SNOMED CT Implementation Pathways

Expo 2018 Tutorial

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SNOMED International

Overview

Part 1

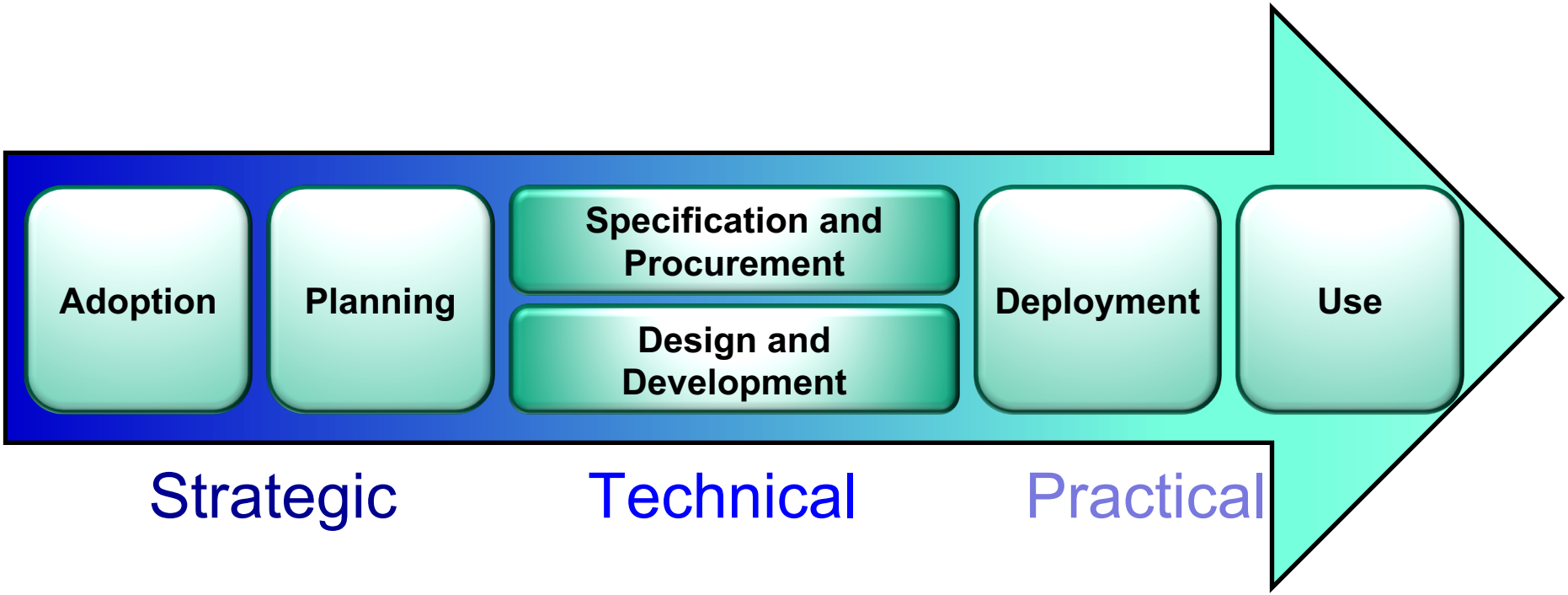
- Adoption and Planning
- Development or Procurement
- Specification and Procurement
- Design and Development
- Deployment & Use

Part 2

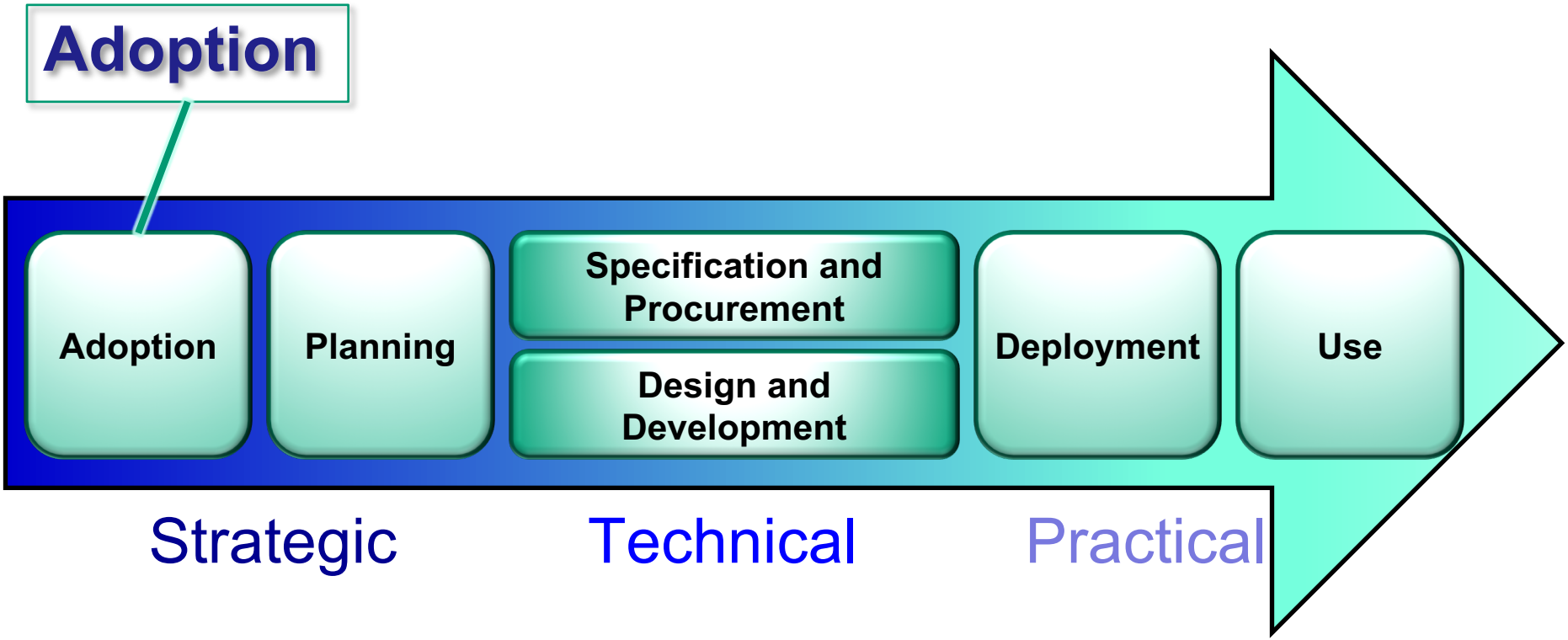
- Services that Enable Implementation
- Features that Deliver Benefits
- Recent and Imminent Enhancements
- Pathways to Implementation

Questions

SNOMED CT Implementation Stages



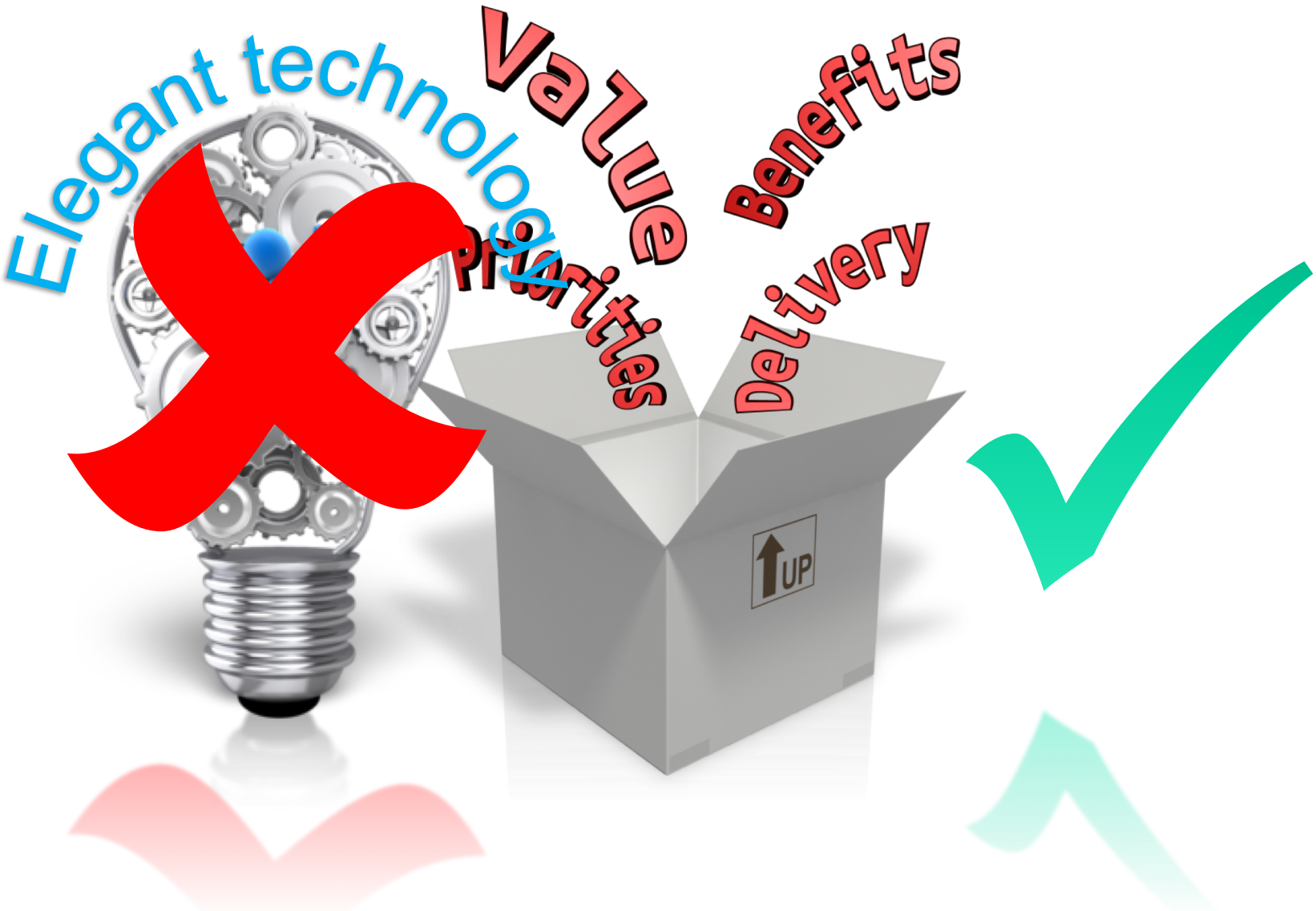
SNOMED CT Implementation Stages



Adoption Occurs at Many Levels

- National adoption
- Organizational adoption
- Adoption in standards
- Vendor adoption
- Project adoption

Adoption Depends on Delivering Value

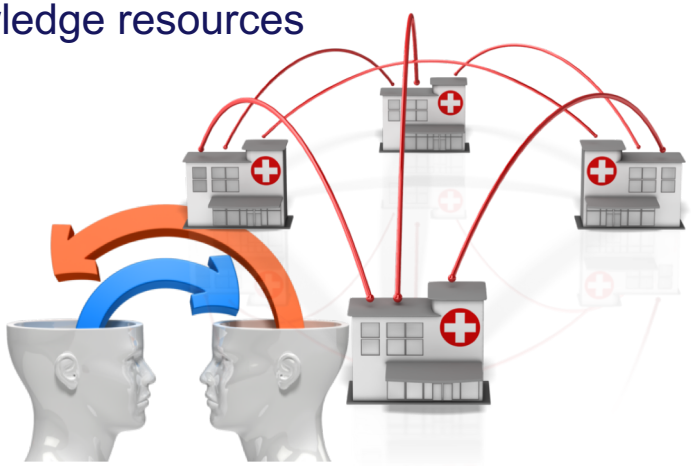


Benefits of SNOMED CT Implementations

A solid foundation for clinical records

Improved access to guidelines and decision support

Interoperable information and knowledge resources

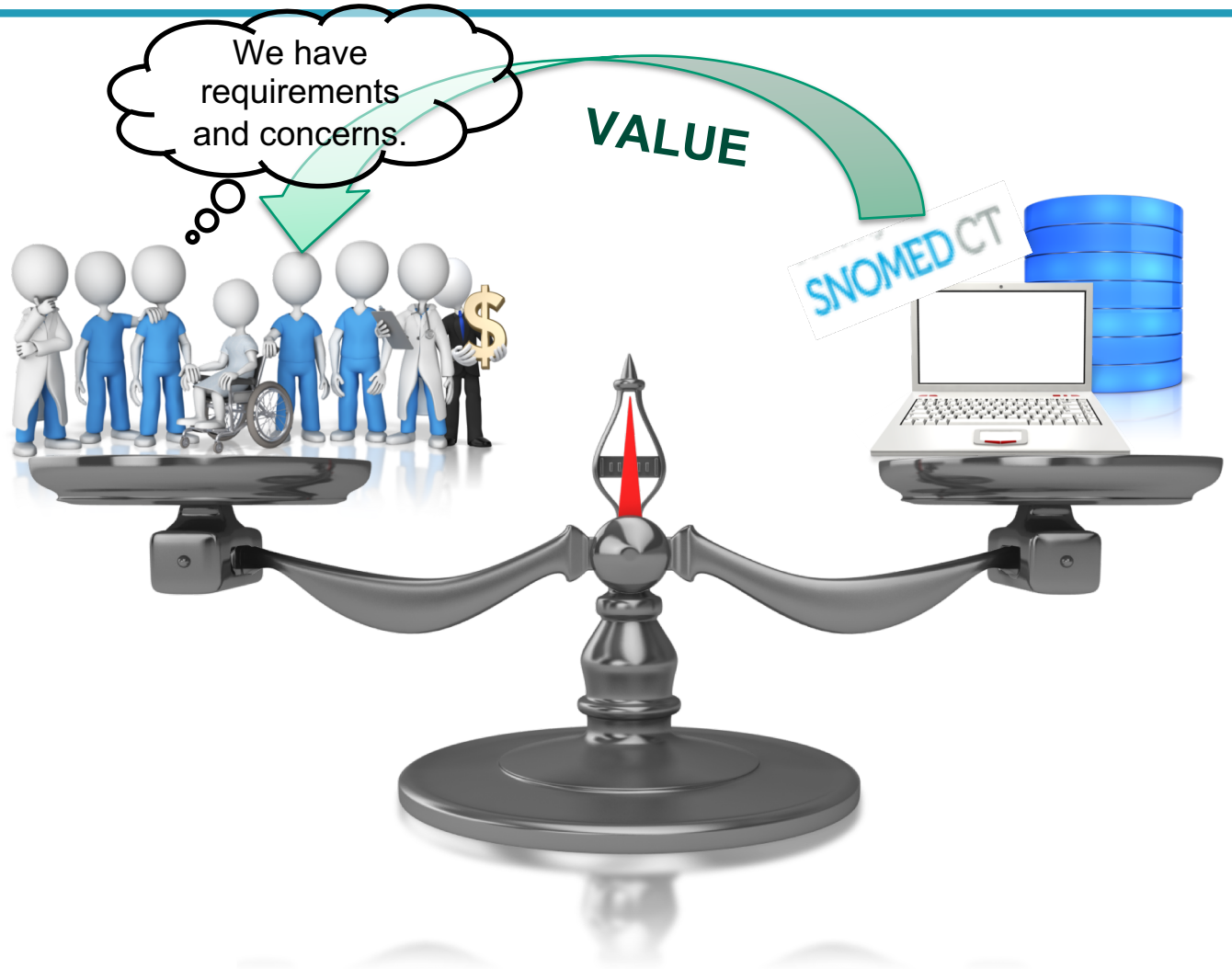


Improved Clinical and Business Intelligence

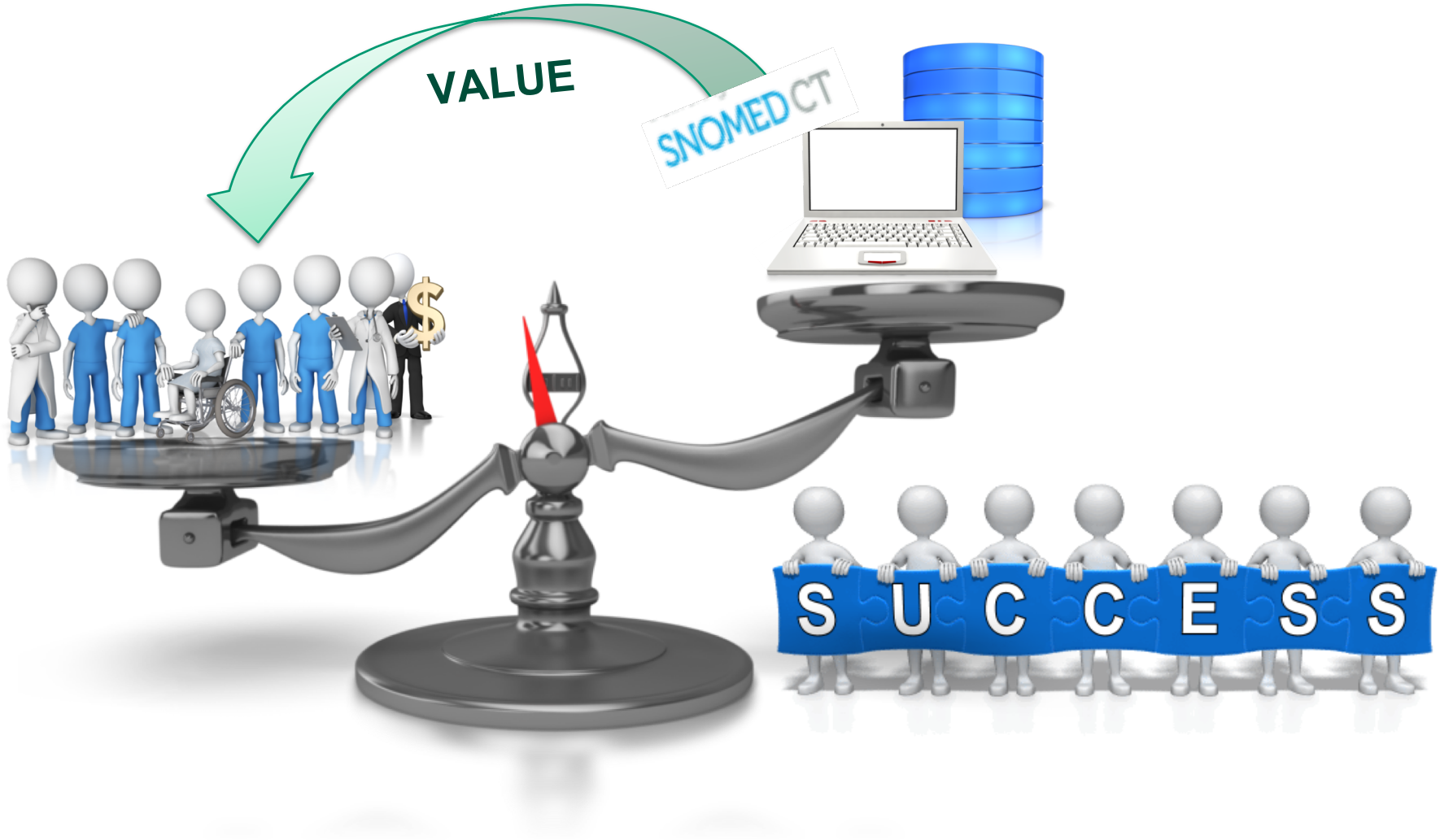
Building the Business Case for SNOMED CT

- Published in 2014
- Sets out the business case for SNOMED CT
  - Costs of adoption
  - Implementation stages
  - Qualitative and quantitative benefits of each stage
- Available for download from our website
  - https://www.snomed.org/
  - Direct link (PDF)
    - http://snomed.org/businesscase

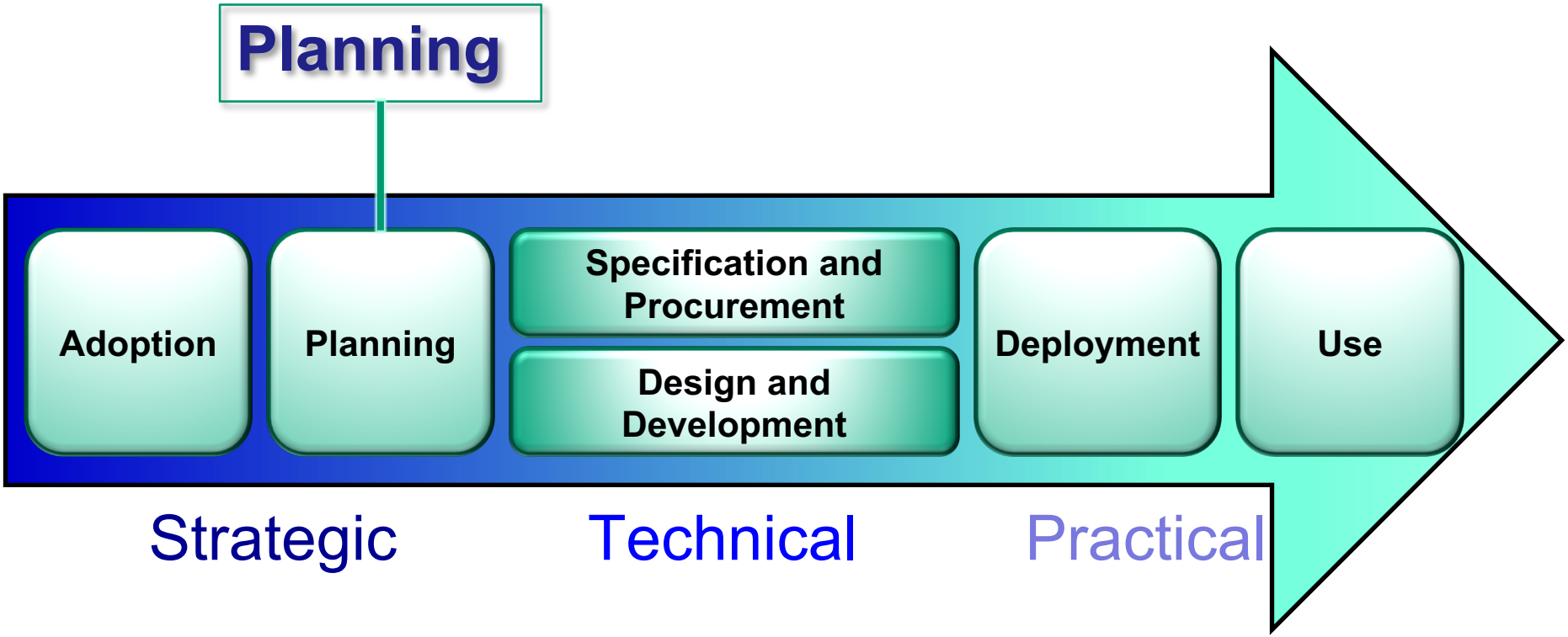
Approach to Successful SNOMED CT adoption



Approach to Successful SNOMED CT adoption



SNOMED CT Implementation Stages



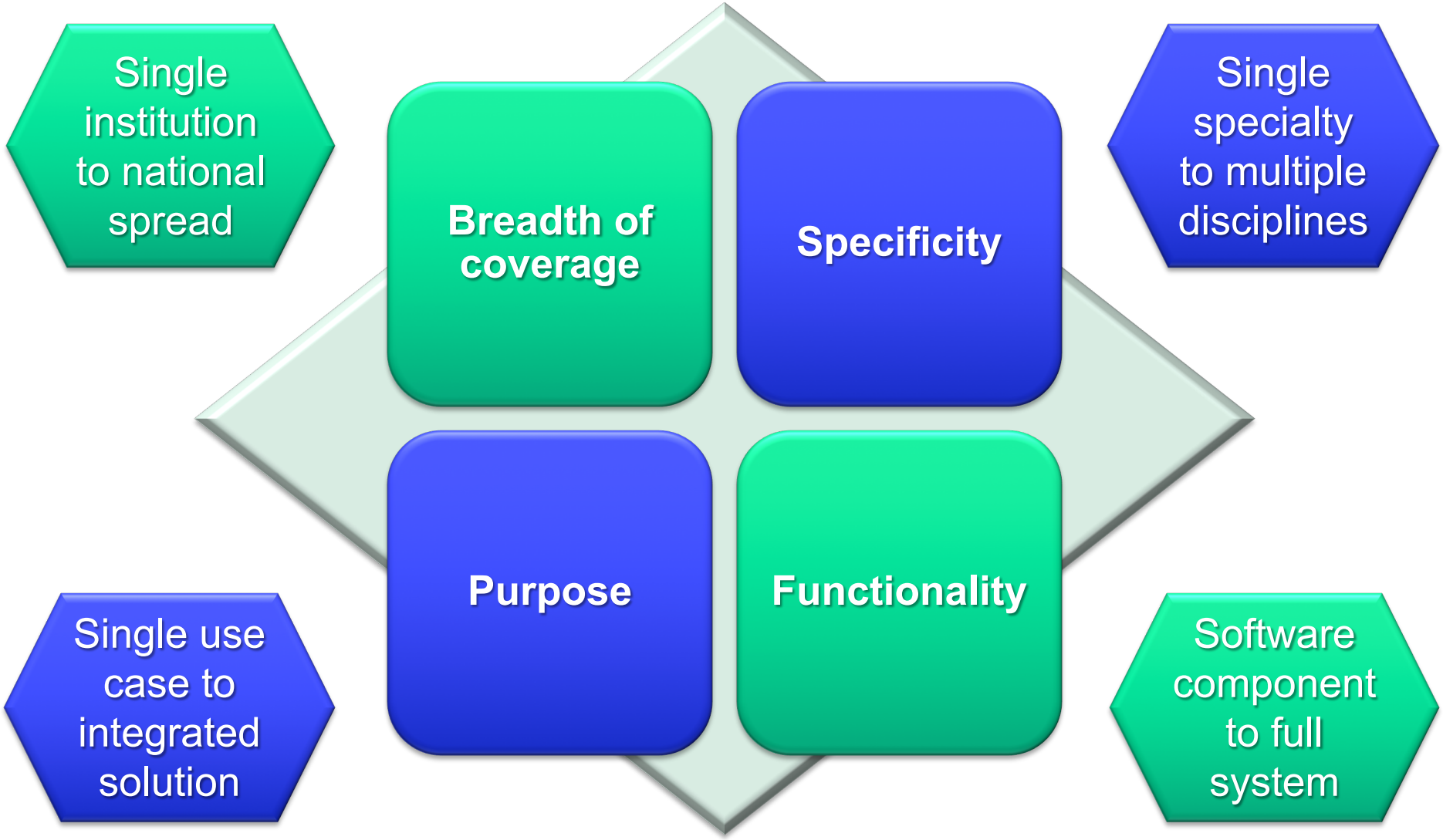
Planning

- Planning how SNOMED CT will be used
- Identifying
  - Existing systems to be modified
  - New systems required
- Determining whether to
  - Design and develop
  - Specify and procure
- Awareness of dependencies
- Setting realistic timescales

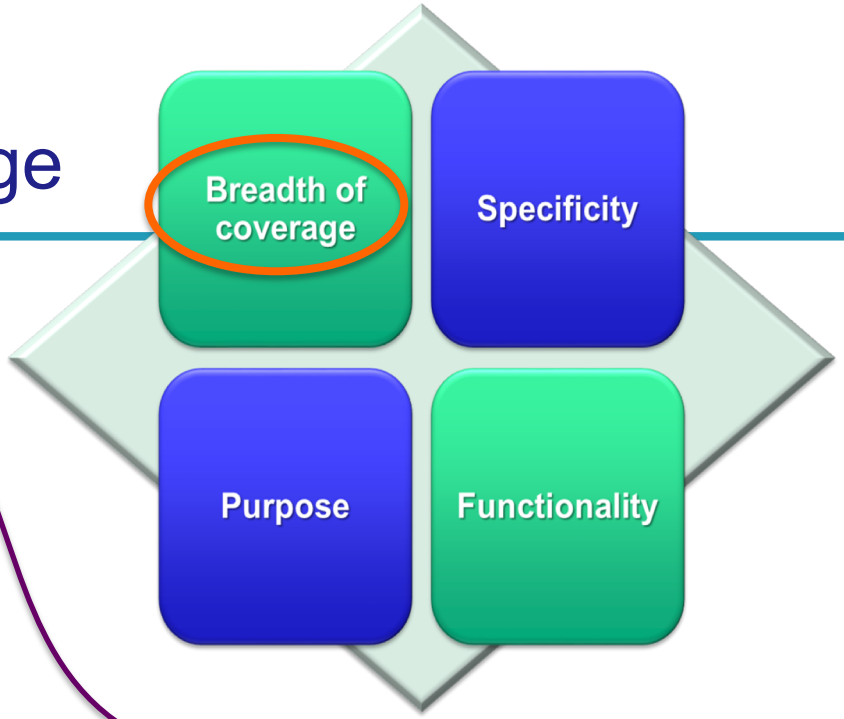
Understand Where Are You Starting From?

- A new system – a fresh start on a ‘greenfield site’
  - Addressing **new requirements** with SNOMED CT
  - Using SNOMED CT as part of a new development
- Replacing a relic of earlier development
  - Replacing a system **without loss of functionality or information**
  - Including SNOMED CT as part of the new solution
- An evolving system
  - Updates to a system **to support use of SNOMED CT**
  - Step by step progress to add SNOMED CT enabled functionality

Understand the Scope of Intended Implementation



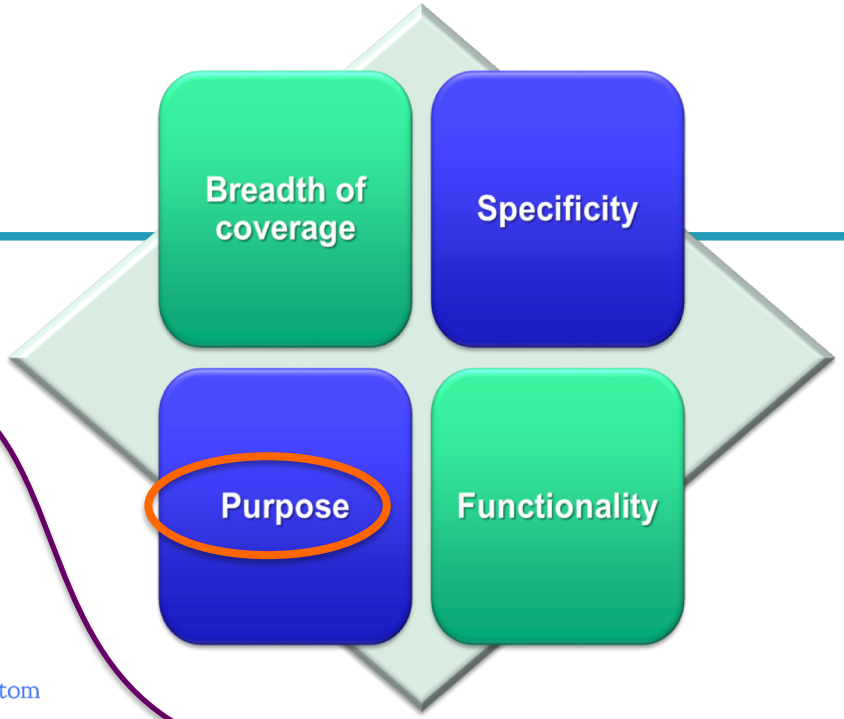
Scope:
Breadth of Coverage

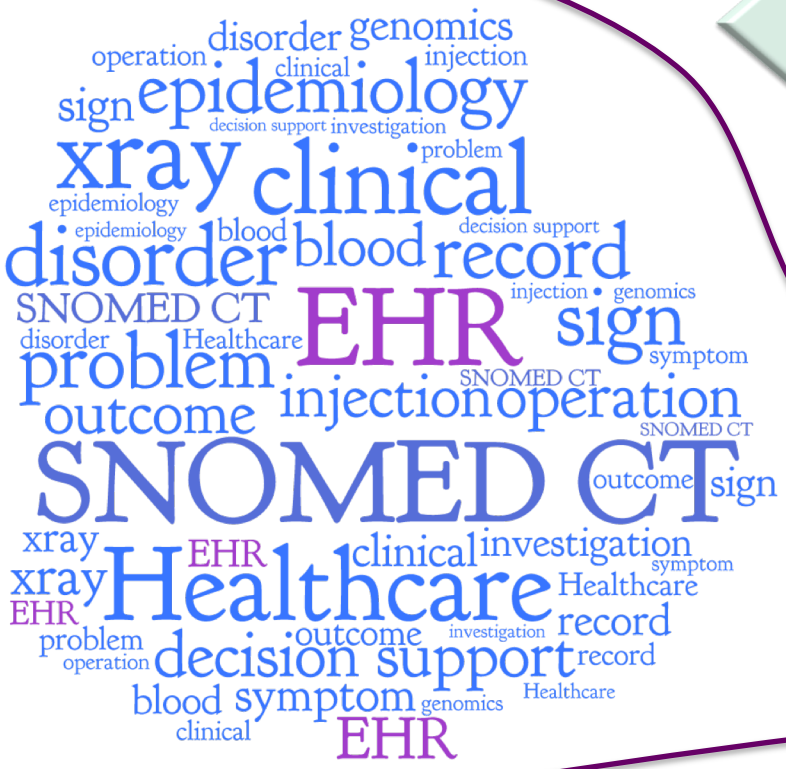


National

Single institution

Scope: Purpose

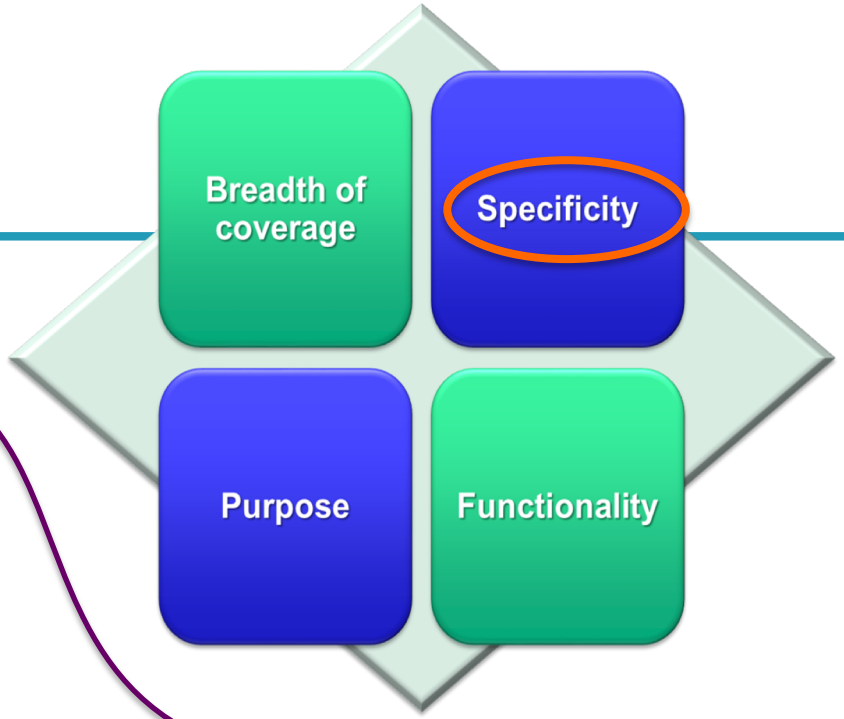




General EHR requirements

Single use case

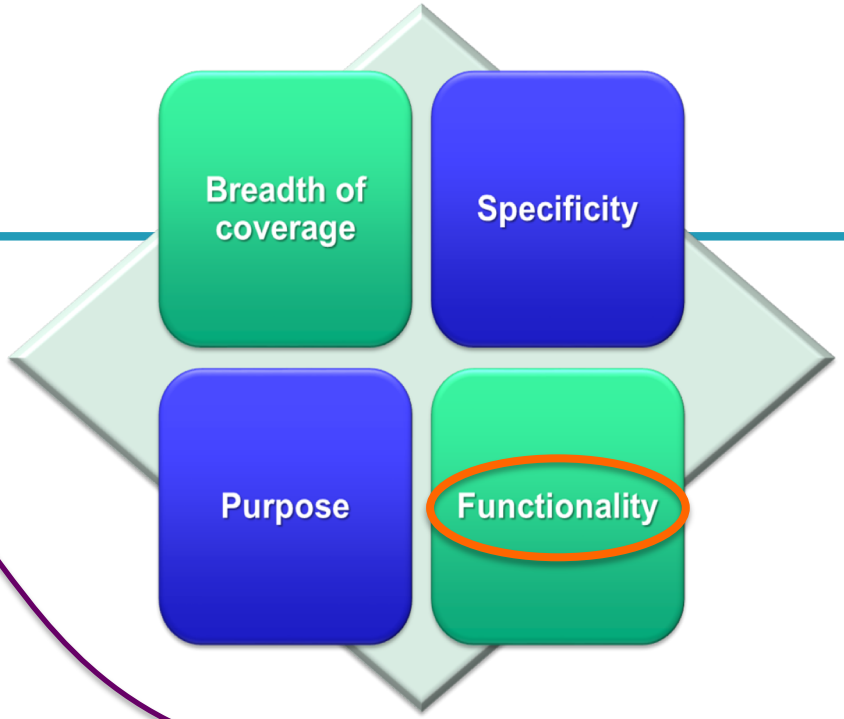
Scope: Specificity

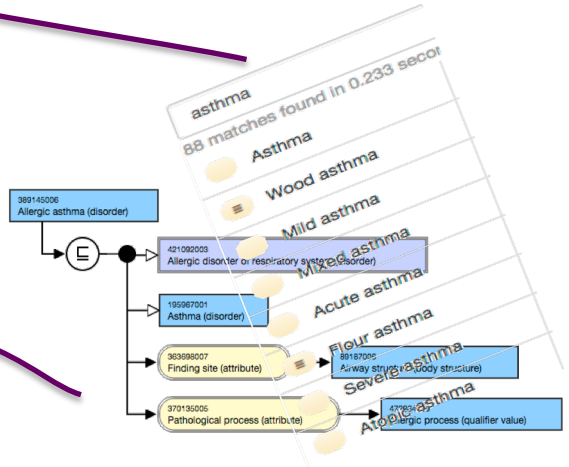


Multidisciplinary EHR

Specialty EHR

Scope: Functionality





Complete system

Software component

Plan to Make Implementation a Team Effort

Clinical Researcher

Health Professional

EHR Developer

EHR Purchaser

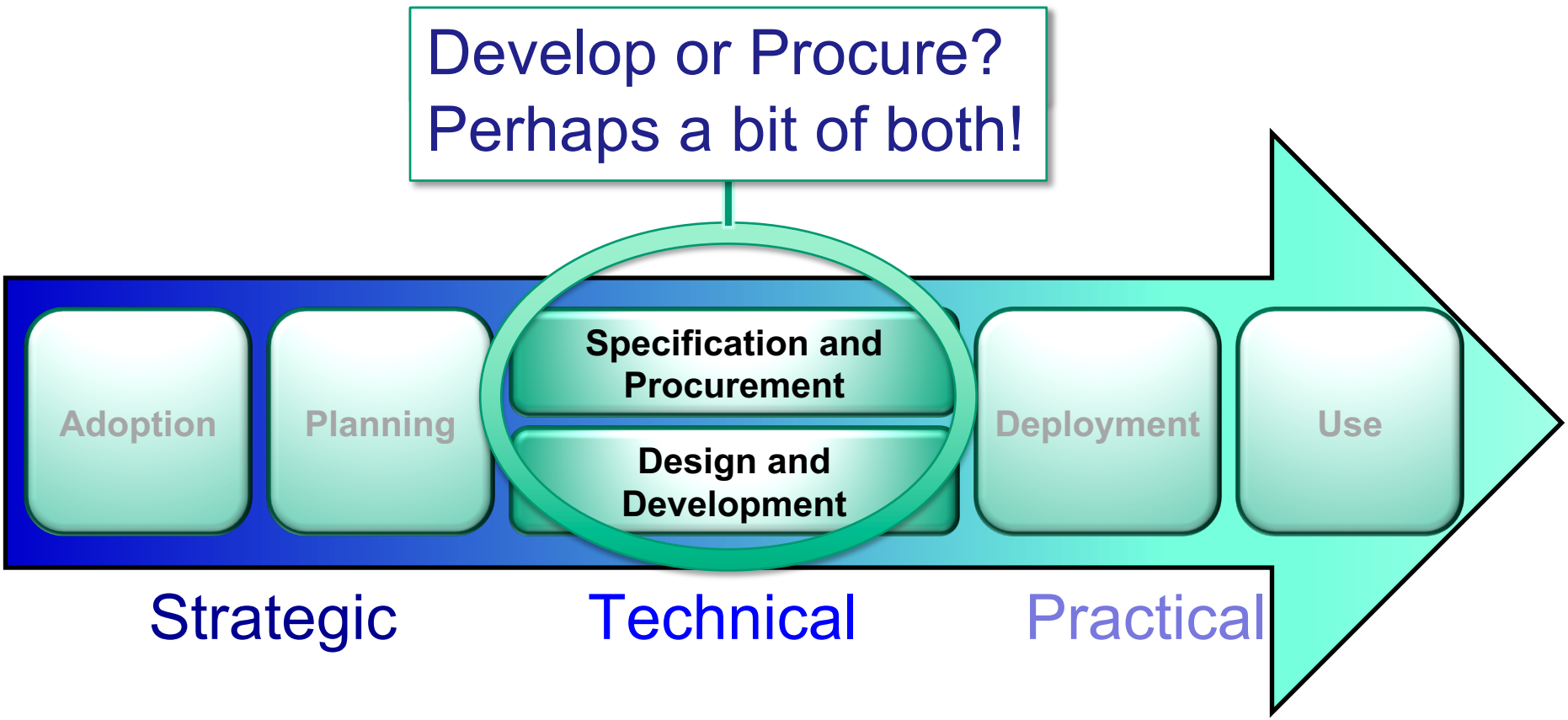
SNOMED CT Advisor

Knowledge Publisher

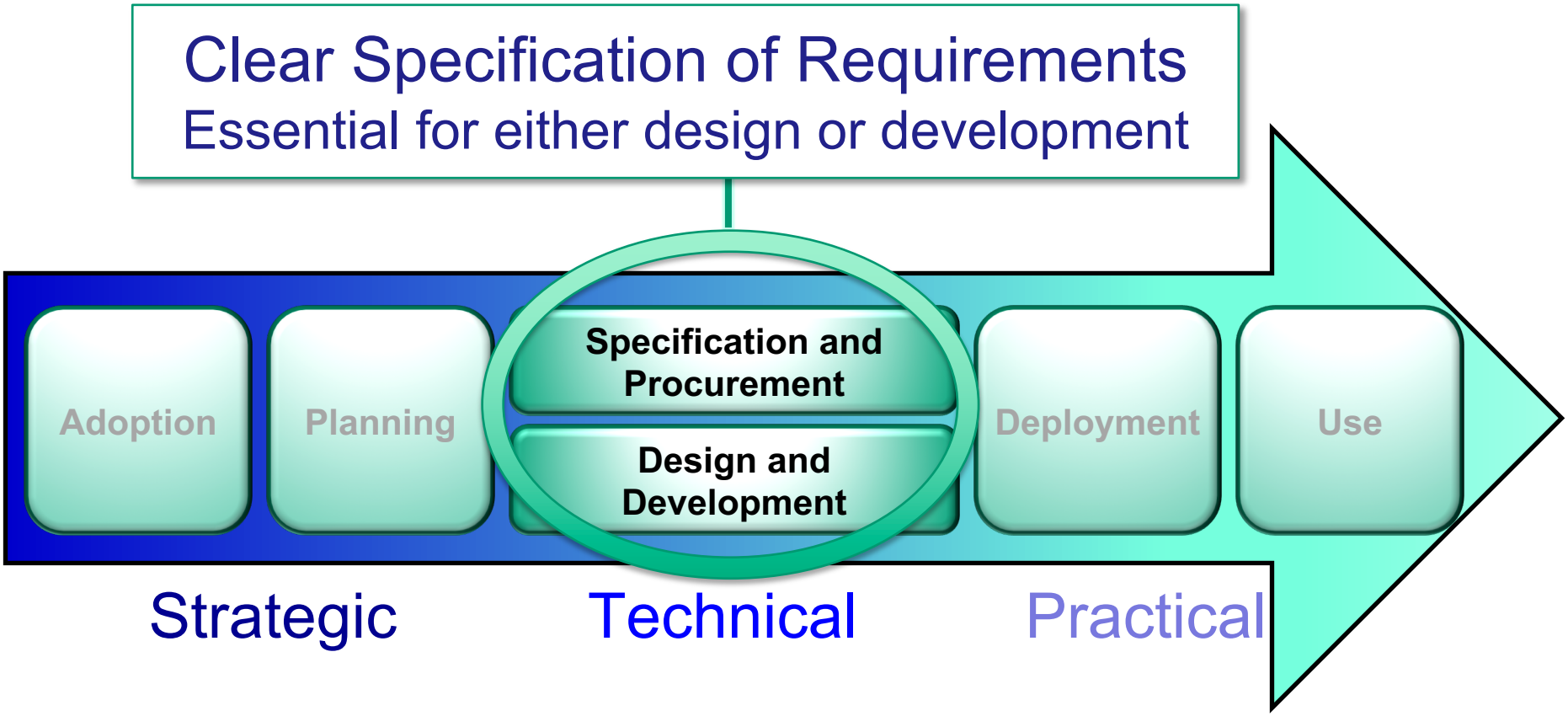
Health Service Manager

Guideline Developer

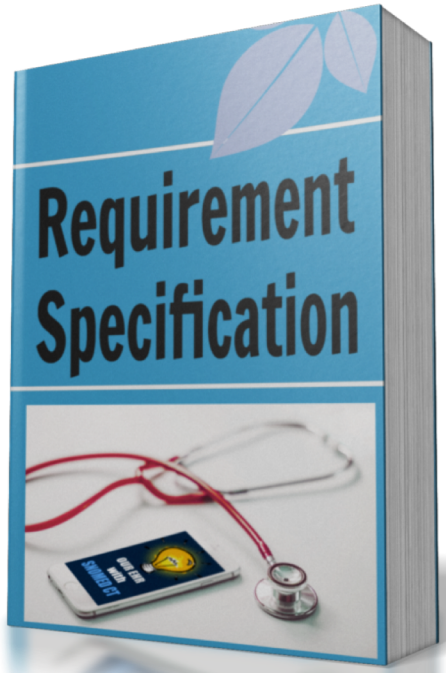
SNOMED CT Implementation Stages



SNOMED CT Implementation Stages



Different Routes to a Common Goal



Procurement

Existing System

Customized System

New System

Evaluate

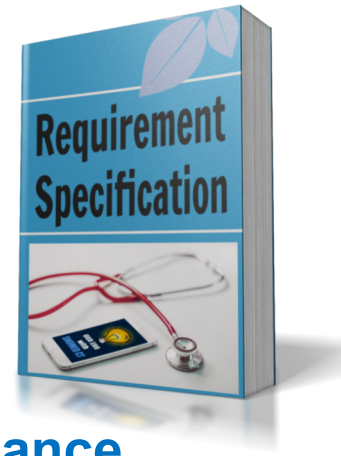
Design

Develop

Test

Solution Meeting Requirements

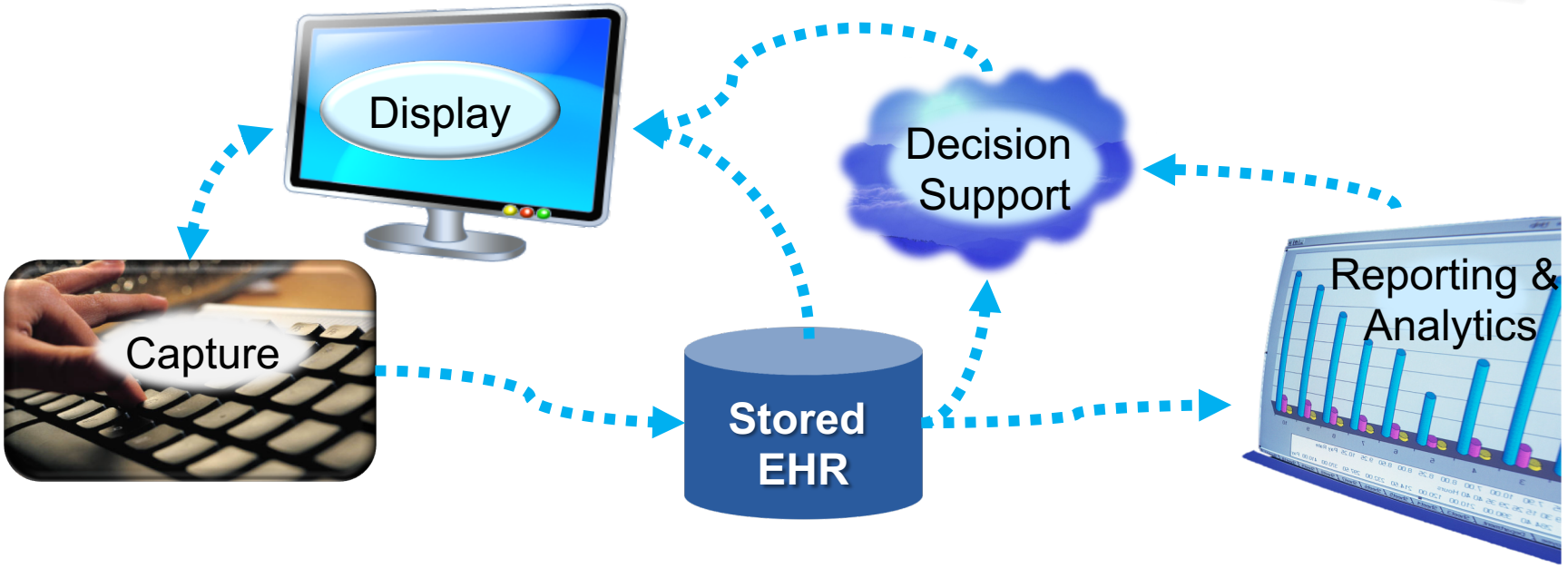
Clearly Document Requirements and Expectations



- Objectives
  - Identify the **benefits** that must be delivered
- Outcomes
  - Set **measurable indicators** for the required benefits
- Practical requirements
  - Specify how the system should work to **support or enhance current working practices**
  - Specify **critical clinical and business processes** that must be supported
  - Specify required performance, security and resilience characteristics
- Transition
  - Specify training and other requirements for smooth and safe transition from existing manual or computerized systems

SNOMED CT Specific Requirements

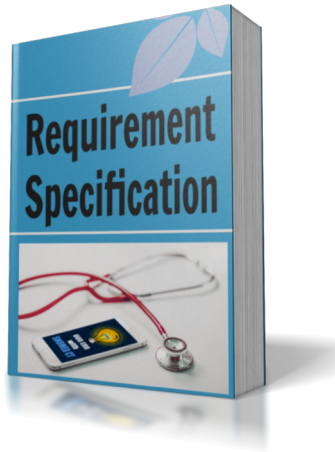
- SNOMED CT specific requirements
  - **May vary depending on overall objectives**
  - Must be considered as part of the **overall solution**
  - Consider **all stages** of the clinical information life cycle



Guidance on SNOMED CT Requirements

- Refer to the SNOMED CT Document Library for advice on **effective ways** to use the terminology
- http://snomed.org/doc
  - Search and Data Entry Guide
  - Practical Guide to References Sets
  - Data Analytics with SNOMED CT
  - Decision Support with SNOMED CT
  - SNOMED CT Release File Specification

  … and a range of other specifications and guides



Overviews	Guides	Specifications	SNOMED CT Expo	Glossary
				

Team Involvement in Requirement Specification

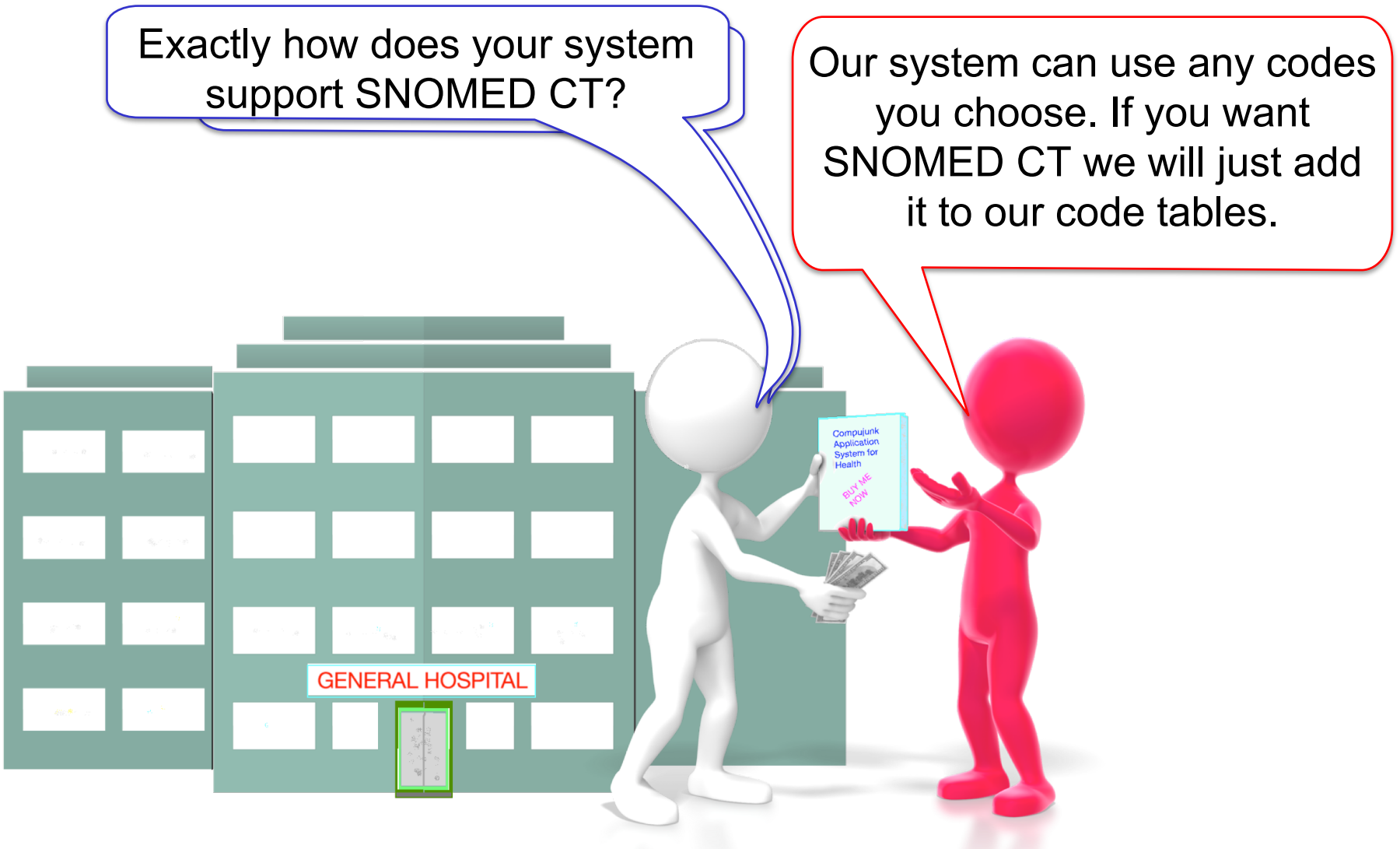
- Clinical input to user interface design and motivation
  - Compatible with clinical practice
  - Identify benefits that will encourage use
- System architects and software designers
  - Robust system design delivering necessary performance
  - Support for SNOMED CT logical design
- Guidelines and decision support developers
  - Support use of SNOMED CT for knowledge linkage
- Management
  - Alignment with key reporting and audit requirements
- Epidemiology and Clinical Research
  - Identify key features for epidemiology and clinical research

Pitfalls When Specifying Requirements

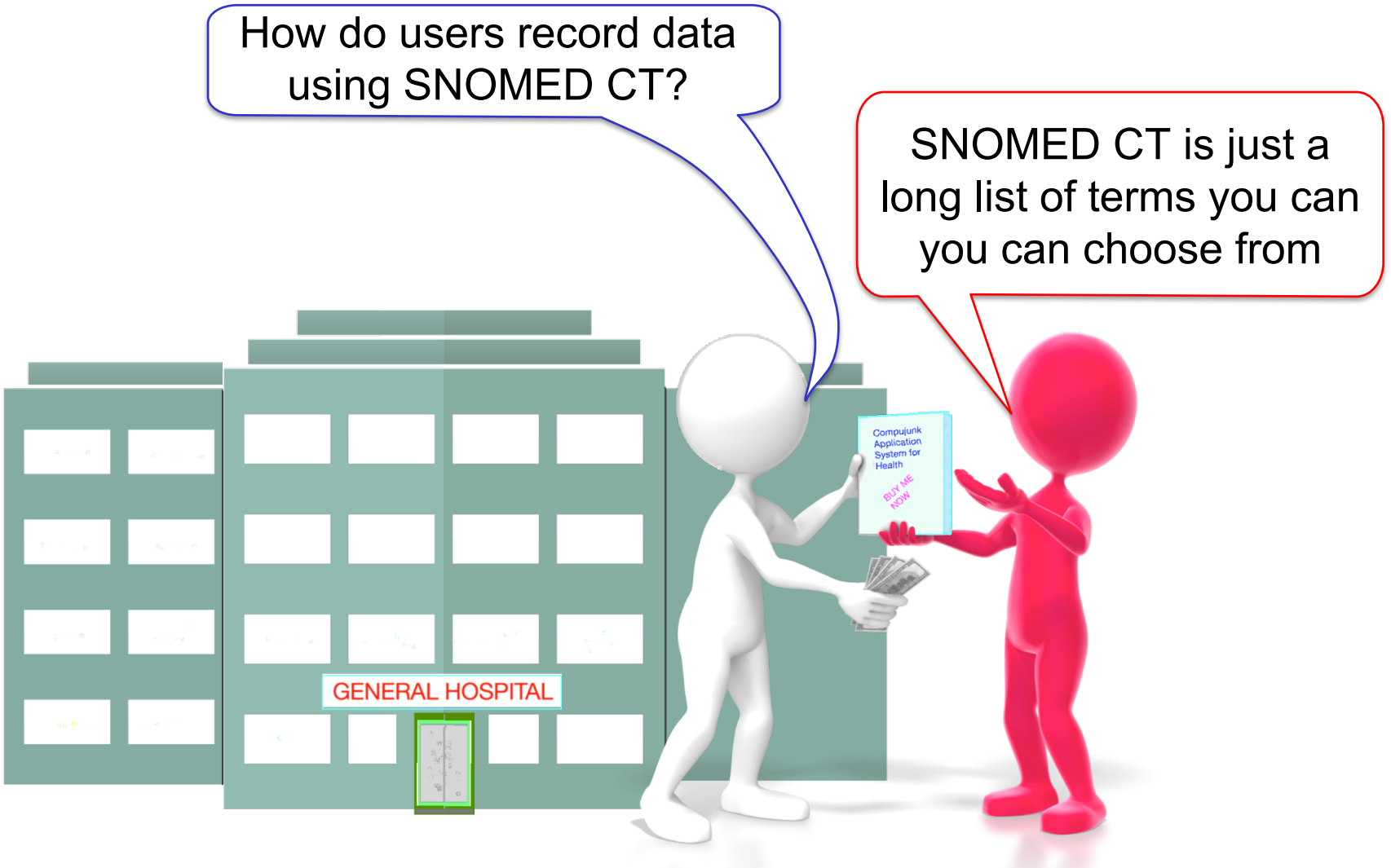
- It is not enough to say ‘Implement SNOMED CT’
  - Some of those responding to a procurement may interpret SNOMED CT implementation in a limited way
- SNOMED CT implementation is not all or nothing
  - There are different approaches to SNOMED CT implementation
- Benefits depend the approach
  - Choose an approach that meets your immediate requirements
    … but consider the impact on next steps …
  - A short-term solution may delay enhancements that meet future requirements and deliver additional benefits

Warnings and Hopeful Signs in a Procurement

Warning Signs During Procurement



Warning Signs During Procurement



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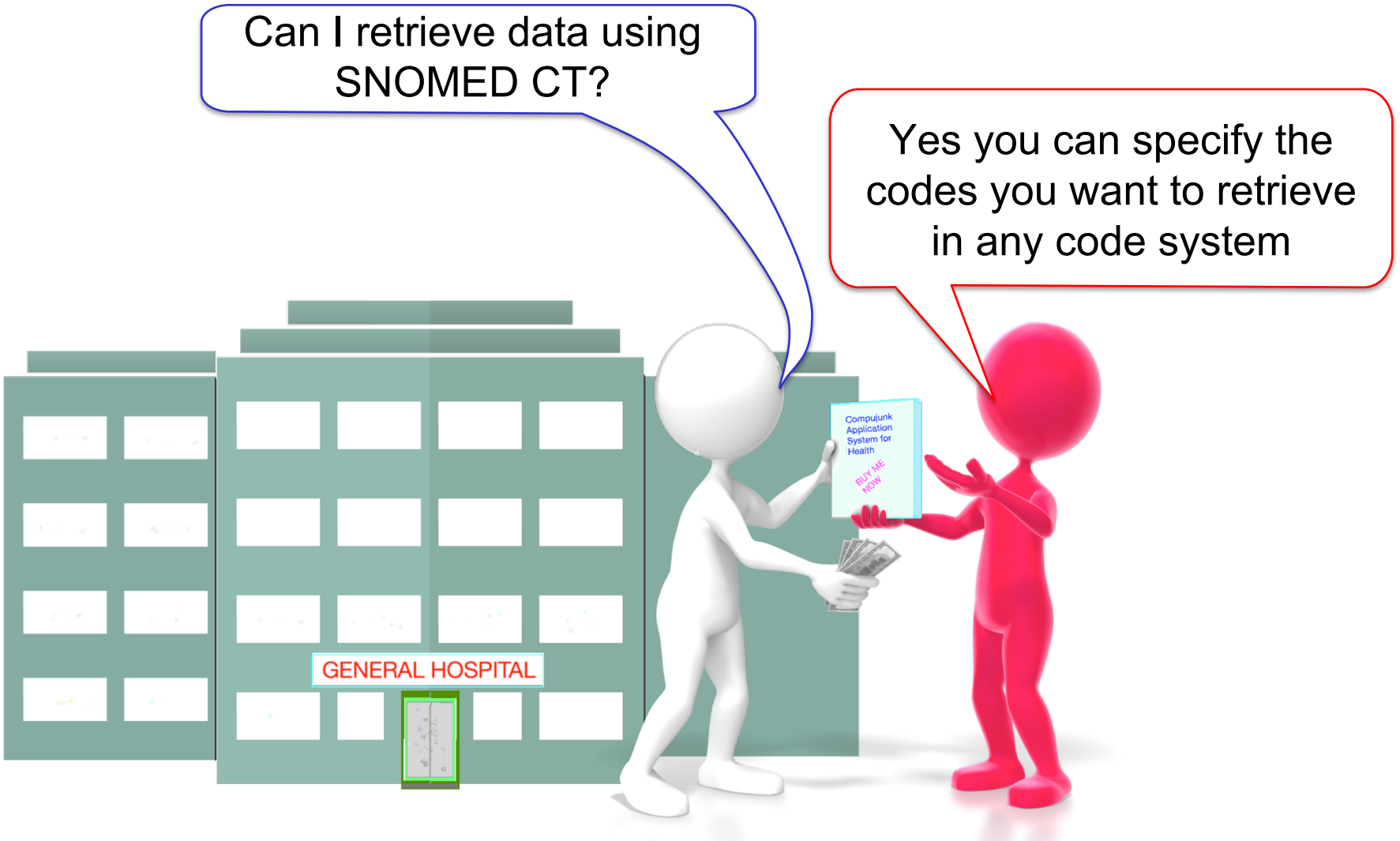
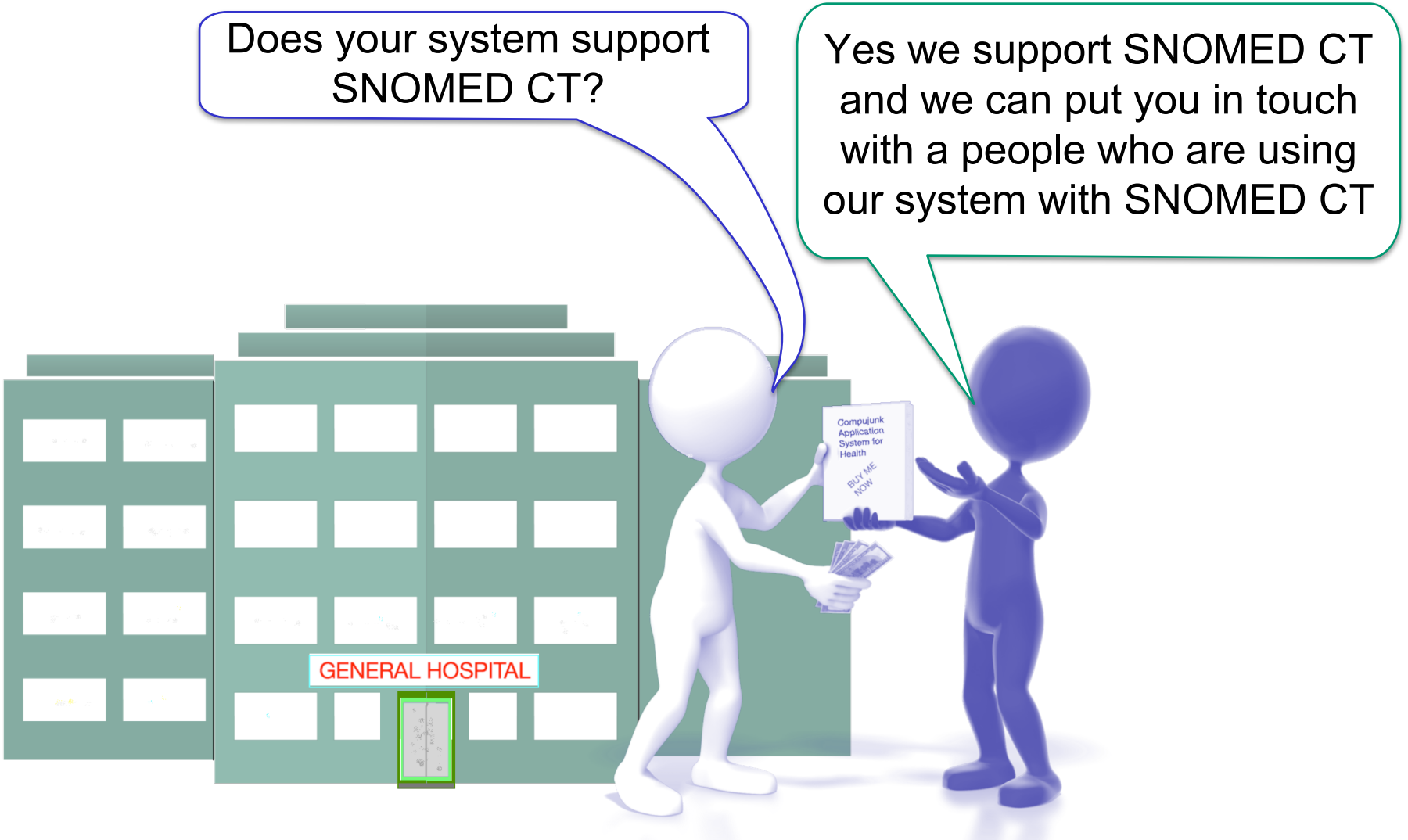
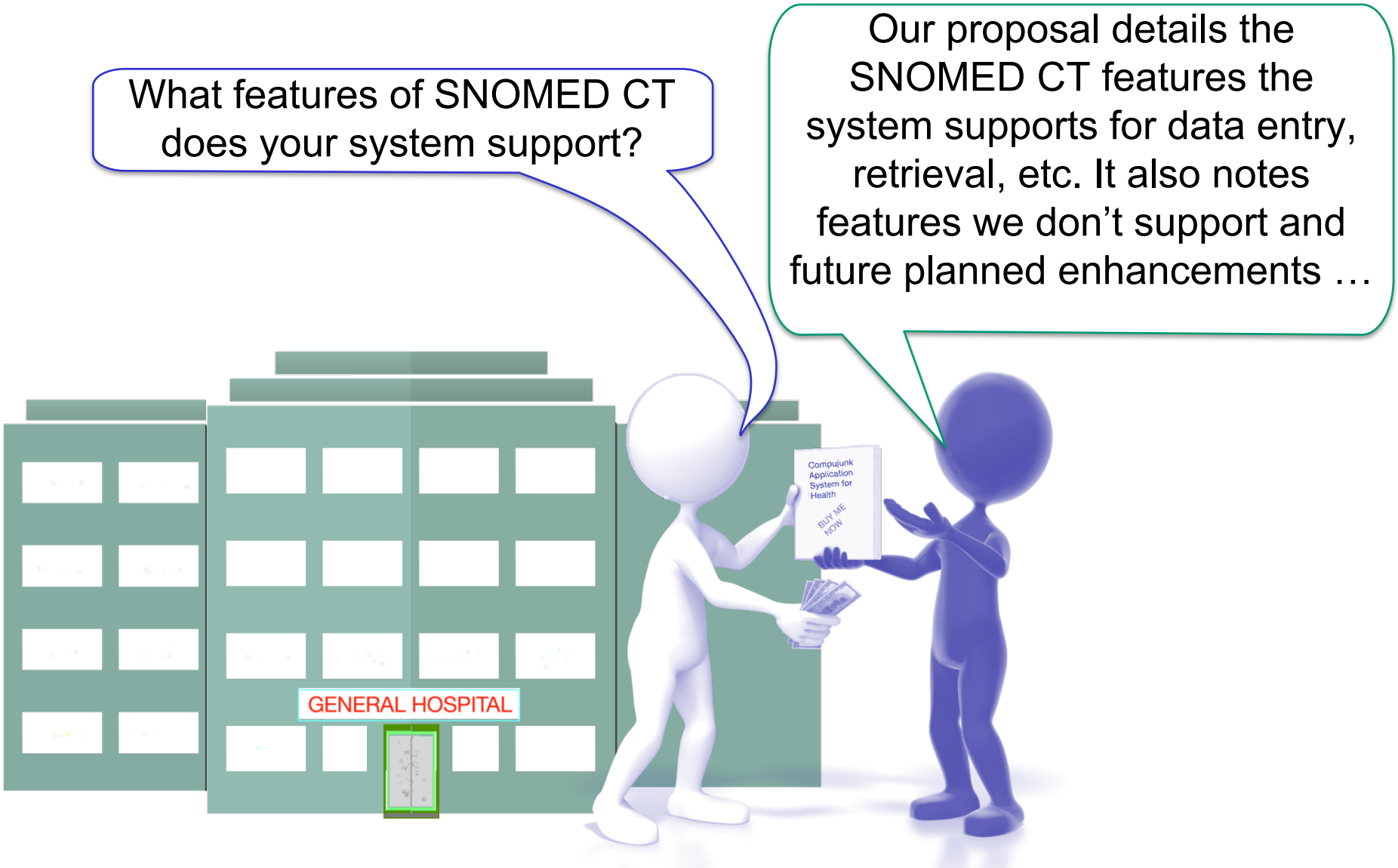


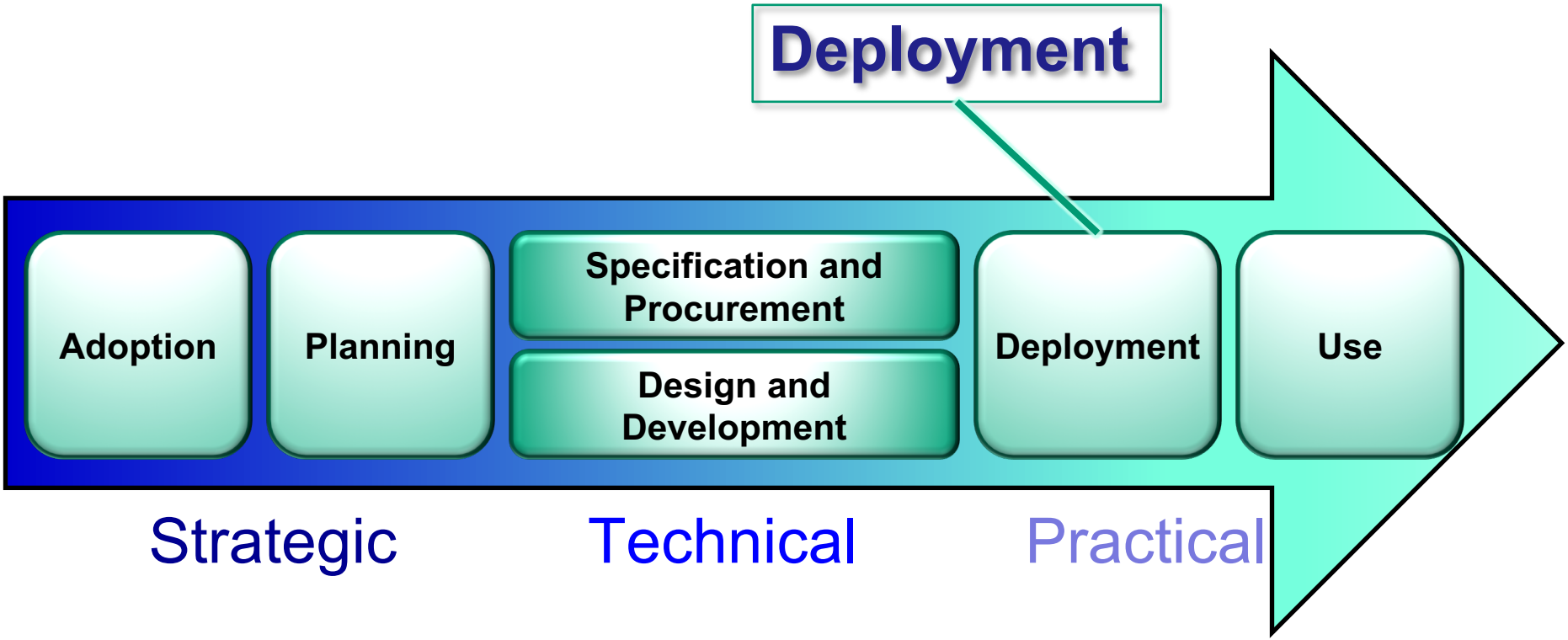
Positive Signs During Procurement



Positive Signs During Procurement



SNOMED CT Implementation Stages



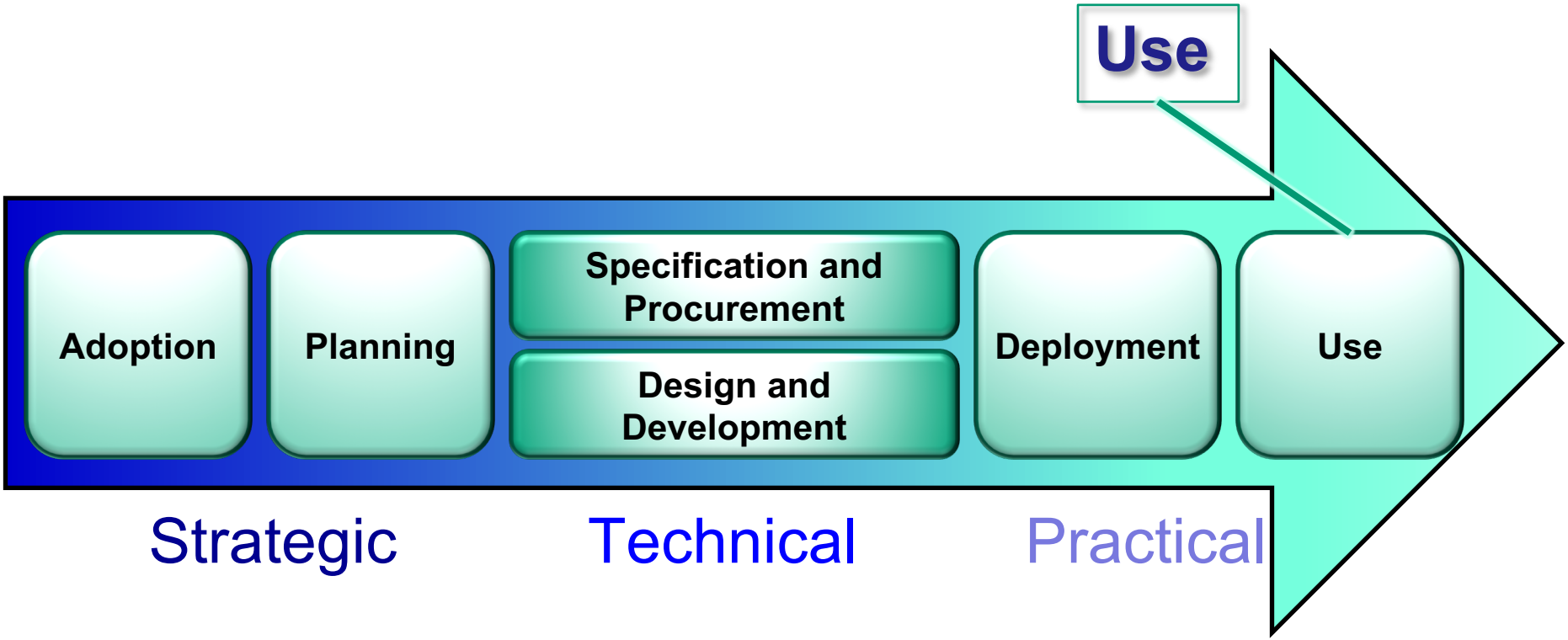
Deployment and use of SNOMED CT Enabled Systems

- Delivery
  - Installation
  - Resolution of dependencies and integration of systems
- Configuration for specific uses and specialties
  - User interface configuration
  - Report and query configuration
- User training including
  - Clinical users
  - Reporting and analytics
- Maintenance
  - SNOMED CT version updates

Deployment Needs Informed Users

- Inform all users about benefits
  - Focus on key features and benefits of meaning-based retrieval
- Involve clinical users in configuration decisions
  - Adapt data capture and display to fit working practices in different departments
    - For example - ensuring searches and pick lists are relevant
- Inform data analysts about SNOMED CT semantics
  - SNOMED CT provides benefits for analytics
    - Full benefit realization requires awareness of the logical semantic definitions provided by SNOMED CT
  - Engage analysts in configuring reports that use these features to meet requirements

SNOMED CT Implementation Stages



Effective Use Needs Motivated Users

- Involve ‘clinical champions’ who understand
  - The requirements that drive day to day use of an EHR
  - The way the EHR system meets those requirements
  - The contribution of SNOMED CT to delivery of benefits
- Provide users with practical benefits
  - Motivate consistent use by providing useful and interesting information derived from their use of the system
- Respond to user input
  - Address issues and emerging requirements

Overview – Part 2

Part 1

- Adoption and Planning
- Development or Procurement
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- Design and Development
- Deployment & Use

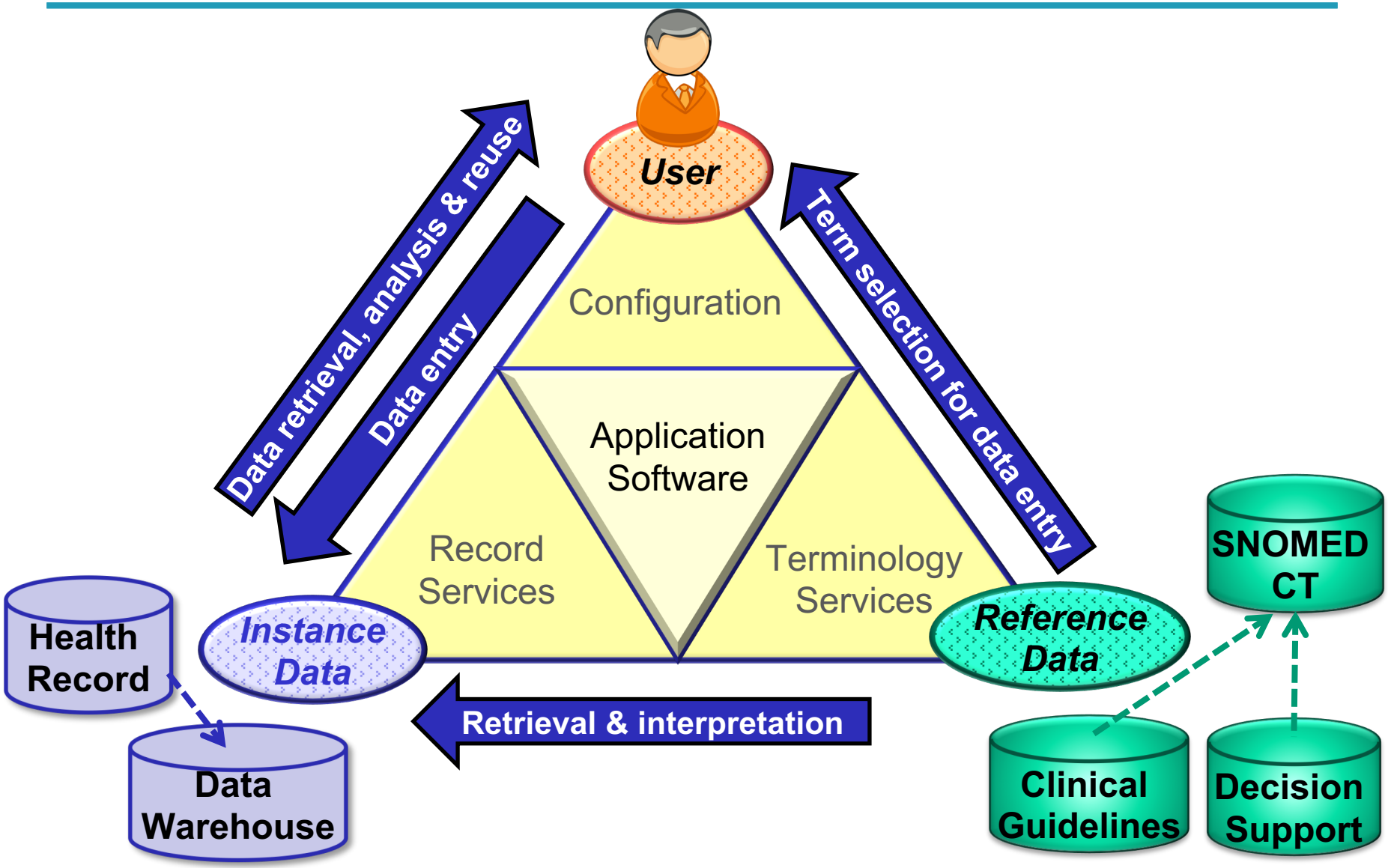
Part 2

- Services that Enable Implementation
- Features that Deliver Benefits
- Approaches to Implementation
- Recent and Imminent Enhancements

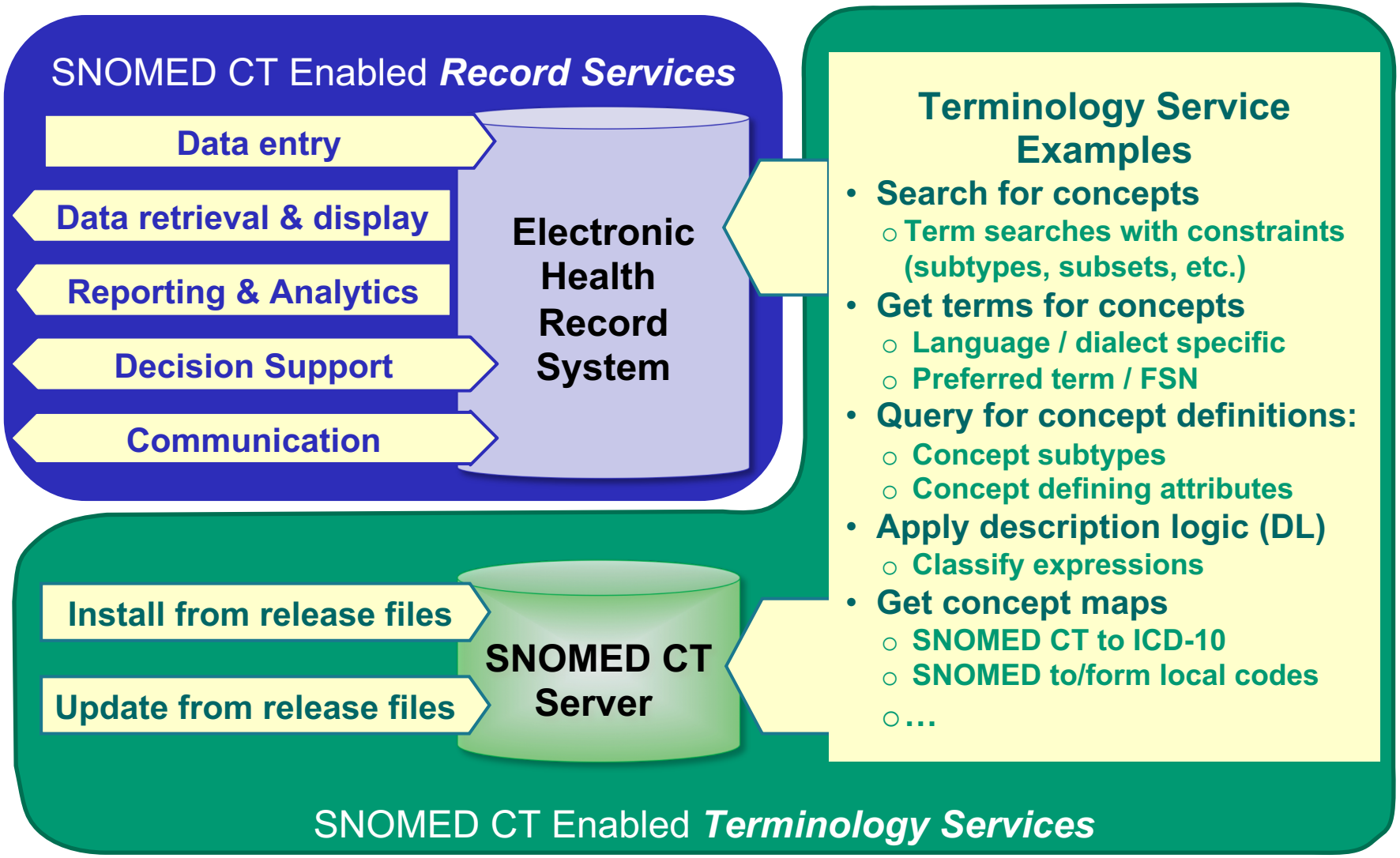
Questions

Services that Enable SNOMED CT Implementation

Users, Software, Services and SNOMED CT



SNOMED CT Enabled EHR Services



SNOMED CT Enabled Services

Software services that support effective use of SNOMED CT as part of health record systems

- Record services
  - Services that directly manage patient health records
  - Data entry, display, retrieval, communication and record sharing
- Terminology services
  - Services manage and provides access to terminology resources
  - Installing, searching, navigating and using the terminology
- Knowledge resource services
  - Clinical guidelines
  - Decision support
- Analytics services
  - Data warehousing
  - Reporting and auditing

Terminology Service Options for Developers

- Developers and suppliers of SNOMED CT solutions can choose between different development options
- For example EHR application developer may
  - Develop and manage their own tools to provide all the required terminology services
  - Integrate an in house EHR development with third party solutions that meet some of their terminology service requirements
  - Leverage open source tools from SNOMED International as a basis for their own development of terminology services

Terminology Service Options for Procurement

- Those procuring a SNOMED CT enabled service may also consider different ways in which their applications may access terminology services
- Options to consider may include
  - Use of one or more applications that include their own integrated terminology service
  - Use of applications that are able to access a common terminology service configured to meet their requirements
  - Leverage of open source tools from SNOMED International as a basis for their own terminology service development

Terminology Service Recommendations

- Ensure terminology services support key features of SNOMED CT that enable delivery of EHR benefits
- Avoid common pitfalls
  - Thinking of SNOMED CT as just a code system replacement
  - Simplistic searches that return long unstructured lists of matches
  - Failing to update to the latest SNOMED CT release
- Review SNOMED International learning resources
  - Detailed guidance in the SNOMED CT Document Library (http://snomed.org/doc)
  - On line training including: SNOMED CT for Developers and the SNOMED CT Implementation Course (https://courses.ihtsdotools.org)
  - Take a look at SNOMED International open source tools (https://www.snomed.org/snomed-ct/software-tools)

SNOMED CT Features that Deliver EHR Benefits

Four Features that Deliver EHR Benefits

Formal concept definitions

- Subtype hierarchy
- Attribute relationships
- Concept model
- Description logic

Multilingual support

- Language reference sets indicate acceptability of terms in a language or dialect
- Additional terms can be linked to a concept by adding descriptions

Reference sets

- Subsets
- Ordered lists and prioritization
- Maps
- Flexible configuration

Computable languages

- Expression constraint language
- SNOMED CT template language

SNOMED CT Features

Formal Concept Definitions – EHR Benefits

Subtype hierarchy

- Allows searches to be limited to concepts of specific type
- Enables retrieval and analysis of all records containing subtypes of a specified concept

Attribute relationships

- Enable retrieval and analysis of concepts with specific attribute values (e.g. procedures with a specific procedure site)

Concept model

- Documents the permitted attribute relationships to define concepts in particular domains
- Specifies refinements that can be applied to add specificity to the meaning of a concept or expression in record

Description logic

- Infers additional relationships from subtype and attribute relationships stated by authors
- Allows postcoordinated expressions to be tested and where appropriate included in reporting and analysis

SNOMED CT Features

Multilingual Support – EHR Benefits

Language reference sets indicate acceptability of terms in a language or dialect

- Enables localization of existing descriptions to align with national or regional acceptability and preferences for particular terms
- Supports extended multilingual use of when accompanied by sets of descriptions in one or more languages

Additional terms can be linked to existing concepts by adding descriptions

- Enables extension of the multilingual scope of SNOMED when accompanied by one or more language reference sets that specify the acceptability of the added descriptions

SNOMED CT Features

Reference Sets – EHR Benefits

Subsets

- Allow searches to be limited members of a particular subset of descriptions of concepts
- Enable retrieval and analysis of all records containing members of subset of concepts

Ordered lists & prioritization

- Supports ordering of pick lists of terms in a user interface control
- Supports ordering or highlighting of terms in a search to take account of those most likely to be used in a particular context

Maps

- Enable representation of maps between local code systems and SNOMED CT
- Map be used to support communication, retrieval and analysis of EHR data encoded using other code systems

Flexible configuration

- Reference sets can be used to flag or annotate concepts to support various requirements
- Reference sets are a standard extensible, versioned, machine readable format and have a wide range of other beneficial uses

SNOMED CT Features

Computable Languages – EHR Benefits

Expression constraints and queries

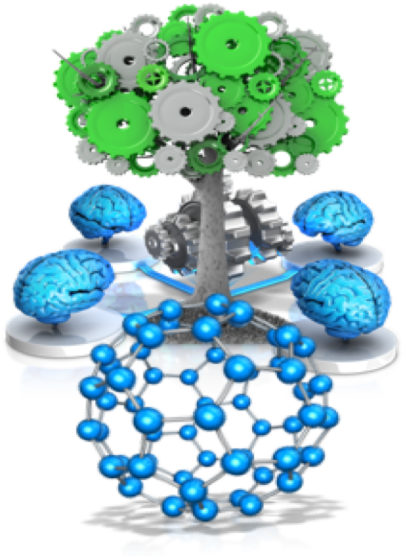
- A formal way to represent criteria for selection of a concept or expression based on format concept definitions and refinements
- Can be used to constrain searches to concepts relevant to a particular data entry context
- Can be used to represent queries for EHR records containing concepts or expressions

SNOMED CT templates

- A formal a way to represent placeholders in expressions, expression constraints and queries
- Can be used represent constraints on entry of postcoordinated expressions
- Can be used to represent pro forma queries that look for records containing concepts that match a specific constraint in a predefined context

SNOMED CT Features

Recent and Imminent Enhancements to SNOMED CT

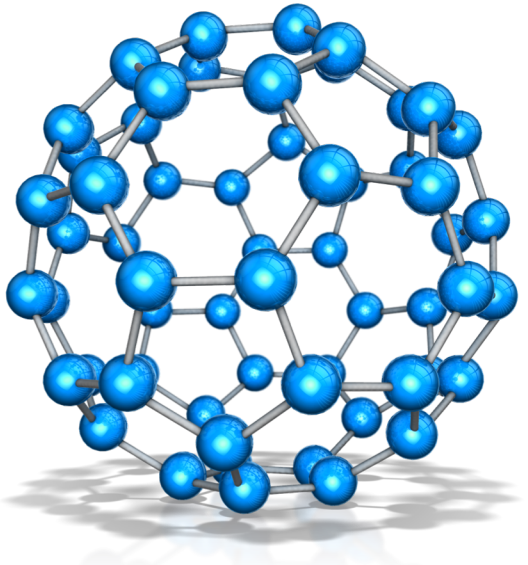


SNOMED International

Machine Readable Concept Model

SNOMED CT Concepts and Relationships

- SNOMED CT contains a vast number of logically interrelated clinical concepts
- To consistently define the meaning of concepts the relationships between concept must follow formal rules
- The concept model
  - Specifies how SNOMED CT concepts may be defined
  - Constrains
    - The attributes that may be applied to concepts in a domain
    - The range of values that may be applied to each attribute
  - Enables consistent application of description logic



Machine Readable Concept Model (MRCM)

- Represents concept model rules in a way that
  - Can be read and processed by a computer
  - Enables tests of the validity concept definitions and expressions
- Distributed as part of SNOMED CT international release
  - MRCM domain reference set
    - Defines the set of concept in a domain
  - MRCM attribute domain reference set
    - Defines the attributes that can be applied to concepts in a domain
  - MRCM attribute range reference set
    - Defines the ranges of values that can be applied to each attribute
  - MRCM module scope reference set
    - Specifies the modules to which a set of MRCM rules applies

MRCM Rules and the Editorial Guide

- SNOMED CT Editorial Guide (http://snomed.org/eg)
  - The key document for authors defining SNOMED CT concepts
  - Includes human readable tables of concept model rules that are generated automatically from the MRCM

Author View of Attributes and Ranges for 71388002 |Procedure (procedure)|

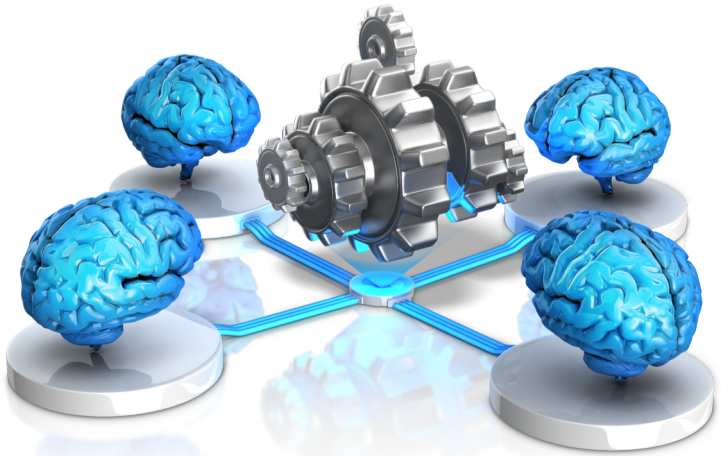
Attribute	Grouped	Cardinality	In Group Cardinality	Range Constraint
246513007 |Revision status (attribute)|	1	0..*	0..1	<< 261424001 |Primary operation (qualifier value)| OR << 255231005 |Revision - value (qualifier value)| OR << 257958009 |Part of multistage procedure (qualifier value)|
260507000 |Access (attribute)|	1	0..*	0..1	<< 309795001 |Surgical access values (qualifier value)|
260686004 |Method (attribute)|	1	0..*	0..1	<< 129264002 |Action (qualifier value)|
260870009 |Priority (attribute)|	1	0..*	0..1	<< 272125009 |Priorities (qualifier value)|
363699004 |Direct device (attribute)|	1	0..*	0..1	<< 49062001 |Device (physical object)|
363700003 |Direct morphology (attribute)|	1	0..*	0..1	<< 49755003 |Morphologically abnormal structure (morphologic abnormality)|
363701004 |Direct substance (attribute)|	1	0..*	0..1	<< 105590001 |Substance (substance)| OR << 373873005 |Pharmaceutical / biologic product (product)|

Implementation Benefits Delivered by the MRCM

- Terminology quality improvements
  - Assists and validates accurate and efficient concept authoring
    - Applicable to International Edition and extensions
  - Provides a formal record of concept model changes that may impact terminology users
- Record design and information modeling
  - Supporting terminology binding to information models
- Supporting data entry
  - Constraining refinements so postcoordinated expressions conform to the concept model
  - Facilitating rational use of natural language processing so it generates valid expressions
- Supporting retrieval and analysis
  - Assisting development of logically valid queries

SNOMED International

Description Logic Enhancements



Defining Concepts with Relationships

- A concept definition consists of
  - A set of defining statements about a concept
  - Each defining statement Is represented by a relationship
  - All defining statement are stated to be necessarily true
  - The concept includes an indication of whether the set of all its defining relationships is sufficient to define the concept
- This structure delivered practical definitions that have served SNOMED CT well for many years
  - It simplified the application of applying description logic rules
  - It enabled a terminology of 350,000 concepts to be classified using the technology available in the year 2002
- However it is an over-simplification
  - It has known limitations
  - It is now possible to rapidly classify more complete definitions

Limitations of Defining Concepts with Relationships

|Secondary diabetes mellitus|
is a |Diabetes mellitus|
EITHER
|due to| a |disease|
OR
|caused by| a |medicinal product|

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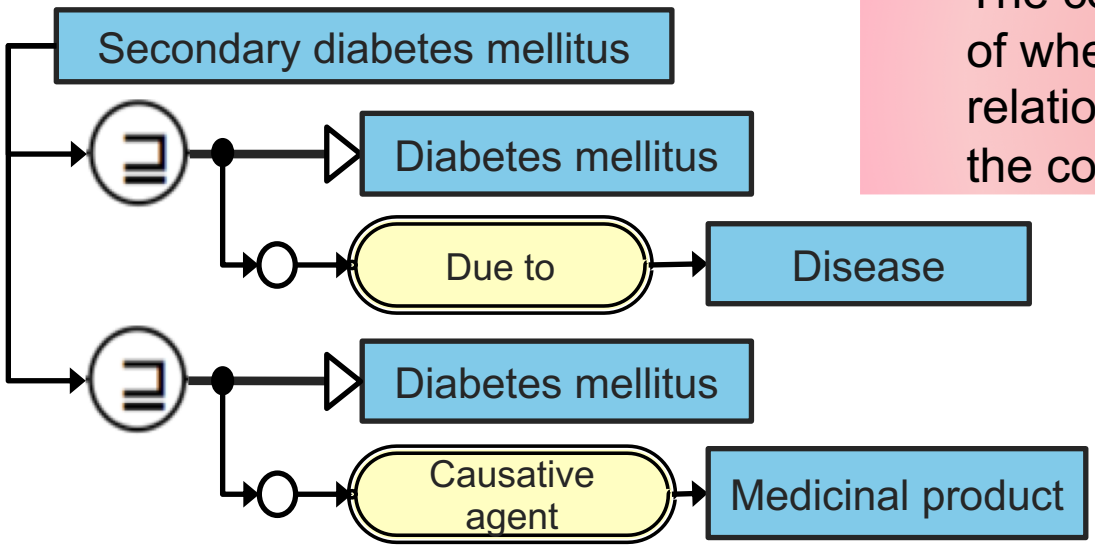


Capabilities of More Expressive DL Profiles

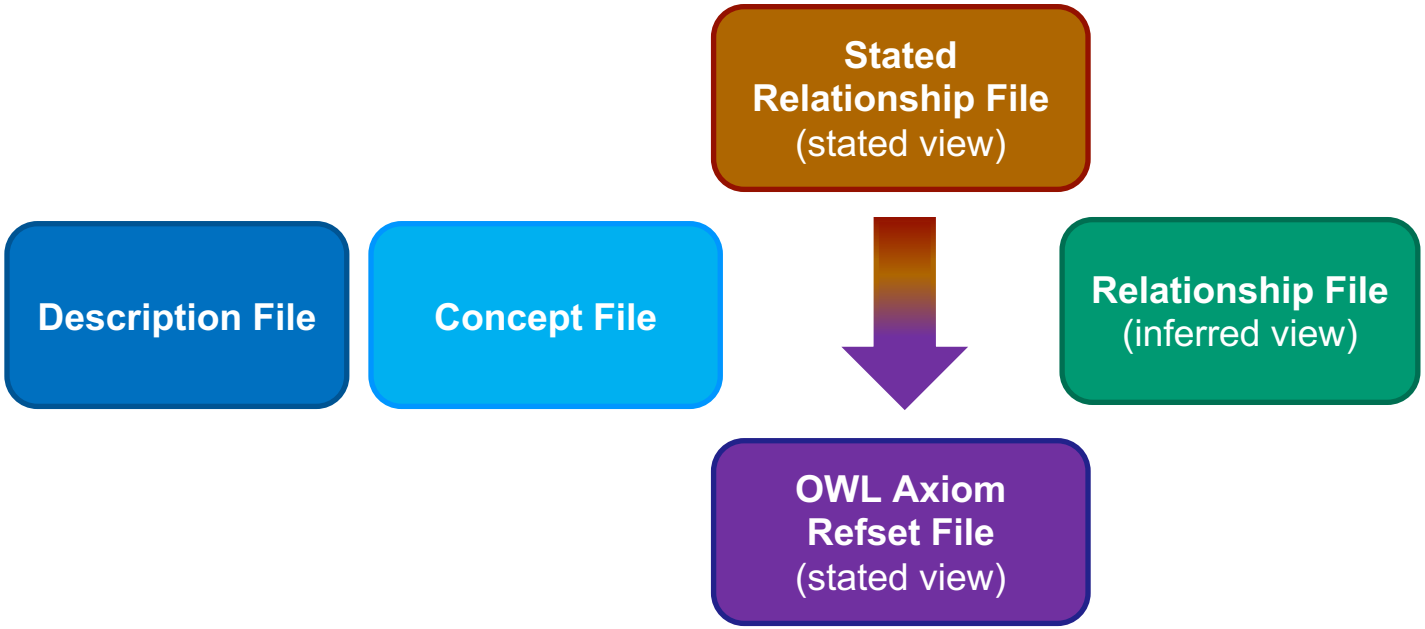
- Representing multiple sufficient definitions
  For example
  - Two sufficient definitions of |secondary diabetes mellitus|
    1. |diabetes mellitus| |due to| |disease|
    2. |diabetes mellitus| |due to| |medicinal product|
- Indicating which defining characteristics are necessarily (always) true of a concept
  - In the case of |secondary diabetes mellitus|
    - |is a| |diabetes mellitus| is necessarily true
    - |due to| |disease| is not necessarily true
    - |due to| | medicinal product | is not necessarily true
- Representing properties of specific attributes including
  - Transitivity (e.g. |part of| → |part of|)
  - Role chaining (e.g. |direct substance| → |active ingredient|)

OWL and Axioms

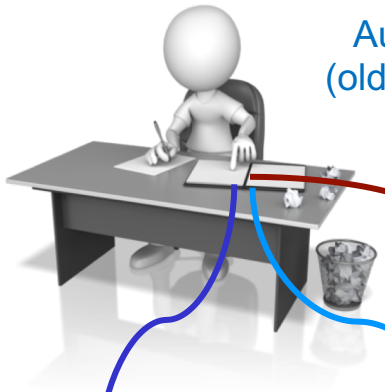
- OWL is the Ontology Web Language
  - It is capable of representing a range of advanced DL profiles
  - OWL represents definitions as sets of axioms rather than sets of relationships
  - The definition of |secondary diabetes mellitus| shown in the earlier slide would be represented as three axioms which would say
    - |secondary diabetes mellitus| is a type of |diabetes mellitus|
    - (|diabetes mellitus| |due to| |disease) is a type of |secondary diabetes|
    - (|diabetes mellitus| |due to| |medicinal product|) is a |type of secondary diabetes|
- OWL specifications include a functional style syntax which is a standard way to represent these axioms

Introducing SNOMED CT OWL Reference Sets

- The OWL axiom reference set file
  - Replaces the stated relationships file
- Each refset row states a logical axiom about a concept
  - The concept is identified by the referencedComponentId
  - A string column contains the axiom in OWL functional syntax
  - Axioms can use any DL construct permitted by the OWL profile



Changes to Authoring Process



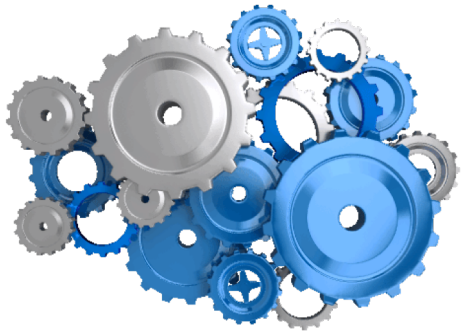
Authoring
(old process)

Stated Relationship File
(stated view)

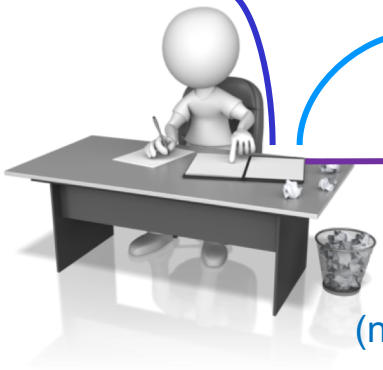
Convert to OWL
and classify

Description File

Concept File



Relationship File
(inferred view)



OWL Axiom Refset File
(stated view)

Combine OWL
and classify

Authoring
(new process)

Impact of DL Enhancements

- All users benefit from
  - More complete concept definitions
  - A more accurate subtype hierarchy
  - Most will not need to directly use the axiom refset
- Users testing postcoordinated expression subsumption
  - Will in future need the axiom refset and a DL classifier
- Extension developer creating new defined concepts
  - Will need to process and add content to the axiom refset

Implementation Benefits of DL Enhancements

- Enable quality improvements
  - More complete definitions can be specified
- Enable improvements to analytics capabilities
  - More complete definitions enable query results to be more complete and more precise
- Increase productivity in concept authoring
  - Support for more complete definitions reduces the need for arbitrary authoring rules

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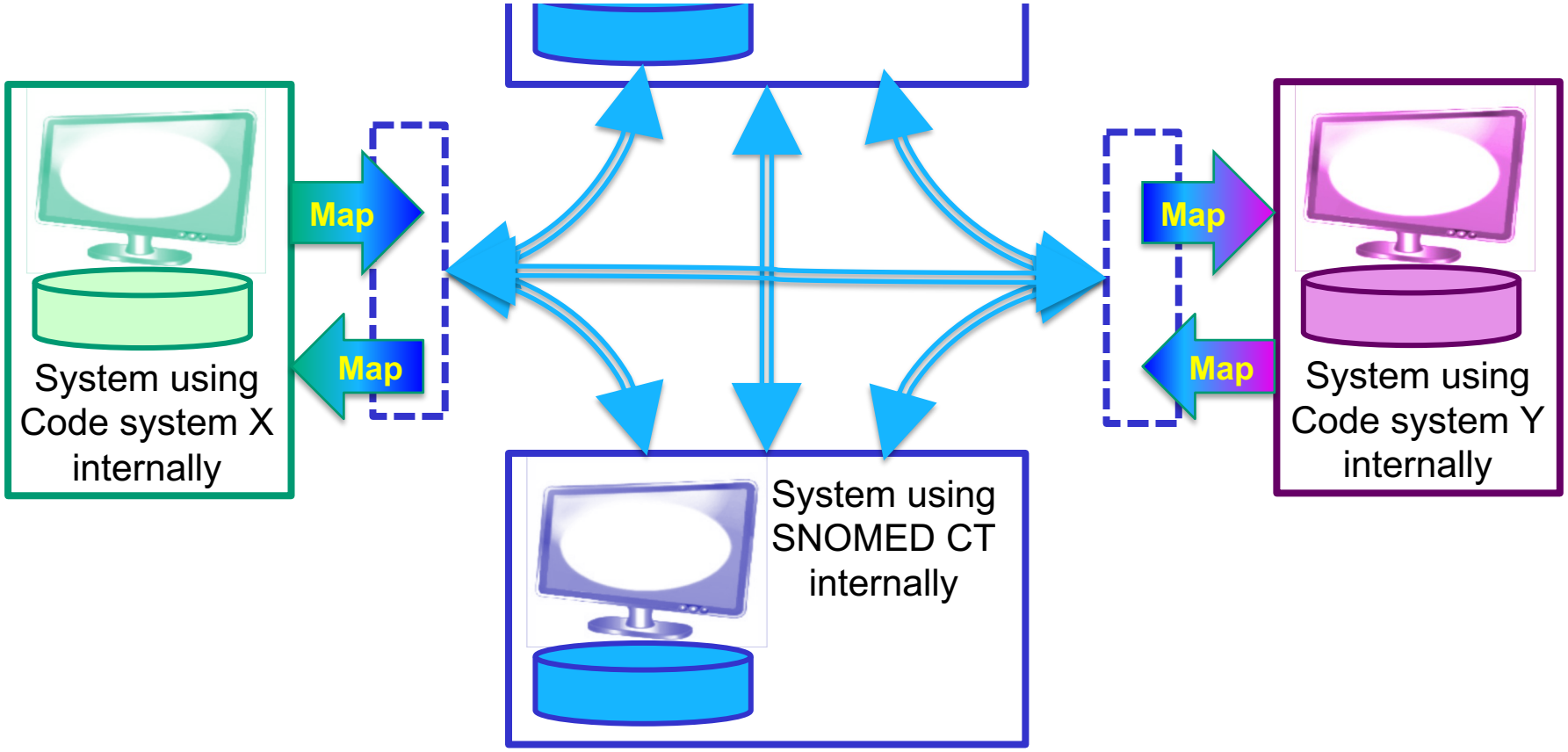
Implementation Pathways that Realize Benefits

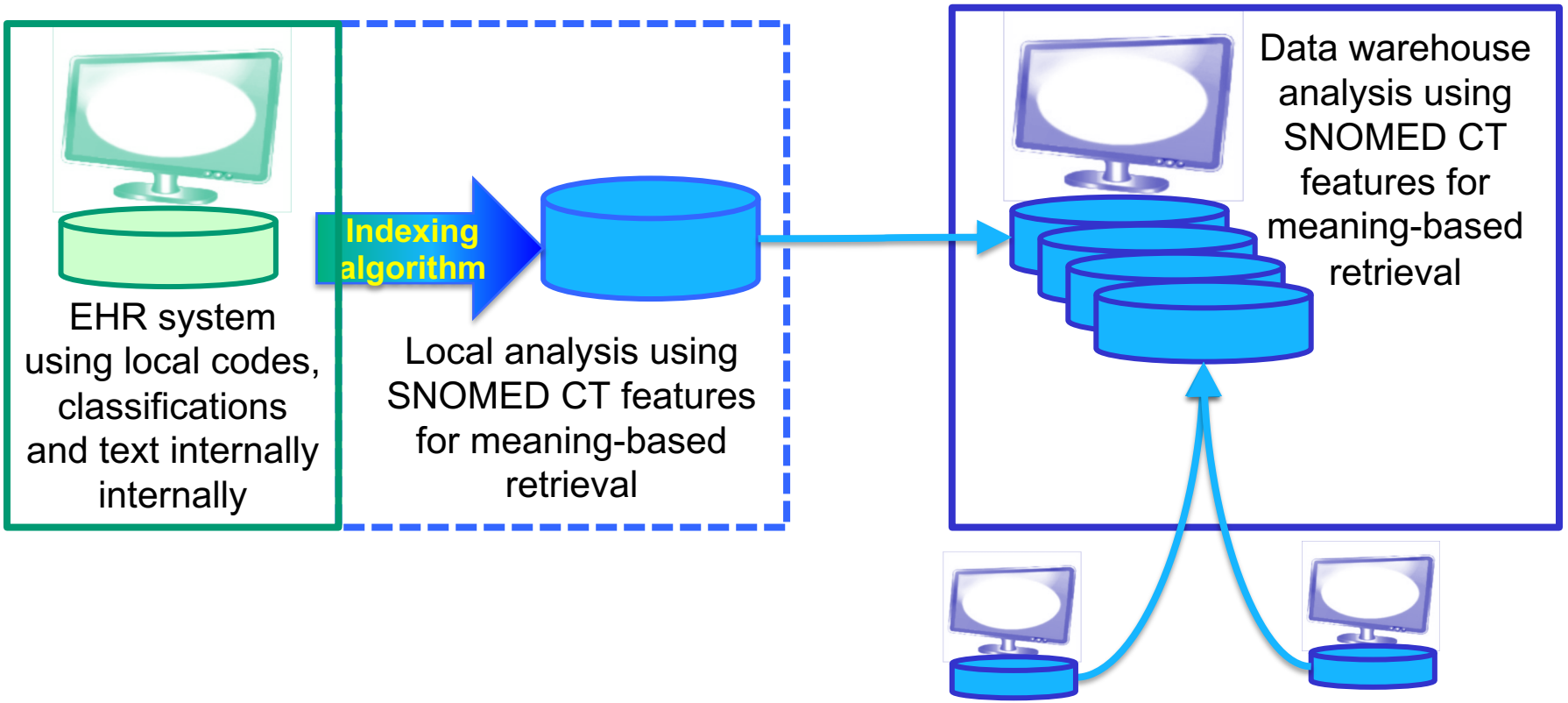
Pathways to SNOMED CT Implementation
Common Terminology for Communication

- Existing systems using different code systems internally
- Map to and from SNOMED CT as a common terminology for communication
- New systems using SNOMED CT communicate without needing to map



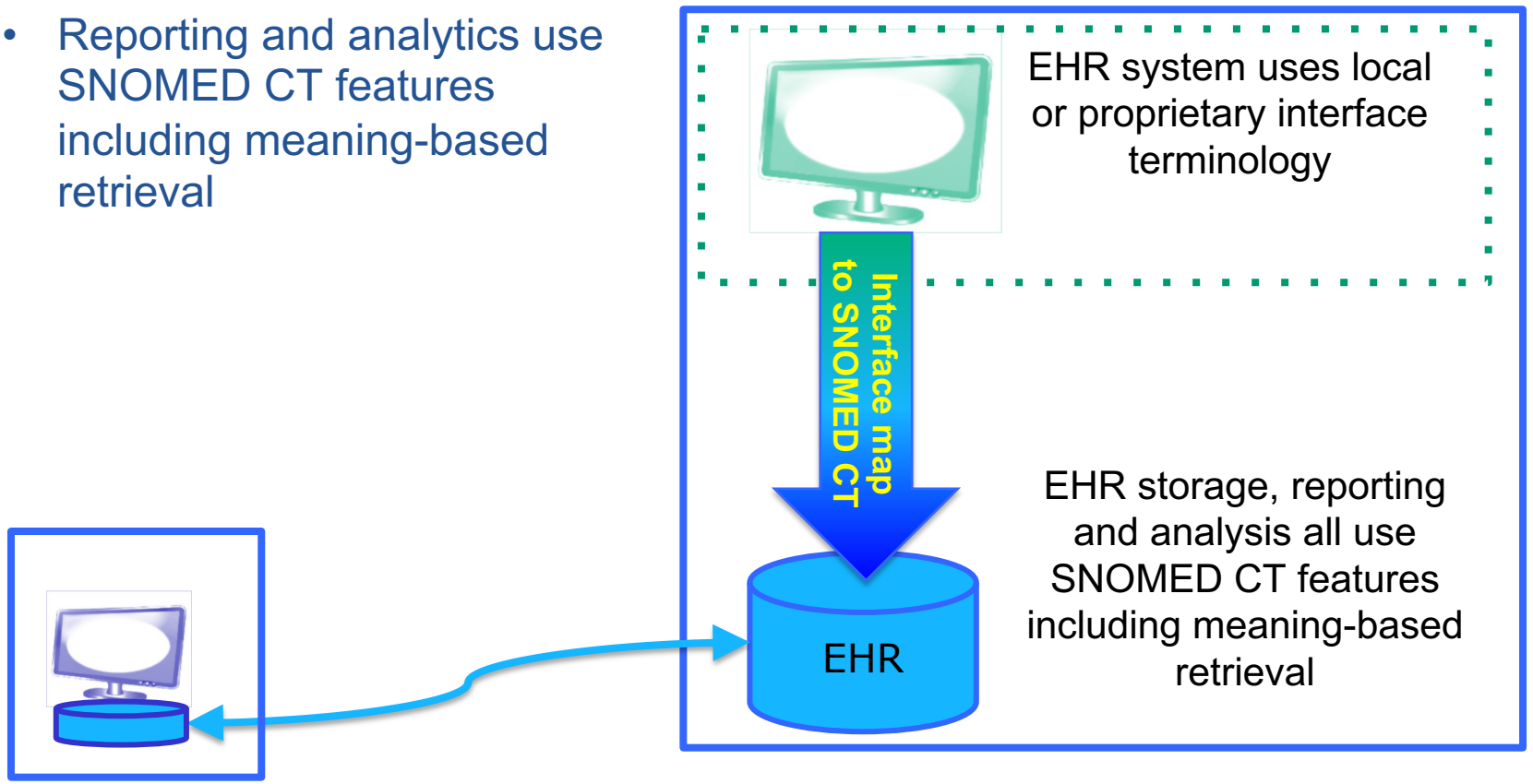
Pathways to SNOMED CT Implementation
Indexing for Analytics

- EHR system using local codes, classification and text to represent records
- Algorithmic rules map and index data with SNOMED CT codes or expressions
  - For local analysis using SNOMED CT semantics
  - For export to data warehouse for larger scale aggregation and analysis



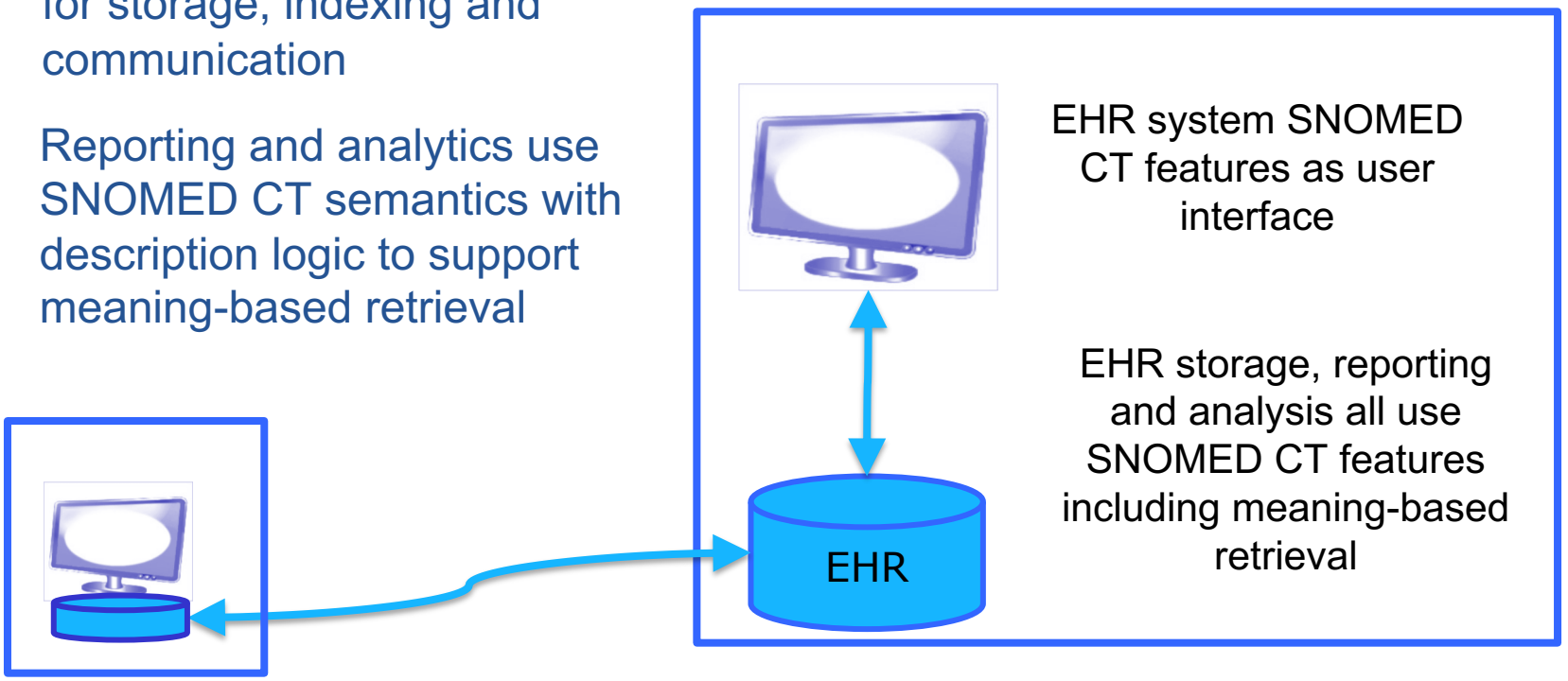
Pathways to SNOMED CT Implementation
Use of SNOMED CT for Internal Storage

- Data capture (and display) use a local or proprietary user interface terminology
- Interface terminology is mapped or linked to SNOMED CT
- EHR system uses SNOMED CT for storage, indexing and communication
- Reporting and analytics use SNOMED CT features including meaning-based retrieval



Pathways to SNOMED CT Implementation
Full Use of SNOMED CT

- Data capture (and display) uses SNOMED CT interface features including
  - Synonyms and language reference sets
  - Subsets and ordered lists represented as SNOMED CT simple or ordered reference sets
  - Searches using subtype filtering to limit list
- EHR system uses SNOMED CT for storage, indexing and communication
- Reporting and analytics use SNOMED CT semantics with description logic to support meaning-based retrieval



Multistep Pathways and Tailor-made Solutions

- A stepwise approach may allow your requirements to be met in stages
  - Ensure each stage delivers benefits to motivate use
  - Lack of short-term benefits may reduce enthusiasm for future steps

- A tailor made solution may meet all your stated requirements
  - But your requirements for SNOMED CT may evolve
  - Can the solution be adapted to meet emerging requirements or will you need to start again?

Summary

- Identify key benefits to catalyze adoption of SNOMED CT
- Plan implementation to target realization of those benefits
  - Engage users and other stakeholders in a team effort
- Specify requirements clearly and in sufficient detail
  - Take note of SNOMED CT implementation guidance
  - Leverage features and enhancements of SNOMED CT
- Choose a pathway to realize your key benefits
  - Avoid pathways with “dead-ends”
  - Be prepared for moving on towards longer term benefits
- Deployment and use
  - Needs informed and motivated users
  - Provide users with value from information they record

Links to Further Information

- SNOMED CT Document Library
  - http://snomed.org/tig
- Vendor Introduction to SNOMED CT
  - http://snomed.org/vendorguide
- Learn More using our E-Learning courses:
  - http://snomed.org/elearning
- SNOMED in Action
  - http://snomedinaction.org
- SNOMED CT Presentations
  - http://snomed.org/expo
- Expo Tutorials
  - http://snomed.org/tutorials2018

- Any Questions ?