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Delivering  
SNOMED CT

# SNOMED CT in the EHR *for clinicians*

January 31st, 2023

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SNOMED International

[snomed.org](https://snomed.org)



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



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

## Outline

- **Background**
- **Clinicians, Clinical Data, and SNOMED CT**
  - A clinically focused language
  - Meaningful view of data
  - Easy and accurate documentation
  - Support research and decision making

(Wednesday)  
February 1



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# Background

[snomed.org](http://snomed.org)



@snomedct



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

## Evolution of Clinical Documentation From Paper to Machine



# Evolution of Clinical Practice From Generalized to Personalized Medicine



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# Clinicians, Clinical Data, and SNOMED CT



[snomed.org](http://snomed.org)



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



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

## Clinicians and SNOMED CT



We want to be able to use data to support **clinical research** and **decision making**

We want clinical documentation to be **fast, easy** and **accurate**

We want to record clinical details using a **clinically-focused language**

We want the **right data** to be available at the **right time** and the **right place**



## SNOMED CT for Clinicians



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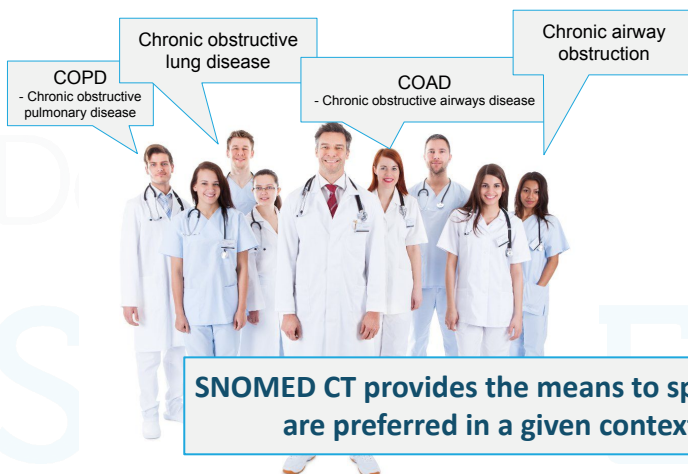


## SNOMED CT A Clinically-focused Language for Health



SNOMED CT doesn't dictate what to say,  
or how to say it...

## SNOMED CT A Clinically-focused Language for Health



COPD  
- Chronic obstructive  
pulmonary disease

Chronic obstructive  
lung disease

COAD  
- Chronic obstructive airways disease

Chronic airway  
obstruction

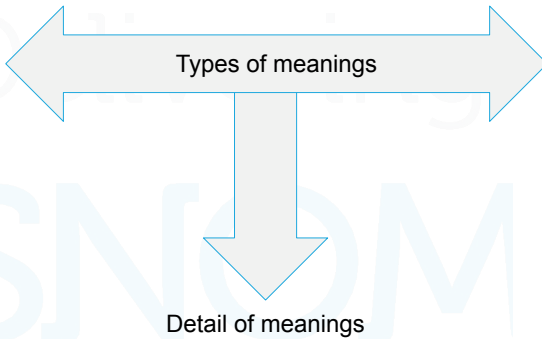
13645005 | Chronic obstructive  
lung disease (disorder) |

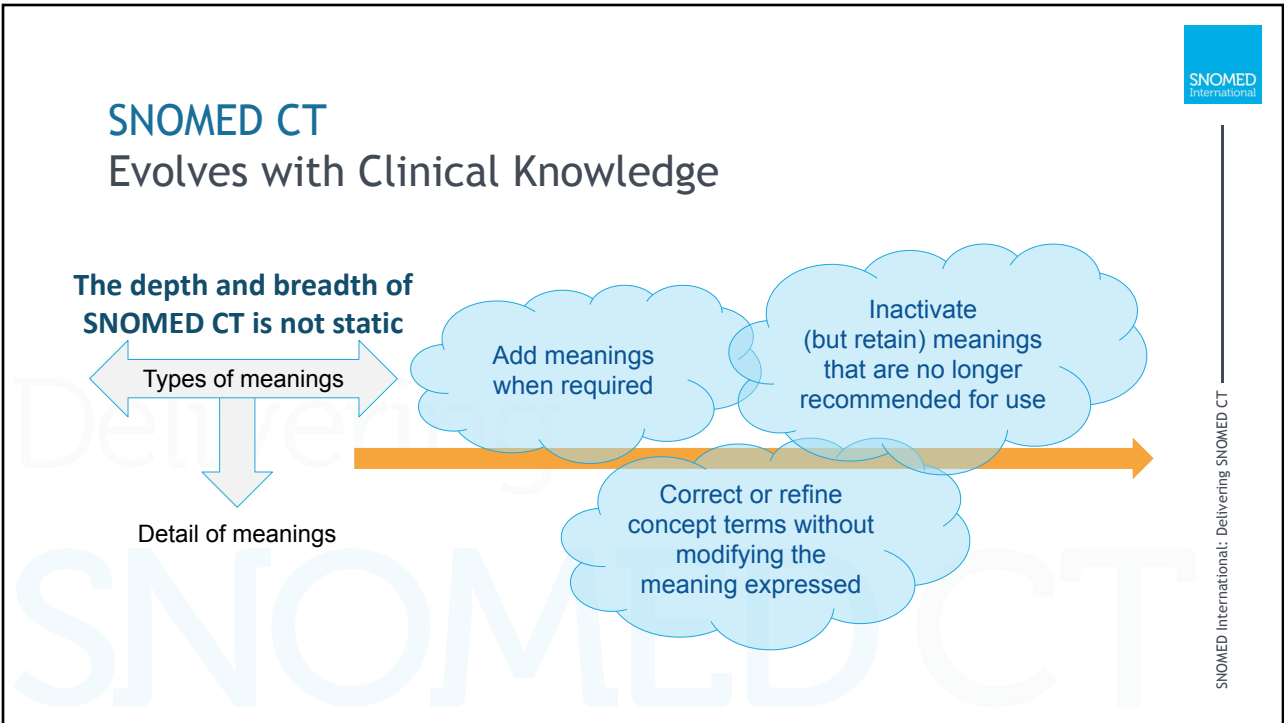
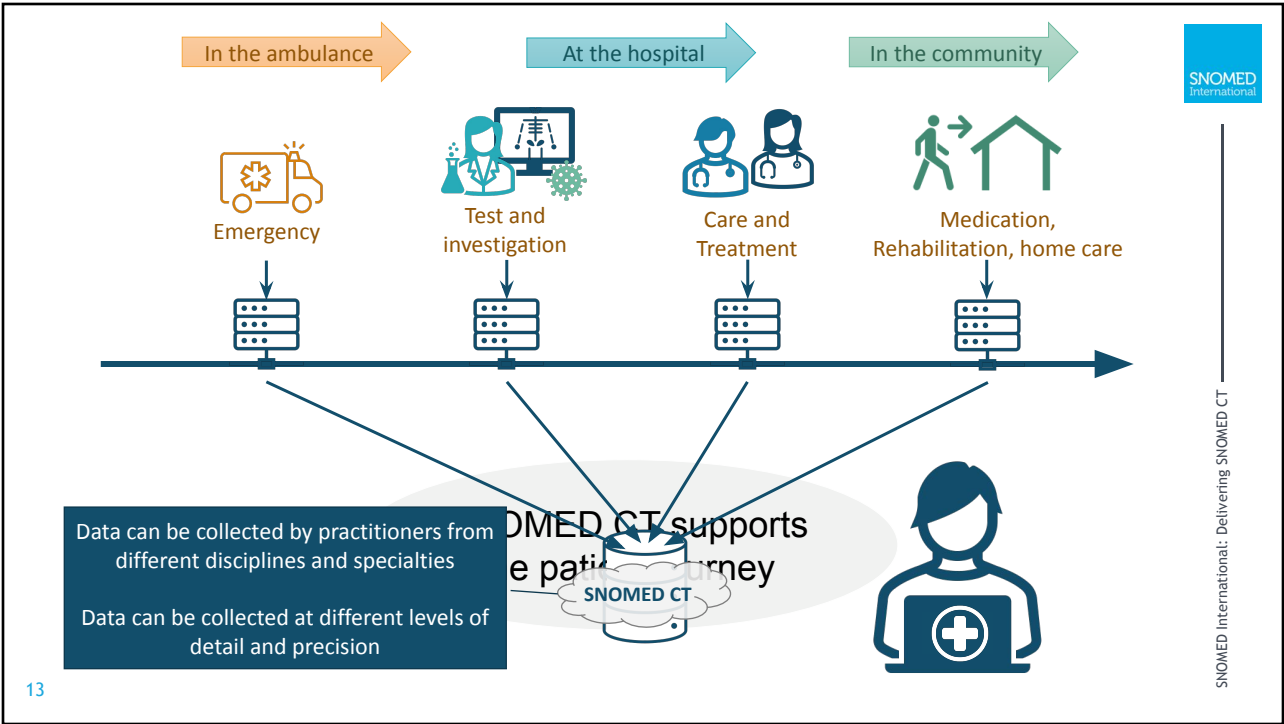
SNOMED CT provides the means to specify what terms  
are preferred in a given context or dialect

# SNOMED CT

## A Clinically-focused Language for Health

SNOMED CT covers the depth and breadth of clinical information





## Clinicians and SNOMED CT

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## ...Right Data?

*“But we have EMRs.... isn’t that sufficient?”*

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## ...Right Data?



### Making health records electronic

- A significant step forward
- Improves communication
- Increases availability of relevant information

*... but this is only a partial solution...  
...the real challenge is ...*

### Making health records meaningful

- Identifying significant facts in oceans of data
- Enabling effective meaning-based retrieval
- Linking the EHR to authoritative clinical knowledge

## ...Right Data?

The problem with process-based views

Many of today's electronic health records focus on process views of health care



### They record what happened using mixtures of

- Free-text
- Local codes or specialty specific codes
- A variety of data sets each designed to meet a specific limited set of requirements

### They report what happened using

- Statistical classifications (such as ICD-10)
- They allow audit of the process of care

They are not so good at presenting or analyzing the current situation

## ...Right Data?



**Clinical decisions require understanding of the current situation rather than detailed data about every event**

**A meaningful record system should be able to make inferences and present a useful view of the current situation as a basis for decision making**

## ...Right Data?

Meaningful view of the current situation

### Descriptive record of what happened?

*To start with, white moved the queen's pawn forward two spaces. Black responded by moving a knight in front of the king's bishop's pawn. White advanced the queen's bishop's pawn two spaces. Black then moved the king's knight's pawn two spaces.*

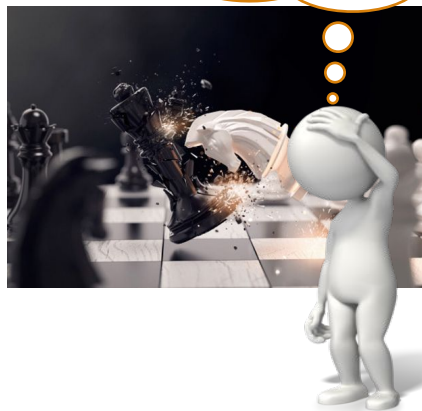
...

*[47 more moves in same style]*

...

Then black moved his king next to his rook.

**What should white do next?**



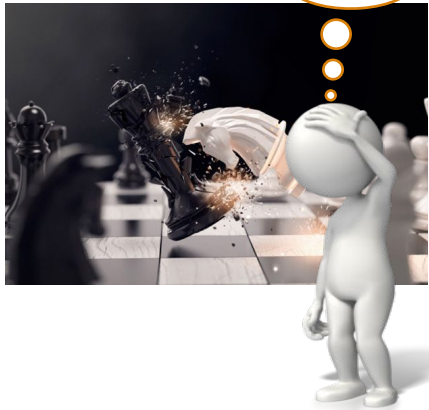
## ...Right Data?

Meaningful view of the current situation

To decide: I need to understand the current situation

### Formal process record of what happened

- |              |               |
|--------------|---------------|
| 1. d4 Nf6    | 14. Bg3 Nc5   |
| 2. c4 g6     | 15. Bxe5 Bxe5 |
| 3. Nc3 Bg7   | 16. Nxe5 Be6  |
| 4. e4 d6     | 17. b4 Ncd7   |
| 5. Be2 e5    | 18. Nf3 Ke7   |
| 6. dxe5 dxe5 | 19. Ng5 Nf8   |
| 7. Qxd8 Kxd8 | 20. Nxe6 Nxe6 |
| 8. f4 Nfd7   | 21. Bg4 Nd7   |
| 9. Nf3 c6    | 22. Rde1 Ndf8 |
| 10. O-O exf4 | 23. Ne4 Nd8   |
| 11. Bxf4 f6  | 24. Nc5 Kd6   |
| 12. Rad1 Ke8 | 25. Rf6 Kc7   |
| 13. e5 fxe5  | 26. Re7 Kb8   |

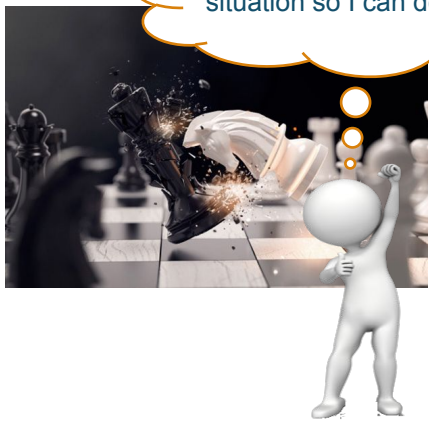
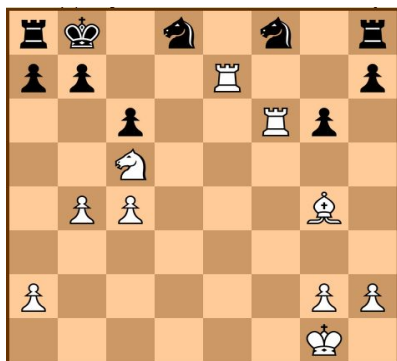


## ...Right Data?

Meaningful view of the current situation

I understand the current situation so I can decide

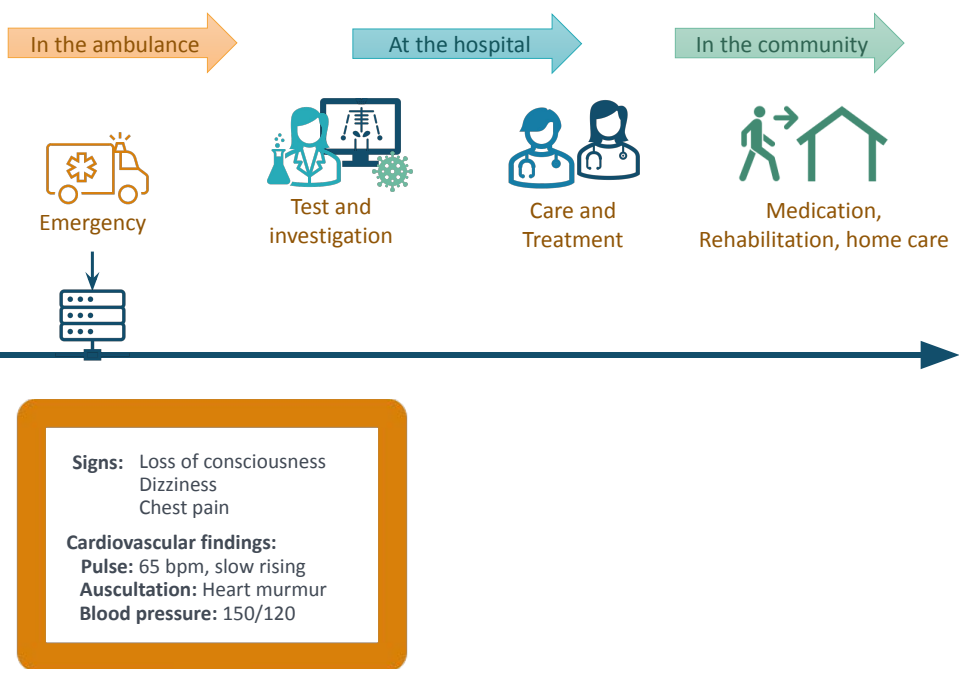
### Summarized and relevant representation



# SNOMED CT Supports Meaningful Views of the Clinical Situation

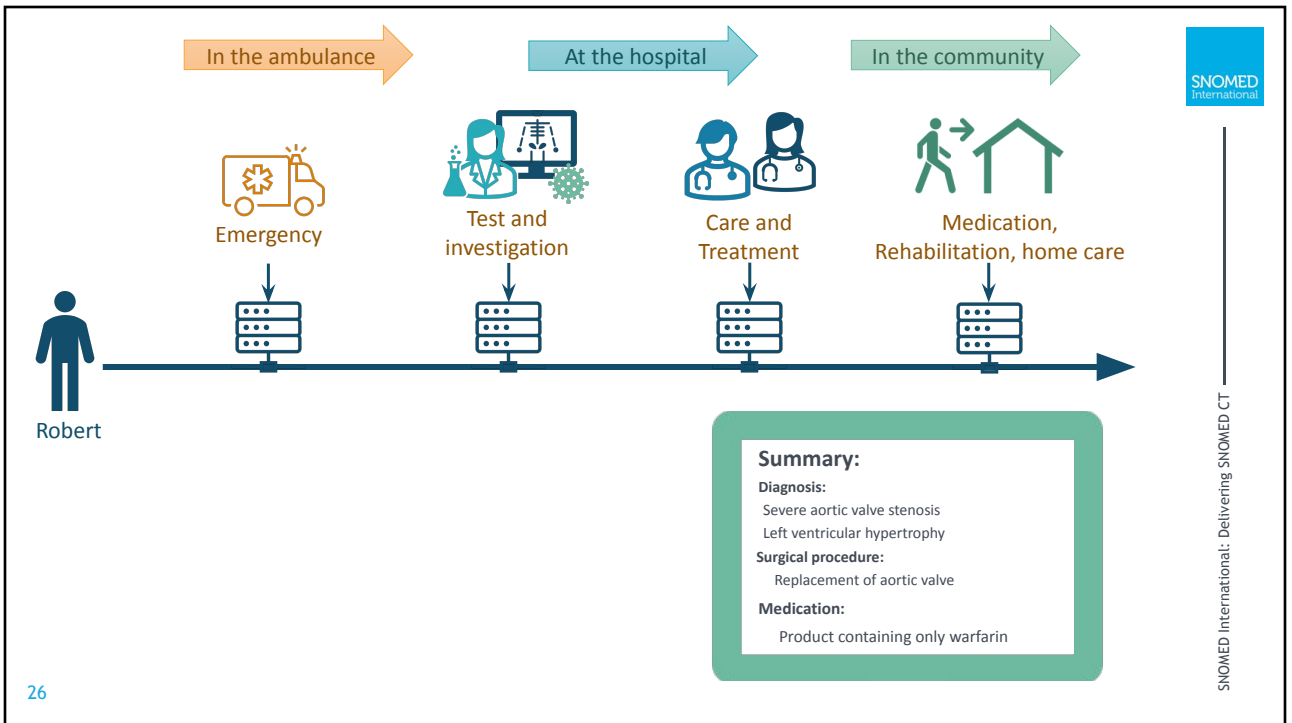
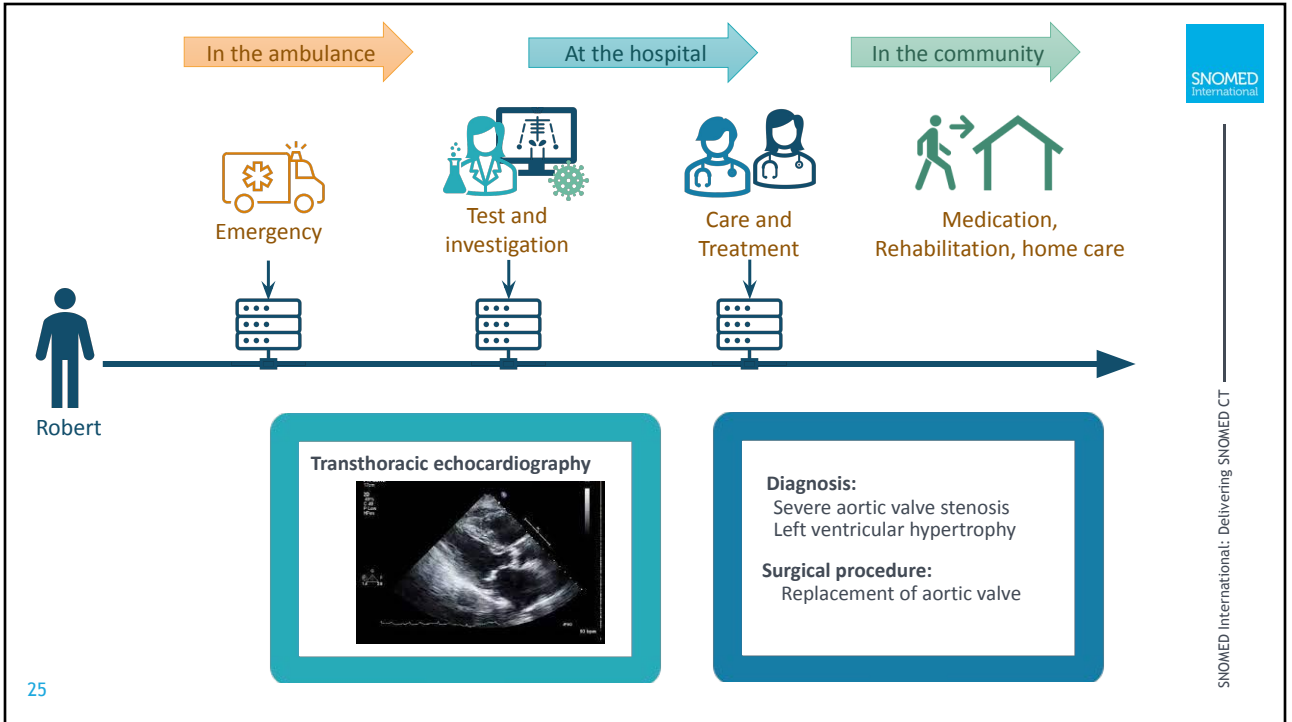


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**Signs:** Loss of consciousness  
Dizziness  
Chest pain

**Cardiovascular findings:**  
Pulse: 65 bpm, slow rising  
Auscultation: Heart murmur  
Blood pressure: 150/120

**Transthoracic echocardiography**



**Diagnosis:**  
Severe aortic valve stenosis  
Left ventricular hypertrophy

**Surgical procedure:**  
Replacement of aortic valve

**Medical treatment:**  
....

**Summary:**

**Diagnosis:**  
Severe aortic valve stenosis  
Left ventricular hypertrophy

**Surgical procedure:**  
Replacement of aortic valve

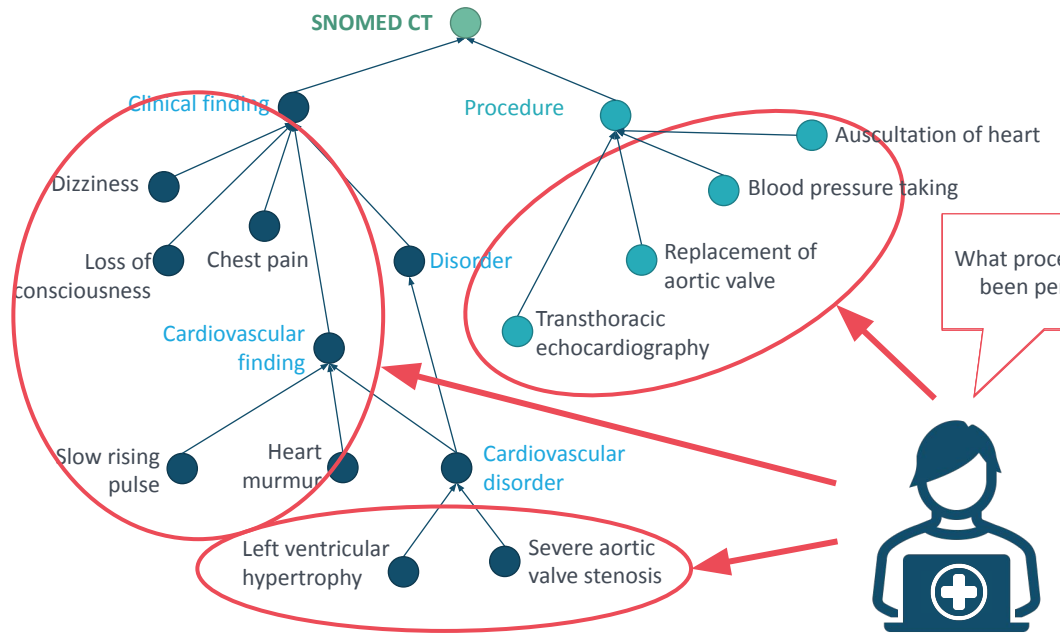
**Medication:**  
Product containing only warfarin



Information can be displayed and retrieved to provide a meaningful overview of the clinical situation



SNOMED CT



What procedures have been performed?



## SNOMED CT

### Supports Meaningful Views of the Clinical Situation

Show all allergies  
of a patient

Show test results  
and examination  
findings

Show current  
diagnoses and  
procedures

...



## Clinicians and SNOMED CT



We want to be able to use  
data to support **clinical  
research** and **decision making**

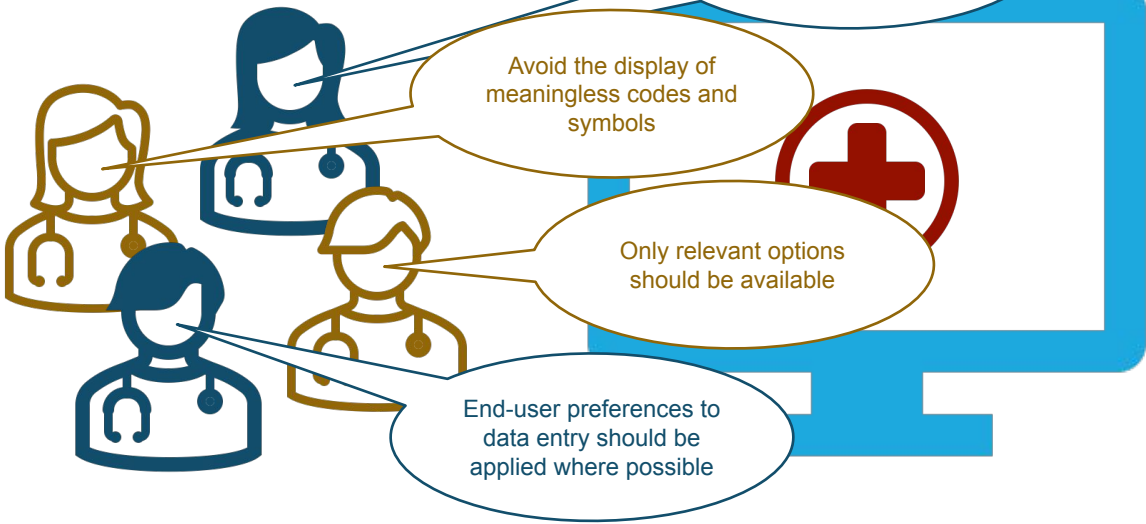
We want clinical  
documentation to be **fast,  
easy** and **accurate**

We want to record  
clinical details using a  
**clinically-focused language**

We want the **right data** to  
be available at the **right  
time** and the **right place**



# Data Entry with SNOMED CT

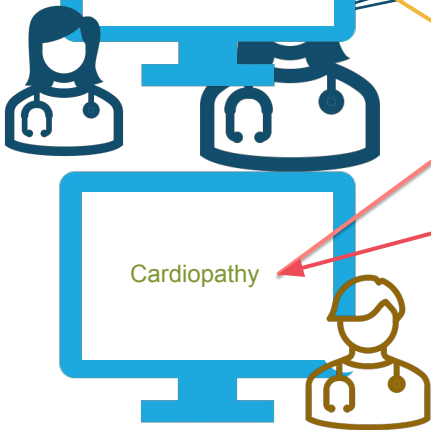


"Patient suffers from a cardiac disorder..."

Heart disease



Language and terms should be understandable and recognizable



Heart disease (disorder) ☆

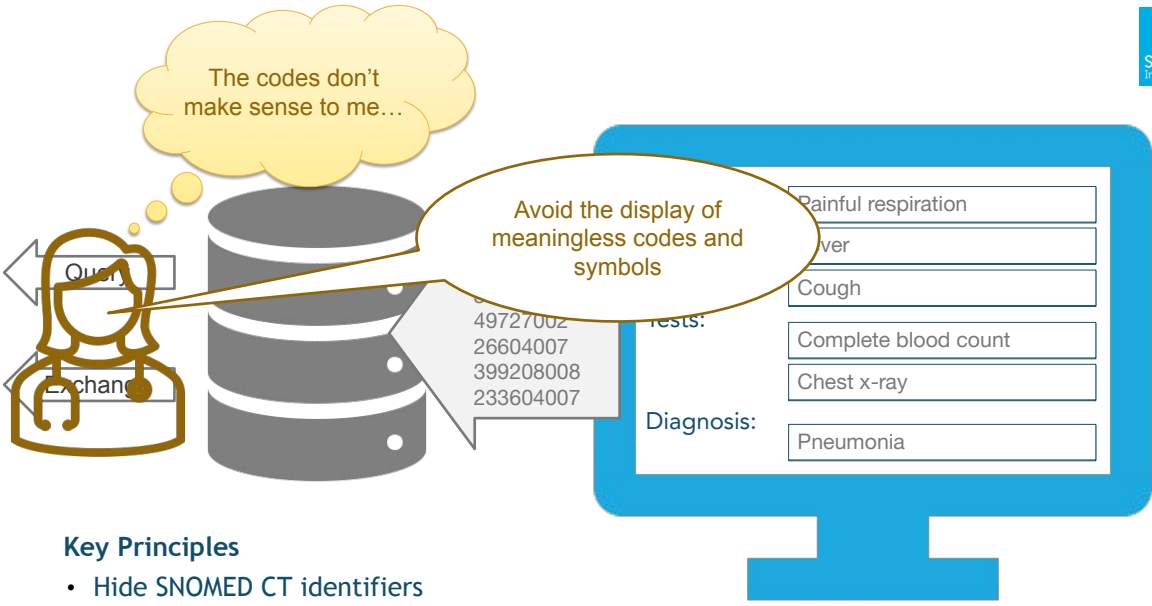
SCTID: 56265001

56265001 | Heart disease (disorder) |

- en Heart disease (disorder)
- en Heart disease
- en Cardiac disorder
- en Cardiopathy
- en Disorder of heart
- en Morbus cordis

Terms can be added in any language or dialect

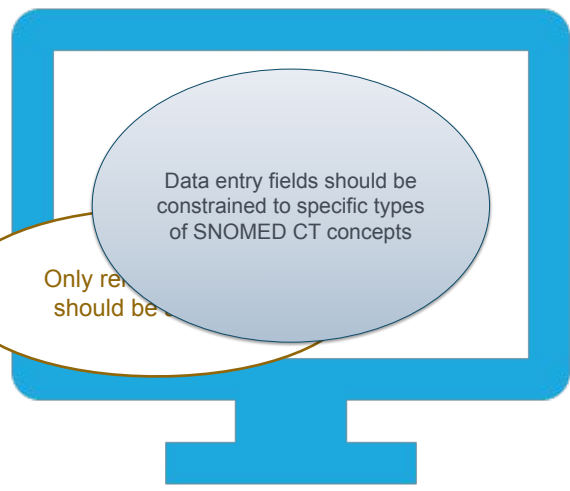
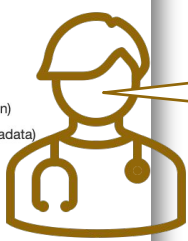




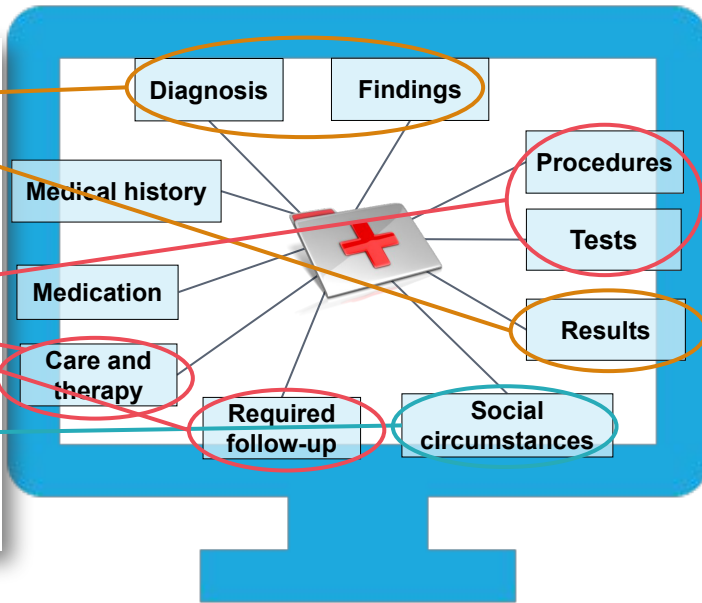
**Key Principles**

- Hide SNOMED CT identifiers
- Use terms that are familiar to the end user


- ▼ SNOMED CT Concept (SNOMED RT+CTV3)
  - ▶ Body structure (body structure)
  - ▶ Clinical finding (finding)
  - ▶ Environment or geographical location (environment / location)
  - ▶ Event (event)
  - ▶ Observable entity (observable entity)
  - ▶ Organism (organism)
  - ▶ Pharmaceutical / biologic product (product)
  - ▶ Physical force (physical force)
  - ▶ Physical object (physical object)
  - ▶ Procedure (procedure)
  - ▶ Qualifier value (qualifier value)
  - ▶ Record artifact (record artifact)
  - ▶ Situation with explicit context (situation)
  - ▶ SNOMED CT Model Component (metadata)
  - ▶ Social context (social concept)
  - ▶ Special concept (special concept)
  - ▶ Specimen (specimen)
  - ▶ Staging and scales (staging scale)
  - ▶ Substance (substance)



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  - ▶ Body structure (body structure)
  - ▶ **Clinical finding (finding)**
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  - ▶ Substance (substance)



## Data Entry

 SNOMED CT doesn't dictate the visual design



End-user preferences to data entry should be applied where possible

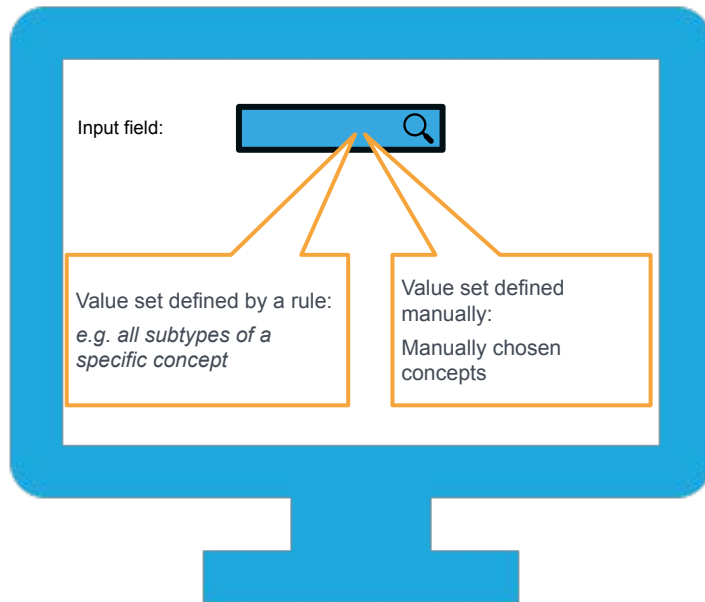


# Data Entry

## Value Set Binding

A value set is the set of coded values that is allowed in an element.

A SNOMED CT value set can be specified using a rule or a specified subset

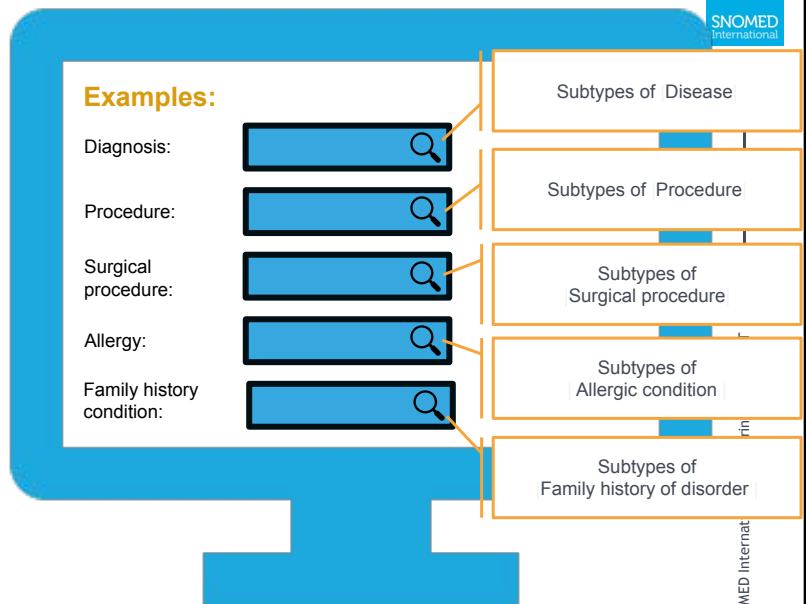


# Data Entry

## Value Set Binding

A value set is the set of coded values that is allowed in an element.

A SNOMED CT value set can be specified using a rule or a specified subset



# Constrained Data Entry



Unconstrained searches of SNOMED CT for “malignant melanoma” return concepts that are not appropriate for recording a new or current diagnosis

- ✘ 372156000 |**Malignant melanoma** - category (morphologic abnormality)|  
The morphological abnormality refers to the cellular anomaly not the clinical diagnosis
- ✘ 161432005 |History of **malignant melanoma** (situation)|  
This concept is used to record a past history not a current diagnosis
- ✘ 427858005 |Family history of **malignant melanoma** (situation)|  
This is a family history concept
- ✔ 372244006 |**Malignant melanoma** (disorder)|  
This concept or one of its subtypes should be used to record the diagnosis

# Unconstrained Data Entry Consequences

Search Term	Concepts Incorrectly Selected as ER Diagnoses	Count
Temperature	246508008  Temperature ( <b>attribute</b> )	1097
High temperature	285717004  High temperature ( <b>physical force</b> )	145
Drug used	246488008  Drug used ( <b>attribute</b> )	17
Alcohol (substance)	53041004  Alcohol ( <b>substance</b> )  ( <i>and similar errors</i> )	747
Lymph node	59441001  Structure of lymph node ( <b>body structure</b> )	33
Stabbing	410706007  Stabbing sensation quality ( <b>qualifier value</b> )	230

“Overall, 11% of all 408,000 coded data items were very obviously coded to clinically impossible or improbable categories (e.g. to a substance, not a diagnosis)”

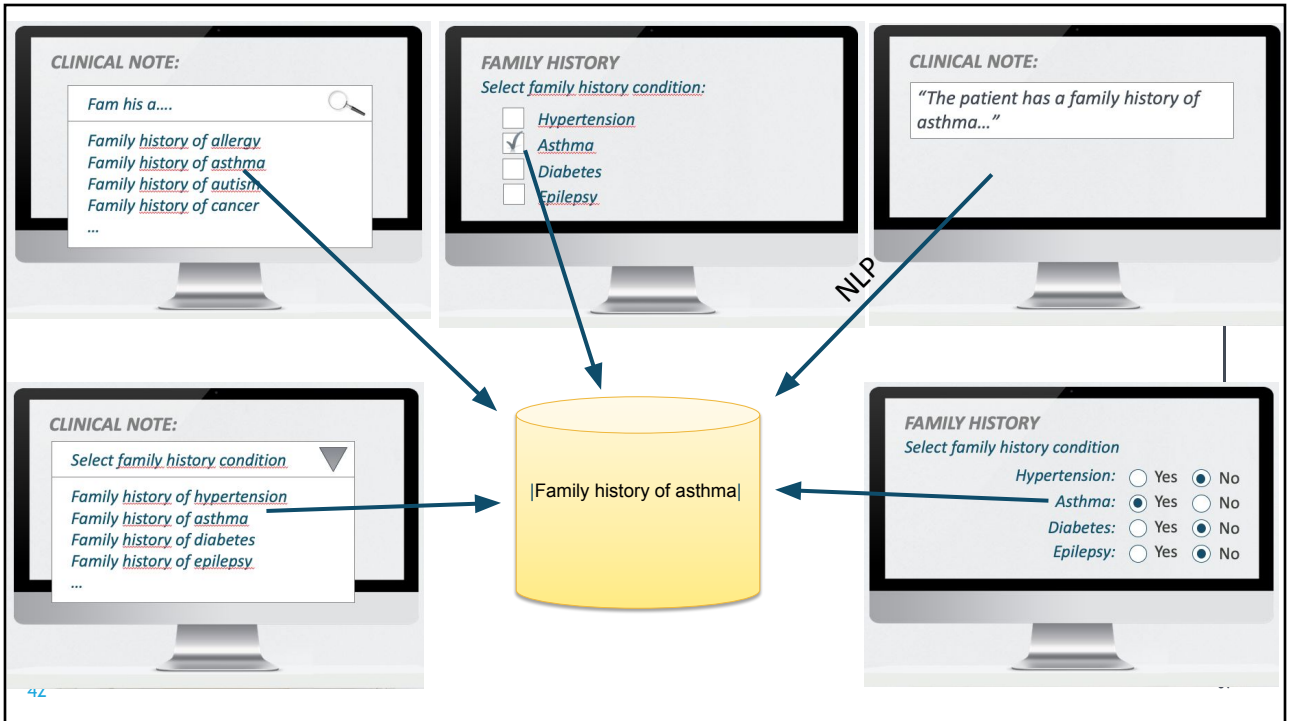
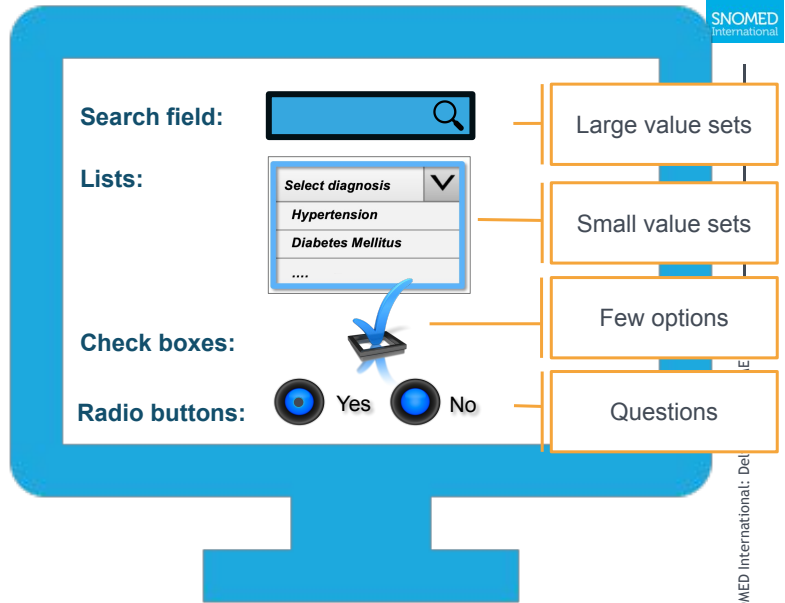
*Dr Jeremy Rogers - 2014 presentation SNOMED Expo*



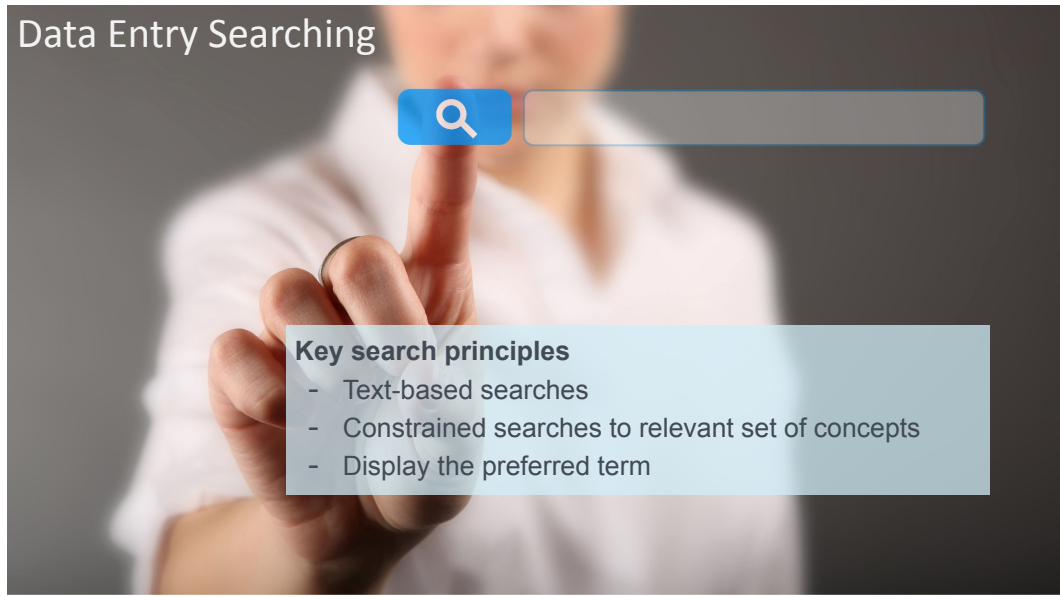
# Choosing UI Controls

Consider UI controls that suit the:

- Size of the value set
- Intended input device
- Preferred data entry practice



## Data Entry Searching



### Key search principles

- Text-based searches
- Constrained searches to relevant set of concepts
- Display the preferred term

## User Interface Demonstration



Clinicians use SNOMED CT through an EHR system

The end-user experience is determined by each implementation

## Clinicians and SNOMED CT



We want to be able to use data to support **clinical research** and **decision making**

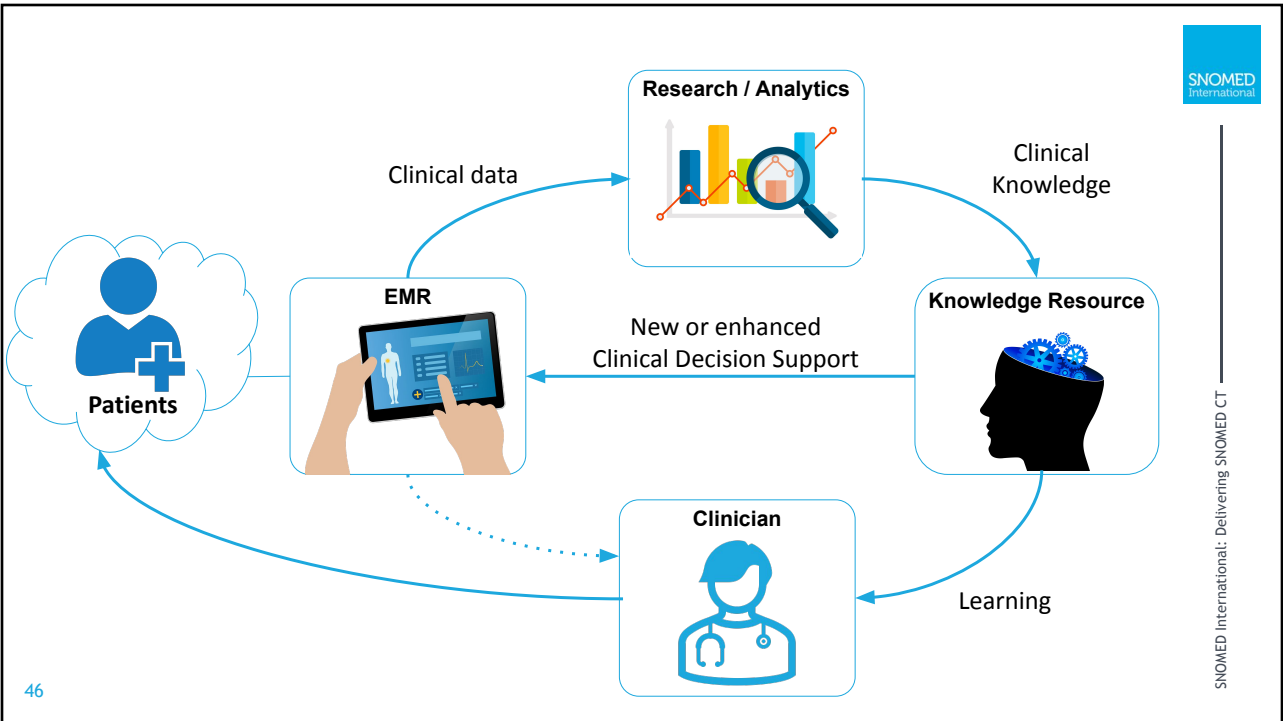


We want to record clinical details using a **clinically-focused language**

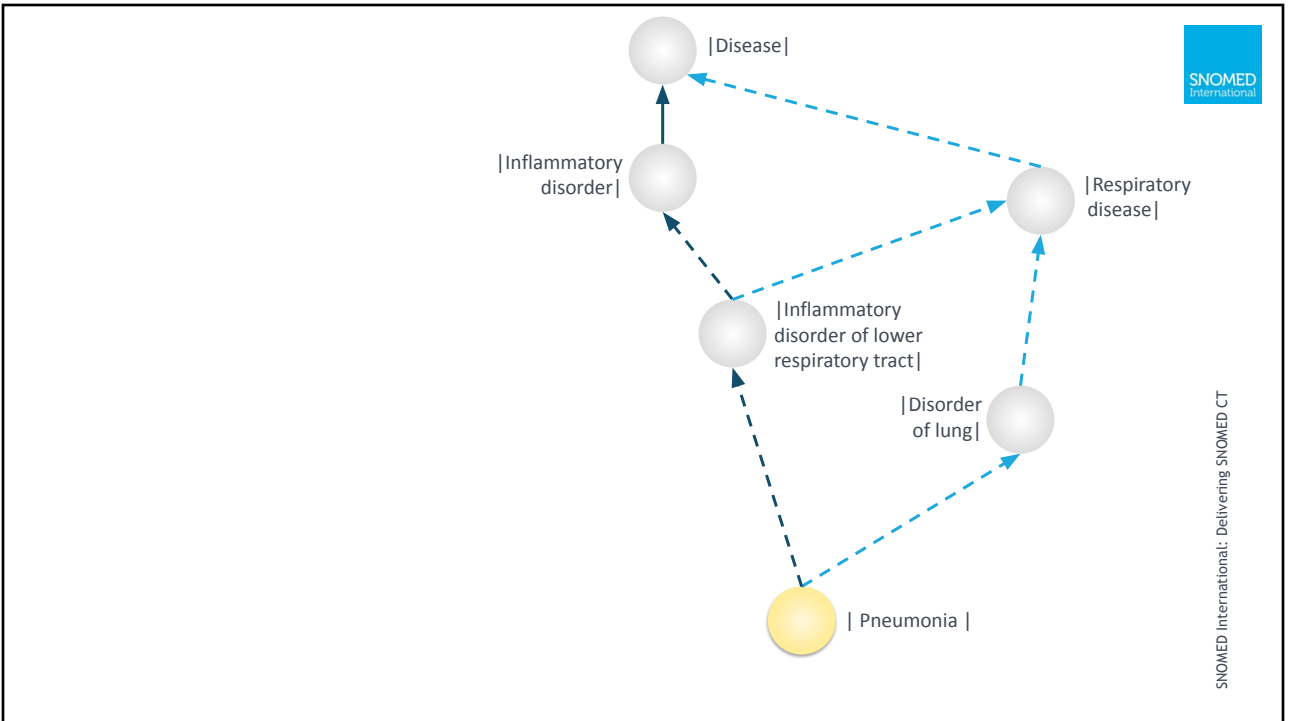
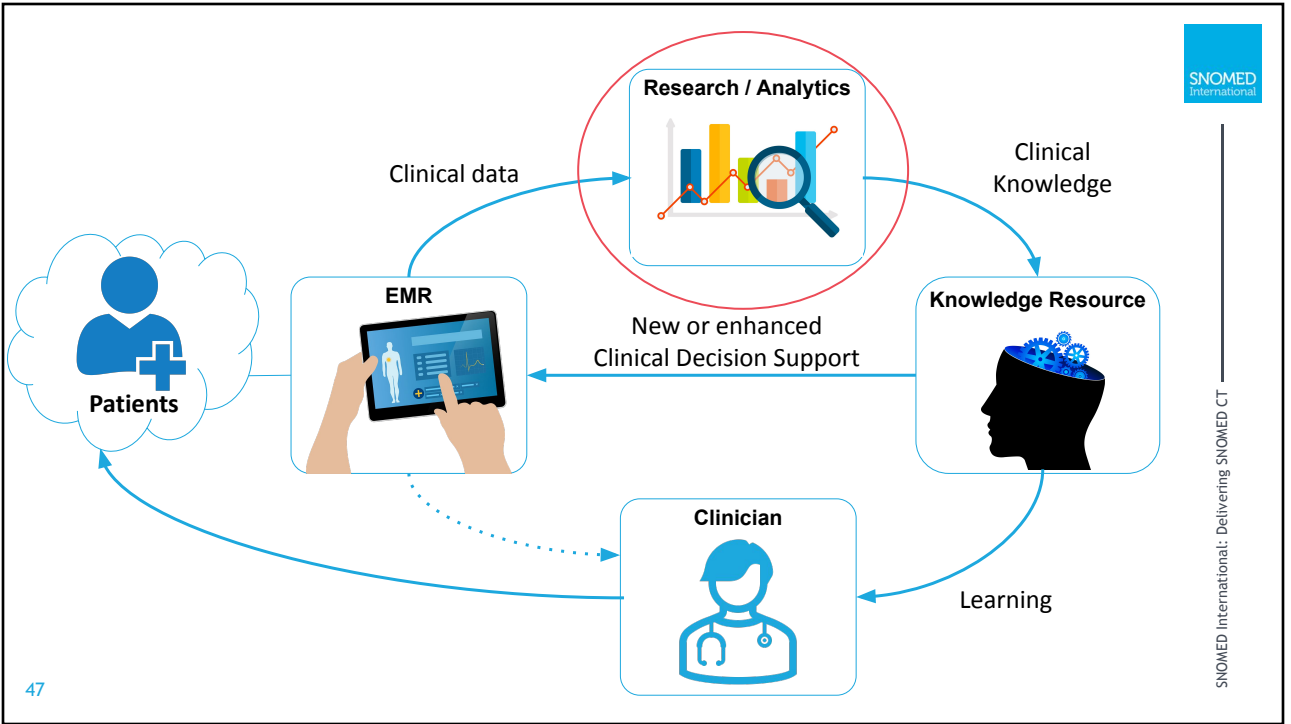
We want clinical documentation to be **fast, easy and accurate**

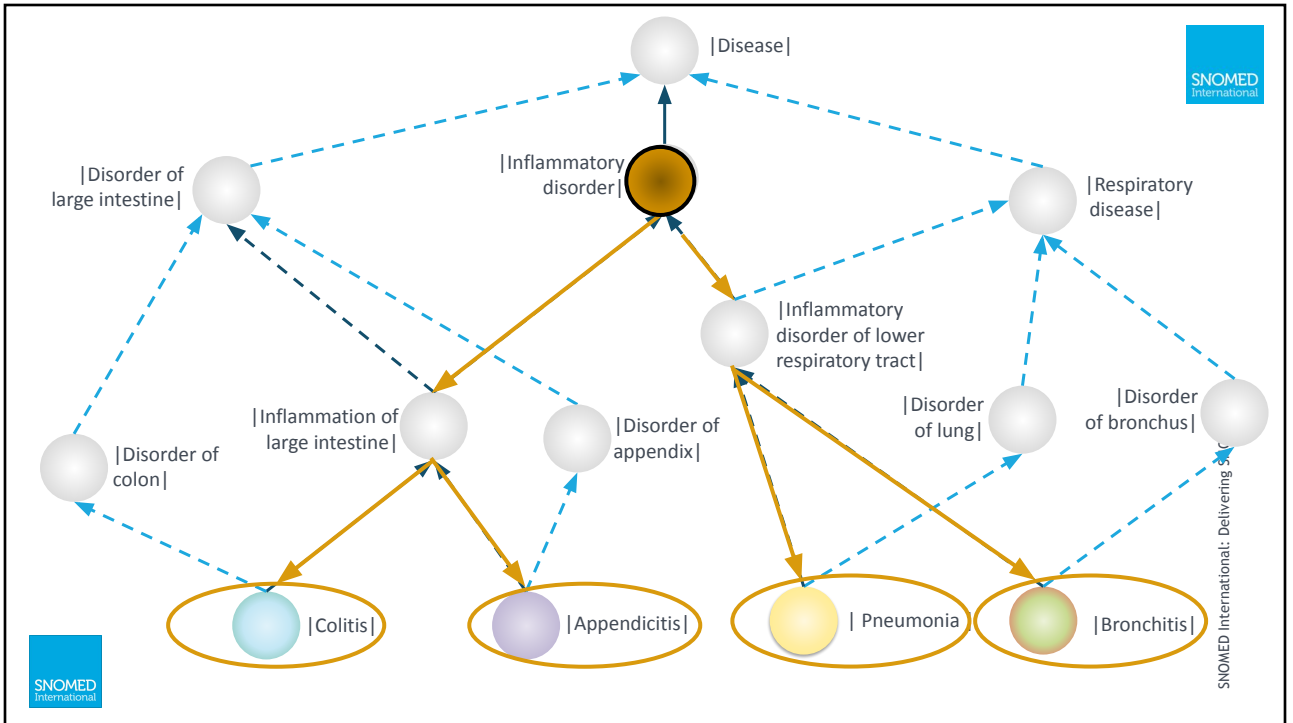
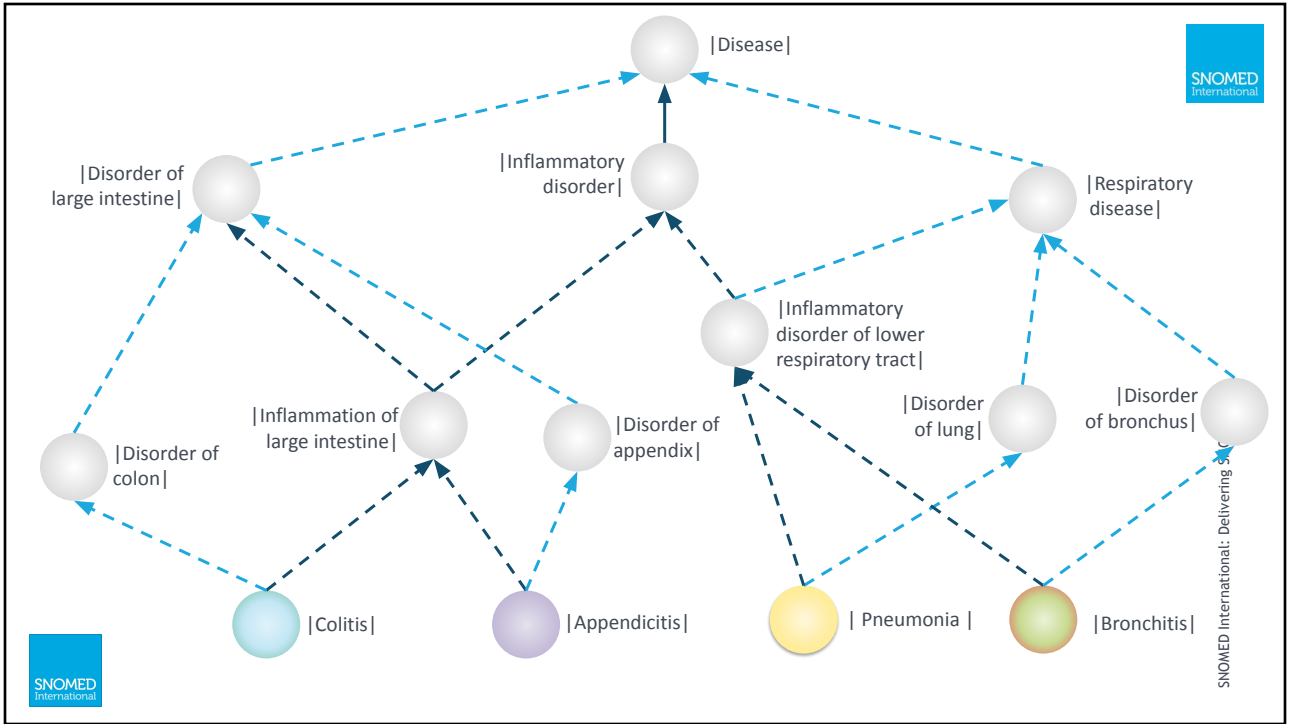
We want the **right data** to be available at the **right time** and the **right place**

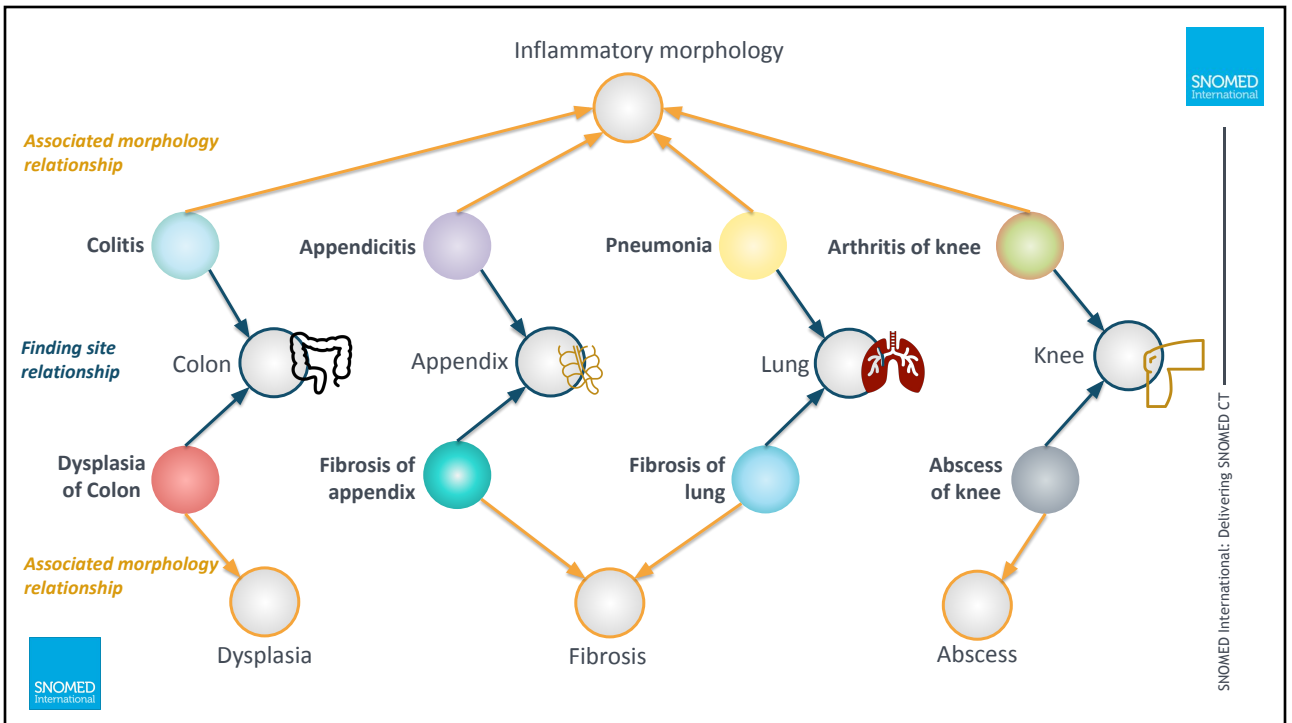
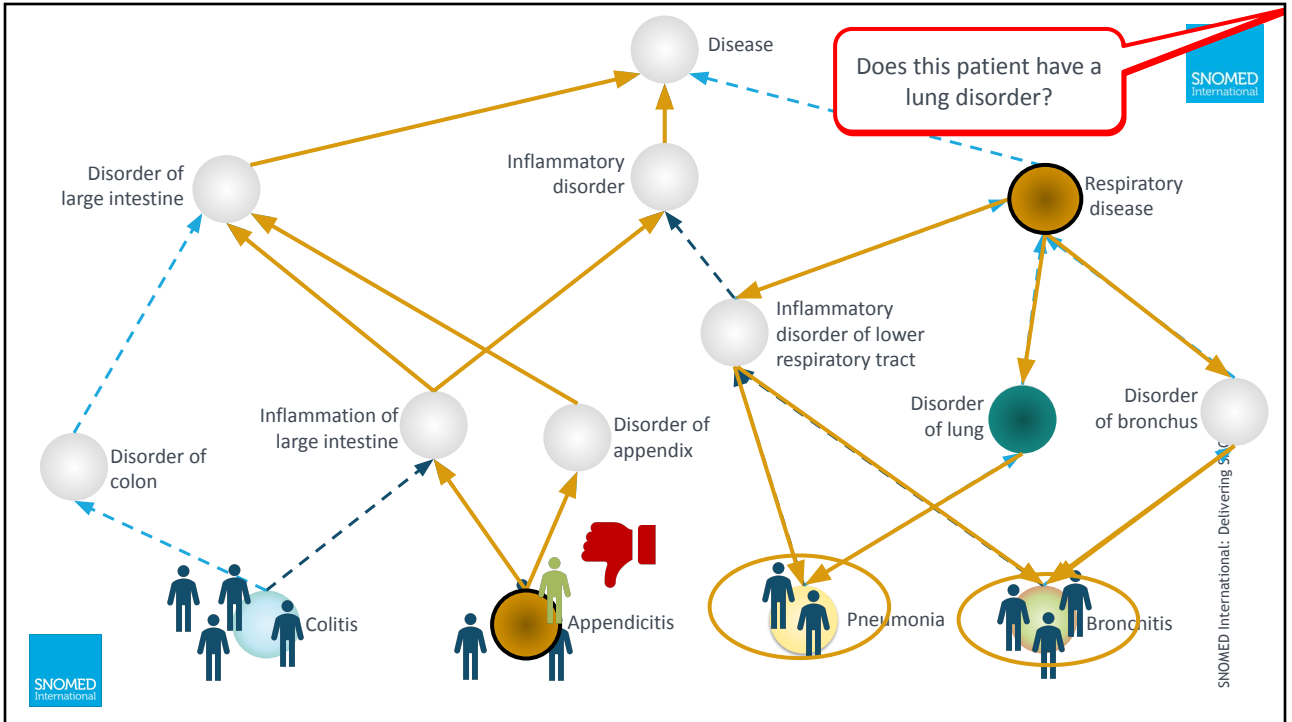
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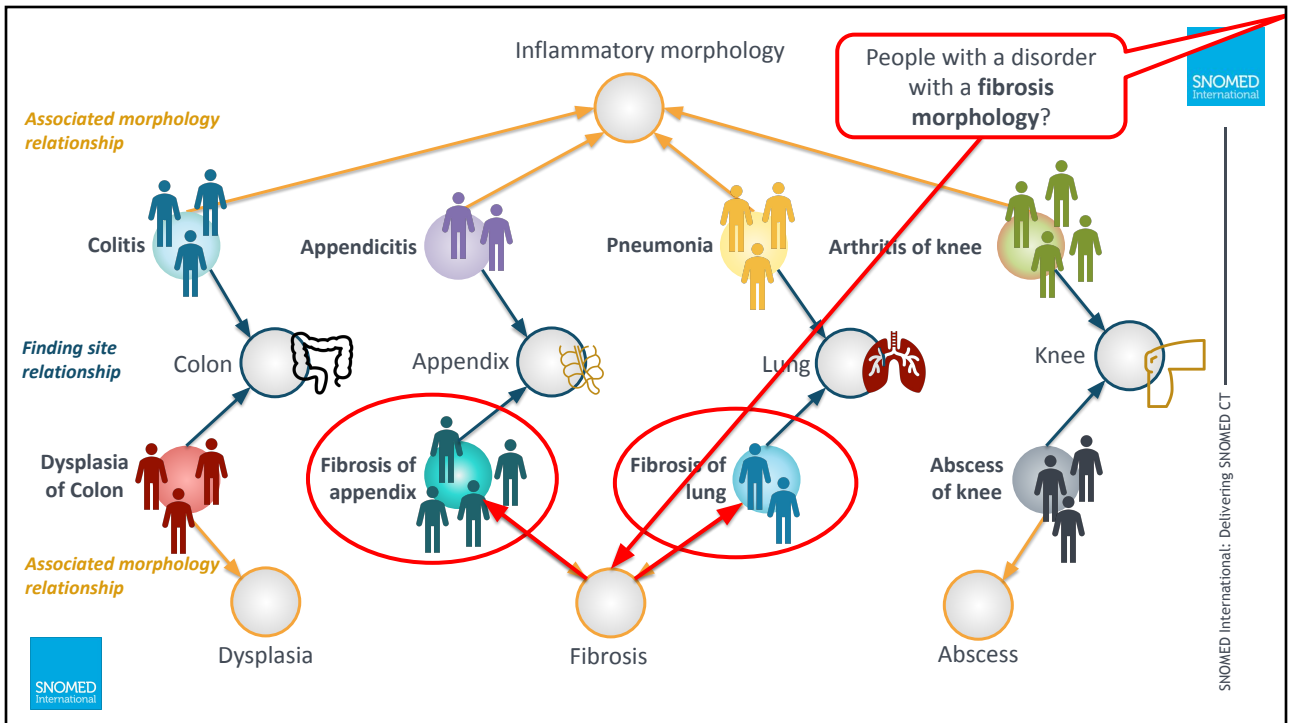
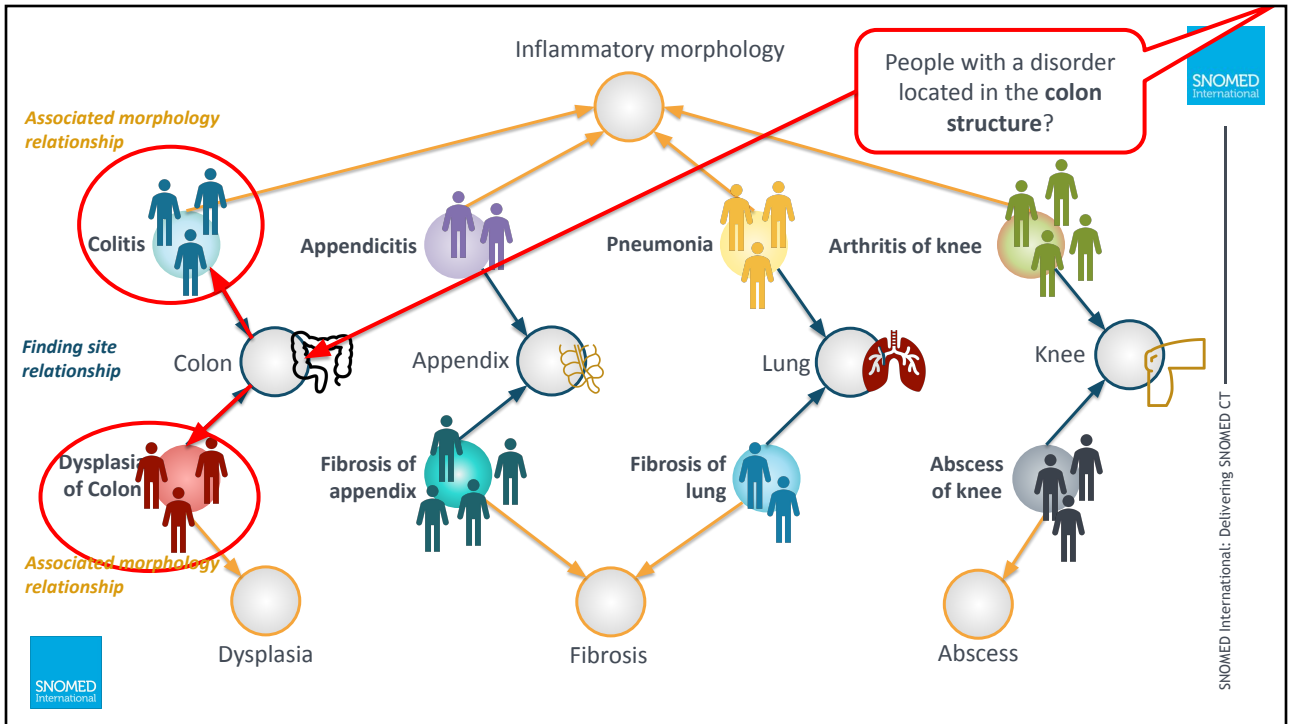
SNOMED International: Delivering SNOMED CT











## Data Analytics BRCA1



## — Data Analytics with SNOMED CT



**Assessing treatments**

*How effective is each treatment option?*

# Data Analytics with SNOMED CT

## 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?

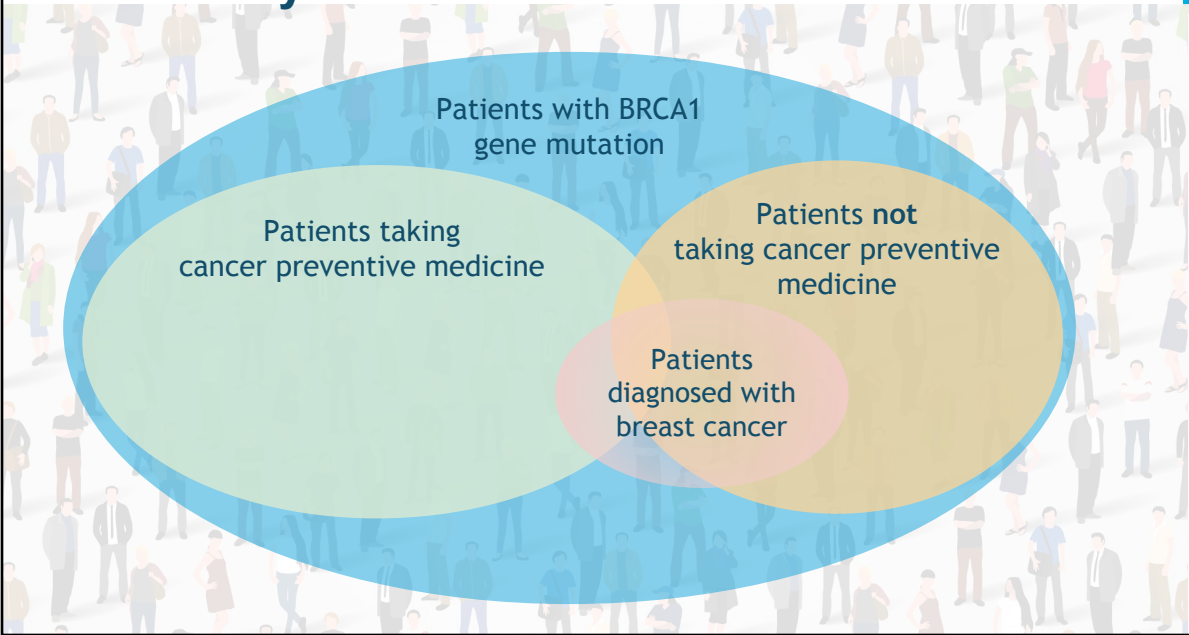
57

# Data Analytics with SNOMED CT

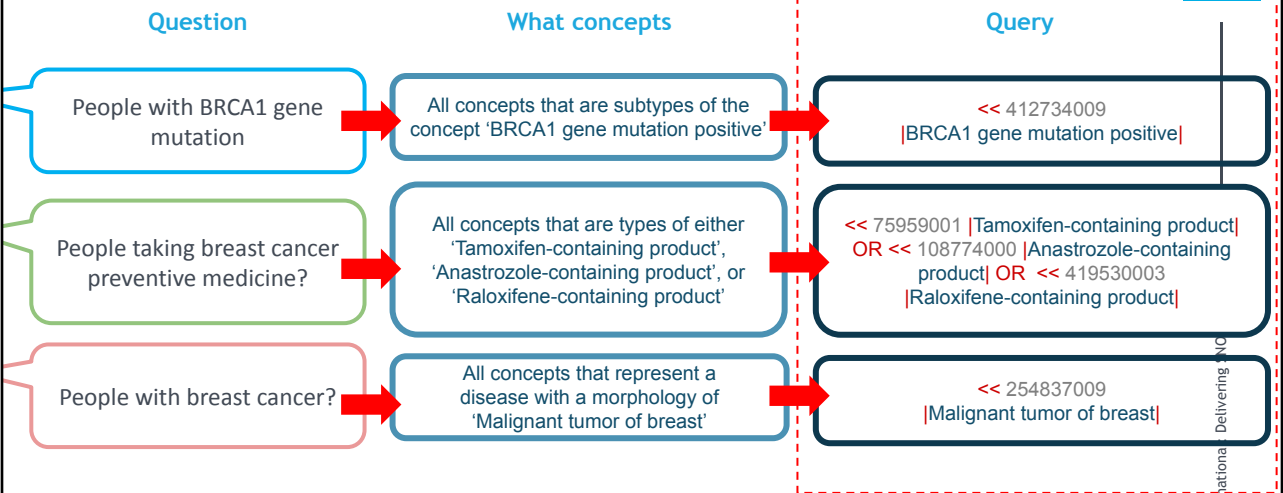


58

# Data Analytics with SNOMED CT



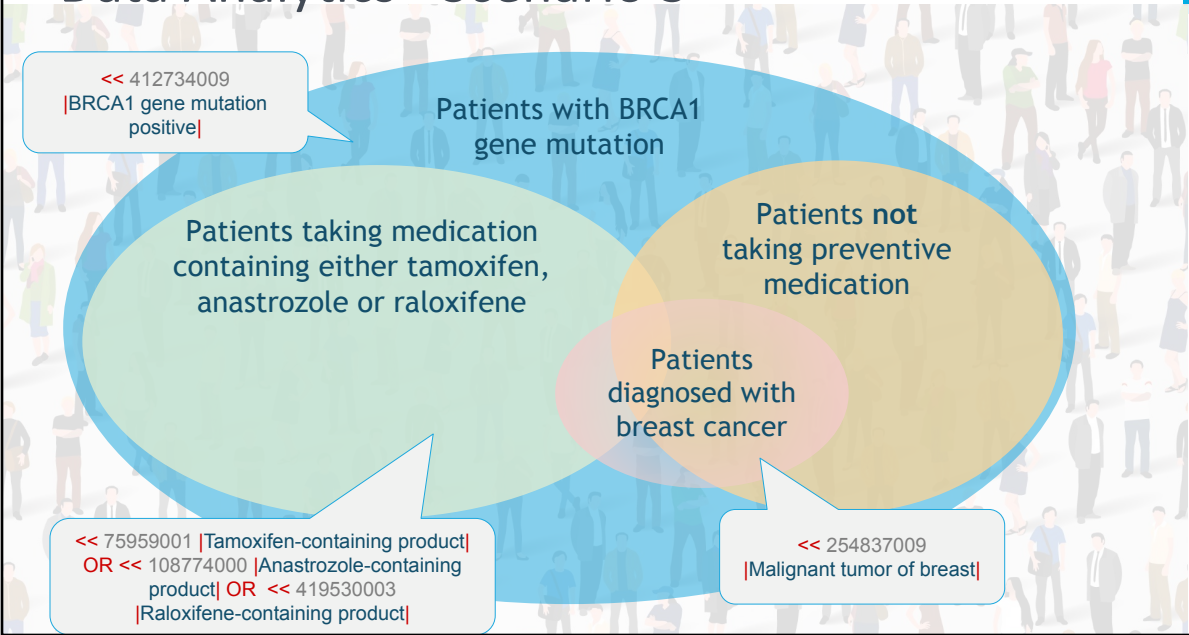
## SNOMED CT Queries



Expression constraint language

Query

# Data Analytics - Scenario 3



# Patient Data Analytics

<< 254837009 |Malignant tumor of breast|

Electronic data (E)

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

# Patient Data Analytics

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



Patient_Id	Diagnosis	Diagnosis term
001	145501000119108	Metastatic malignant neoplasm of breast
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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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# Patient Data Analytics

```
SELECT Patient_Id FROM EHR WHERE Diagnosis =
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Patient_Id	Diagnosis	Diagnosis term
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ECL Expansion
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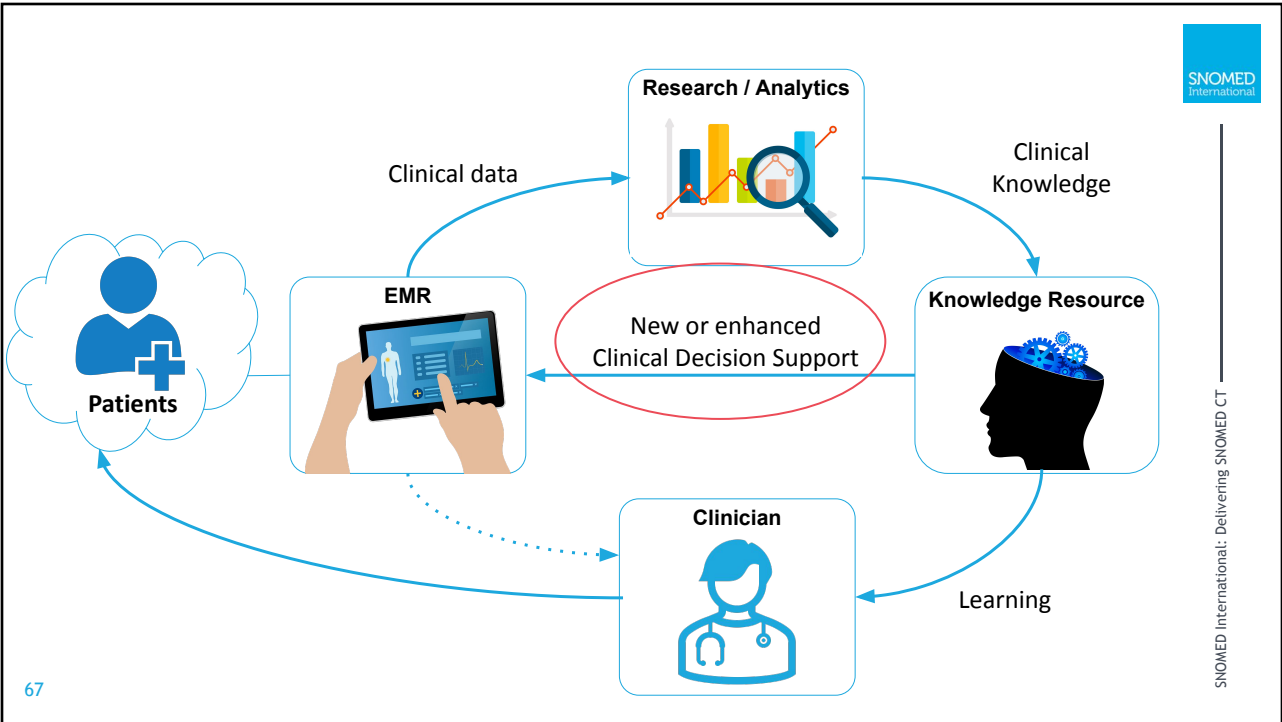
Electronic data (EHR)

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ECL Expansion
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403458008
373082000
373081007
254837009
254841008
188159008
188159008
...

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## SNOMED CT

Supports knowledge linkage and decision support

- Alerts and reminders** (Warning icon)
- Clinical Guidelines** (Document with question mark icon)
- Diagnostic Support Tools** (Compass icon)
- Smart forms** (Document with checkmark and plus icon)
- Conditional order sets and pathways** (Flowchart icon)

SNOMED CT

# SNOMED CT

Supports knowledge linkage and decision support

Alerts and reminders



Medical evidence shows that patients receiving |Mechanical ventilation| are at high risk for |Aspiration pneumonia|

Guidelines 4 recommend |Elevation of head of bed| from 30° to 45°, if not contraindicated, to reduce risk of |Pneumonia|.

# SNOMED CT

Supports knowledge linkage and decision support

Alerts and reminders



423171007 |Elevation of head of bed (procedure)|

Guidelines 4 recommend |Elevation of head of bed| from 30 to 45°, if not contraindicated, to reduce risk of |Pneumonia|.

Artificial respiration (procedure) ☆

SCTID: 40617009

40617009 | Artificial respiration (procedure) |

- en Artificial respiration (procedure)
- en Artificial respiration
- en Artificial ventilation
- en Mechanical ventilation
- en Mechanically assisted breathing
- en Mechanically assisted ventilation
- en Respiratory assist, mechanical
- en An assistance of respiration

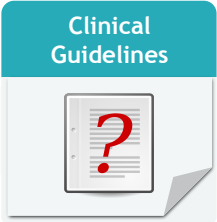
Procedure site - Direct → Structure of respiratory system

Children (16)

- Artificial respiration by electrophrenic stimulation (procedure)
- Bennett respirator therapy (procedure)
- Blivel artificial ventilation (regime/therapy)
- Bird respiratory therapy (procedure)
- > Control of end expiratory pressure (procedure)
- > Controlled ventilation (procedure)
- Cuirasse ventilation (procedure)
- Domiciliary ventilation (procedure)
- > Expired air ventilation (procedure)
- Inhalation anesthesia, machine system, semi-closed, no rebreathing of primary agent (procedure)
- > Jet ventilation procedure (procedure)
- > Mechanically assisted spontaneous ventilation (procedure)
- Minimum minute volume ventilation (regime/therapy)
- Nasal ventilation therapy (regime/therapy)
- > Respiratory assist, manual (procedure)
- Resuscitation with artificial respiration (procedure)



**SNOMED CT Semantic Metadata Tags:**  
 195967001 |Asthma (disorder)|  
 406162001 |Asthma management (regime/therapy)|  
 445531003 |Asthma control questionnaire (assessment scale)|

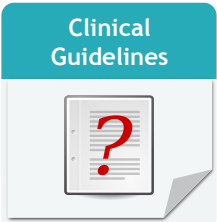


**STEPWISE APPROACH FOR MANAGING ASTHMA LONG TERM**  
 The stepwise approach tailors the selection of medication to the level of asthma severity (see page 5) or asthma control (see page 6). The stepwise approach is meant to help, not replace, the clinical decisionmaking needed to meet individual patient needs.

**ASSESS CONTROL:** **STEP UP IF NEEDED** (first, check medication adherence, inhaler technique, environmental control, and comorbidities) **STEP DOWN IF POSSIBLE** (and asthma is well controlled for at least 3 months)

	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6
At each step: Patient education, environmental control, and management of comorbidities						
	<b>Intermittent Asthma</b>	<b>Persistent Asthma: Daily Medication</b>				
Preferred Treatment <sup>1</sup>	SABA <sup>a</sup> as needed	low-dose ICS <sup>a</sup>	medium-dose ICS <sup>a</sup>	medium-dose ICS <sup>a</sup> + either LABA <sup>a</sup> or montelukast	high-dose ICS <sup>a</sup> + either LABA <sup>a</sup> or montelukast	high-dose ICS <sup>a</sup> + LABA <sup>a</sup> or montelukast + oral corticosteroids
Alternative Treatment <sup>1,2</sup>		cromolyn or montelukast				
If clear benefit is not observed in 4-6 weeks, and medication technique and adherence are satisfactory, consider adjusting therapy or alternate diagnoses.						
Quick-Relief Medication	<ul style="list-style-type: none"> <li>SABA<sup>a</sup> as needed for symptoms; intensity of treatment depends on severity of symptoms.</li> <li>With viral respiratory symptoms: SABA every 4-6 hours up to 24 hours (longer with physician consult). Consider short course of oral systemic corticosteroids if asthma exacerbation is severe or patient has history of severe exacerbations.</li> <li>Caution: Frequent use of SABA may indicate the need to step up treatment.</li> </ul>					

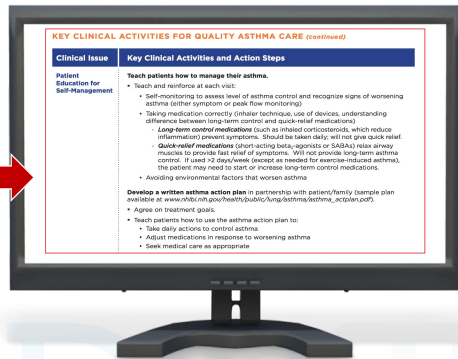
*\*Asthma Care Quick Reference, Asthma Management Guideline (US Department of Health and Human Services, National Institutes of Health, National Heart Lung and Blood Institute)*



**Patient Encounter:**

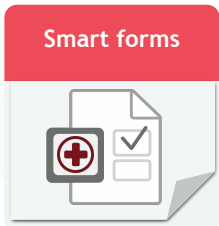
**Diagnosis:**

Chronic asthmatic bronchitis



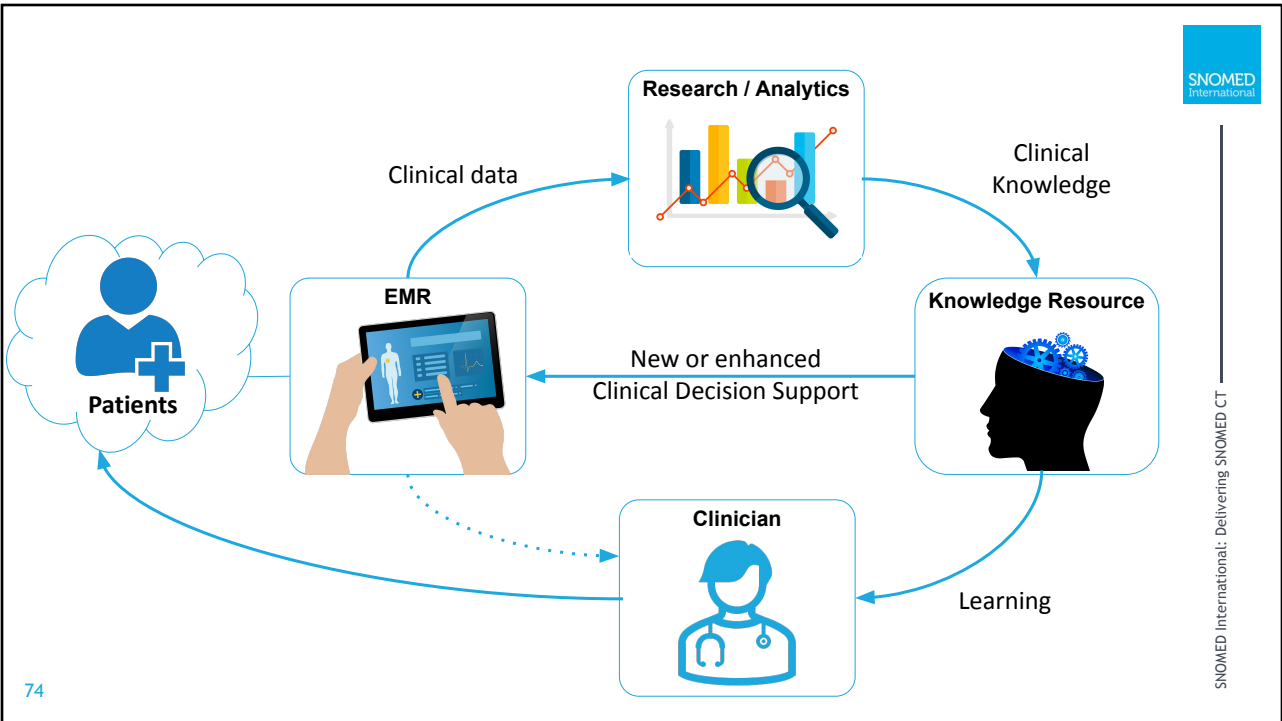
# SNOMED CT

## Supports knowledge linkage and decision support



A prepopulated 'smart form' may be provided when a patient is diagnosed with a communicable disease that is considered reportable.

SNOMED CT

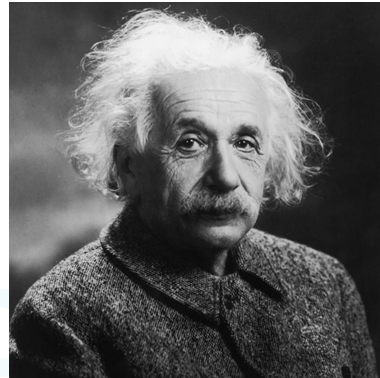


# SNOMED CT

## A foundation for clinical research

*"You Don't Have to Know Everything.  
You Just Have to Know Where to Find It."*

*Albert Einstein*



# Questions?





# THANK YOU

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

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