

SNOMED CT



Application to eHRs

Where do you find SNOMED CT?

- ▶ May be the backbone of your eHR system
- ▶ May be part of a cross mapping table from legacy data
- ▶ May have components integrated into a knowledge engine (weighted concepts, CDS)
- ▶ May be integrated with other code sets
- ▶ May be totally off-line (value sets, quality measures)
- ▶ May be part of drop-down menus or search terms

..... **Varies with type of implementation**

Front-end versus Back-end

Differences in opinion

..some want SNOMED CT “preferred terms” for interface

...others want to use terms they prefer in their practice (customized by locale, use of templates, etc.)

May vary by country (lot of nuances with language/translation)



Hospital System

XXX123 myocardial infarct



ABC444 cardiac infarction



22298006
myocardial infarction
(disorder)

SNOMED CT

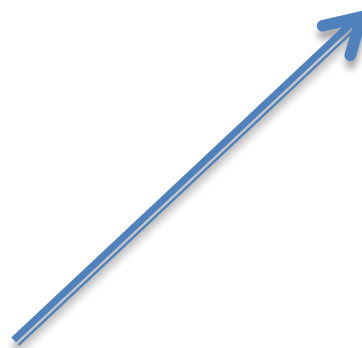


Doctor's Office



Outpatient Dept.

56789X heart attack



Shows interoperability
and enabling of data
integration across
disparate systems

SNOMED CT enables the
integration of clinical data
from disparate systems

Interface

View Report Comment/Suggestion Post Problem List

Chest Pain

- PATIENT HISTORY**
 - CHIEF COMPLAINT**
 - HISTORY OF PRESENT ILLNESS**
 - Chest Discomfort absent
 - Dyspnea absent
 - Dyspnea On Exertion absent
 - Paroxysmal Nocturnal Dyspnea absent
 - Diaphoresis absent
 - Nausea present
 - Orthopnea present
 - Extremity Edema
 - Palpitations
 - Presyncope
 - Sense Of Impending Doom
 - Relative Exercise Tolerance
 - PAST MEDICAL HISTORY
 - PHYSICAL EXAMINATION
 - DATA REVIEW
 - ASSESSMENT
 - PLAN
- Chronicity**
 - Pattern Of Occurrence
 - Orthopnea Pillows Quantitative**
 - One Pillow
 - Two Pillows**
 - Three Pillows
 - Four Pillows
 - Sitting In A Chair
 - Other
 - Timing**

Interface of clinical application

Recent, two pillows orthopnea is present. The orthopnea started 3 weeks ago.

Interface

View Report Comment/Suggestion Post Problem List

Chest Pain **Chronicity**

PATIENT HISTORY

- CHIEF COMPLAINT
- HISTORY OF PRESENT ILLNESS
 - Chest Discomfort absent**
 - Dyspnea absent**
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 - Extremity Edema
 - Palpitations
 - Presyncope
 - Sense Of Impending Doom
 - Relative Exercise
- PAST MEDICAL HISTORY
- PHYSICAL EXAMINATION
- DATA REVIEW
- ASSESSMENT
- PLAN

ID14859	CHEST DISCOMFORT HISTORY OR SYMPTOM
ID00456	DYSPNEA HISTORY OR SYMPTOM
ID02455	DYSPNEA ON EXERTION HISTORY OR SYMPTOM
ID00457	DYSPNEA PAROXYSMAL NOCTURNAL HISTORY OR SYMPTOM
ID00044	DIAPHORESIS HISTORY OR SYMPTOM
ID00364	NAUSEA HISTORY OR SYMPTOM
ID00462	ORTHOPNEA HISTORY OR SYMPTOM
ID14993	EXTREMITY EDEMA HISTORY OR SYMPTOM
ID00169	CHEST PALPITATIONS HISTORY OR SYMPTOM
ID00415	PRESYNCOPE HISTORY OR SYMPTOM
ID01594	FEAR OF IMPENDING DEATH OR DOOM HISTORY OR SYMPTOM
ID01007	EXERCISE TOLERANCE RELATIVE HISTORY OR SYMPTOM

Proprietary terminology representing the interface terms

Recent, two pillows orthopnea is present. The orthopnea started 3 weeks ago.

Interface terminology	Reference terminology
Front end – SNOMED to represent the clinical terms needed by an eHR product	Back end –SNOMED CT is the reference standard for interoperability (Other code sets are also important)
Want one to one mapping interface terms and SNOMED CT (pre-coordinated terms; use of local extensions)	SNOMED CT modeled in back end from interface term (terms can be post-coordinated)
End-users want only one-click	Vendors customize interface/use templates
Implementers/vendors must design products to display SNOMED CT terms (drop downs/search)	Implementers/vendors allow for customization– use of local terms/use of templates
SNOMED CT tied to end-users practice	SNOMED CT is seamless to end-user
Other standards depend on SNOMED CT concepts	SNOMED CT is only one of several standards within an eHR

The quality of data collected is directly proportional to the care with which options are presented to the user

...so the functionality of the eHR product is as important as the terminology

(Usability factors)



How SNOMED CT relates to clinical applications

Terminology model now needs to relate to the architecture or design of a clinical system



Information model

There is more than one way to manipulate data
....must balance between
Terminology model and Information model

	Hx and Physical Patient Name...xxx	
<i>Allergies</i>	Penicillin	Disorder
<i>BP</i>	180/95	
<i>Temp</i>	-	Observable entity
<i>Resp</i>	24	
<i>Pulse</i>	74	
<i>FH</i>	Lung cancer	
<i>PMH</i>	Chronic lung disease	Situation with explicit context
<i>Exam</i>	↓ Breath sounds on R	Clinical finding
<i>Dx</i>	Pneumonia	Disorder
<i>Plans</i>	Bronchoscopy, sputum culture Rx: Amoxicillin 500mg TID X 10d	Procedures

Observable entity

- └─ SNOMED CT Concept
 - └─ **Observable entity**
 - └─ Body product observable
 - └─ Clinical history/examination observable
 - └─ Device observable
 - └─ Drug therapy observable
 - └─ Functions
 - └─ General clinical state
 - └─ Imaging observable
 - └─ Interpretation of findings
 - └─ Laboratory biosafety level
 - └─ Lethal dose
 - └─ Monitoring features
 - └─ Population statistic
 - └─ Radiation therapy observable
 - └─ Rate of administration of intravenous fluid
 - └─ Sample observable
 - └─ Social / personal history observable
 - └─ Substance observable
 - └─ Temporal observable
 - └─ Tumor observable
 - └─ Additional pathologic finding in tumor specimen
 - └─ Breslow depth staging for melanoma
 - └─ Clark's melanoma level
 - └─ Degree of pigmentation of tumor
 - └─ Dukes stage

Represent a question or a feature which can be given an answer or result

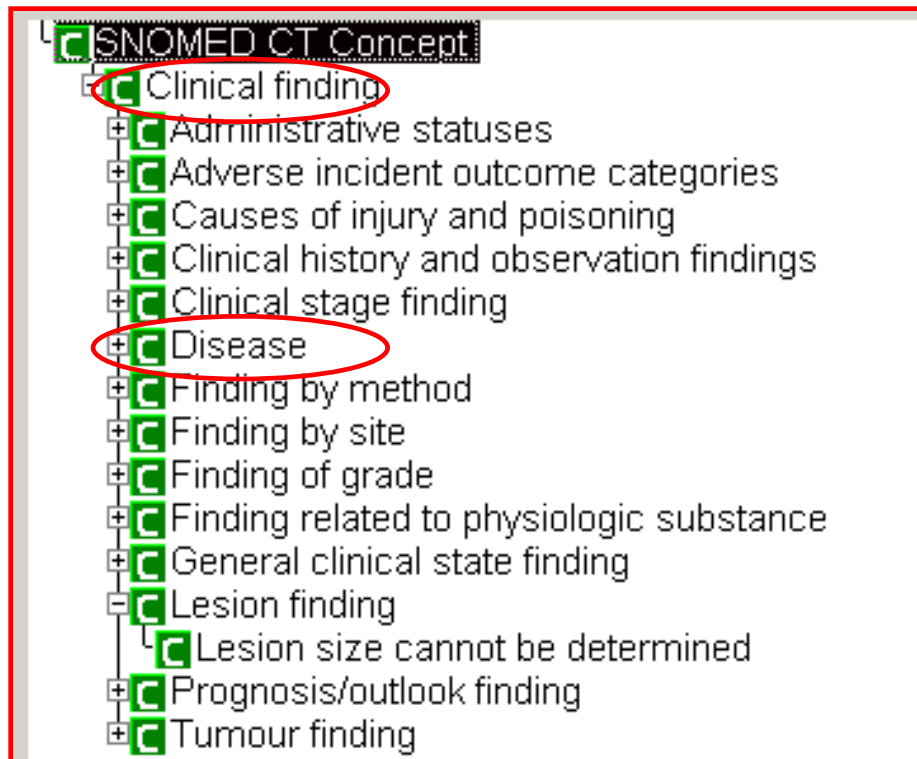
Things that can be measured or observed

Example – structured docs

Observable entity

- ▶ Blood pressure (observable entity)
- ▶ Heart rate (observable entity)
- ▶ Respiratory rate (observable entity)
- ▶ Patient name (observable entity)

Clinical finding



The result of a clinical observation, assessment or judgment

Includes both normal and abnormal clinical states

The sub-hierarchy of “Disease” includes everything that could be called a “disorder”

Clinical finding

- ▶ finding of increased blood pressure (finding)
- ▶ fever (finding)
- ▶ tachypnea (finding)

Example:

BP = 180/95  Elevated blood pressure

- ▶ A clinical finding interprets an observation

Pearl

#1 Observation or clinical finding?

Examples

- ▶ PR interval feature (observable entity)
- ▶ Prolonged PR interval (finding)
- ▶ Body temperature (observable entity)
- ▶ Hypothermia (finding) / Fever (finding)
- ▶ Knee reflex (observable entity)
- ▶ Knee reflex brisk (finding)

Observable entity + Value = Clinical finding

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Situation with explicit context

138875005 SNOMED CT Concept	
243796008	situation with explicit context
276445008	A/N risk factors
405647008	critical incident factors
405648003	critical incident properties
398819009	diabetic foot at risk
33993005	disease type AND/OR category not applicable
66678007	disease type AND/OR category not assigned
271336007	examination / signs
57177007	family history of
413350009	finding with explicit context
4908009	history of
405280005	operating room unavailable
416534008	outbreak
161766002	past pregnancy outcome NOS
398138002	patient interval change
129125009	procedure with explicit context
182985004	response to treatment

Used to represent findings and procedures that make explicit:

Whether a finding is present or absent or probable, or a procedure was done or not done, or planned, etc.

Who the finding or procedure is about

When the finding or procedure occurred

Situation with explicit context (whether, who, when)

- ▶ family history of neoplasm of lung (situation)
- ▶ no cough (situation)
 - Absent clinical findings
- ▶ lung volume test not done (situation)
- ▶ history of – chronic lung disease (situation)

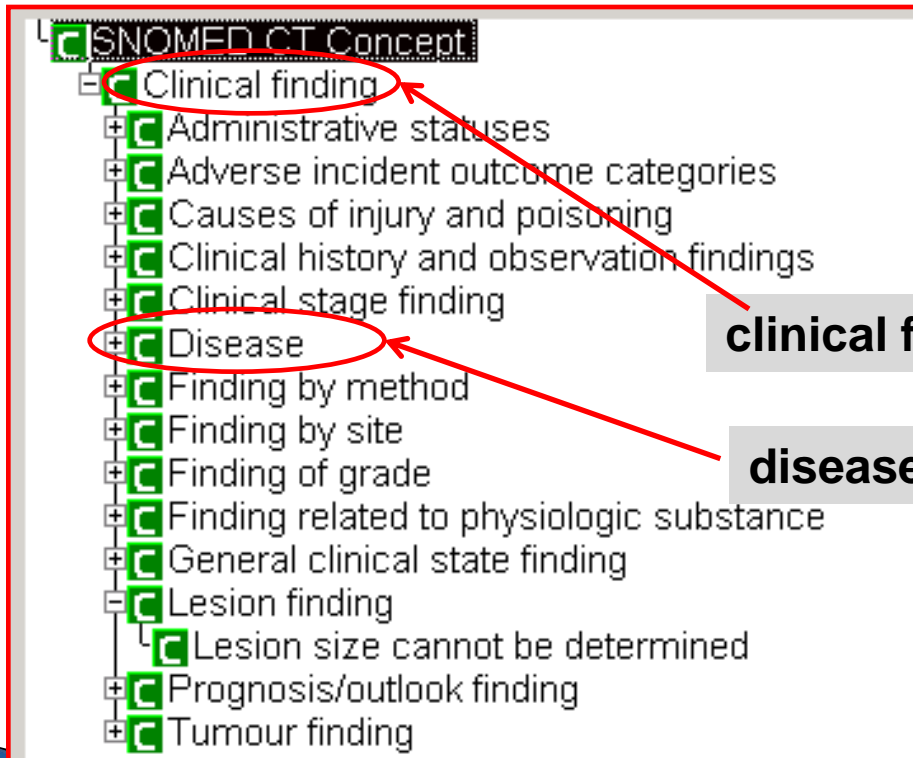
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Pearl

#2 Clinical finding or disorder?

- ▶ Disorder – same as disease
- ▶ *Always abnormal

Disease is a sub hierarchy of clinical findings



clinical finding (finding)

disease (disorder)

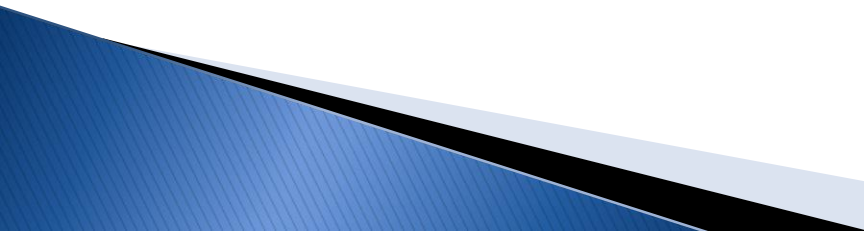
Different FSNs

All Diseases are Clinical Findings

Disease/Disorder

- ▶ pneumonia (disorder)
- ▶ asthma (disorder)
- ▶ chronic obstructive lung disease (disorder)

Clinical Finding

- ▶ decreased breath sounds (finding)
 - ▶ large airway sounds (finding)
 - ▶ dyspnea on exertion (finding)
- 

	Hx and Physical Patient Name...xxx	
<i>Allergies</i>	Penicillin	Disorder
<i>BP</i>	180/95	
<i>Temp</i>	-	
<i>Resp</i>	24	Observable entity
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Body structure

SNOMED CT Concept	Concept Name
123037004	body structure
442083009	anatomical or acquired body structure
91832008	anatomical organizational pattern
258331007	anatomical site notations for tumor staging
118956008	morphologically altered structure
278001007	nonspecific site
361083003	normal anatomy
91722005	physical anatomical entity
21229009	topography not assigned
87100004	topography unknown

“Body structure” includes normal and abnormal structures

Anatomical concepts used to specify the site of a “Procedure” or of a “Clinical finding” are found in this hierarchy

Body structure

- ▶ Lobe of liver (body structure)
- ▶ Mitral valve structure (body structure)
- ▶ Cecum structure (body structure)
- ▶ Bone structure of sternum (body structure)
- ▶ Lung structure (body structure)

Morphologic abnormality

138875005 SNOMED CT Concept	
123037004	body structure
442083009	anatomical or acquired body structure
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278001007	nonspecific site
361083003	normal anatomy
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21229009	topography not assigned
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Sub-hierarchy of “Body structure”

Used for “Clinical finding” concepts as value of “Associated morphology”

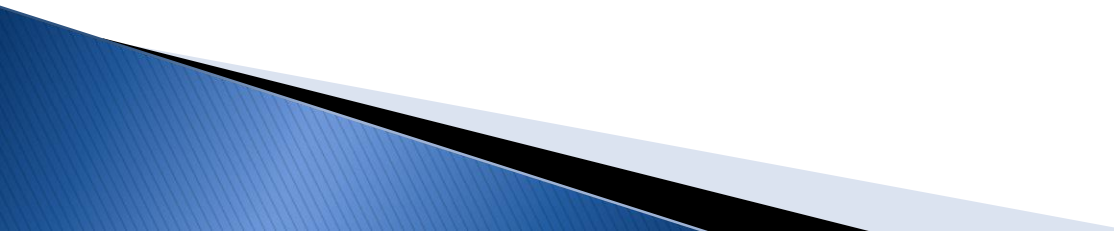
Used for “Procedure” concepts as the value of “Procedure morphology”

Morphologic abnormality

- ▶ Polyp (morphologic abnormality)
- ▶ Plaque (morphologic abnormality)
- ▶ Adenosarcoma (morphologic abnormality)
- ▶ Embolus (morphologic abnormality)
- ▶ Inflammation (morphologic abnormality)
- ▶ Consolidation (morphologic abnormality)

Hx and Physical	
Patient Name...xxx	
<i>Allergies</i>	Penicillin } Disorder
<i>BP</i>	180/95
<i>Temp</i>	-
<i>Resp</i>	24 } Observable entity
<i>Pulse</i>	74
<i>FH</i>	Lung cancer
<i>PMH</i>	Chronic lung disease } Situation with explicit context
<i>Exam</i>	↓ Breath sounds on R } Clinical finding
<i>Dx</i>	Pneumonia } Disorder
<i>Plans</i>	Bronchoscopy, sputum culture } Procedures
	Rx: Amoxicillin 500mg TID X 10d
	ACTION ITEMS

Plans – ACTION ITEMS

- ▶ Diagnostic
Chest X-Ray, Bronchoscopy, Sputum culture
 - ▶ Therapeutic....prescribe medication
Amoxicillin 500 TID X 10 days
 - ▶ Patient Education
Referral to stop-smoking clinic
- 

Procedure

- ▶ Prescription of drug (procedure)
- ▶ Ambulating patient (procedure)
- ▶ Standard chest X-ray (procedure)
- ▶ Lobectomy of lung (procedure)

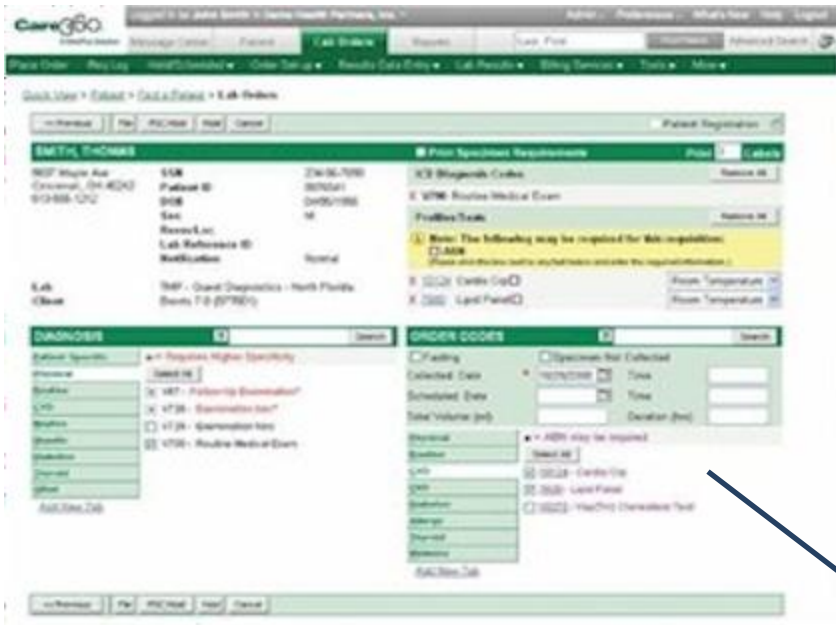
Procedure

- └─ SNOMED CT Concept
 - └─ Procedure
 - └─ Administrative procedure
 - └─ Community health procedure
 - └─ Environmental care procedure
 - └─ General treatment
 - └─ Laboratory procedure
 - └─ Procedure by approach
 - └─ Procedure by device
 - └─ Procedure by intent
 - └─ Procedure by method
 - └─ Procedure by priority
 - └─ Procedure by site
 - └─ Procedure related to anesthesia and sedation
 - └─ Procedure with a clinical finding focus
 - └─ Procedure with a procedure focus
 - └─ Provider-specific procedure
 - └─ Regimes and therapies

Represent ACTIONS

Includes administrative, invasive, diagnostic, imaging and education procedures

How does SNOMED CT relate to what you see?



↓ Breath sounds on R

What you see

} Interface term

SNOMED CT representation of interface term

IS A	58840004	decreased breath sounds
FINDING SITE	34922002	lung field
INTERPRETS	52653008	respiratory sounds
FINDING METHOD	37931006	auscultation
LATERALITY	24028007	right

What you get { Stored terms

How does SNOMED CT relate to what you see?

The screenshot shows a medical software interface with several sections:

- EMR/ E-Orders:** Patient information including name, ID, sex, and location.
- Lab:** Details of a lab order, including the test name and location.
- DIAGNOSIS:** A list of medical conditions with checkboxes.
- ORDER CODES:** A list of codes for the lab order.
- Alert:** A yellow box with a warning icon and the text: "Note: This medication may be contraindicated for this population." Below this, "AMX" is listed as a medication.



Order for Amoxicillin

TRIGGERS ALERT

	Hx and Physical Patient Name...xxx
<i>Allergies</i>	Penicillin
<i>BP</i>	180/95
<i>Temp</i>	-
<i>Resp</i>	24
<i>Pulse</i>	74
<i>FH</i>	Lung cancer
<i>PMH</i>	Chronic lung disease
<i>Exam</i>	↓ Breach sounds on R
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<i>Plans</i>	Bronchoscopy, sputum culture Rx: Amoxicillin 500mg TID X 10d

TRIGGERS ALERT



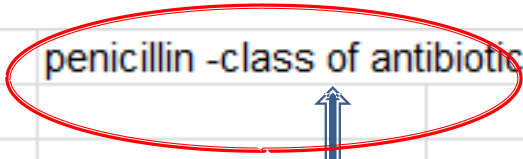
allergy to penicillin (disorder)



PATIENT HISTORY

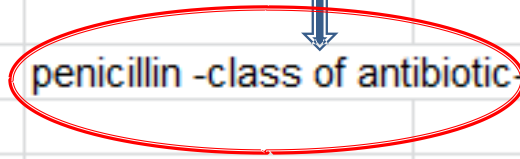
CAUSATIVE AGENT

penicillin -class of antibiotic- (substance)



ALERT TRIGGERED

penicillin -class of antibiotic- (substance)



IS A

broad spectrum penicillins (substance)

IS A

aminopenicillin (substance)

IS A

MEDICATION ORDER



Amoxicillin (product)

HAS ACTIVE INGREDIENT

amoxicillin (substance)



Problem list

- ▶ Diagnoses ← Pneumonia
- ▶ Findings
- ▶ Procedures
- ▶ Allergies ← Allergy to Penicillin

CDS



Abdominal pain
21522001

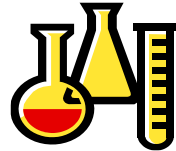
Hemorrhagic diarrhea
95545007

Hemolytic anemia
61261009

Serum creatinine
raised
166717003
(SNOMED CT)

Patient signs and
symptoms

Integration with other code sets



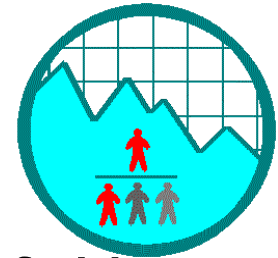
Stool culture + e.coli 0157
(Lab Code)

Lab Result

Hemolytic uremic
syndrome (disorder)
111407006
(SNOMED CT)

Diagnosis

For public health/reporting



Notifiable Disease

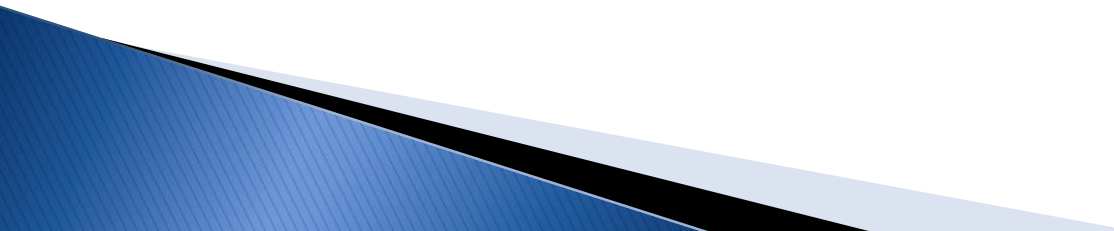
Hemolytic-uremic
Syndrome
283.11
(ICD9CM)

Billing



For administrative
/billing
/statistics

Analysis

- ▶ Can analyze data by different hierarchies
 - ▶ Find all patients with diseases having lung consolidation
 - ▶ Or all procedures done on gastric mucosa
- 

Recommendations for Successful Implementation

- ▶ Begin with products (eHRs) that clinicians use
- ▶ Make interfaces easy and not require SNOMED knowledge by end-users
- ▶ Clinician focus is on patient care
....not searching for codes -not during pt visit
- ▶ Put standards on the back end
- ▶ Help from Informaticists and domain experts
- ▶ Implement only what you understand....includes *meaning* and *context*...Do No Harm!

Thank You

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