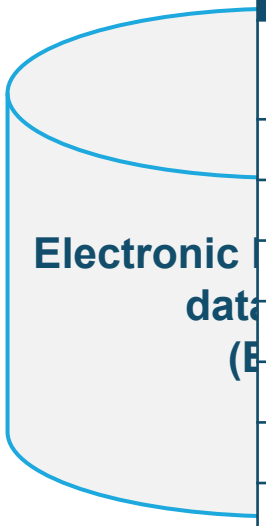


Data Analytics - Scenario 3



Patient Data Analytics

<< 254837009 |Malignant tumor of breast|



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009	405944004	Asthmatic bronchitis
010	46635009	Type 1 diabetes mellitus

Patient Data Analytics

SELECT Patient_Id **FROM** EHR **WHERE** Diagnosis =
(<< 254837009 |Malignant tumor of breast|)

Electronic
data
(E

Patient_Id	Diagnosis	Diagnosis term
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ECL Expansion
15950061000119105
353421000119109
145501000119108
354591000119108
448435005
254840009
286896005
278050001
271467005
403458008
373082000
373081007
254837009
254841008
188159008
188159008
…

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SELECT Patient_Id **FROM** EHR **WHERE** Diagnosis =
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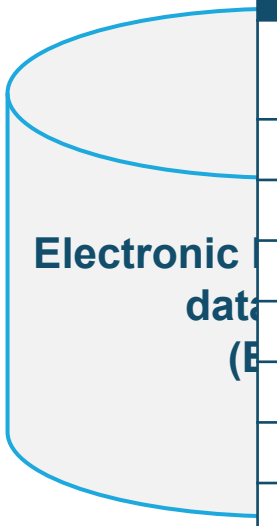

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Demonstration

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Interpreting The Results

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Interpreting Results (General)

- Correlation does not equal causation!
  - These reports create correlations which provide an important first step in clinical research, however a correlation on it's own does not provide enough evidence to support decision making
  - Additional statistical techniques should be used to verify the results
  - The Snolytical API supports accessing the raw data for this purpose

- We must check for alternative patterns and explanations for the results
  - For example, when comparing two drugs:
    - **Drug A** may appear to perform much better than **Drug B** when measuring outcomes alone.
    - However **Drug B** may be routinely chosen for patients with existing severe comorbidities because it has less side effects. Therefore which drug is prescribed is **not the only factor.**
  - Examples of factors that can influence outcomes:
    existing conditions, lifestyle, family history, age, genetics, drug interactions.. many others

Questions?

THANK YOU

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