



Using SNOMED CT in an International Clinical Information System

SNOMED CT Implementation Showcase 2014

M. Hendrickson RN-BC, MSN, MSCS

Principal Scientist, Clinical Software Architect

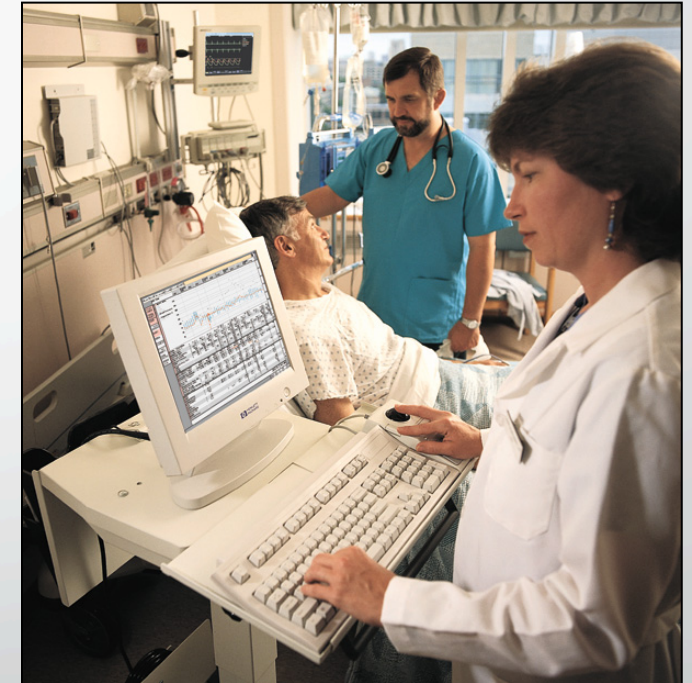
Philips Healthcare

Objectives

- Describe the benefits of using SNOMED CT within an international clinical information system(CIS)
- Describe how SNOMED CT can be incorporated into an international clinical information system
- Describe the challenges of using SNOMED CT in an international clinical information system

Clinical Information System Overview

- For the care of critical care patients, including neonates
- International: more than 20 countries and 15 languages
- Multidisciplinary: nurses, physicians, and others
- Extensive system interfaces: labs, ADT, orders, etc.
- Functionality: documentation, decision support, and CPOE
- Highly configurable – customers define their own data dictionary elements as needed
- Third generation product



History with Terminologies

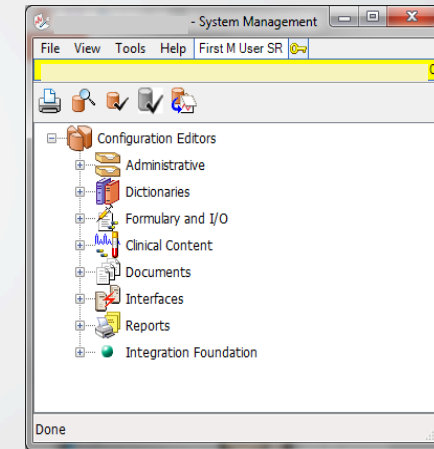
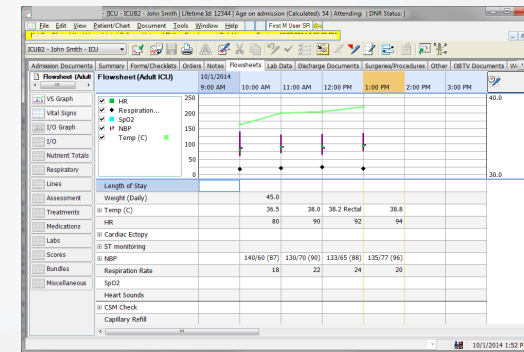
- Why a reference terminology?
 - Learned from past experiences
 - Want to compare data across customers as a benchmarking service
 - Highly configurable product to adapt to patient populations and locales
 - Reference terminology is not displayed to the clinician at the bedside
- Reference terminology framework was part of the initial architecture.
 - First reference terminology was provided by a third party terminology vendor
 - Gaps and inconsistencies existed in that terminology
- Changed to SNOMED CT about 2004
 - Recognized that SNOMED CT met the product requirements
 - After Read codes from the UK were incorporated into SNOMED CT
 - Around the time US government purchased the nationwide license
 - After lengthy licensing discussions with the College of American Pathologists

Why SNOMED CT?

- Multidisciplinary
- Extensive clinical scope: problems, orders, drugs, results, and others
- International
- Dedication to maintenance and improvements
- Terminology architecture
- Positive future

Main Components of the CIS

- Applications:
 - Used for patient record charting by clinicians
- Configuration editors:
 - Data Dictionary Elements
 - Documents
 - Drugs and others materials
 - Administrative information
 - Used by senior clinicians and field organization to modify/define the data dictionary items
- Data Access Repository:
 - A separate database
 - All patient data
 - Used by senior clinicians for quality analysis and clinical research

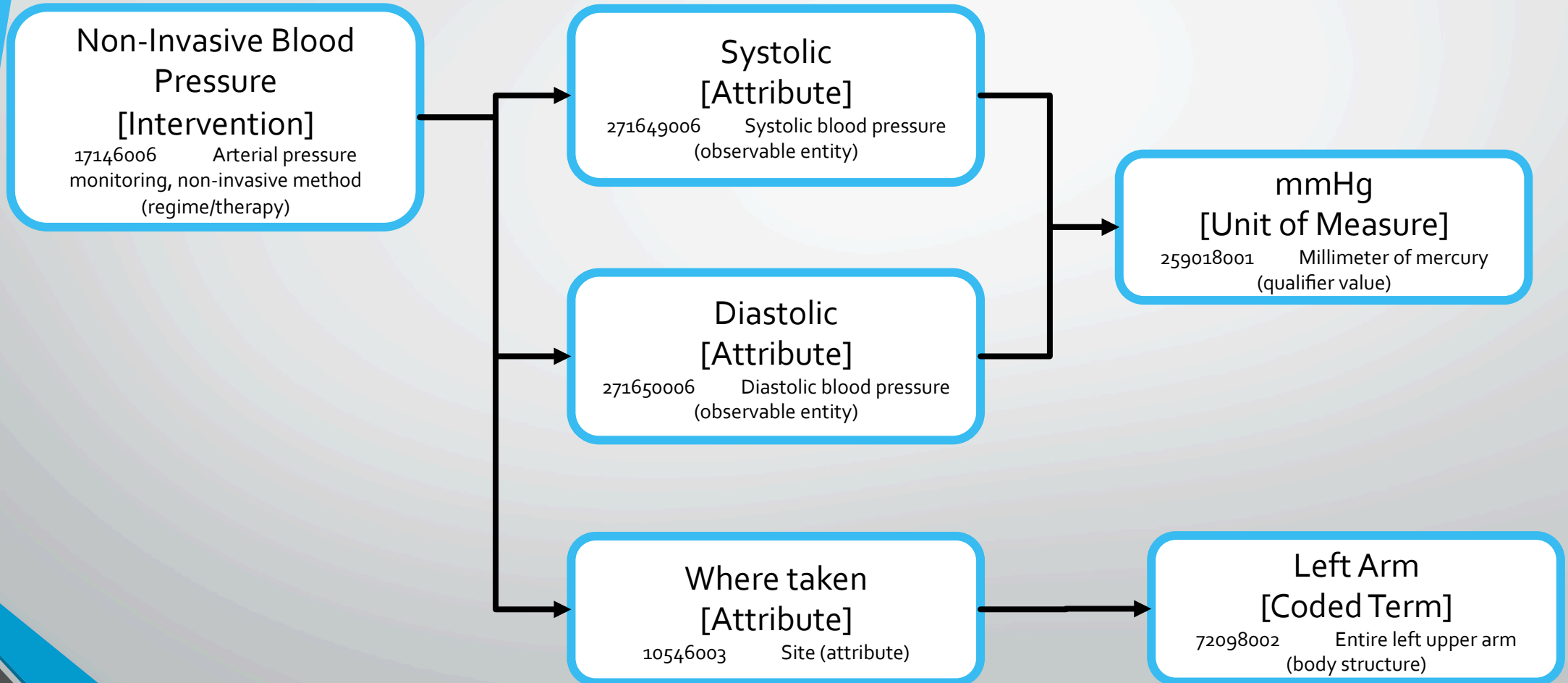


Main Approach to Incorporate SNOMED CT

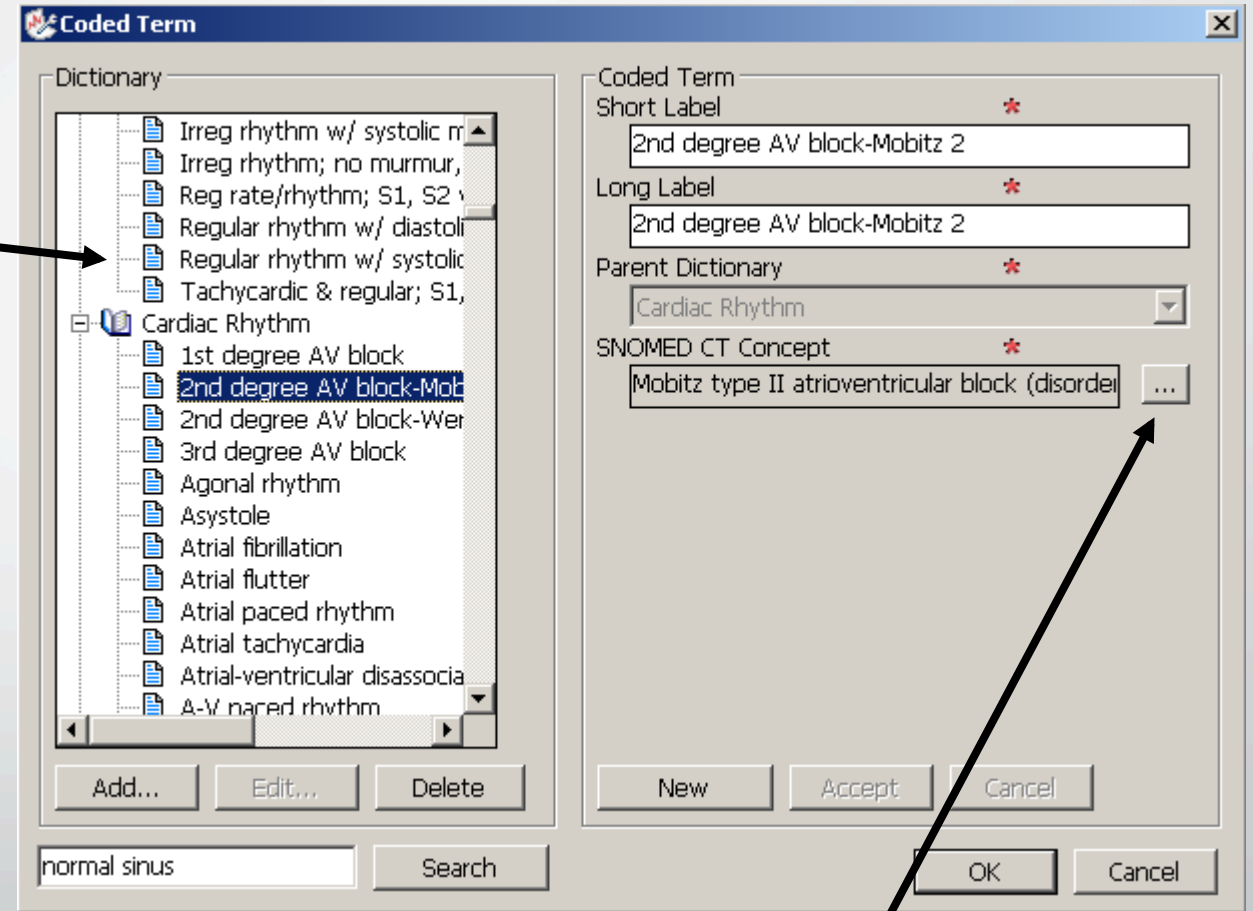
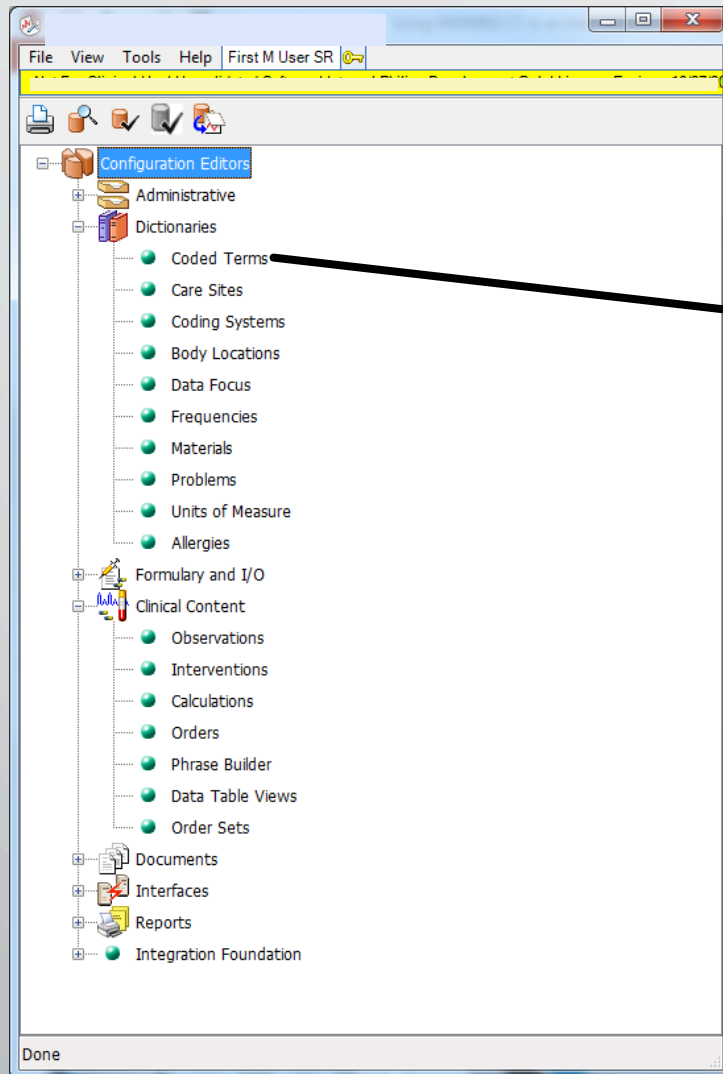
- Purpose: to tag all components of data dictionary with a reference terminology concept, whether it was defined by the vendor or by the customer
- Data dictionary contains the following:
 - Data Elements have 1..N attributes
 - Data Elements are orders, interventions, problems, etc.
 - Dictionaries of coded items are used in selection lists
 - Includes materials/drugs
- SNOMED CT codes are assigned during the configuration of the data dictionary items using the configuration editors

Use in the System

- Every item in the data dictionary is tagged with a SNOMED CT concept



Configuration Editors



Selecting a SNOMED CT Concept

Anywhere
Beginning
End
Exact
Keywords (all)
Keywords (any)

The screenshot shows the 'Concept Catalog' window. The 'Search For' field contains 'SVRI'. The 'Search Type' dropdown is set to 'Anywhere in the string', which is highlighted by an arrow from the text on the left. The 'Results' table shows one entry: 'SVRI - Systemic vascular resistance index' with the parent concept 'Systemic vascular resist'. The 'SNOMED CT Concepts' tree on the right shows a hierarchical view of concepts, with 'Systemic vascular resistance index (observable entity)' selected. The 'Concept Details' pane at the bottom shows the selected concept's name, SNOMED ID (276900001), terms, and super concepts.

Concepts and Terms	Parent Concept
SVRI - Systemic vascular resistance index	Systemic vascular resist

SNOMED CT Concepts

- Pulse rate (observable entity)
- Vascular measure (observable entity)
 - Arterial measure (observable entity)
 - Aortic pressure (observable entity)
 - Arterial blood pressure (observable entity)
 - Arterial diameter (observable entity)
 - Arterial flow (observable entity)
 - Arterial impedance (observable entity)
 - Arterial pressure index (observable entity)
 - Arterial velocity (observable entity)
 - Arterial velocity waveform (observable entity)
 - Upstroke time of arterial pressure (observable entity)
 - Vascular resistance (observable entity)
 - Pulmonary vascular resistance (observable entity)
 - Pulmonary vascular resistance index (observable entity)
 - Systemic vascular resistance (observable entity)
 - Systemic vascular resistance index (observable entity)
 - Total pulmonary resistance index (observable entity)
- Blood pressure (observable entity)
- Blood velocity (observable entity)
- Circulation status (observable entity)
- Degree of blood vessel lumen cross sectional area reduction (observable entity)
- Degree of blood vessel lumen diameter reduction (observable entity)

Concept Details

- Name
 - Systemic vascular resistance index (observable entity)
- SNOMED ID
 - 276900001
- Terms
 - Systemic vascular resistance index (observable entity)
 - Systemic vascular resistance index
 - SVRI - Systemic vascular resistance index
- Super Concepts
 - Vascular resistance (observable entity)

Database Structure

- Terminologies are maintained in a separate terminology database
- Database tables for SNOMED CT are similar in structure to the content provided by IHTSDO
- All data dictionary items have a mapping to a SNOMED CT concept in the database. More than 40,000 items are mapped in the starter configuration
- SNOMED CT tables are only accessed with the configuration editors
- Use the non-human subset to eliminate veterinary specific terms

Benefits

- The full potential is yet to be realized
- HL7 interfaces
- Data Access Repository

Outbound HL7 Interfaces

- Export of patient data via the HL7 interface (ORU)

```
MSH|^~\&||||20041019172122|SECURITY|ORU^Ro1|MSG001-1|P|2.4||NE|NE|
```

```
PID|||123456||Smith^Anne||19630625|F|
```

```
PV1|1||Unit1^^Bed1|||||||||VN765|
```

```
OBR|2|||386534000^Arterial BP^SNM3||200410191720
```

```
NTE|1|O|30 minutes after start of vasopressin drip|RE
```

```
OBX|1|NM|72313002^Systolic^SNM3||120|259018001^mmHg^SNM3||N||F||200410191720
```

```
OBX|2|NM|271650006^Diastolic^SNM3||80|259018001^mmHg^SNM3||N||F||200410191720
```

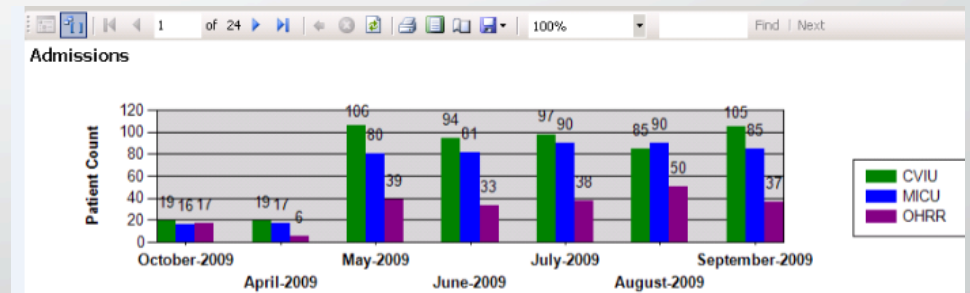
```
OBX|3|NM|6797001^Mean^SNM3||95|259018001^mmHg^SNM3||N||F||200410191720
```

Inbound HL7 Interfaces

- Interfaces:
 - ADT
 - Laboratory
 - Orders
- Approach:
 - Depends on mappings between inbound data and the CIS data dictionary
 - Explicit mapping is defined in the interface configuration editors
 - SNOMED CT is used as a secondary level of mapping

Data Access Repository

- Data Access Repository
 - All patient data is tagged with SNOMED CT concepts
 - SNOMED CT concepts identifies the data to be used in quality reports
 - SNOMED CT concepts are used for database queries
 - Includes
 - Customer's configured data dictionary
 - Can include data from multiple systems



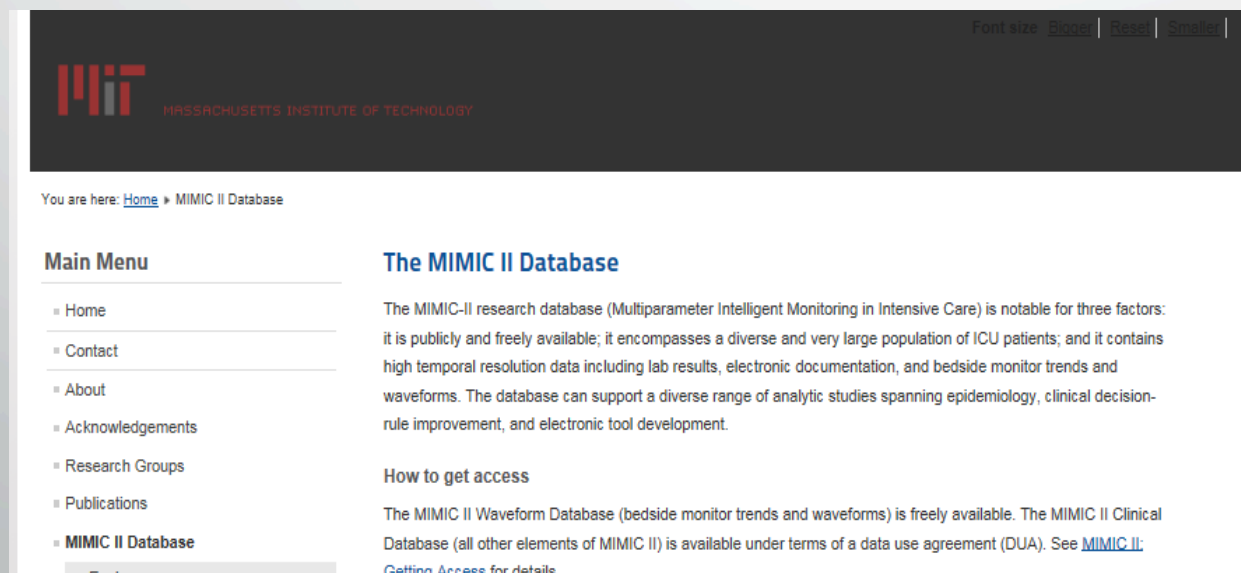
Patient	Date of Birth	Life Time Number	Patient Id	Clinical Unit	Admit Time	Out Time
				CVIU	5/4/2009 10:40:14 PM	5/4/2009 10:40:22
				OHRR	5/5/2009 3:40:03 PM	5/5/2009 3:50:06 P
				OHRR	6/29/2009 9:32:59 AM	6/29/2009 9:35:26
Abbott Freda, J	8/5/1949	413059	103650917	MICU	8/31/2009 4:14:15 AM	9/1/2009 5:52:44 P
Abbott Freda, J	8/5/1949	413059	103748158	CVIU	9/13/2009 1:08:40 AM	9/13/2009 11:40:2
Acree David, A	4/24/1946	303284	103440145	CVIU	8/2/2009 5:06:59 PM	8/4/2009 9:58:07 A
ADAMS ALMA, BRENTLINGE	1/29/1925	142348	102918323	MICU	5/23/2009 1:20:34 PM	5/24/2009 6:45:21
Adams Edgwina	6/20/1962	419804	103153235	CVIU	6/23/2009 4:18:34 AM	6/30/2009 7:58:46
Adams Ina, M	4/6/1943	417674	102823473	MICU	5/12/2009 12:18:44 AM	5/16/2009 5:54:23
Adams Joseph, K	4/27/1925	60785	103284352	CVIU	7/11/2009 7:12:52 AM	7/12/2009 12:52:58
Adams Nadine	8/14/1935	325065	102780897	CVIU	5/2/2009 6:47:18 PM	5/5/2009 10:38:32

Other Benefits

- Most items can be assigned appropriate SNOMED CT concepts
 - SNOMED CT provides good coverage
 - Critical care CIS concepts and drugs
- Easy installation and implementation
 - One international version of SNOMED CT
 - Licensing
 - One licensing arrangement for all installations
 - Licensing model matches product licensing
- Future needs most likely will be met
 - SNOMED CT is expanding to cover other clinical domains
 - SNOMED CT is expanding to other locales/countries

Future Benefits?

- Benchmarking across customers
 - Master Data Access Repository
 - Quality reports comparing customers clinical practice and outcomes
- Research database
 - Clinical patient data across multiple customers
 - Similar to the MIMIC II database <https://mimic.physionet.org>



The screenshot shows the MIMIC II Database website. At the top left is the MIT logo (Massachusetts Institute of Technology). In the top right corner, there are links for 'Font size: Bigger', 'Reset', and 'Smaller'. Below the logo, it says 'You are here: [Home](#) » MIMIC II Database'. On the left side, there is a 'Main Menu' with a list of links: Home, Contact, About, Acknowledgements, Research Groups, Publications, and MIMIC II Database. The main content area has a heading 'The MIMIC II Database' followed by a paragraph: 'The MIMIC-II research database (Multiparameter Intelligent Monitoring in Intensive Care) is notable for three factors: it is publicly and freely available; it encompasses a diverse and very large population of ICU patients; and it contains high temporal resolution data including lab results, electronic documentation, and bedside monitor trends and waveforms. The database can support a diverse range of analytic studies spanning epidemiology, clinical decision-rule improvement, and electronic tool development.' Below this is a section titled 'How to get access' with the text: 'The MIMIC II Waveform Database (bedside monitor trends and waveforms) is freely available. The MIMIC II Clinical Database (all other elements of MIMIC II) is available under terms of a data use agreement (DUA). See [MIMIC II: Getting Access](#) for details.'

Challenges of Using SNOMED CT in a CIS

- Handling SNOMED CT Updates
- Gaps in concept coverage
- Country specific versions of SNOMED CT
- Customers' configuration practices

Handling SNOMED CT updates

- Customers expect the product to use a recent version of SNOMED CT
- SNOMED CT content in the product's terminology database is updated with every major release
- Upon customer site upgrades to the new software version, SNOMED CT content is updated as well as data dictionary assignments.

Handling SNOMED CT updates

- During product development within R&D
 - Latest version of SNOMED CT is loaded into a development system
 - Sql queries identify data dictionary items referencing retired SNOMED CT concepts
 - Clinicians use the configuration editors to change SNOMED CT codes
 - Database migration scripts are developed

	Intervention_Label	SNOMED_CT_ConceptId	SNOMED_CT_Name	Status
1	A-a gradient	251890007	Alveolar-arterial oxygen tension difference (observabl...	0
2	Acetaminophen	46093004	Acetaminophen measurement (procedure)	0
3	Acetone	105050005	Acetone measurement (procedure)	0
4	ACT	69874005	Coagulation time, activated (procedure)	0
5	Albumin	26758005	Albumin measurement (procedure)	0
6	Alkaline Phosphatase	271234008	Serum alkaline phosphatase measurement (procedure)	0
7	ALT (SGPT)	34608000	Alanine aminotransferase measurement (procedure)	0
8	Ammonia	59960001	Ammonia measurement (procedure)	0
9	Amylase	64435009	Amylase measurement (procedure)	0
10	Anion Gap	25469001	Anion gap measurement (procedure)	0
11	Antithrombin III Activity	401039000	Plasma antithrombin III activity measurement (proced...	0
12	APTT	42525009	Partial thromboplastin time, activated (procedure)	0
13	Arterial HCO3	88645003	Bicarbonate measurement (procedure)	0
14	Arterial O2 Content	373628000	Finding of arterial oxygen concentration (finding)	0
15	Arterial CO2	255564007	Measurement of arterial carbon dioxide concentration (finding)	0

SNOMED CT Content Gaps

- Recognize that extensive efforts have been made to address gaps
- We have a responsibility to help to address the gaps
- Examples of gaps:
 - SNOMED CT gaps for HL7 messages
 - Message segments and items
 - Example from the PID segment: birth order, patient account number
 - Entries in the HL7 tables including state transitions
 - Ideally, want a SNOMED CT concept for every clinically relevant message field, message segment, and entry in an HL7 table.
 - Infusion base solutions such as D/10/LR and Amino Acid 15%.
 - Scores: Aldrete, SAPS, CAM score, IMPROVE bleeding risk, Padua thrombosis risk, WAKE, etc.

How Gaps are Handled

- Non-clinical items are assigned a single SNOMED CT
“Chart Group Failure” 360307003 Computer equipment (physical object)
- Assigned a more general concept if clinically acceptable
“ABD Binder Premium Sm-Med” 21944004 Abdominal binder, device (physical object)
- Create company proprietary concepts – avoid if possible
- For pre-coordinated definitions – assign the concept of the main idea
“Accurate urine output monitoring” 444990003 Measurement of urine output (procedure)
- Attempt to make the assignment unique within the context if clinically relevant

Country Specific Versions of SNOMED CT

- Concerned that country specific versions have conflicting or duplicate content
- Product is designed to handle one version of SNOMED CT for all customers
- Different versions impair the ability to benchmark across countries
- Prefer country specific concepts are merged into the international version through a formal process

Customers' Configuration Practices

- Customers do not consistently assign appropriate SNOMED CT values to their configuration.
 - Takes time
 - Lack of SNOMED CT experience
 - English is not their primary language
 - Do not recognize the benefits



Thank You

Questions?

Maria.hendrickson@Philips.com