

SNOMED
International

Delivering
SNOMED CT

Implementation Support

SNOMED CT in Finland

Kai Kewley and Anne Randorff Højen

SNOMED International Implementation Support Team

December 2023

snomed.org



[@snomedct](https://twitter.com/snomedct)



linkedin.com/company/ihtsdo/



Agenda

1. Implementation and Education Resources
2. Implementation roadmap for healthcare organizations and vendors
3. Terminology servers
4. Benefits of SNOMED CT in data analytics
5. Decision support and examples
6. Discussion and questions



Delivering
SNOMED CT

Implementation and Education Resources

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[linkedin.com/company/ihtsd/](https://www.linkedin.com/company/ihtsd/)

SNOMED International's Implementation Support Team

Our goal - To collaborate with Members to achieve their SNOMED CT implementation goals, in a way that delivers the most value for them



Alejandro Lopez Osornio
Senior Implementation
Support Specialist



Anne Randorff Højen
Implementation Support
Specialist

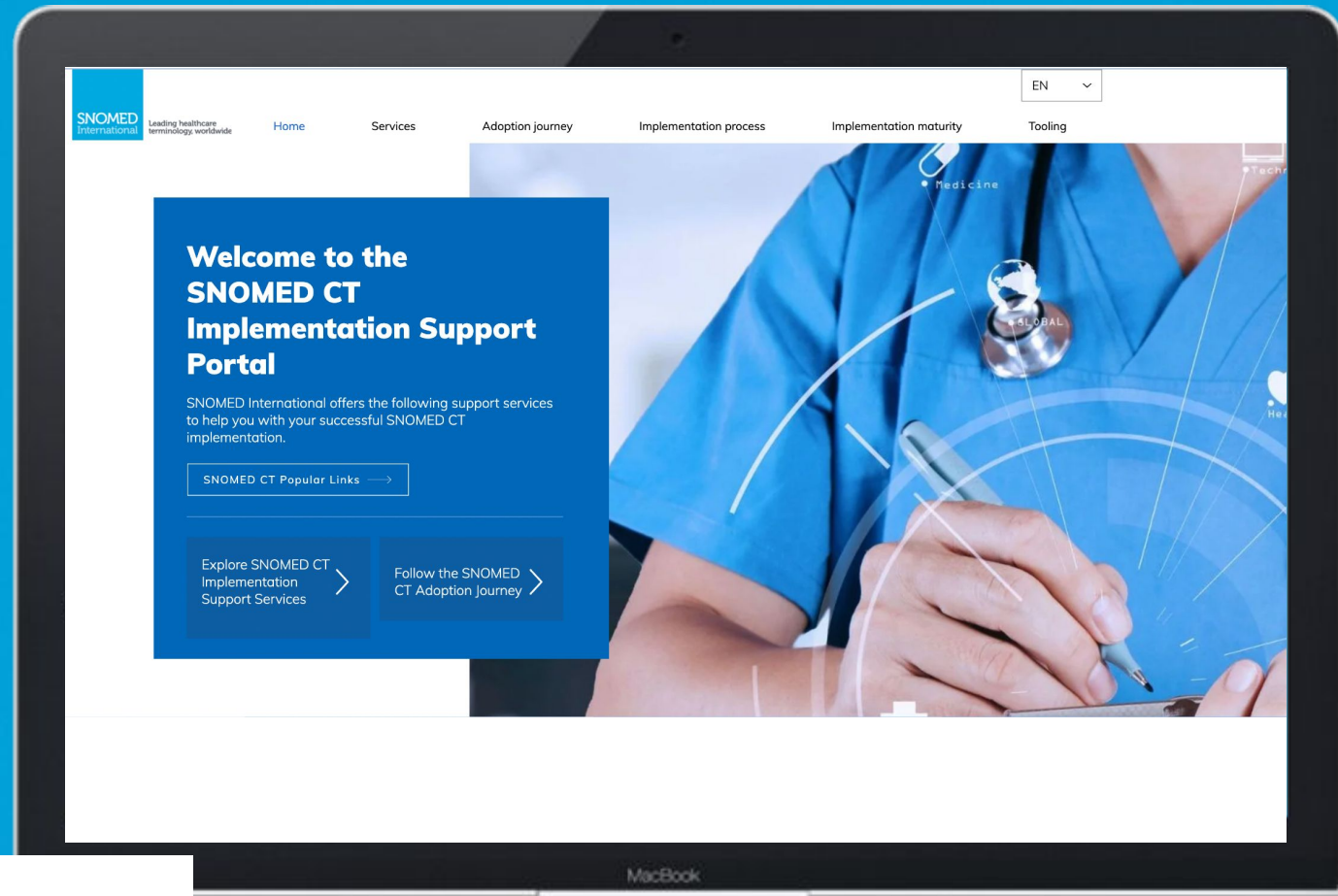


Kai Kewley
Implementation Support
Technical Specialist

implementation@snomed.org

Implementation Support Portal

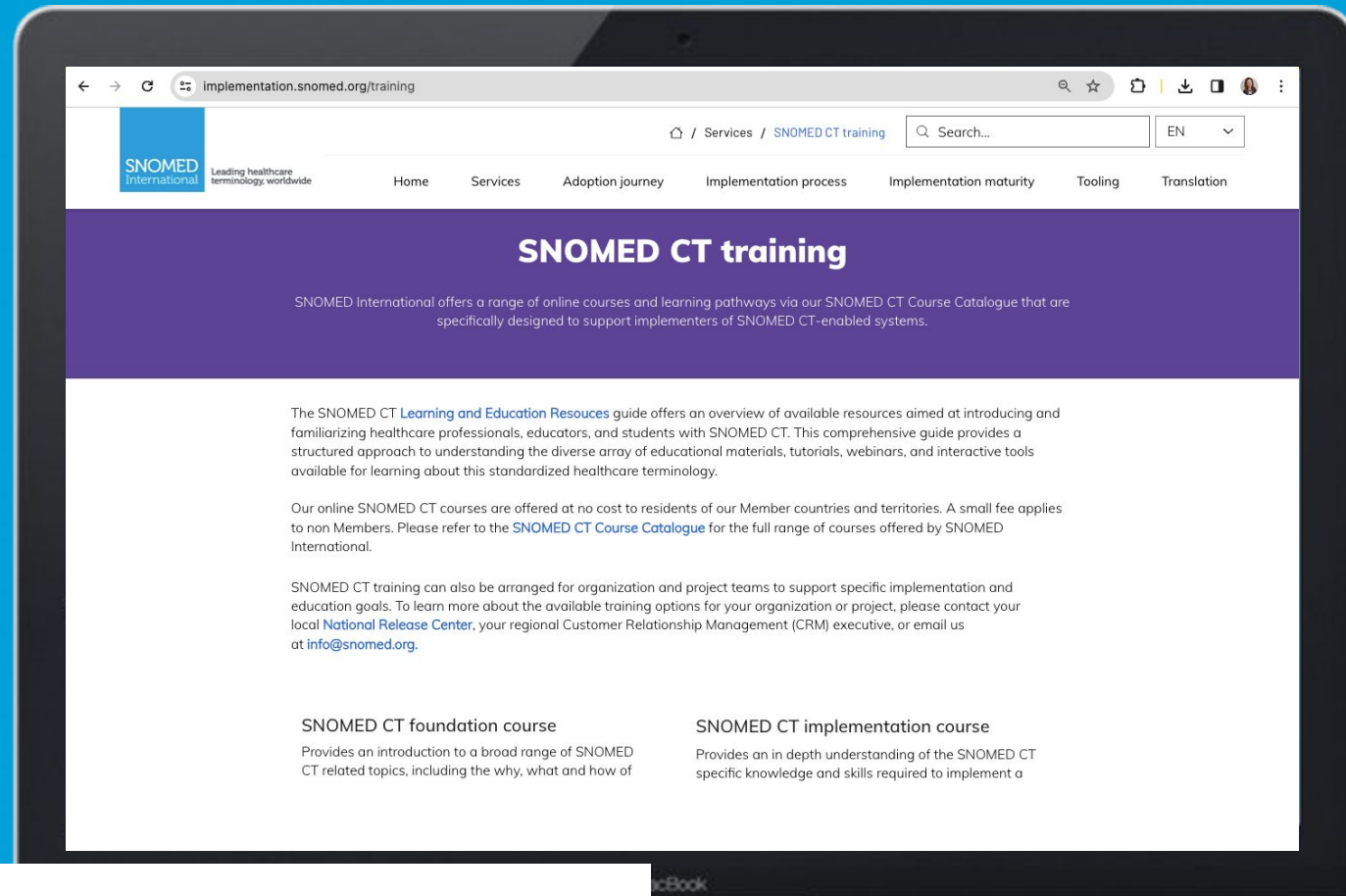
A comprehensive guide to
implementation resources
and services



Available at:
<http://snomed.org/support>

Learning and Education Guide

A comprehensive guide to
SNOMED CT Learning and
Education resources



Available at:

<https://implementation.snomed.org/training>

SNOMED CT Courses

Courses

- Foundation
- Implementation
- Terminology Services
- Authoring Level 1
- Authoring Level 2

Certifications

- Terminology Services
- Authoring Level 1
- Authoring Level 2

Learning pathways

- Developers
- Data analysts
- Clinicians
- Translation

Available at:

<https://courses.ihtsdotools.org>

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SNOMED CT

Document Library

An important source of information for anyone adopting, authoring, implementing, deploying or using SNOMED CT

- Overviews
- Guides
- Specifications
- SNOMED CT Expo
- Glossary

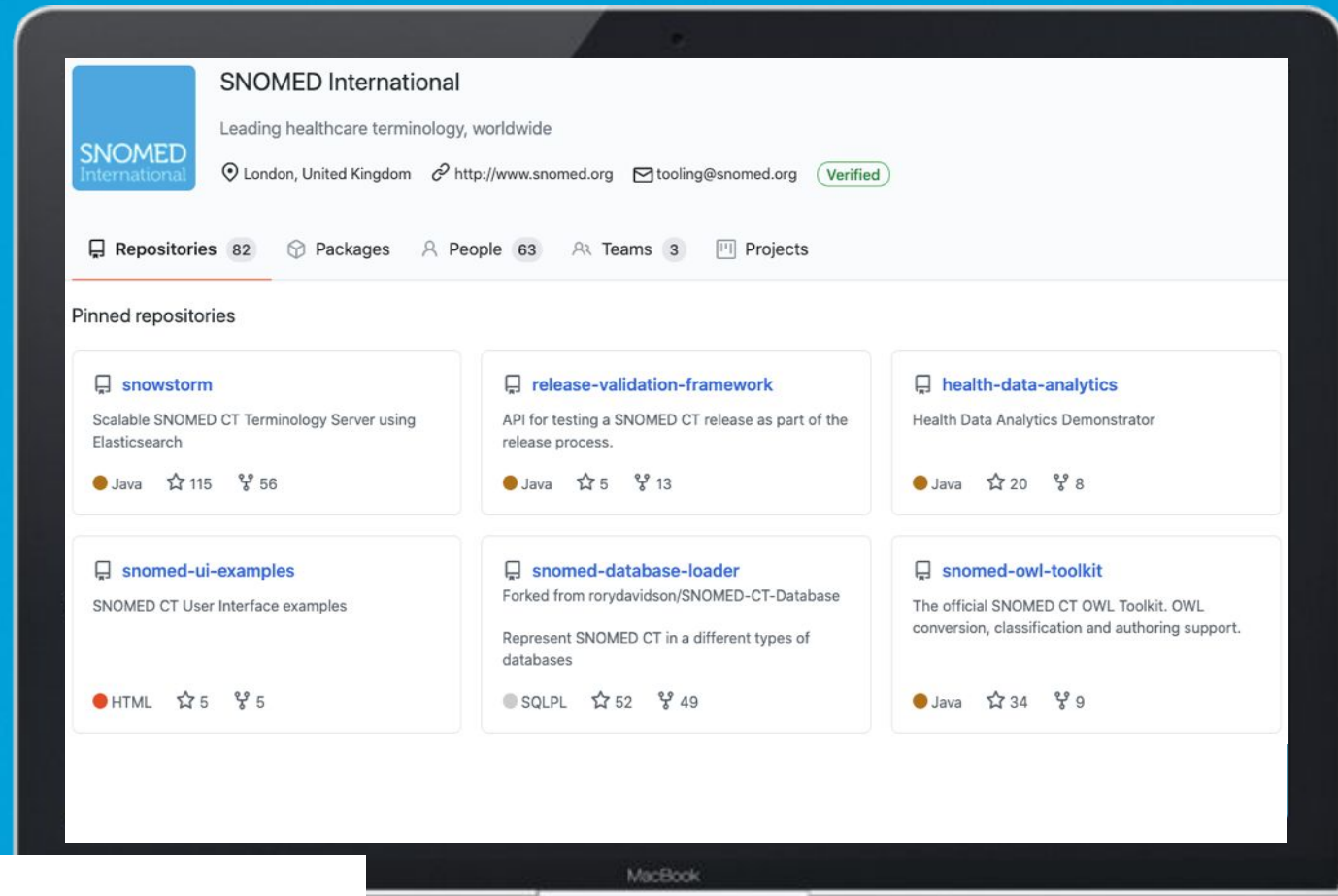


Available at:

<http://snomed.org/doc>

IHTSDO GitHub Repositories

Contain open source code
for a range of SNOMED CT
software tools



Available at: <https://github.com/IHTSDO>

Questions?

The logo for SNOMED International, featuring the text "SNOMED" in a large, bold, white sans-serif font above the word "International" in a smaller, white sans-serif font, both centered within a solid blue square.

SNOMED
International





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Implementation Roadmap for Healthcare Organizations and Vendors

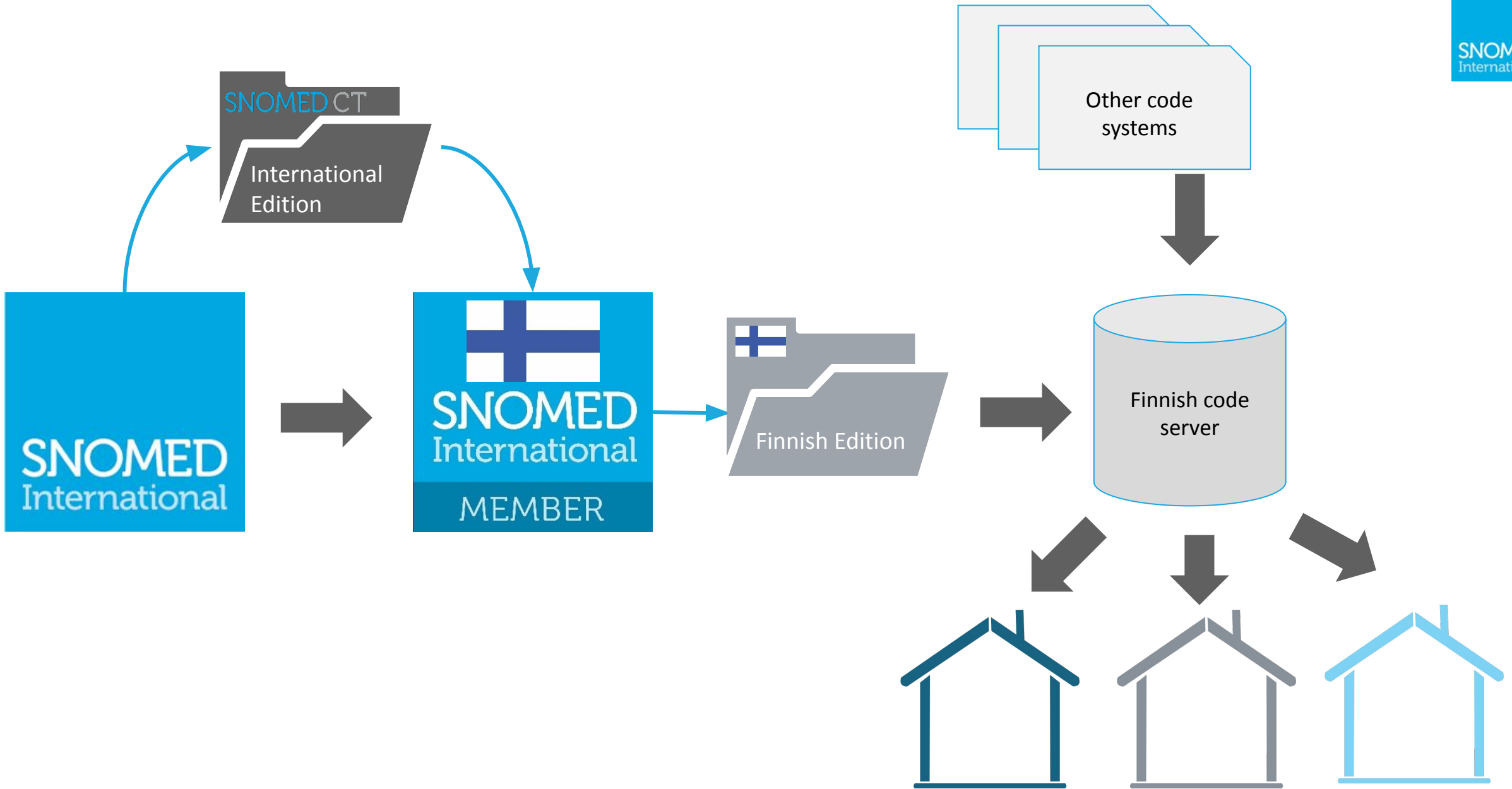
snomed.org

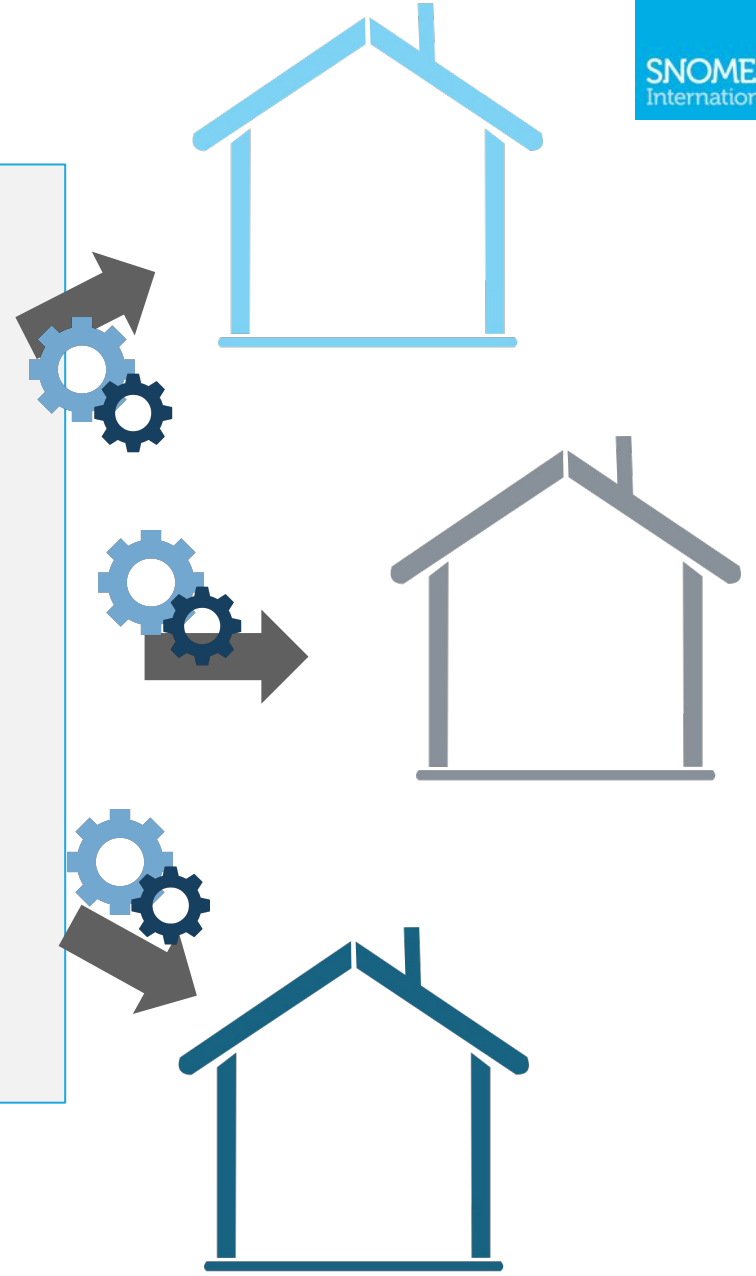
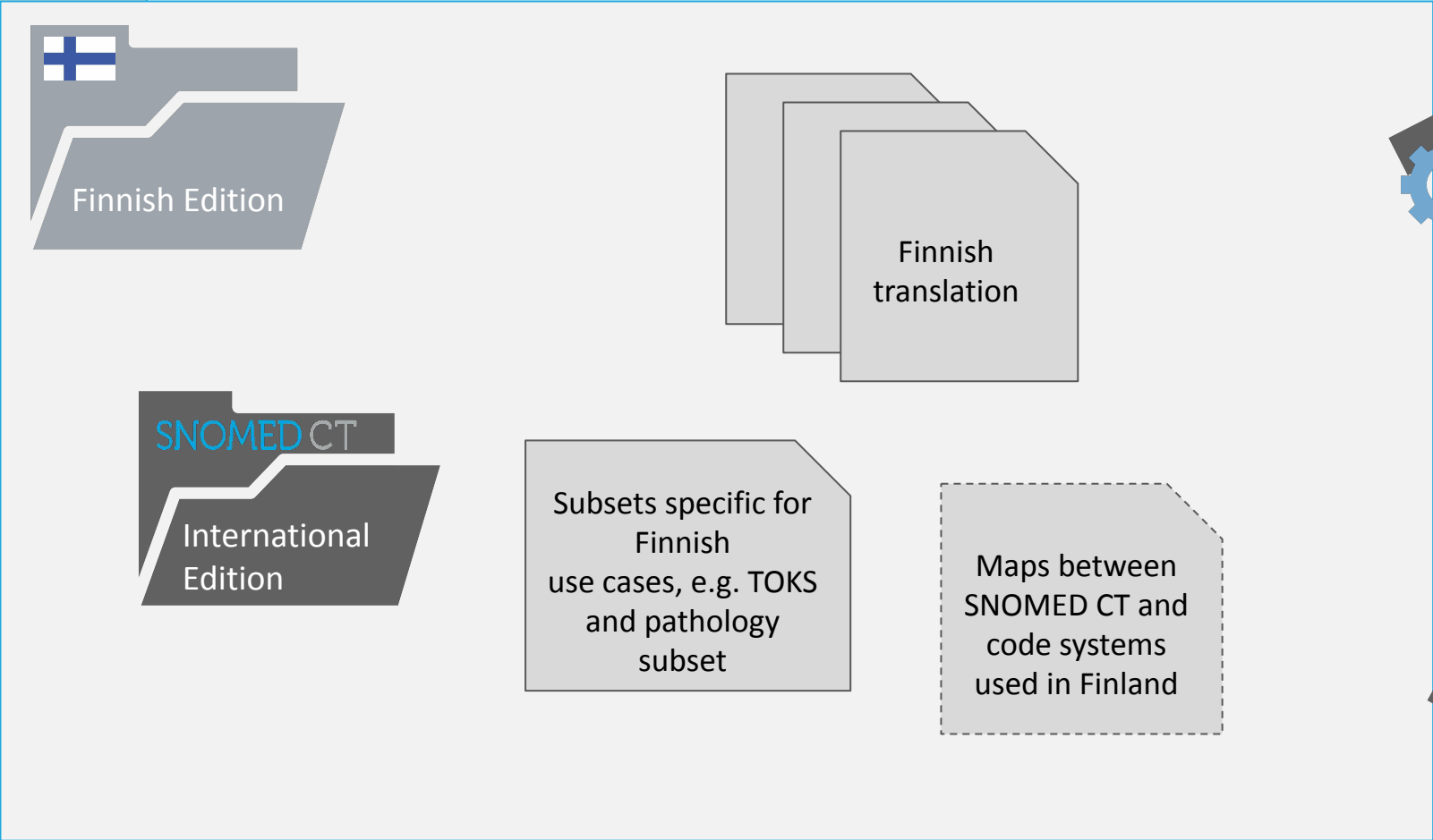


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1. SNOMED CT roadmap planning
2. Developing & maintaining SNOMED CT artifacts (subsets, maps, etc.)
3. Deploying terminology services
4. Embedding SNOMED CT in clinical systems
5. Training and stakeholder engagement





1. SNOMED CT roadmap planning

Developing & maintaining SNOMED CT artifacts
(subsets, maps, etc.)

Terminology services

- **Goals**
 - Short- and long term objectives (what benefits do you wish to obtain?)
- **Approaches and architecture**
 - How can objectives be met by existing architectural dependencies?
 - What changes are possible to support these objectives?
- **Terminology derivatives**
 - What subsets, maps, services are required to support the objectives?
 - How will these derivatives be developed, maintained and implemented?

Understanding
Implementation
Options

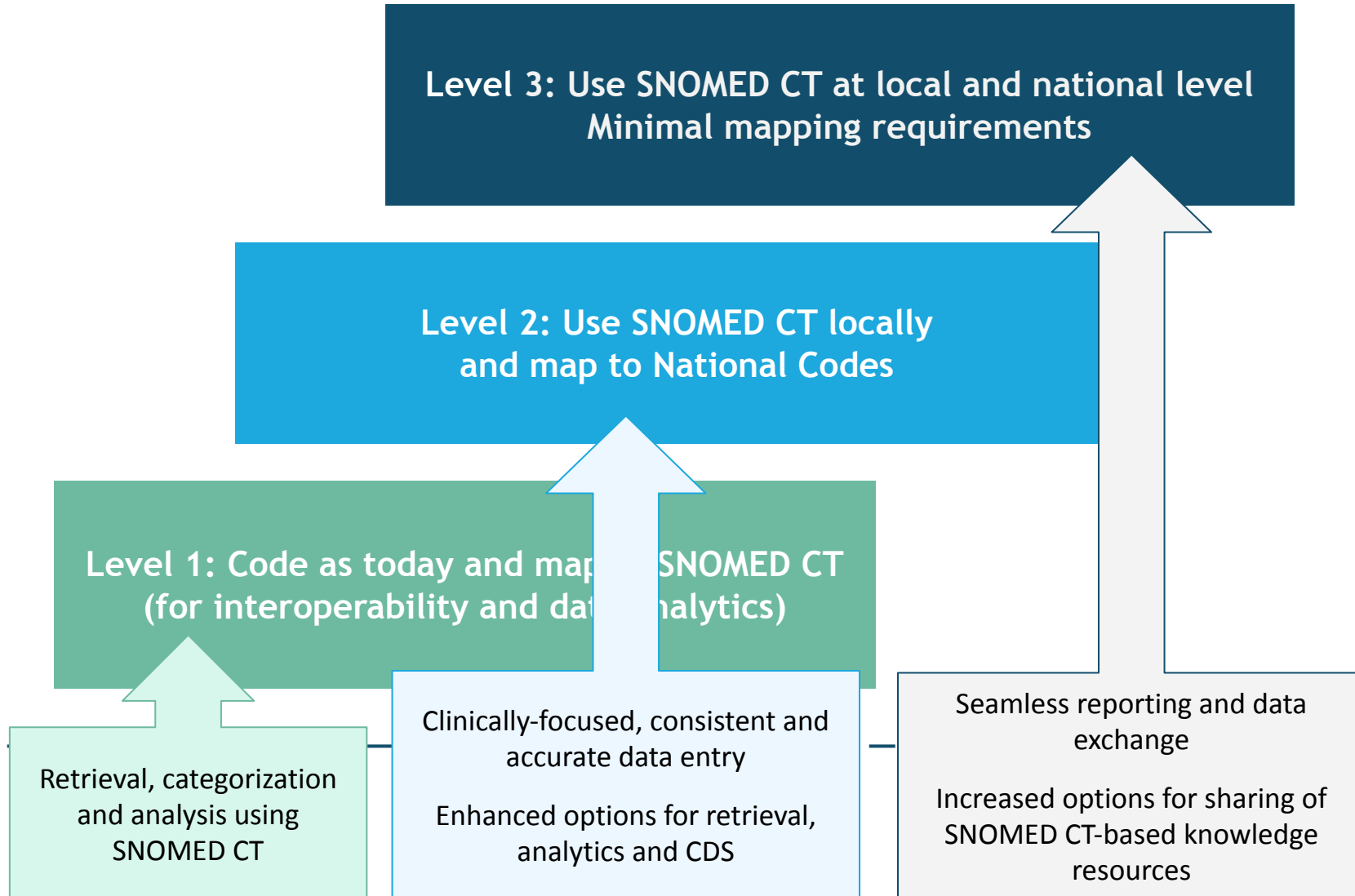
SNOMED CT Integration Options

(National standardization) ↑

More changes

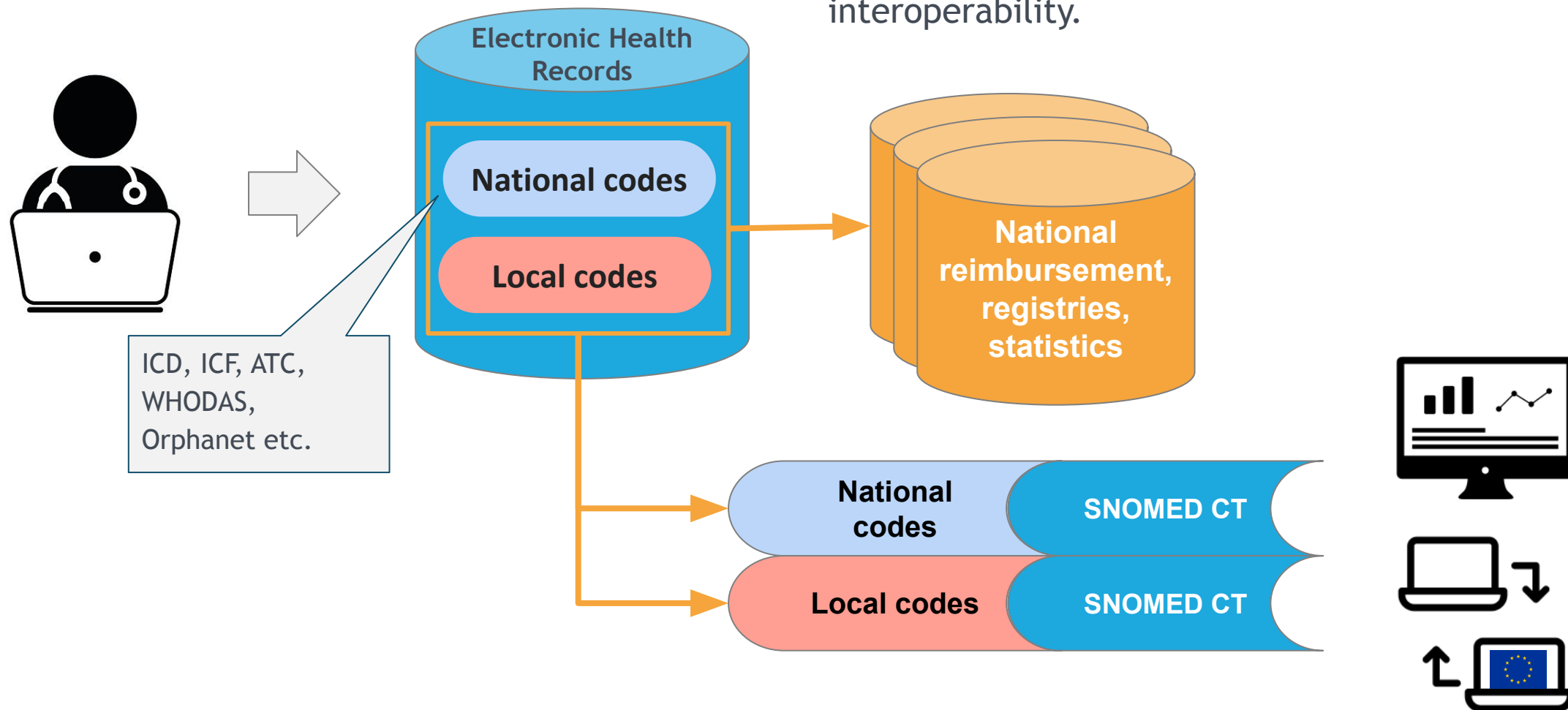
Changes to data workflows and information systems

Less changes



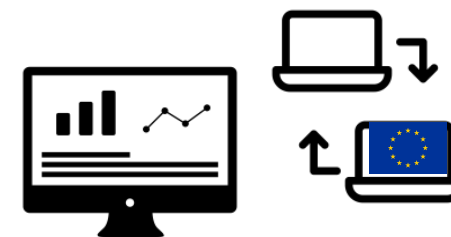
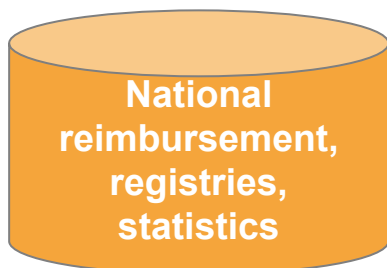
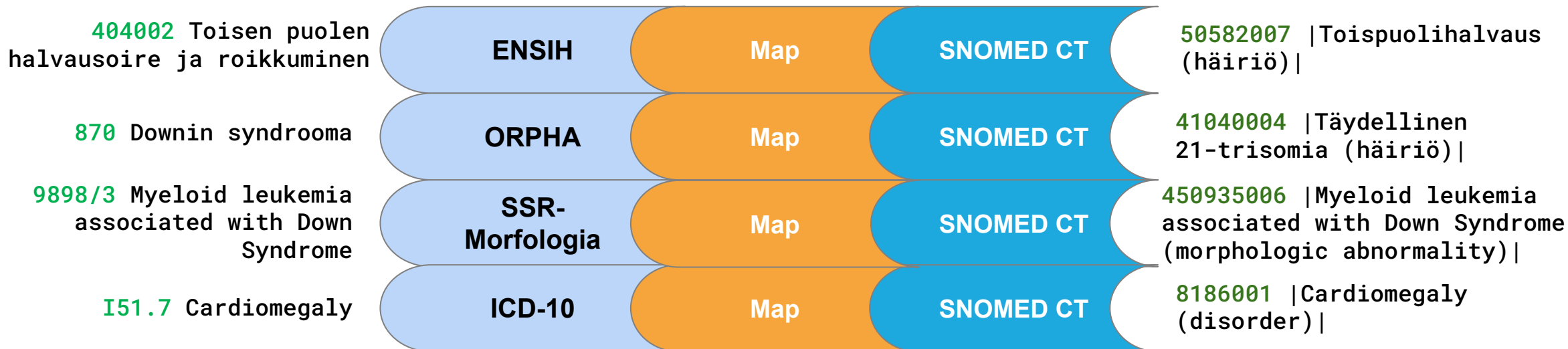
Level 1: Code as today and map to SNOMED CT (for interoperability and data analytics)

- Hospitals can code with the same code systems they use today, and submit national codes using existing processes.
- Maps between SNOMED CT and local, national and other codes enable data analytics and interoperability.



Level 1: Code as today and map to SNOMED CT (for interoperability and data analytics)

- Mapping to SNOMED CT provides a uniform representation of the clinical information using an international standard, ready for data analytics and interoperability



Level 1: Code as today and map to SNOMED CT (for interoperability and data analytics)

Parents

- ▶ Disorder of the central nervous system (disorder)
- ▶ Paralytic syndrome on one side of the body (disorder)

Hemiplegia (disorder)

SCTID: 50582007

50582007 | Hemiplegia (disorder) |

- en Hemiplegia (disorder)
- en Hemiplegia
- en Hemiplegia (paralysis on one side)

Finding site → Structure of central nervous system

Interprets → Movement observable
Has interpretation → Absent

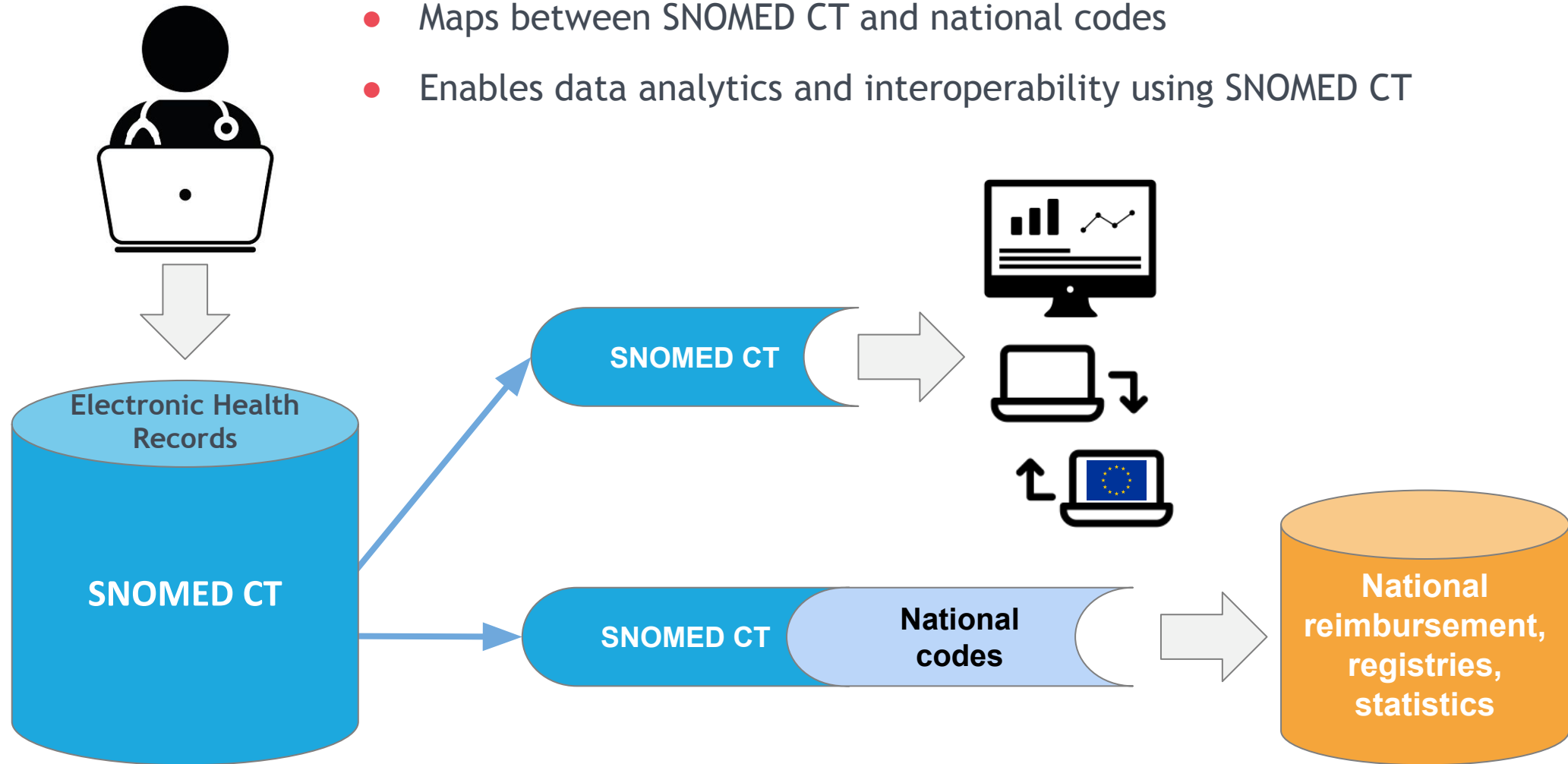
Interprets → Movement

Children (16)

- ▶ Alternating hemiplegia (disorder)
- Alternating hypoglossal hemiplegia (disorder)
- Cerebral hemiplegia (disorder)
- Facial hemiplegia (disorder)
- ▶ Flaccid hemiplegia (disorder)
- ▶ Hemiplegia as late effect of cerebrovascular disease (disorder)
- ▶ Hemiplegia of dominant side (disorder)
- ▶ Hemiplegia of nondominant side (disorder)
- Infantile hemiplegia (disorder)
- Laryngeal hemiplegia (disorder)
- Left hemiplegia (disorder)

Level 2: Use SNOMED CT locally and map to National Codes

- Maps between SNOMED CT and national codes
- Enables data analytics and interoperability using SNOMED CT



Level 2: Use SNOMED CT locally and map to National Codes

- Mapping from SNOMED CT allows the use of the full diversity of SNOMED CT codes in the clinical records, with different granularities. The mapping may require manual selection and validation.

109820009 |Nodular hyperplasia of liver|

SNOMED CT

Map

National codes

K76.89 Other specified diseases of liver

235887001 |Rupture of liver|

SNOMED CT

Map

National codes

K76.89 Other specified diseases of liver

111371005 |Subcapsular hemorrhage of liver|

SNOMED CT

Map

National codes

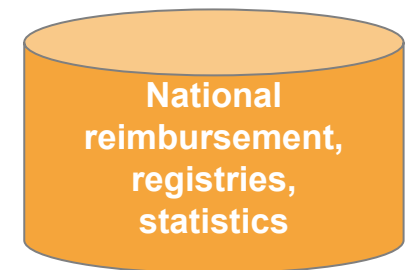
K76.89 Other specified diseases of liver



Granular and accurate recording for clinical precision



Coarse grained coding for reporting and statistics



Level 2: Use SNOMED CT locally and map to National Codes

- **Semi-automated mapping:** mapping from SNOMED CT to National Codes or ICD in some instances require human adjudication of the final code/s.

18557009 |Closure by suture|

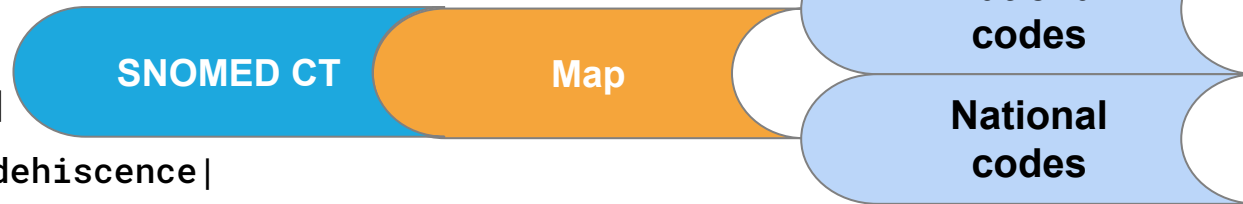
74230002 |Delayed suture of wound|

287903004 |Suturing of hand|

446937004 |Suturing of scalp|

29629000 |Resuture of wound dehiscence|

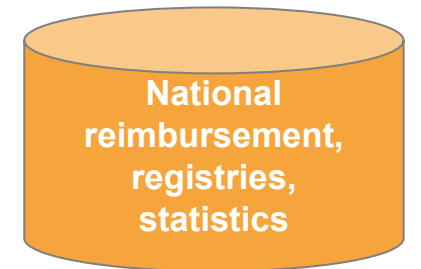
...



Granular and accurate recording for clinical precision

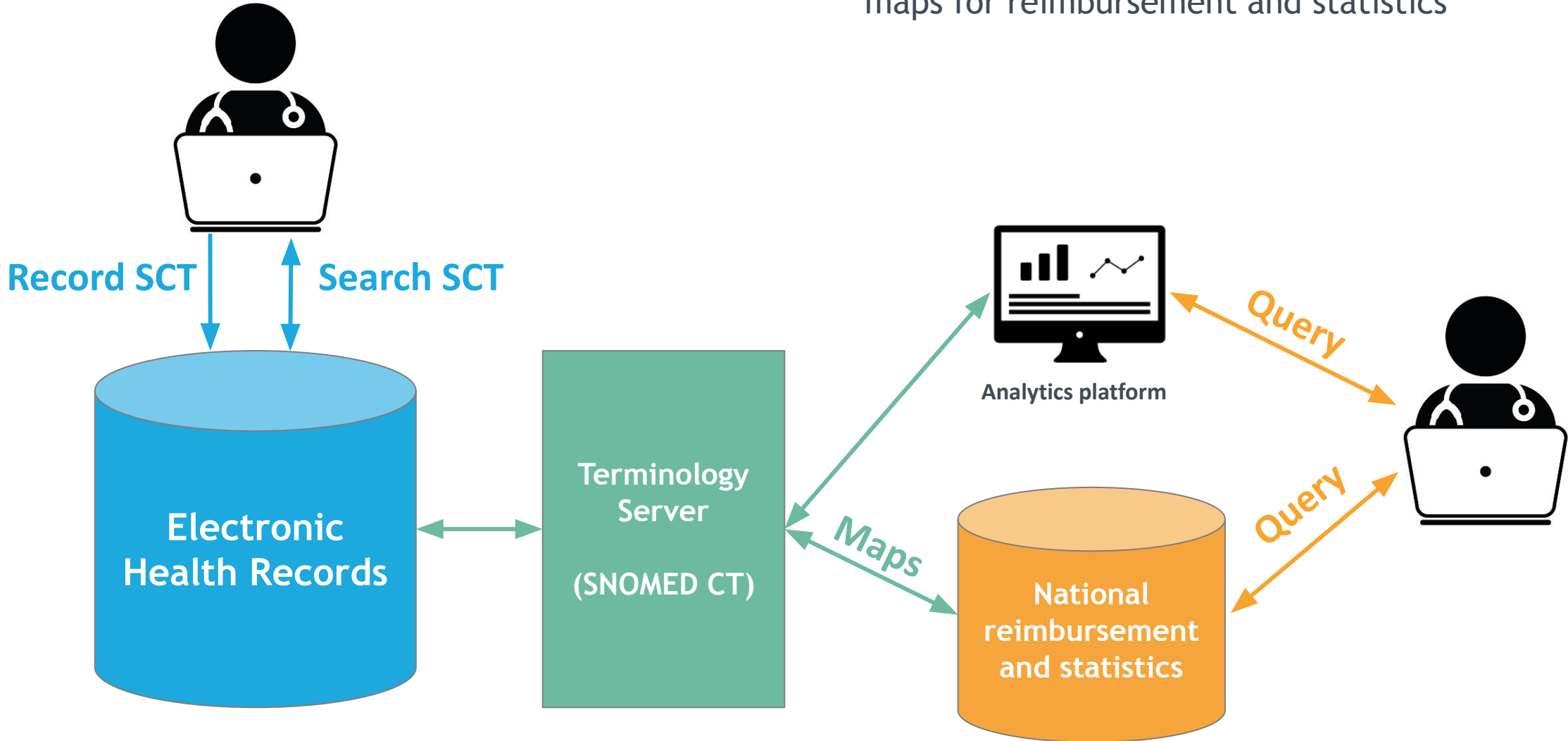


Coarse grained coding for reporting and statistics



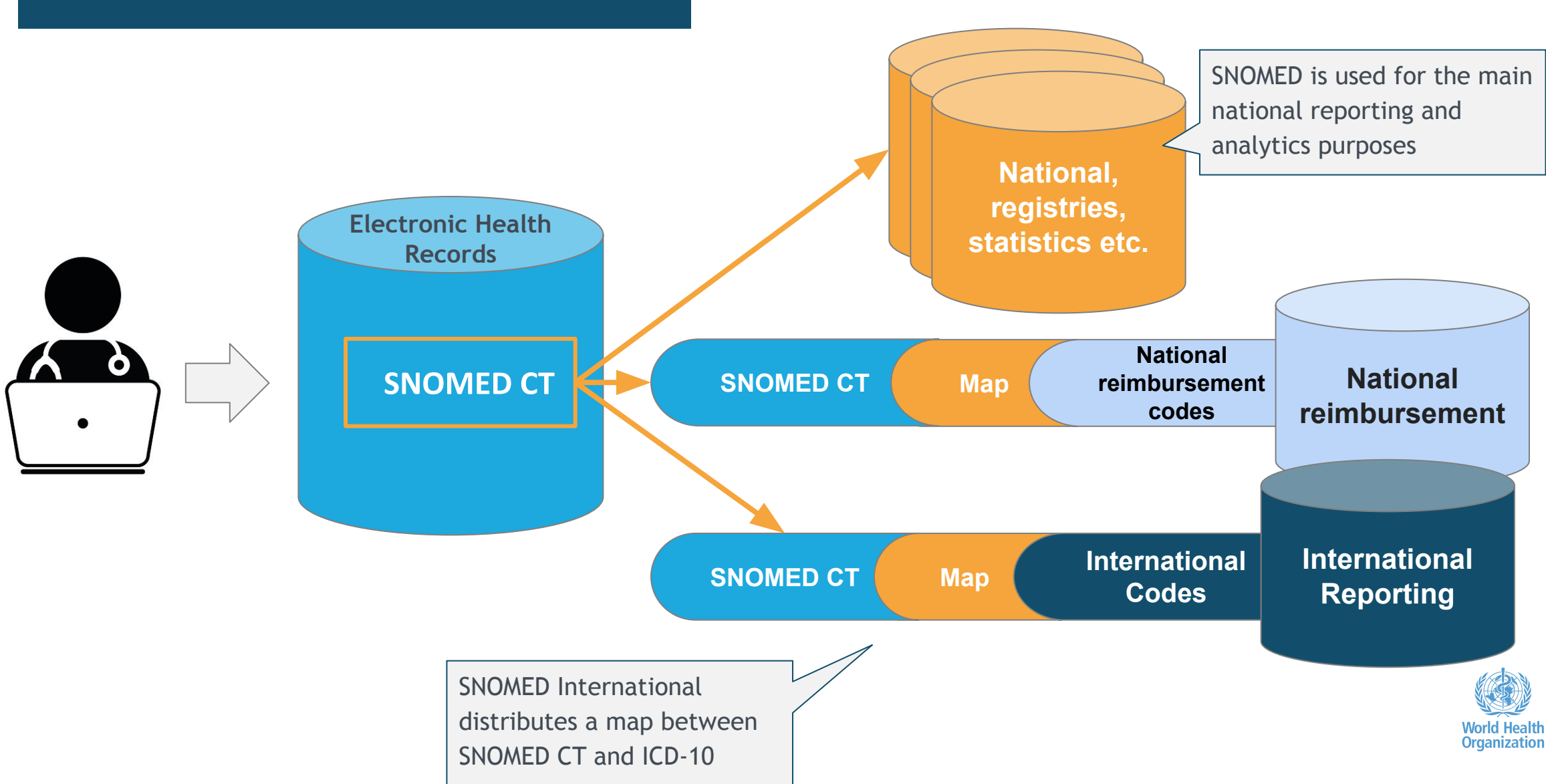
Level 2: Use SNOMED CT to code and semi-automated map to National Codes

- Using a terminology server to search and select codes to record in the EHR, to perform advanced queries for analytics, and using maps for reimbursement and statistics



Level 3: Use SNOMED CT at local and national level
Minimal mapping requirements

- SNOMED CT is the main terminology used for national reporting and data analytics



Considerations

Level 1: Code as today and map to SNOMED CT
(for interoperability and data analytics)

- Natural starting point when options for system changes are limited
- Health record can keep using local codes
- Large effort to establish and maintain maps
- Risk of low accuracy for secondary use cases

Level 2: Use SNOMED CT locally
and map to National Codes

- Point-of-care data capture using SNOMED CT (high accuracy)
- Foundation for data analytics and clinical decision support utilizing features of SNOMED CT
- System must be updated to apply SNOMED CT
- Maps must be developed and maintained

Level 3: Use SNOMED CT at local
and national level

- As for level 2, but
 - Minimal mapping requirements



1. SNOMED CT roadmap planning
2. Developing & maintaining SNOMED CT artifacts (subsets, maps, etc.)

ing terminology services

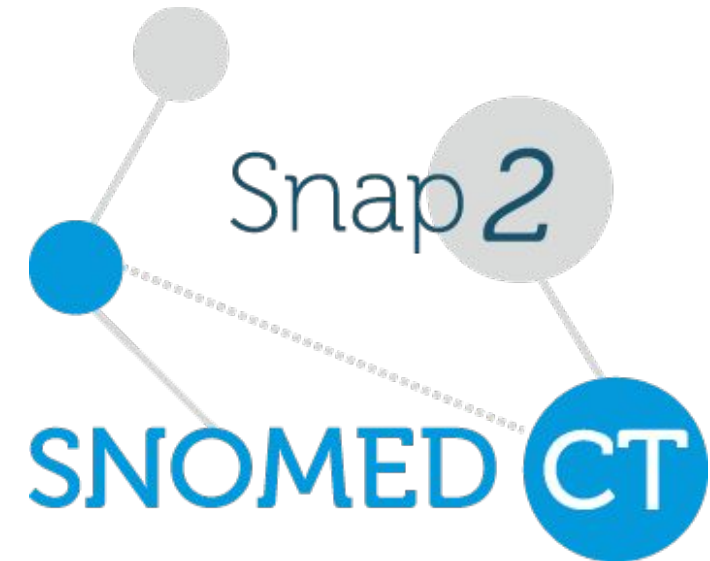
SNOMED CT in clinical systems

- **SNOMED CT value sets** - <https://refset.snomedtools.org> (new tool under development)
 - Tool for developing and maintaining SNOMED CT simple reference sets (subsets)
- **SNOMED CT maps** - <https://snap.snomedtools.org>
 - Collaborative tool for creating and maintaining maps to SNOMED CT

Snap2Snomed

Level 1: Code as today and map to SNOMED CT
(for interoperability and data analytics)

- A collaborative mapping tool
- Auto-map feature with lexical matches
- Includes a revision process
- Maps can be published in different formats
- Facilitates the migration if an existing map to new versions of SNOMED CT
- Useful in **Level 1**, to map local codes to SNOMED



To learn more visit:

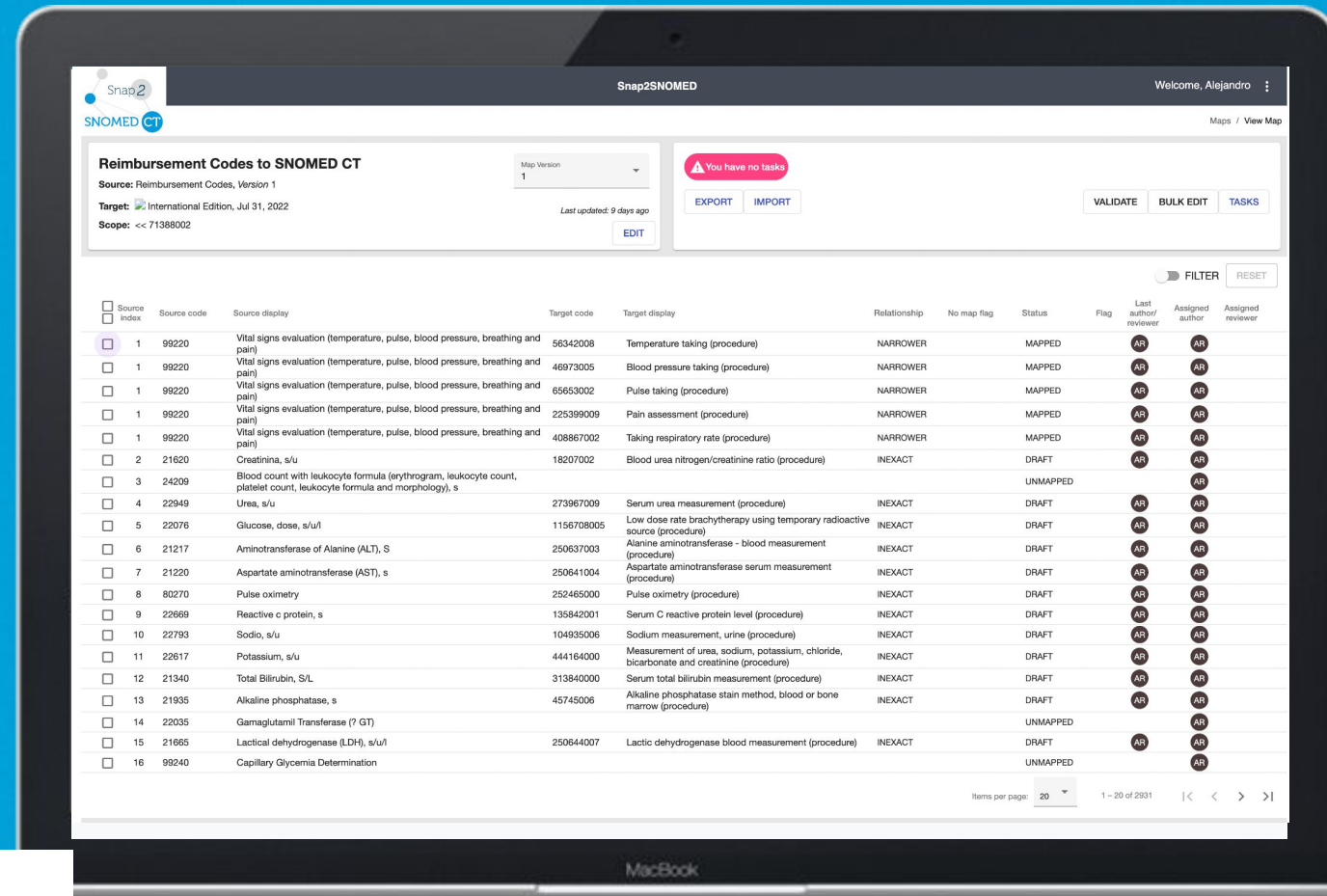
<https://snap.snomedtools.org/>

Snap2Snomed Mapping tool

Free access mapping tool for users in SNOMED International Member Countries.

Supports mapping from local terminologies to SNOMED CT.

Collaborative mapping with authors and reviewers



To learn more visit:

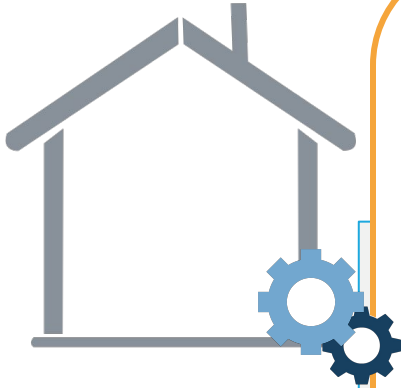
<https://snap.snomedtools.org/>





1. SNOMED CT roadmap planning
2. Developing & maintaining SNOMED CT artifacts (subsets, maps, etc.)
3. **Deploying terminology services**
 - Adding SNOMED CT in clinical systems

- **Snowstorm** - <https://github.com/IHTSDO/snowstorm>
- **Terminology Services training**
 - **Guide:** <http://snomed.org/tsg>
 - **Terminology Services course:** <https://courses.ihtsdotools.org/product?catalog=TSC>
 - **Developer day:** <https://snomed.org/dev-training>



- Terminology binding (enable SNOMED CT in specific parts of applied information models)

Resources for demonstrating and applying SNOMED CT in Clinical Systems

- Implementation demonstrators
 - <https://www.implementation.snomed.org/demonstrators>
- Implementation Guides for clinical use cases
- SNOMED CT derivative products - maps, subsets etc.

3. De-terminology services
4. Embedding SNOMED CT in clinical systems
5. Training and stakeholder engagement



- **Collaborative Approach**

- Foster multidisciplinary collaboration among clinicians, developers, and policymakers
- Implement effective communication and feedback loops for continuous involvement and alignment

3. D... terminology services
4. ...bedding SNOMED CT in clinical systems
5. **Training and stakeholder engagement**



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Terminology Servers

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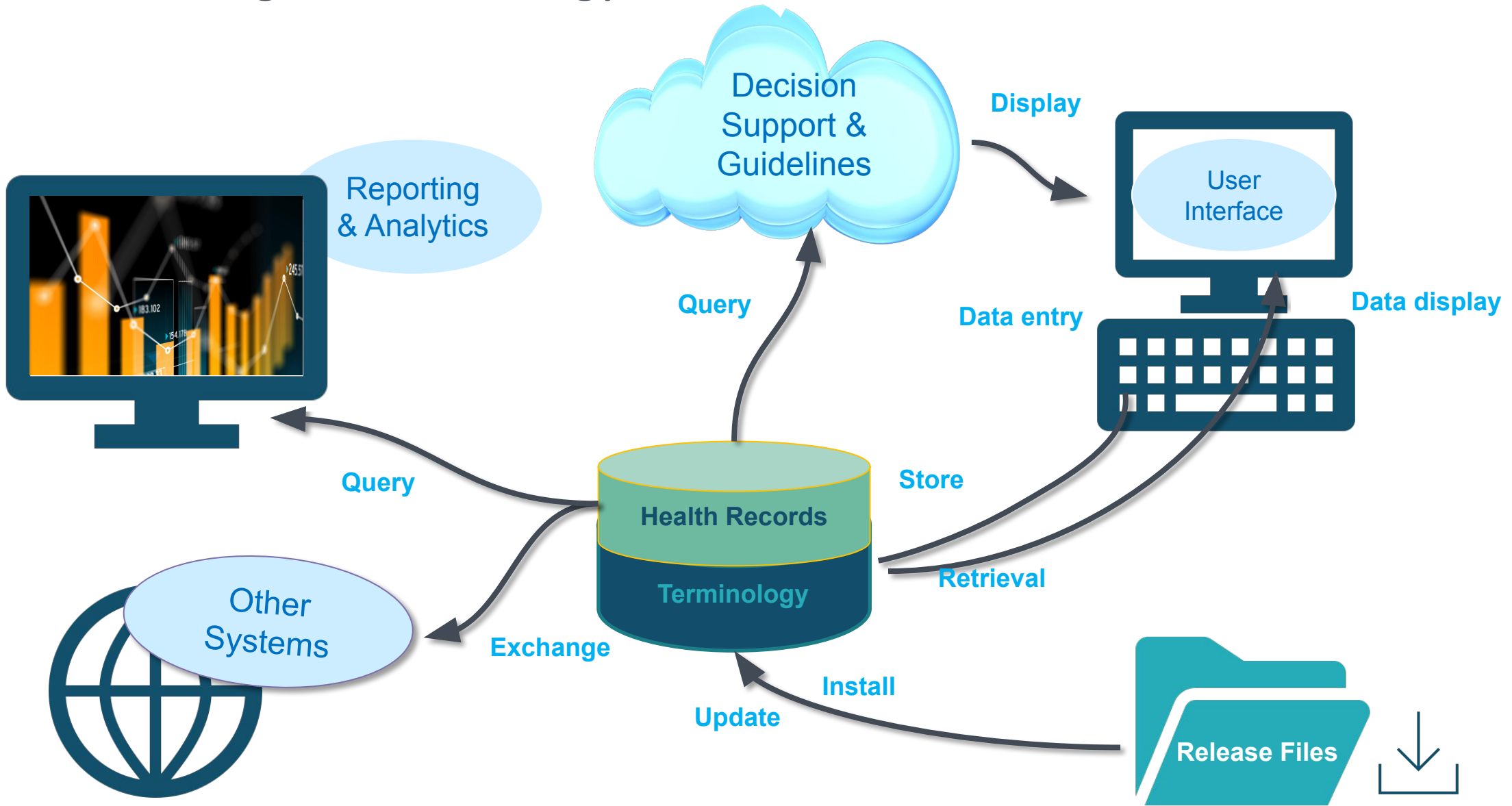


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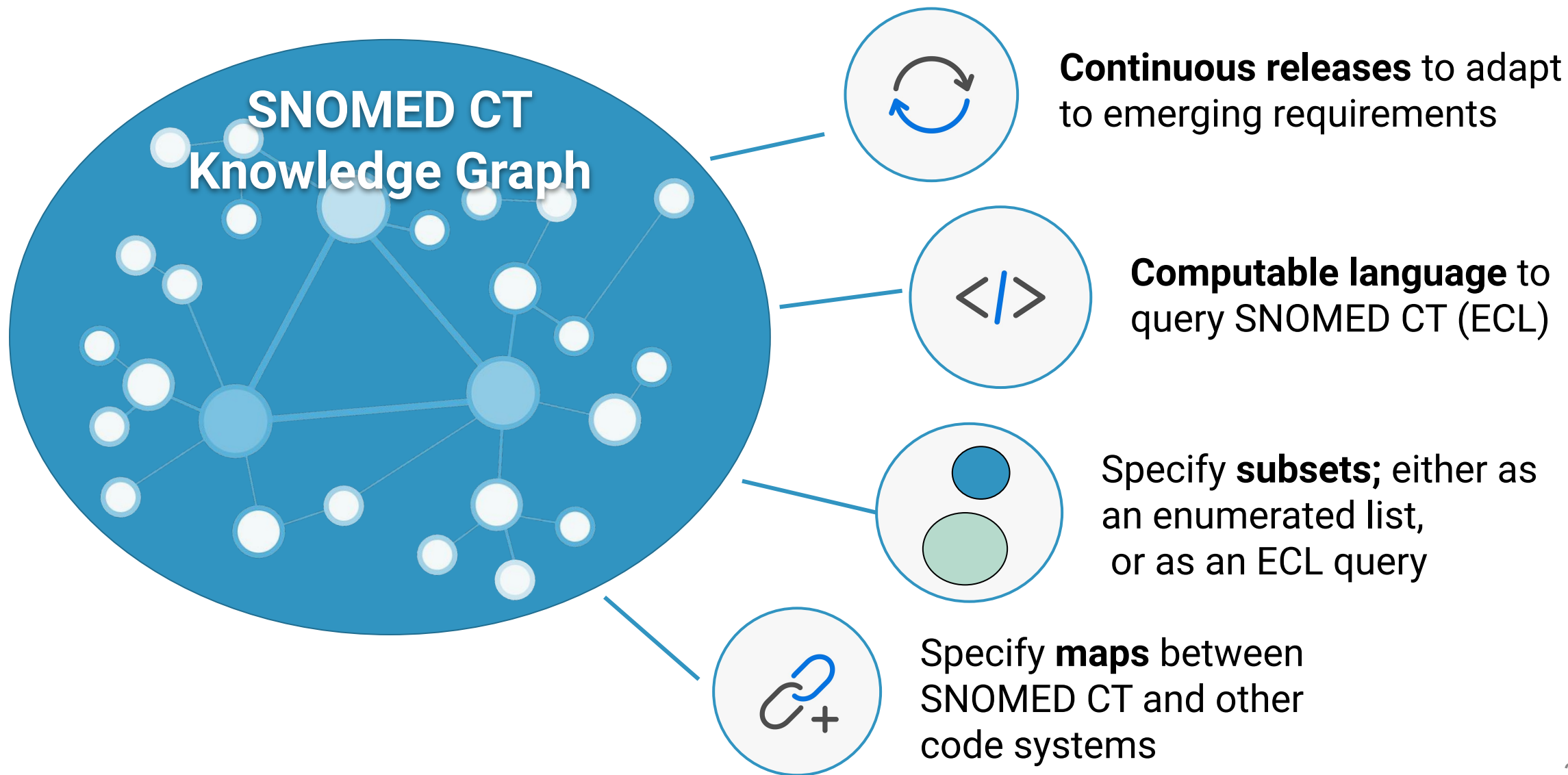


[linkedin.com/company/ihtsdo/](https://www.linkedin.com/company/ihtsdo/)

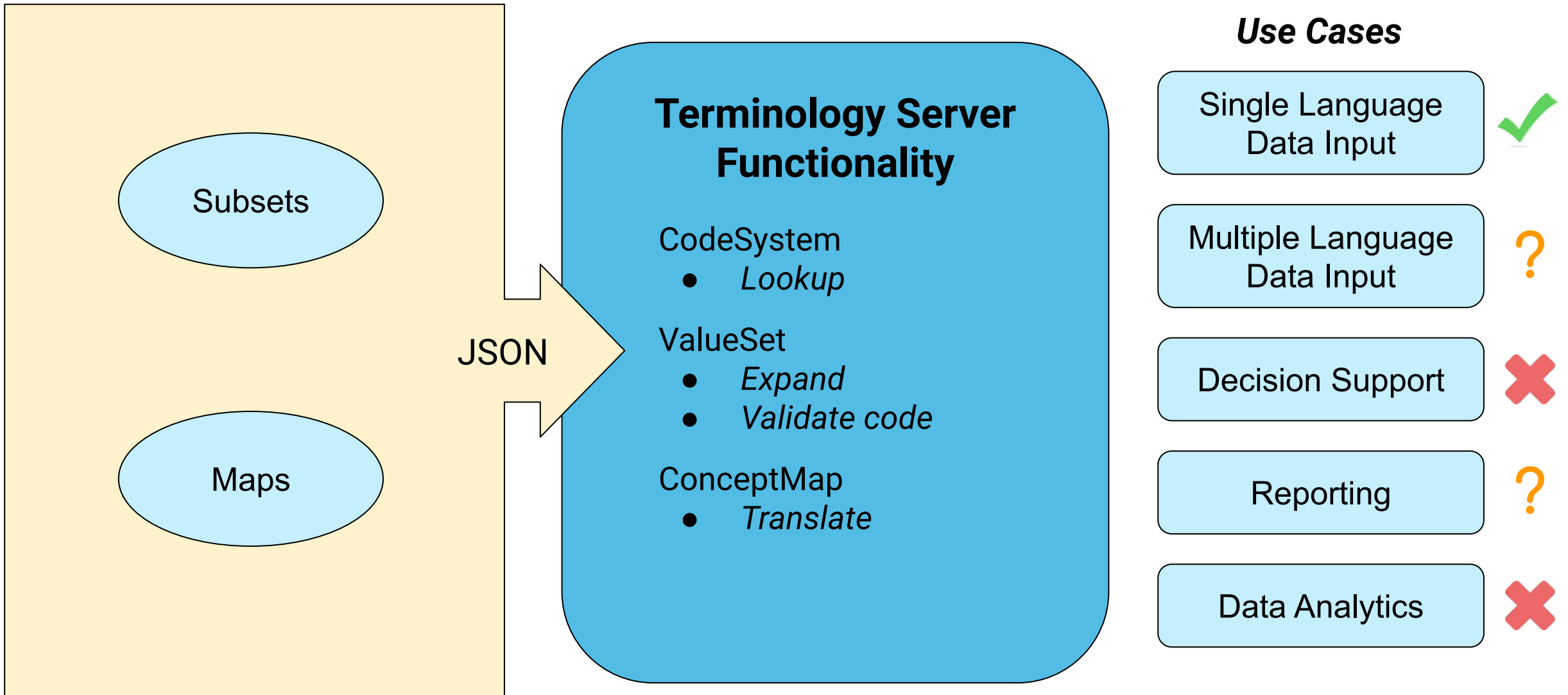
EHR Design - Terminology Use



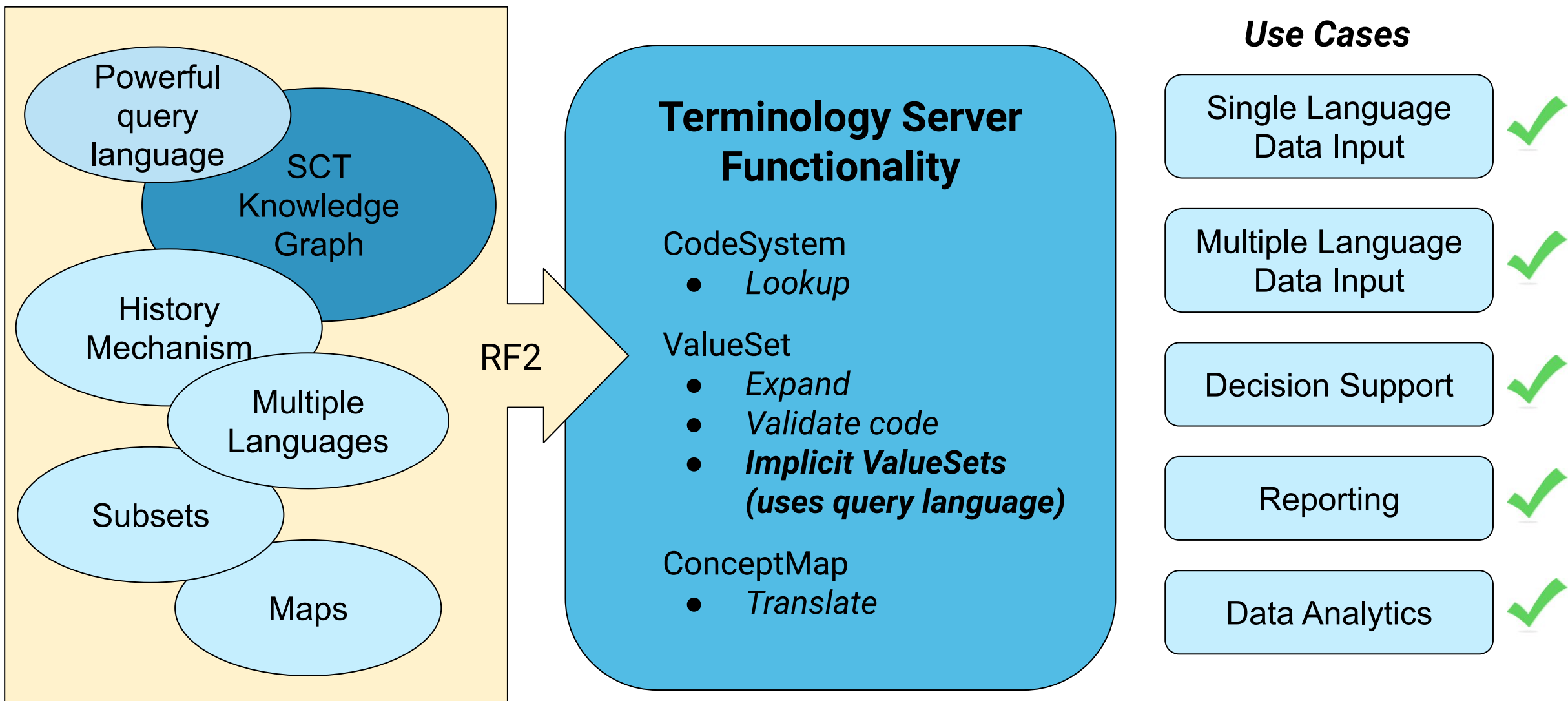
SNOMED CT is a Graph of Clinical Knowledge



Terminology Services based on flat lists



Terminology Services based on full SNOMED CT



SNOMED CT Enabled EHR Services

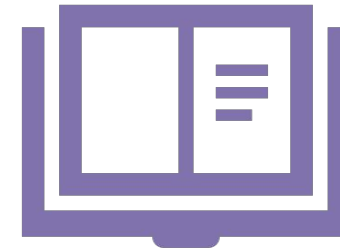
Record Services



Analytics Services

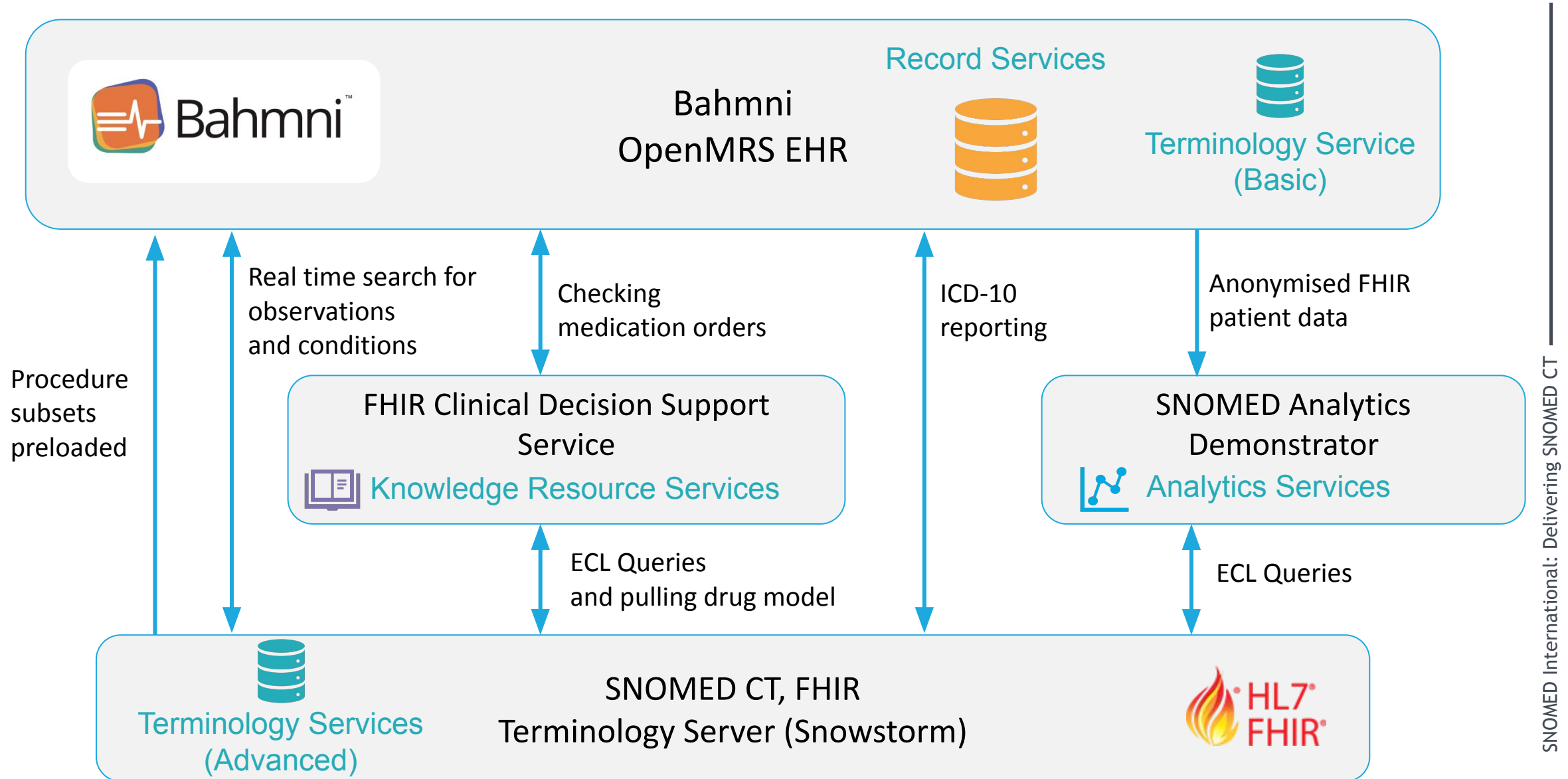


Knowledge Resource Services



Terminology Services

Example: Bahmni Integration Architecture



Terminology services

SNOMED CT Terminology Services provide an effective way of implementing SNOMED CT by enabling SNOMED CT content to be searched and queried via an API (application programming interface).

A rapid and effective way of deploying SNOMED CT in a national or local implementation is to use a SNOMED CT enabled terminology server. A SNOMED CT terminology server simplifies the development of clinical applications that use SNOMED CT, by providing optimized terminology services through an APIs (Application Programming Interfaces). Terminology services may include:

- Searching for SNOMED CT content using term matching, the hierarchy, or defining relationships (see [Snowstorm Search Guide](#)),
- Retrieving information about a given concept, including descriptions for a given dialect, supertypes, subtypes and defining relationships,
- Executing [Expression Constraint Queries \(ECL\)](#) on a particular SNOMED CT edition, and
- Accessing maps to/from SNOMED CT and other reference set information.

Terminology servers can either import data from a SNOMED CT release package, or periodically synchronise its content with another terminology server. The loaded SNOMED CT content can then be made available to browsers or electronic health records using a convenient API that implements terminology best practices. Using a terminology server in your implementation can save time, by removing the need to implement these services from scratch. The use of standardized APIs can also simplify their integration into end user applications.

To learn more about using terminology services, please enrol in our [SNOMED CT Terminology Services Course](#) (free for Members).



SNOMED International develops and maintains Snowstorm, a SNOMED CT terminology server built on top of Elasticsearch, with a focus on performance and enterprise scalability. Snowstorm provides the terminology server API for a range of SNOMED CT tools used by SNOMED International, including the SNOMED CT Browser and the SNOMED CT Authoring Platform. As an open-source tool, Snowstorm can be installed locally to provide a terminology services API to clinical applications.

- Source code: <https://github.com/IHTSDO/snowstorm>
- Snowstorm API : <https://snowstorm.snomedtools.org/snowstorm/snomed-ct>
- FHIR API: <https://snowstorm.snomedtools.org/fhir/>

Snowstorm: An Open Source Application

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- **Open Source**

- <https://github.com/IHTSDO/snowstorm>
- Apache 2.0 license

- **Features**

- Provides FHIR terminology services
- Cross platform, simple to install and run
- Support for the SNOMED ECL query language
- Can hosts multiple FHIR code systems (LOINC/ICD etc)
- Fast and horizontally scalable using Elasticsearch

- **Tools that leverage Snowstorm**

- SNOMED International Authoring Platform, Browser, Analytics and UI Demonstrators
- Bahmni OpenMRS EHR system
- Many more!



SNOWSTORM
by SNOMED International



Snowstorm: What it is not

- Snowstorm is an application that you should deploy within your own country. The public Snowstorm instance hosted by SNOMED International is not intended for production use.
- SNOMED International is heavily invested in maintaining the Snowstorm application, but the organisation are not able to provide any commercial support agreement. We can provide informal support to NRCs and vendors.



SNOWSTORM
by SNOMED International



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Benefits of SNOMED CT in Data Analytics

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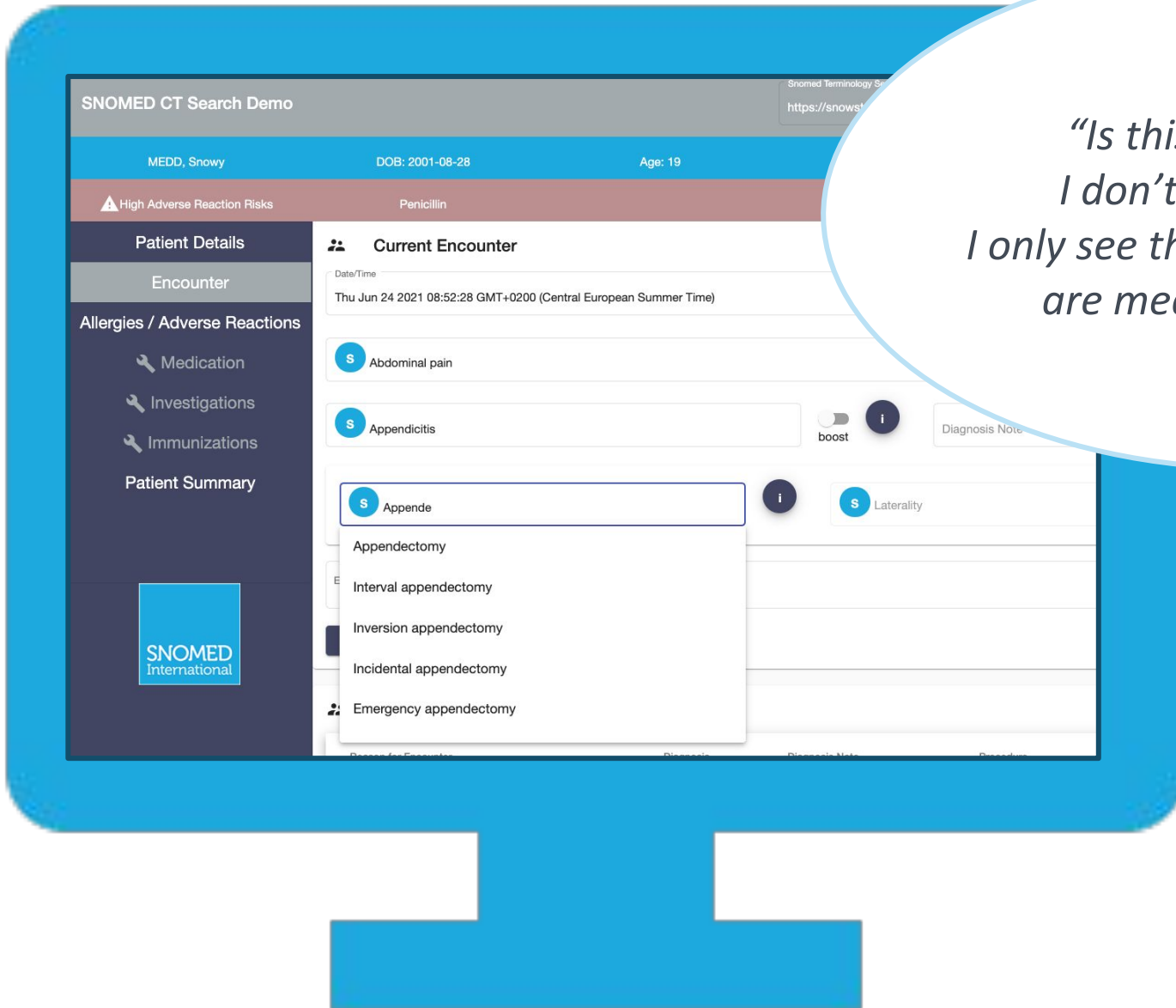


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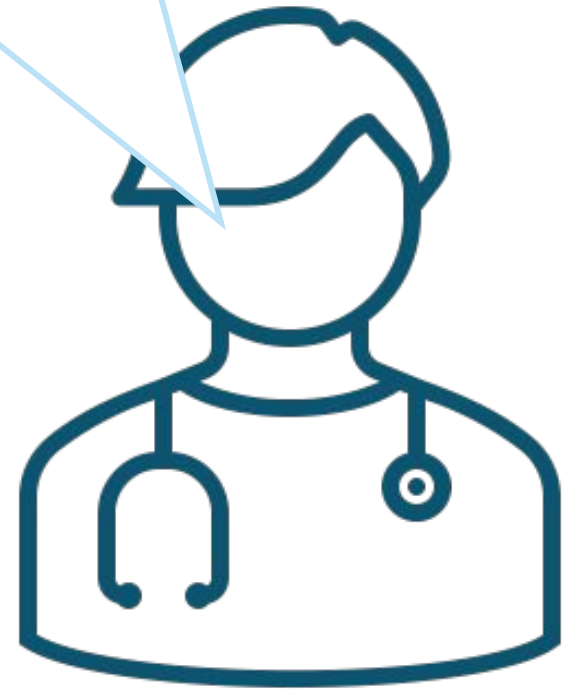
Outline

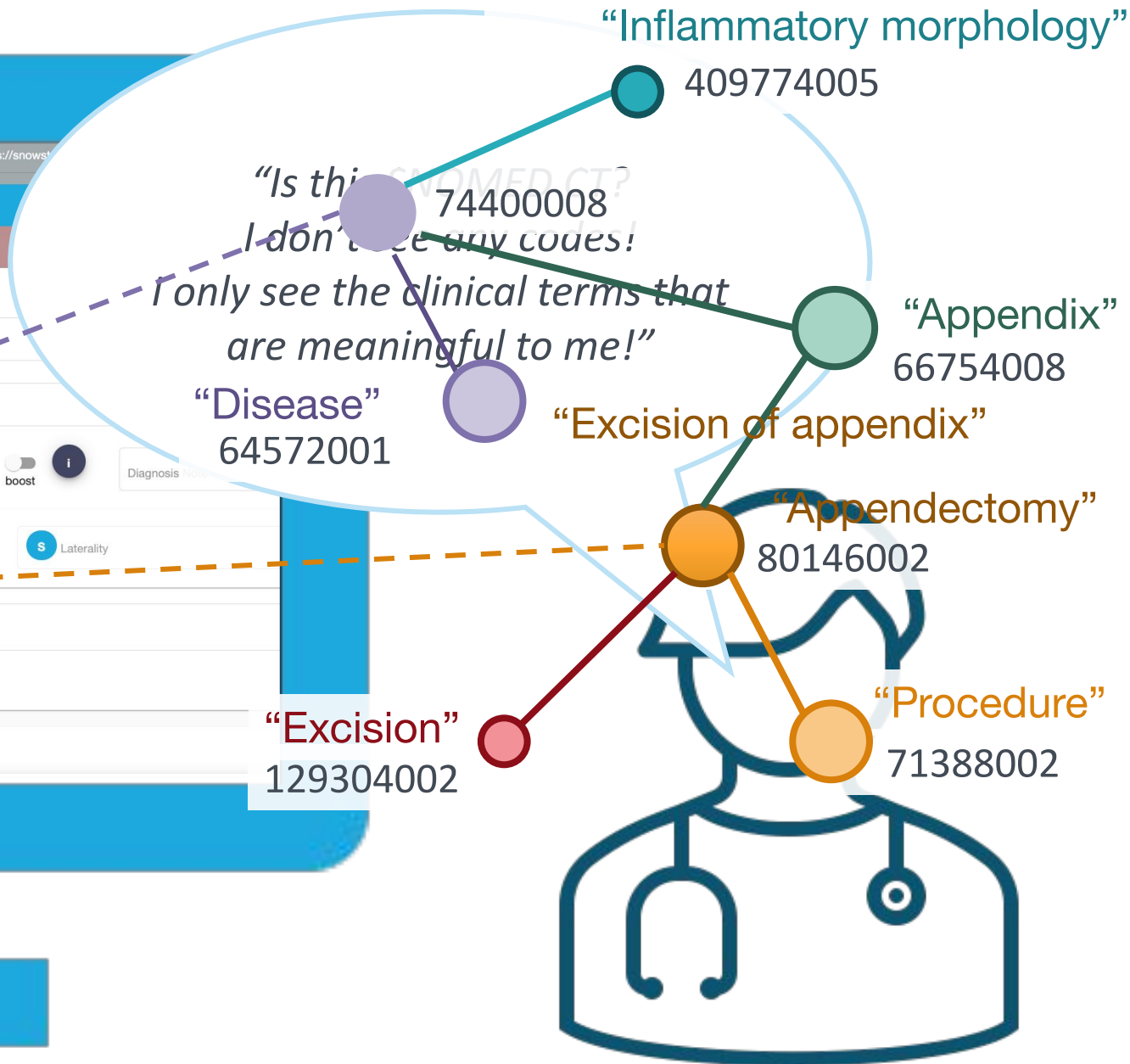
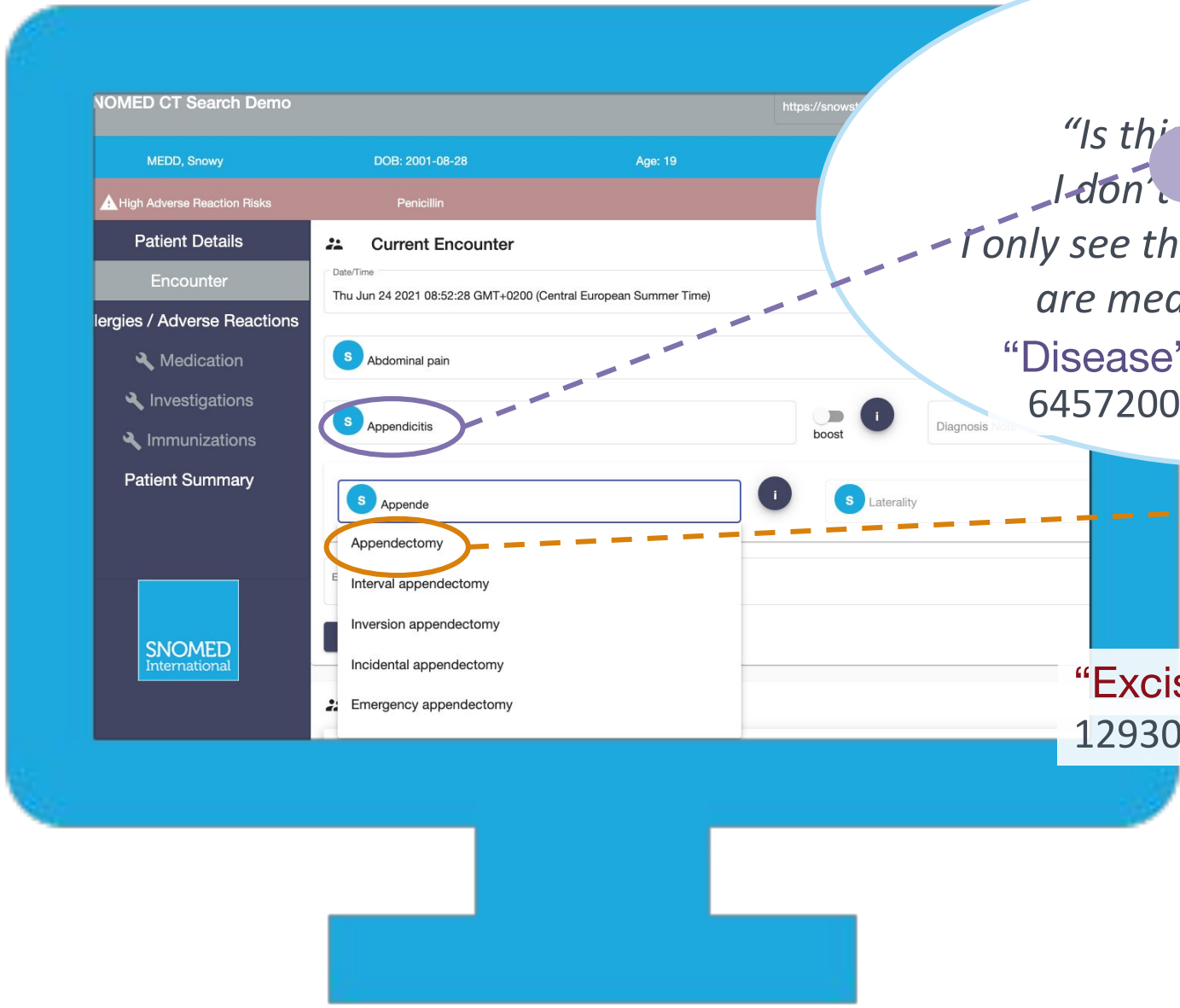
*Insights for
Better
Healthcare*

- **Background**
 - SNOMED CT: A Cornerstone of Clinical Data Analysis
- **Introduction**
 - Clinical data analytics
 - Meaning-based retrieval with SNOMED CT
- **Analytics scenarios**
 - Population health monitoring
 - Designing preventative measures
 - Assessing treatments
- **Interpreting the Results**



*“Is this SNOMED CT?
I don’t see any codes!
I only see the clinical terms that
are meaningful to me!”*





The screenshot shows a 'NOMED CT Search Demo' interface. At the top, it displays patient information: MEDD, Snowy; DOB: 2001-08-28; Age: 19; Sex: Male. Below this, a warning for 'High Adverse Reaction Risks' is shown for 'Penicillin'. The main content area is divided into sections: 'Patient Details', 'Encounter', 'Allergies / Adverse Reactions', 'Medication', 'Investigations', 'Immunizations', and 'Patient Summary'. The 'Encounter' section shows a date and time: 'Thu Jun 24 2021 08:52:28 GMT+0200 (Central European Summer Time)'. Below the encounter, there are search results for 'Appendectomy'. The results include 'Appendicitis', 'Appendectomy', 'Interval appendectomy', 'Inversion appendectomy', 'Incidental appendectomy', and 'Emergency appendectomy'. The 'Appendectomy' result is highlighted with an orange oval, and a dashed orange line connects it to a corresponding node in the network diagram on the right. The 'Appendicitis' result is highlighted with a purple oval, and a dashed purple line connects it to a corresponding node in the network diagram.

“Inflammatory morphology”

409774005

74400008

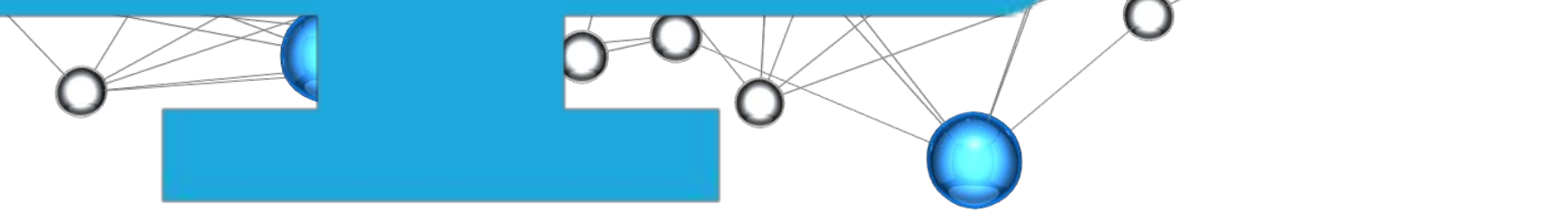
“Disease”
64572001

“Appendix”
66754008

80146002

“Excision”
129304002

“Procedure”
71388002





Accurate and consistent recording of clinical information

Flexible retrieval of clinical information

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



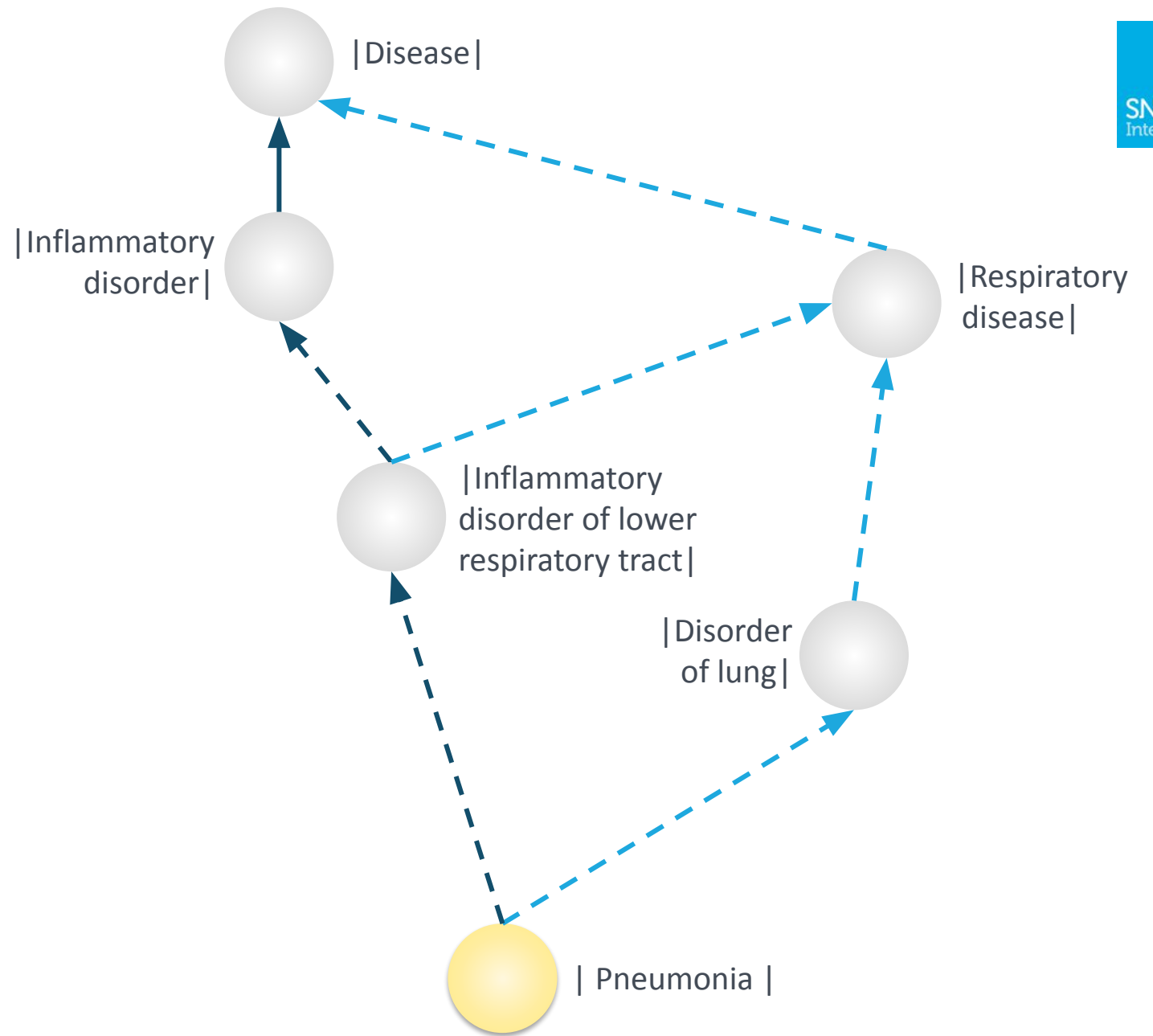
Assessing treatments
What will happen to me?

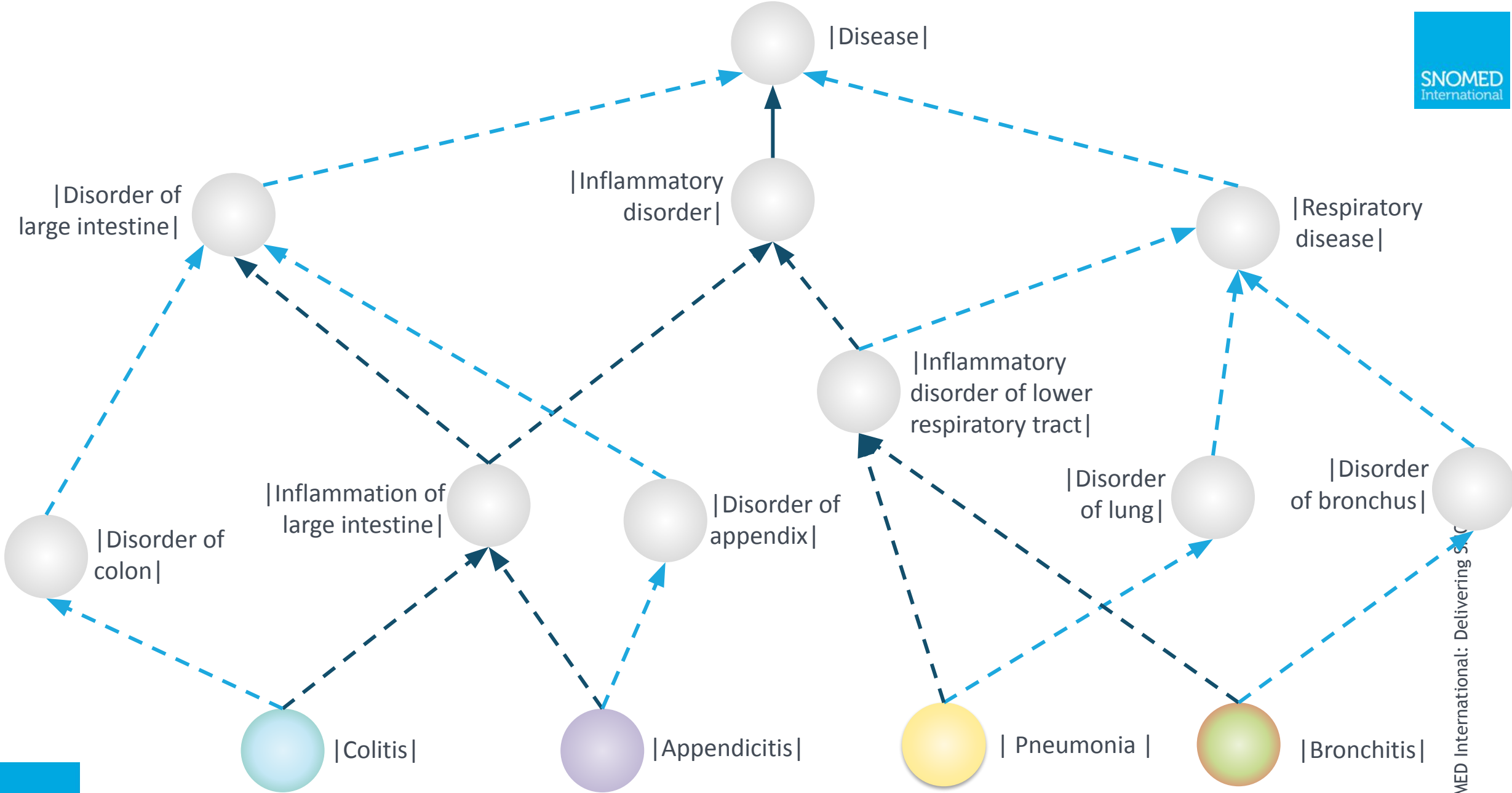


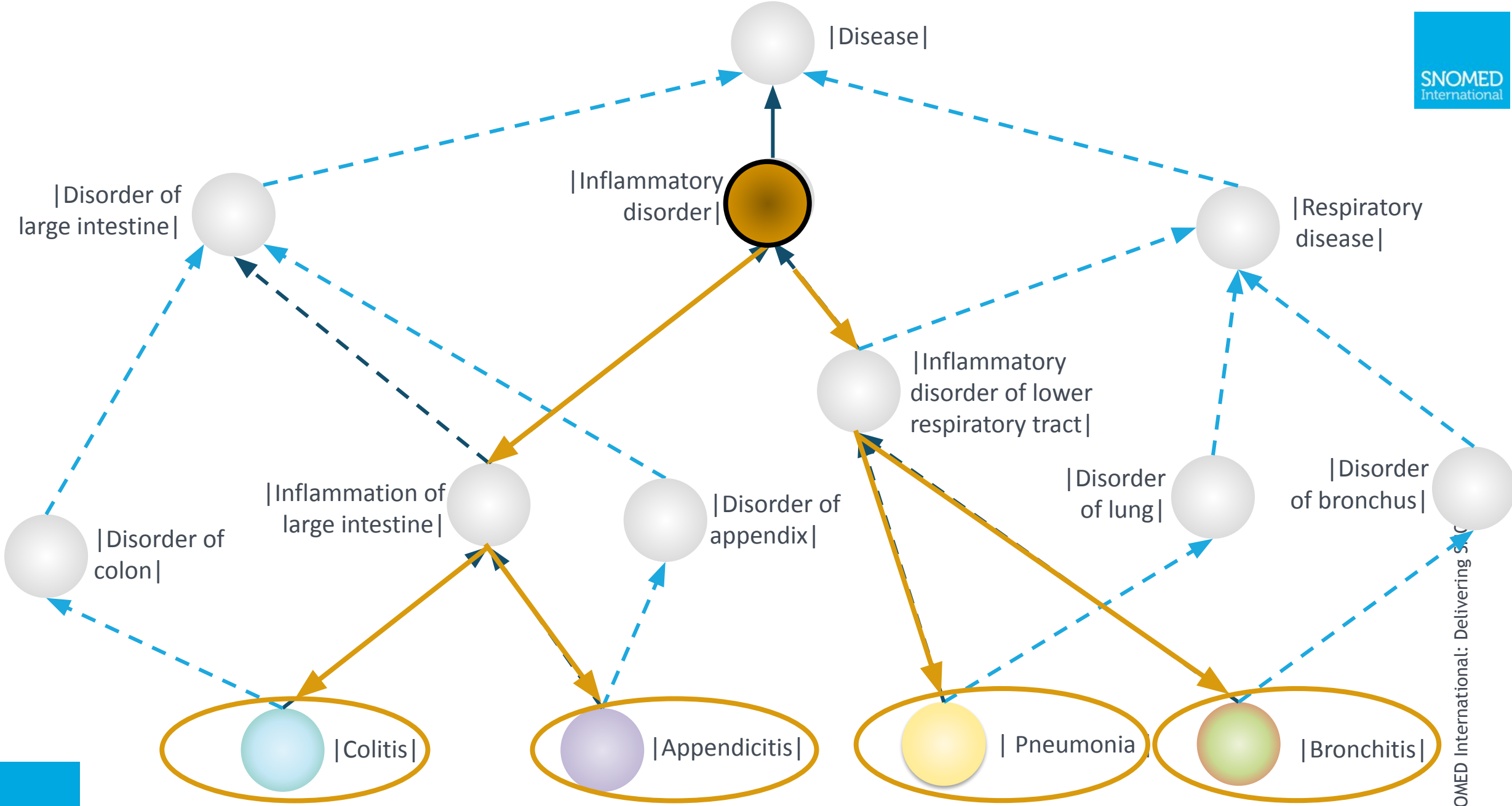
Improving the quality and efficiency of care
What are the causal effects?

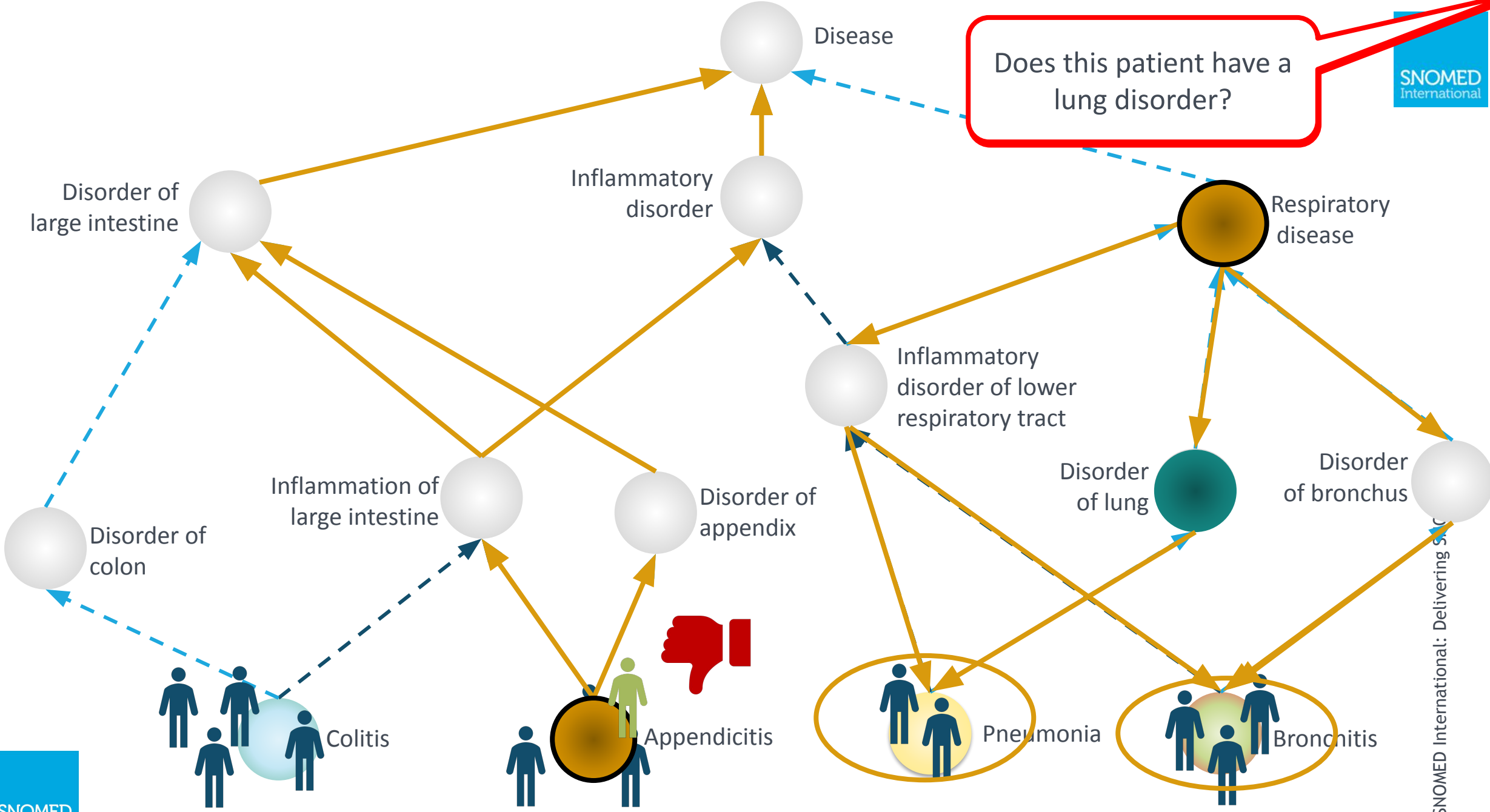
Data Analytics









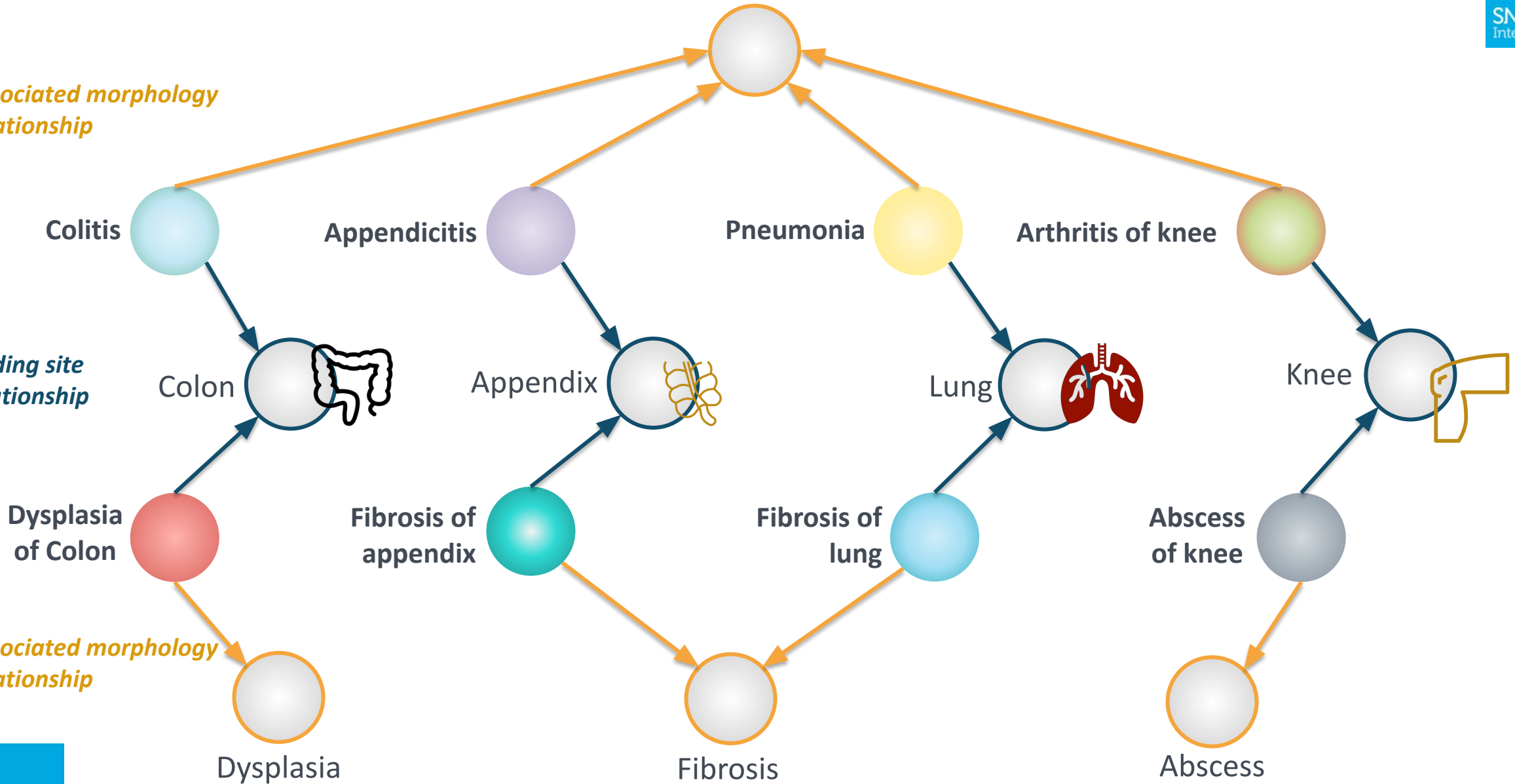


Inflammatory morphology

Associated morphology relationship

Finding site relationship

Associated morphology relationship

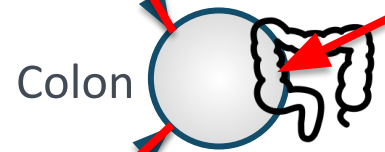
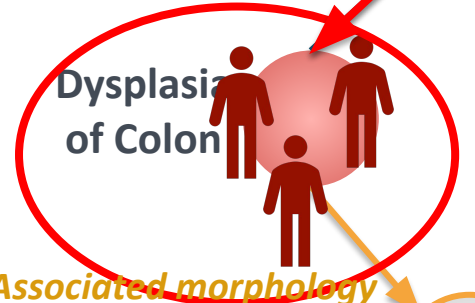
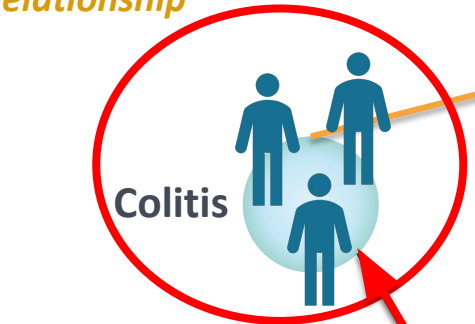


People with a disorder located in the **colon** structure?

Associated morphology relationship

Finding site relationship

Associated morphology relationship



Dysplasia

Appendicitis

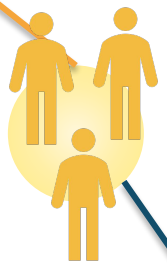


Fibrosis of appendix



Fibrosis

Pneumonia

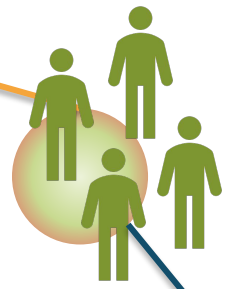


Fibrosis of lung

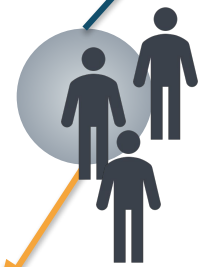


Fibrosis

Arthritis of knee

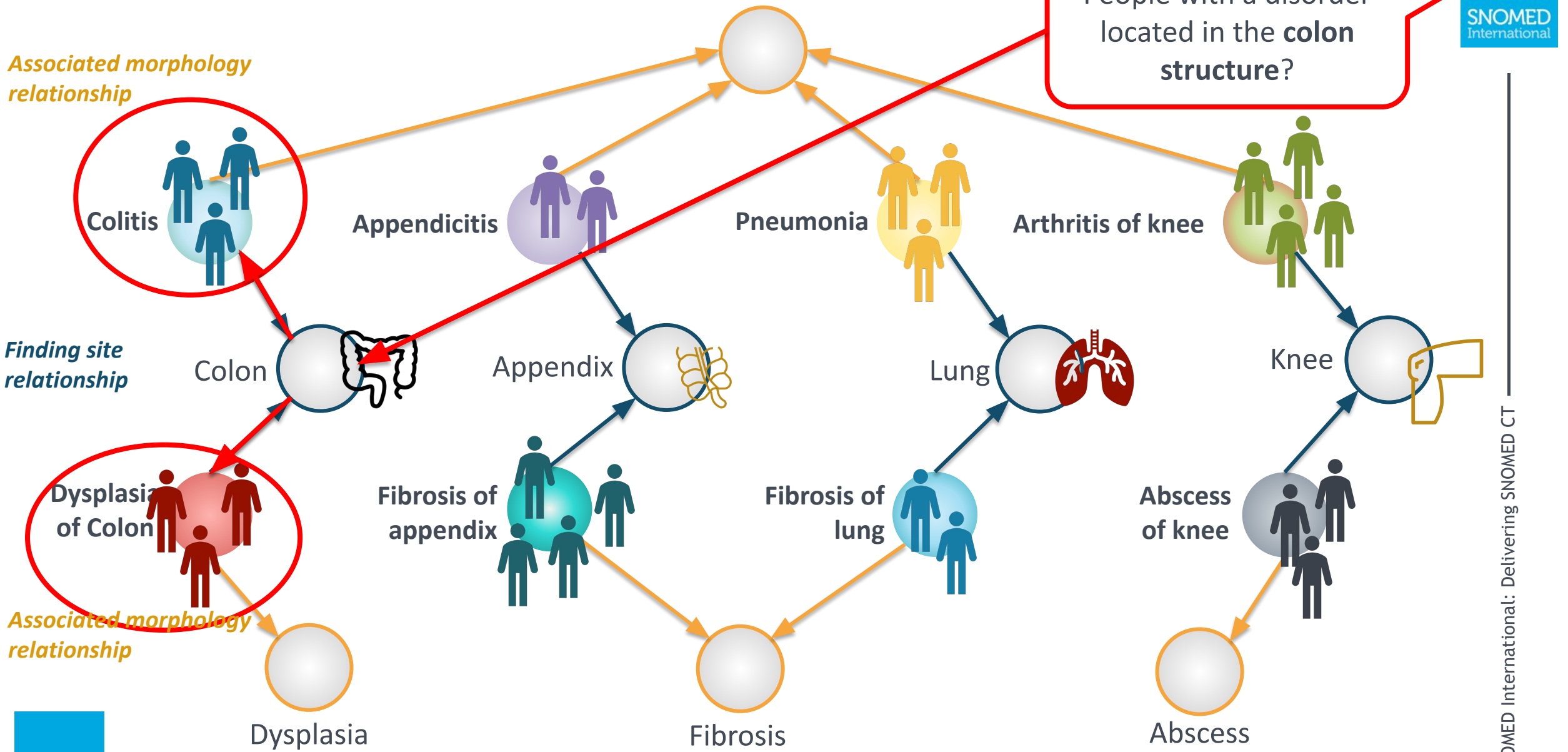
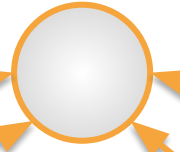


Abscess of knee



Abscess

Inflammatory morphology

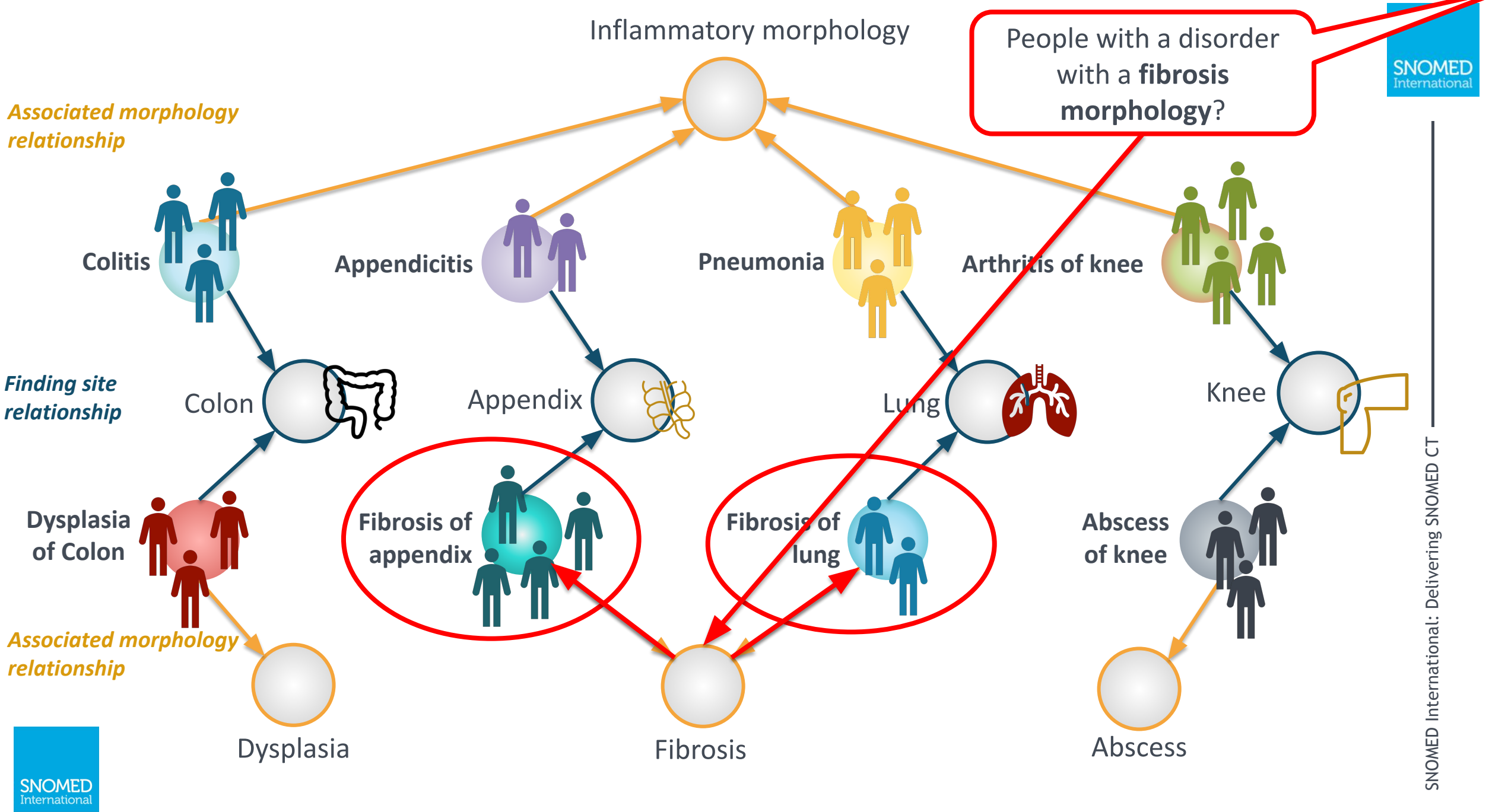


Associated morphology relationship

Finding site relationship

Associated morphology relationship

People with a disorder with a **fibrosis morphology**?



Question

People with a **respiratory disease**?

People with a disorder located in the **colon structure**?

People with a disorder with a **fibrosis morphology**?

What concepts

All concepts that are subtypes of the concept 'respiratory disease'

All concepts that represent a disease with a finding site of 'colon structure'

All concepts that represent a disease with a morphology of 'fibrosis'

Expression constraint language

Query

```
<< 50043002 |Respiratory disease|
```

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

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

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

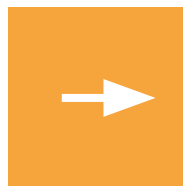
Expression constraint language

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>

Expression Constraint Language



<< 254837009 |Malignant tumor of breast|

Enter an ECL query (ECL Version: 2.0)

<< 254837009 ||Malignant tumor of breast|

ECL Builder

Execute

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)|

Enter an ECL query (ECL Version: 2.0)

< 64572001 |Disease| :
363698007 |Finding site| = << 76752008
116676008 |Associated morphology| = <<

ECL Builder

Execute

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	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|

Terminology Server

Patient_Id	Diagnosis	Diagnosis term
001	145501000119108	Metastatic malignant neoplasm of breast
002	722223000	Cyst of kidney
003	254840009	Inflammatory carcinoma of breast
004	64226004	Colitis
005	1197732001	Colorectal Crohn disease
006	278050001	Sarcoma of breast
007	1197732001	Colorectal Crohn disease
008	254837009	Malignant tumor of breast
009	405944004	Asthmatic bronchitis
010	46635009	Type 1 diabetes mellitus

EHR
or Data Warehouse

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Population Health Monitoring

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[linkedin.com/company/ihtsdo/](https://www.linkedin.com/company/ihtsdo/)

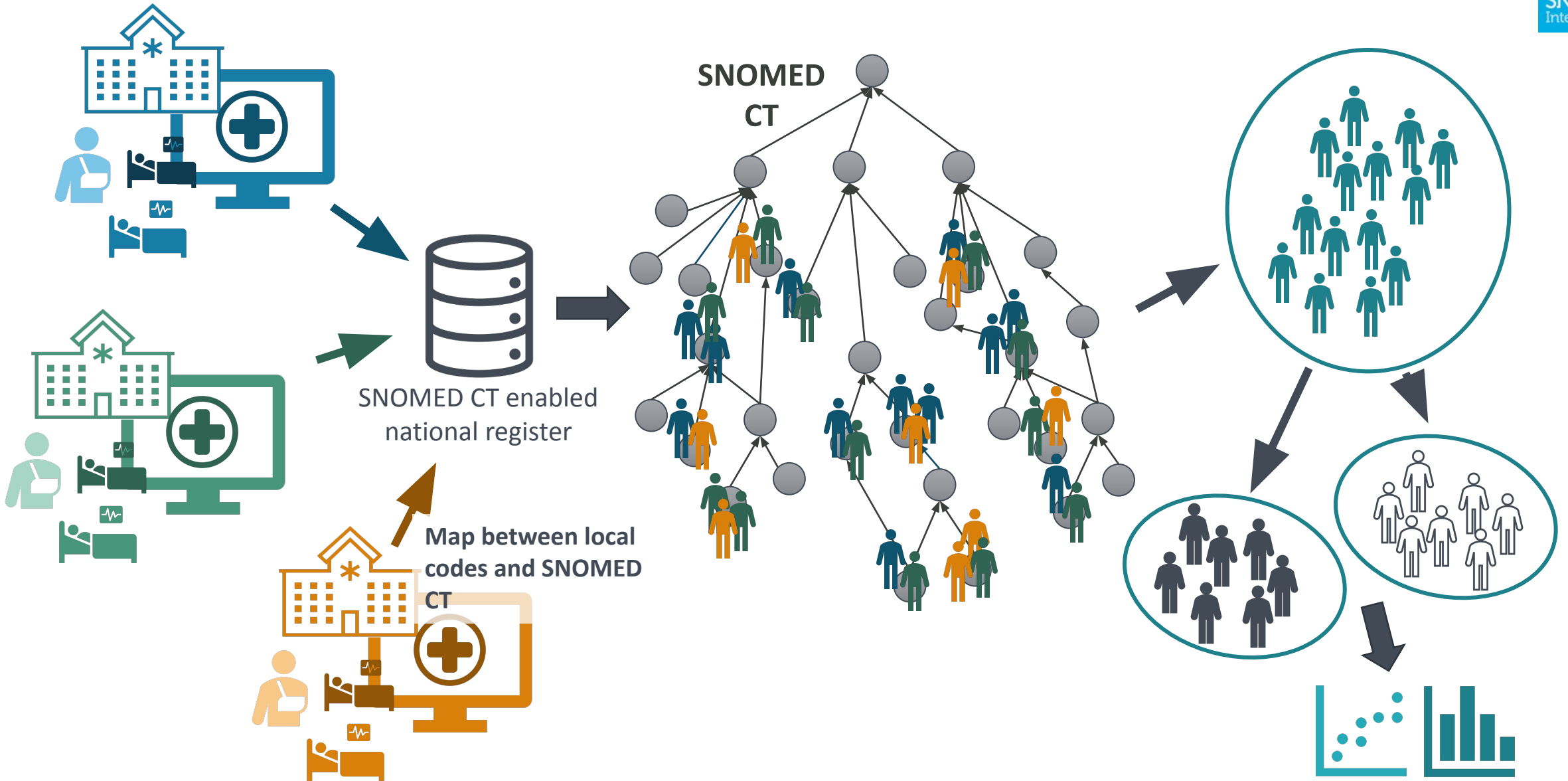
Data Analytics 1 - Population monitoring

Population health



Population health monitoring
What are the trends?

Point of Care



SNOMED CT enabled national register

SNOMED CT

Map between local codes and SNOMED CT

Data Analytics 1 - Population monitoring

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

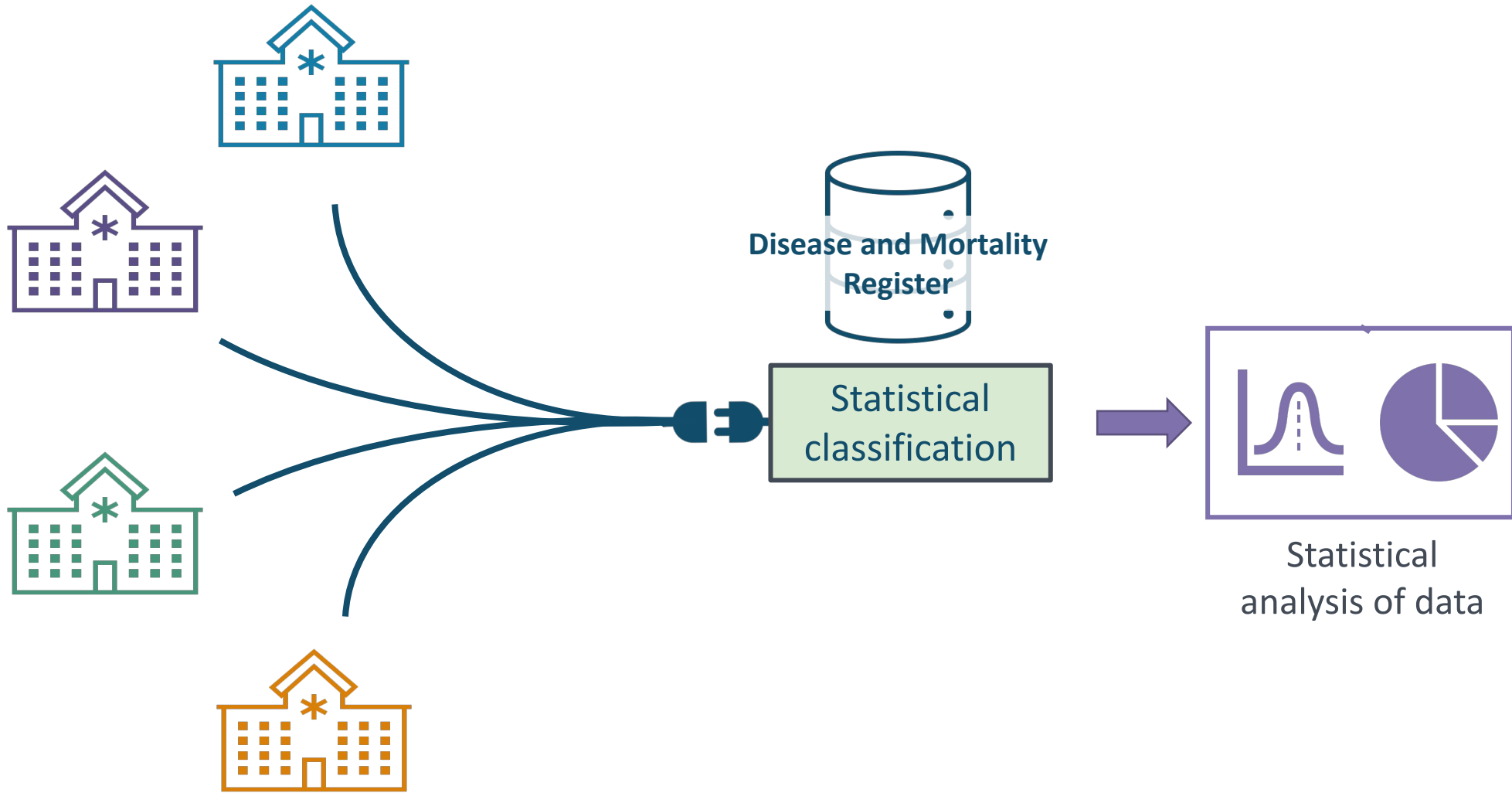
Balance and prioritize
healthcare related costs

Demonstration 1 - Population monitoring

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

Small 1 million person population for demo





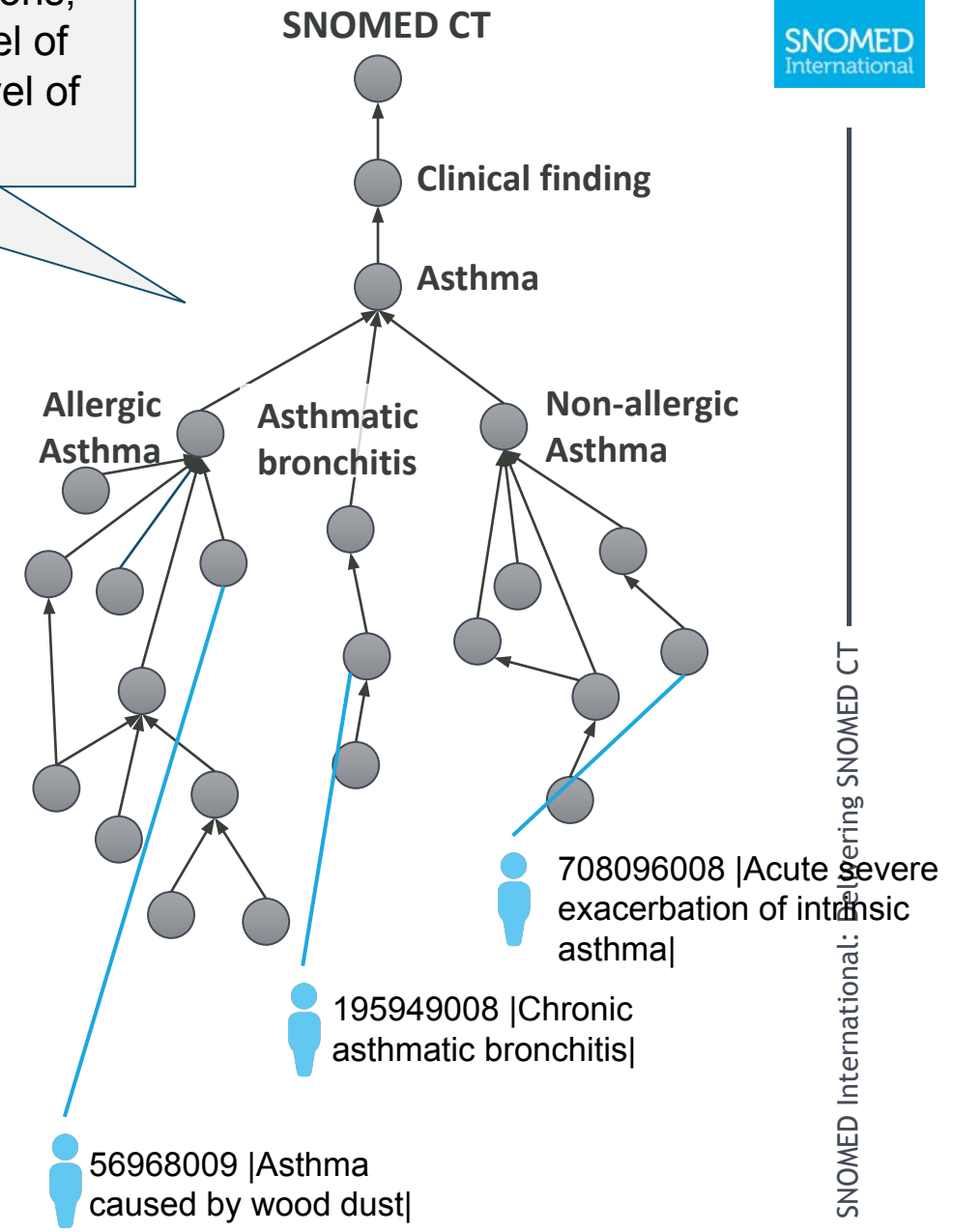
Compared to statistical classifications, SNOMED CT provides a high level of flexibility when determining the level of aggregation



SNOMED CT

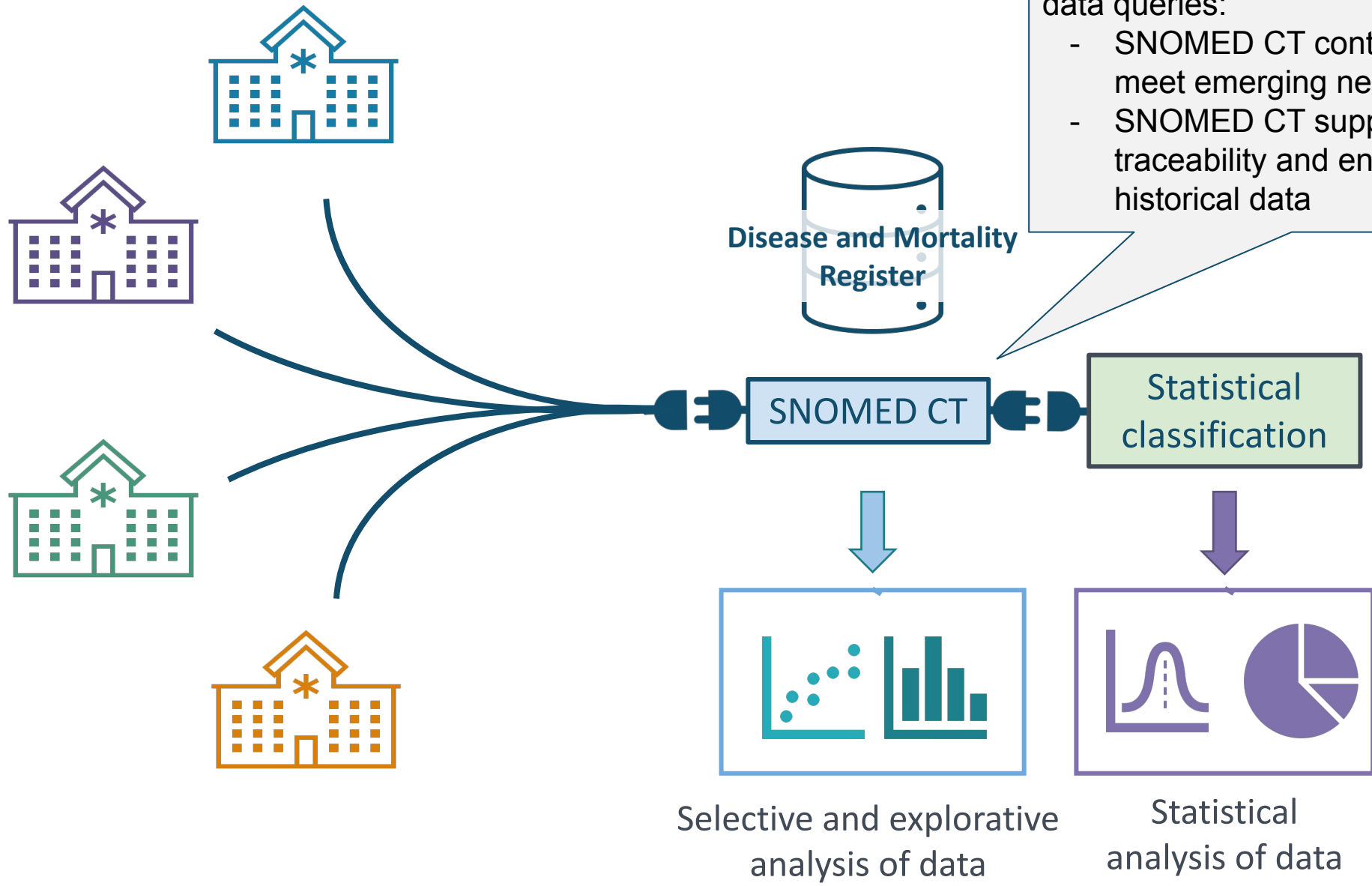


Selective and explorative analysis of data



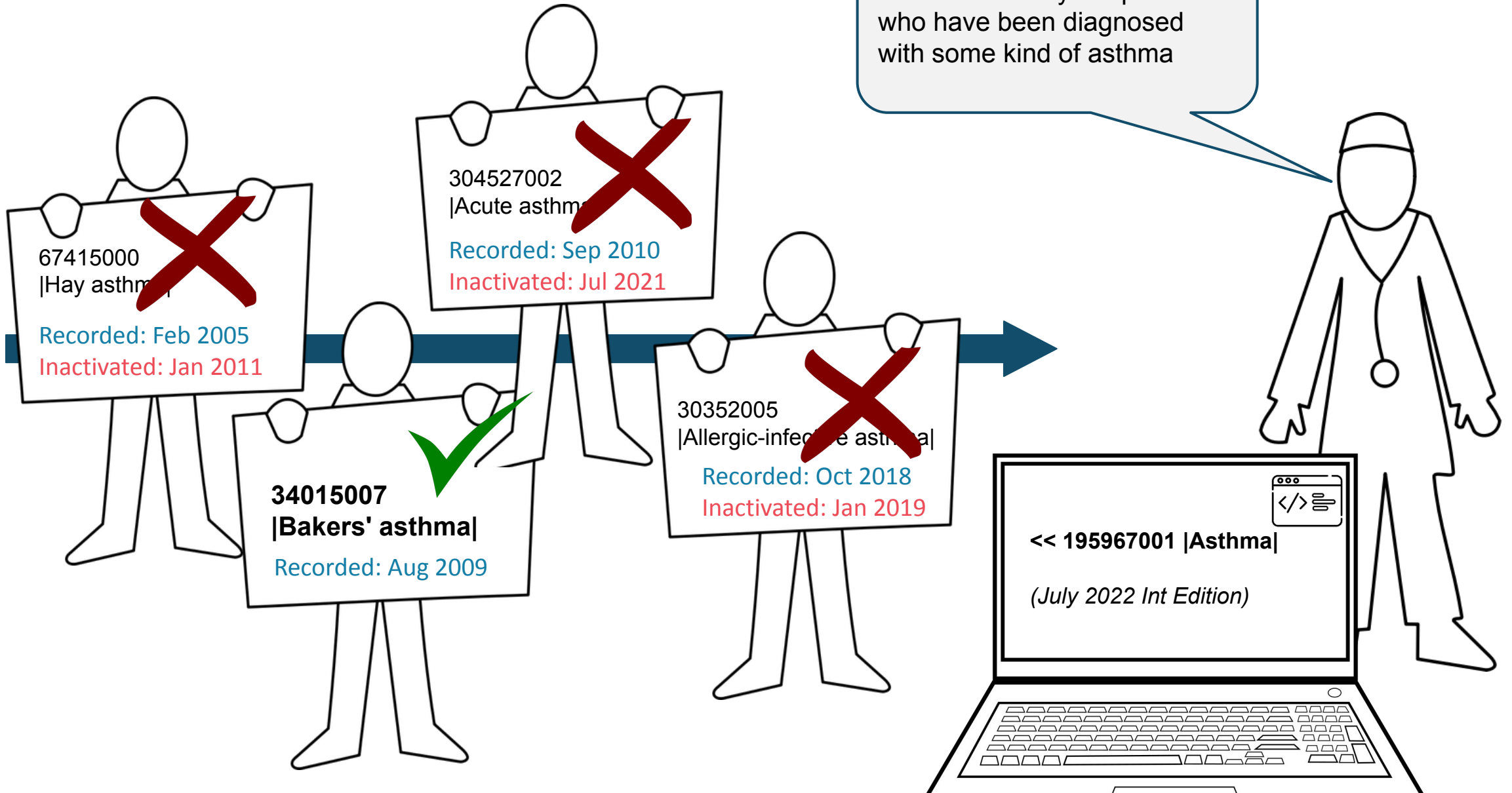
Using SNOMED CT as the core terminology is beneficial for longitudinal data queries:

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



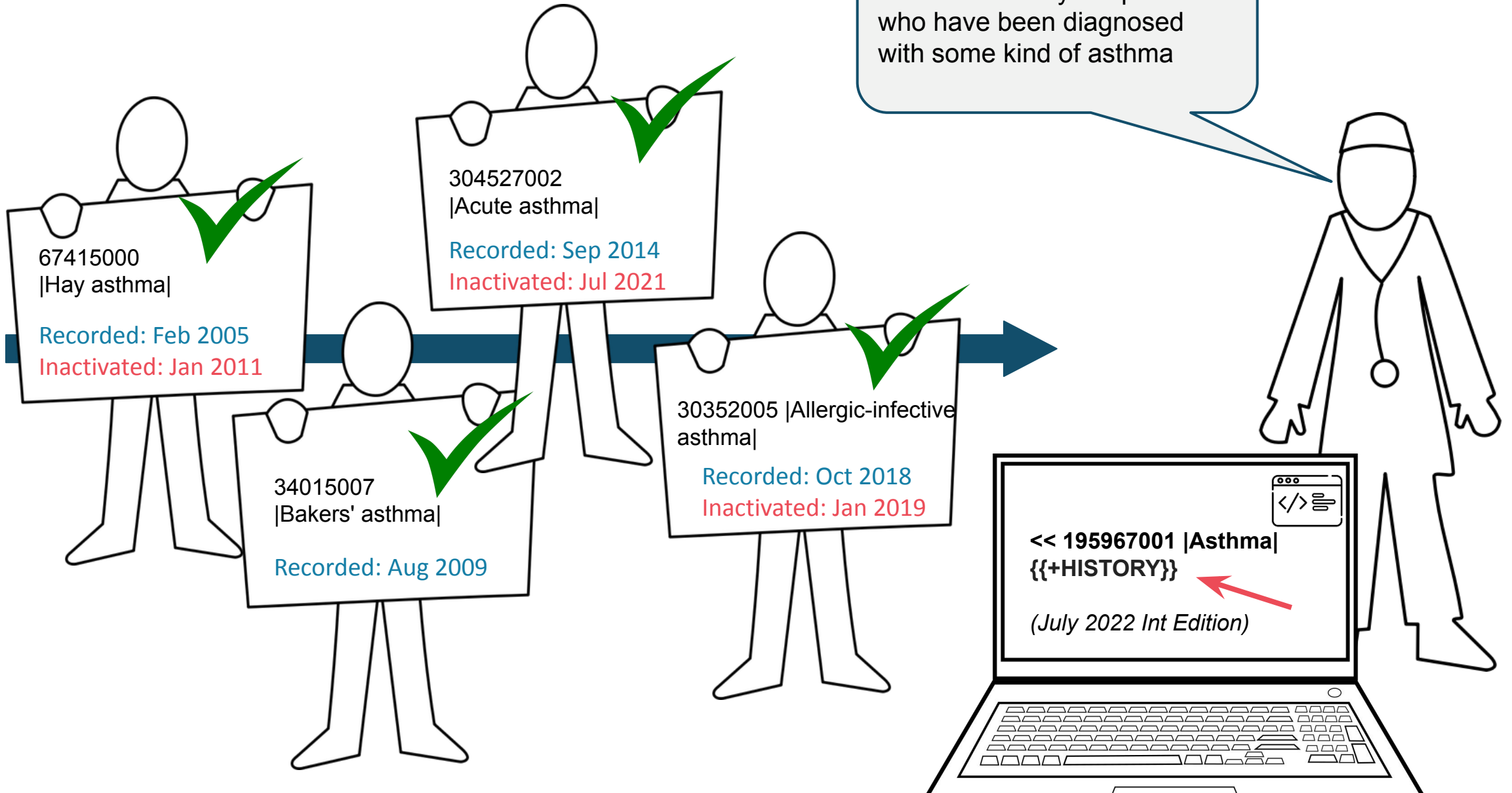
Querying Historical data (ECL)

I need to identify the patients who have been diagnosed with some kind of asthma



Querying Historical data (ECL)

I need to identify the patients who have been diagnosed with some kind of asthma



History Supplements (ECL v2.0)

Parents

No parents



Allergic-infective asthma
(disorder)



SCTID: 30352005

30352005 | Allergic-infective asthma (disorder) |

en Allergic-infective asthma (disorder)

en Allergic-infective asthma

No attributes

Why are concepts inactivated?

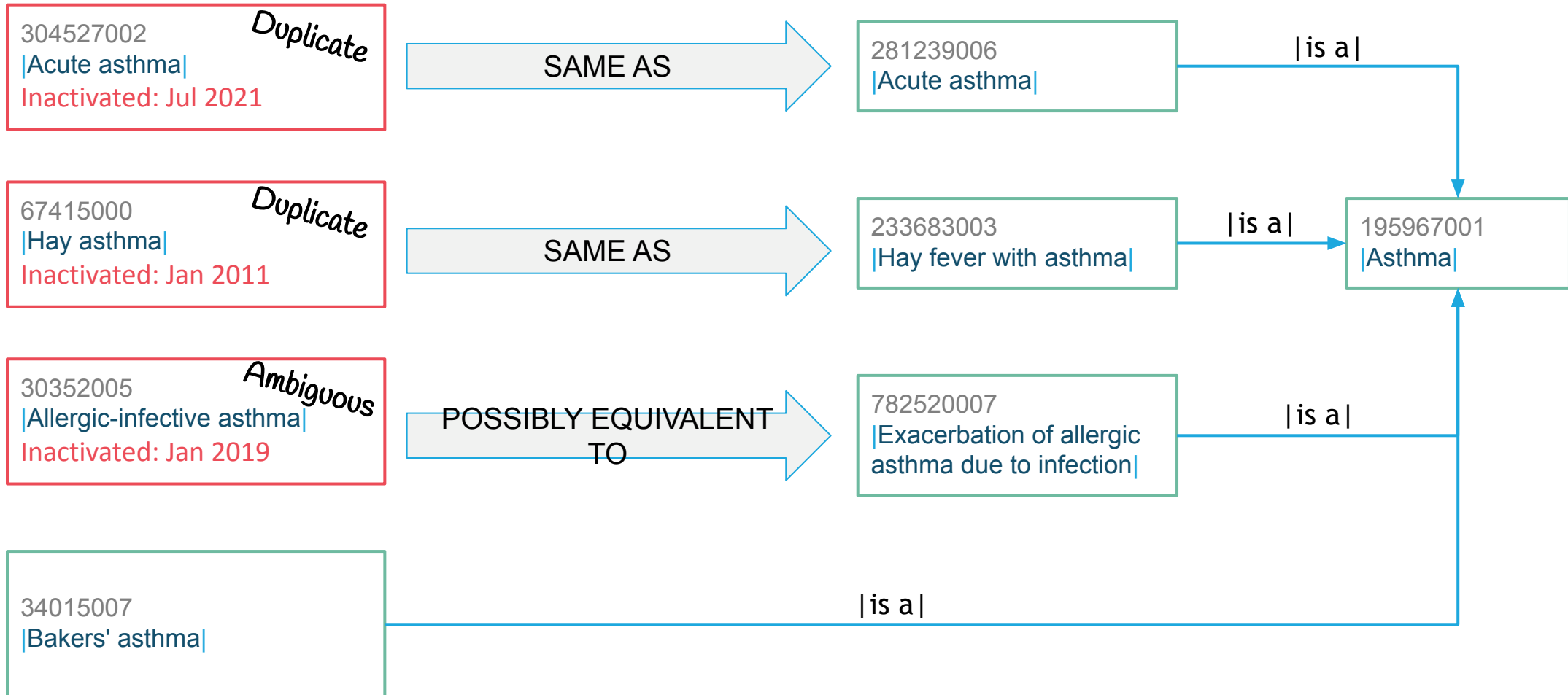
Inactivations are required to ...
Correct errors and keep pace with
changing clinical knowledge

Important to retain access to
inactivated content to support
historical records

Children

No children

History Supplements (ECL v2.0)

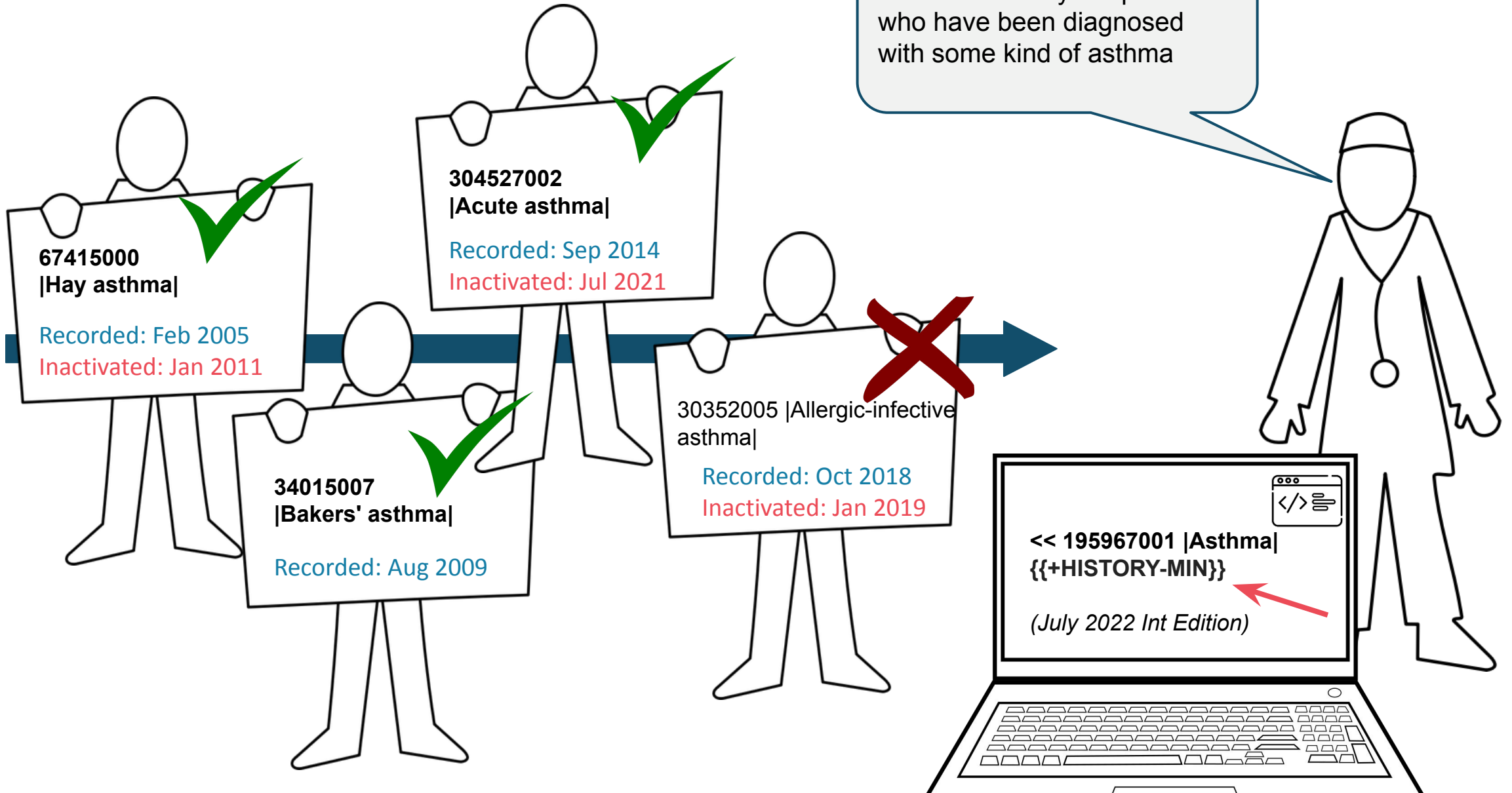


History Supplements (ECL v2.0)

History Profile	Historical Association Reference Sets
HISTORY-MIN	<ul style="list-style-type: none"><li>● 900000000000527005 SAME AS association reference set
HISTORY-MOD	<ul style="list-style-type: none"><li>● 900000000000527005 SAME AS association reference set <li>● 900000000000526001 REPLACED BY association reference set <li>● 900000000000528000 WAS A association reference set <li>● 1186924009 PARTIALLY EQUIVALENT TO association reference set
HISTORY-MAX HISTORY (*)	<ul style="list-style-type: none"><li>● < 900000000000522004 Historical association reference set

Querying Historical data (ECL)

I need to identify the patients who have been diagnosed with some kind of asthma



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Enabling Preventive Care Measures

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[linkedin.com/company/ihtsd/](https://www.linkedin.com/company/ihtsd/)

Data Analytics 2 - Preventative Measures

Research



Improving the quality and
efficiency of care

*Which groups are most at risk?
Consider preventative measures?*

Data Analytics 2 - Preventative Measures

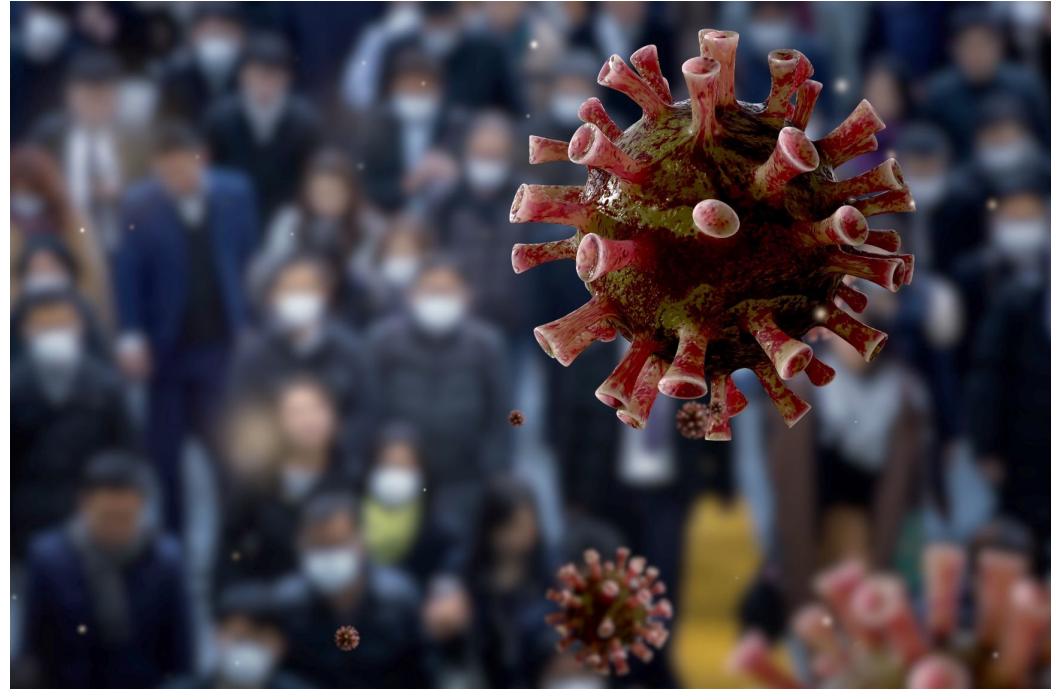
Patient group

People with COVID-19
(any variant)

Outcomes

People with pneumonia
due to COVID-19

People died



Risk factors

Obesity

Diabetes

Hypertension

Data Analytics 2 - Preventative Measures

Patients with COVID-19

<< 840539006
| COVID-19 |

<< 882784691000119100
| Pneumonia caused by
SARS-CoV-2 |

Patients with
pneumonia due to COVID-19

<< 419099009
| Dead |

Diabetes

both

Hyper-
tension

Obesity

Patients
who died

Obesity

Diabetes

both

Hyper-
tension

<< 414916001
| Obesity |

<< 73211009
| Diabetes mellitus |

<< 38341003
| Hypertensive disorder |

Demonstration 2 - Preventative Measures



Data Analytics 3 - Assessing Treatments



Assessing treatments

How effective is each treatment option?

Data Analytics 3 - Assessing Treatments

Patient cohort

BRCA1 gene mutation

Increased risk of breast cancer

Treatment

Drug prevention available

Risk of severe side effects



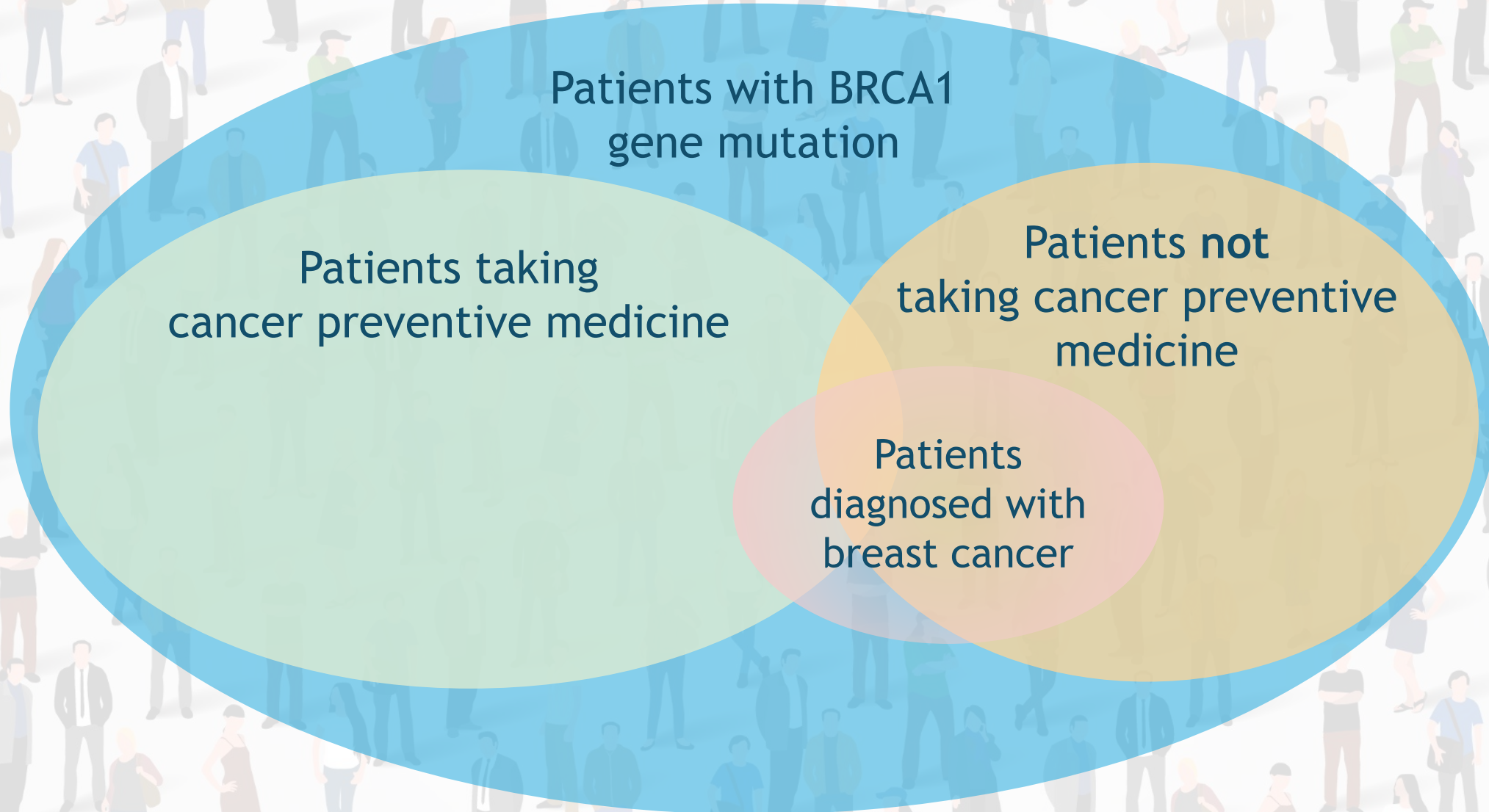
Question

Does the medication significantly reduce the risk of cancer?

Data Analytics 3 - Assessing Treatments



Data Analytics 3 - Assessing Treatments



SNOMED CT Queries

Question

What concepts

Query

People with BRCA1 gene mutation

All concepts that are subtypes of the concept 'BRCA1 gene mutation positive'

<< 412734009
|BRCA1 gene mutation positive|

People taking breast cancer preventive medicine?

All concepts that are types of either 'Tamoxifen-containing product', 'Anastrozole-containing product', or 'Raloxifene-containing product'

<< 75959001 |Tamoxifen-containing product|
OR << 108774000 |Anastrozole-containing product| OR << 419530003
|Raloxifene-containing product|

People with breast cancer?

All concepts that represent a disease with a morphology of 'Malignant tumor of breast'

<< 254837009
|Malignant tumor of breast|

Expression constraint language

International Delivering NO

Data Analytics 3 - Assessing Treatments

<< 412734009
|BRCA1 gene mutation
positive|

Patients with BRCA1
gene mutation

Patients taking medication
containing either tamoxifen,
anastrozole or raloxifene

Patients not
taking preventive
medication

Patients
diagnosed with
breast cancer

<< 75959001 |Tamoxifen-containing product|
OR << 108774000 |Anastrozole-containing
product| OR << 419530003
|Raloxifene-containing product|

<< 254837009
|Malignant tumor of breast|

Patient Data Analytics

<< 254837009 |Malignant tumor of breast|

Electronic
data
(E)

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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
(EHR)

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ECL Expansion
15950061000119105
353421000119109
145501000119108
354591000119108
448435005
254840009
286896005
278050001
271467005
403458008
373082000
373081007
254837009
254841008
188159008
188159008
...

Patient Data Analytics

```
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ECL Expansion
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286896005
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373082000
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...

Patient Data Analytics

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188159008
...

Demonstration 3 - Assessing Treatments



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Interpreting The Results

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[linkedin.com/company/ihtsdo/](https://www.linkedin.com/company/ihtsdo/)

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
 - SNOMED CT can be used for this too!



Agenda

1. Implementation and Education Resources
2. Implementation roadmap for healthcare organizations and vendors
3. Terminology servers
4. Benefits of SNOMED CT in data analytics
5. Decision support and examples
6. Discussion and questions

Decision Support and Examples

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linkedin.com/company/ihtsdo/

Bahmni EHR Integration

Project Brief

- Enable use of SNOMED CT in low resource and digitally maturing settings
- Demonstrate high value features
- Create an implementation exemplar for other software vendors to follow
- Gain implementation experience

Bahmni EHR Integration

What is Bahmni™

- Bahmni is an easy-to-use open source EMR & hospital system using OpenMRS and other components
- Recognized as a Digital Public Good
- Widely implemented: 500+ sites. 50+ Countries. 4K+ Users. 2M+ Patient Records
- Bahmni Coalition: Strong community

Bahmni EHR Integration

Collaboration Approach

- Bahmni started without native SNOMED CT support
- First goal was to record using SNOMED CT
- Second goal was to leverage SNOMED CT to deliver benefits to users
- The Implementation Team worked collaboratively with the Bahmni development team

Bahmni EHR Integration

Features Delivered

1. Diagnosis Search and Save
2. Procedure Order Entry
3. Medication Clinical Decision Support
4. Interoperability Features
5. Analytics Integration

Questions?

The logo consists of a solid blue square. Inside the square, the word "SNOMED" is written in a bold, white, sans-serif font. Below it, the word "International" is written in a smaller, white, sans-serif font.

SNOMED
International



THANK YOU

