

# BioSense: Data Elements, Parsing and Binning Routes

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# Topics

- What are the sources of BioSense data?
- What kind of data elements does BioSense currently receive?
- How does BioSense aggregate chief complaint and ICD-9-CM data into syndromes and sub-syndromes?



# Data Source Overview

- DoD
- VA
- LabCorp
- BioWatch
- Hospital (RT)



# DoD Data

- Department of Defense (DoD) ambulatory care Medical Treatment Facilities (n~490)
  - ICD-9 CM diagnosis codes
  - CPT procedure codes
  - Patient demographics
  - Patient zip code
  - Disposition
- Latency 3-7 days
  - Relatively fast for ICD-9 data
- No patient ID
  - Makes public health follow up difficult



# VA Data

- Veterans Affairs (VA) outpatient medical centers and clinics (n~890)
  - ICD-9 CM diagnosis codes
  - CPT procedure codes
  - Patient demographics
  - Patient zip code
- Latency 3-7 days
  - Relatively fast for ICD-9 data



# LabCorp Data

- Laboratory Corporation of America
  - Reason for test orders (ICD-9-CM)
    - Often unrelated to the test at hand or do not make sense (i.e. prostate problems for females)
  - Diagnostic test orders (no results)
  - Patient demographics
  - Patient zip code
- Latency 2-4 days
- No patient ID
  - Makes public health follow up difficult



# Hospital (RT) Data

- **Source**
  - State/local surveillance systems
  - Individual hospitals/hospital systems
- **Real-time data**
  - Latency varies by data type – real-time can be a misnomer for some data types
- **Foundational (ADT and census):** demographics, chief complaint, diagnoses
  - Chief complaints tend to be very timely (latency = 0-2 days)
  - Diagnoses tend not to be timely (latency  $\geq$  7 days)
  - Hospital census is daily



# Hospital (RT) Data

- **ED Clinical**
- **Laboratory:** microbiology orders and results
- **Pharmacy:** medication orders
- **Radiology:** orders and interpretation results





# Laboratory Data Processing

- Work in progress. Data not currently visualized in the BioSense application
- Mapping LOINC and SNOMED codes to BT agents, notifiable diseases, other diseases of interest, common pathogens (not syndromes or sub-syndromes)
- Some labs send only text results – requires text parsing



# Radiology Data Processing

- Work in progress. Displayed in Patient Detail module of BioSense application, but not currently queryable.
- Mapping free text radiology impressions to pneumonia and fractures (not syndromes and sub-syndromes)
- Requires text parsing (no coded data)



# Pharmacy Data Processing

- Work in progress. Displayed in Patient Detail module of BioSense application, but not currently queriable.
- Mapping drug names (mostly uncoded) to categories of interest - in progress
- Data most complete for inpatient class. Only 20-40% of ED visits have Rx data (likely due to transactions occurring outside the hospital pharmacy system)



# RT Facilities Sending Data

- Total 376 facilities
  - 5 sending Census only
  - 371 send Admit/Transfer/Discharge data
    - 295 from state Syndromic systems, “lite” ADT data
    - 76 sending fuller ADT data



# RT Facilities Sending Data

- Total 371 facilities sending visits
  - Early Indicator Data: 366
  - Working Diagnosis: 104
  - Final Diagnosis: 96



# RT Facilities Sending Data

- Total 371 facilities sending visits
  - Emergency: 364
  - Inpatient: 91
  - Outpatient: 90



# “Bucket” Definitions

Bucket ID	Patient Class	Category Type
11	E	Chief complaint
12	E	Working diagnosis
13	E	Final diagnosis
14	I	Reason for Admit
15	I	Working diagnosis
16	I	Final diagnosis
17	O	Reason for visit
18	O	Working diagnosis
19	O	Final diagnosis



# RT Facilities Sending Data

## Bucket Sources

- Emergency (364)
  - Chief Complaint: 359
    - ADT messaging 353
    - ED Clinical messaging 26
  - Working Diagnosis: 97
  - Final Diagnosis: 95
    - ADT Messaging 94
    - ED Clinical messaging 17





# RT Facilities Sending Data Bucket Sources

- Inpatient (91)
  - Reason for Admit : 91
  - Working Diagnosis: 63
  - Final Diagnosis: 71



# RT Facilities Sending Data Bucket Sources

- Outpatient (90)
  - Reason for Visit : 87
  - Working Diagnosis: 61
  - Final Diagnosis: 70



# RT Facilities Sending Data

## Extended Data Types

- Add on to foundational ADT data
  - Limited to the 76 fuller sites
  - ED Clinical observations
    - 26 Total
    - 26 provide Emergency Chief Complaint
    - 17 provide Emergency Final Diagnosis
  - Laboratory Data
    - 27 send microbiology orders
    - 31 send results



# RT Facilities Sending Data

## Extended Data Types

- Add on to foundational ADT data
  - Radiology Data
    - 30 send orders
    - 41 send results
  - Pharmacy Orders
    - 32 send orders



# RT Facilities Sending Data

## Extended Data Types

- Lab Tests Targeted

IMM: Immunology

MB: Micro

MCB: Mycobacteriology

MYC: Mycology

OSL: Outside Lab (mostly microbiology)

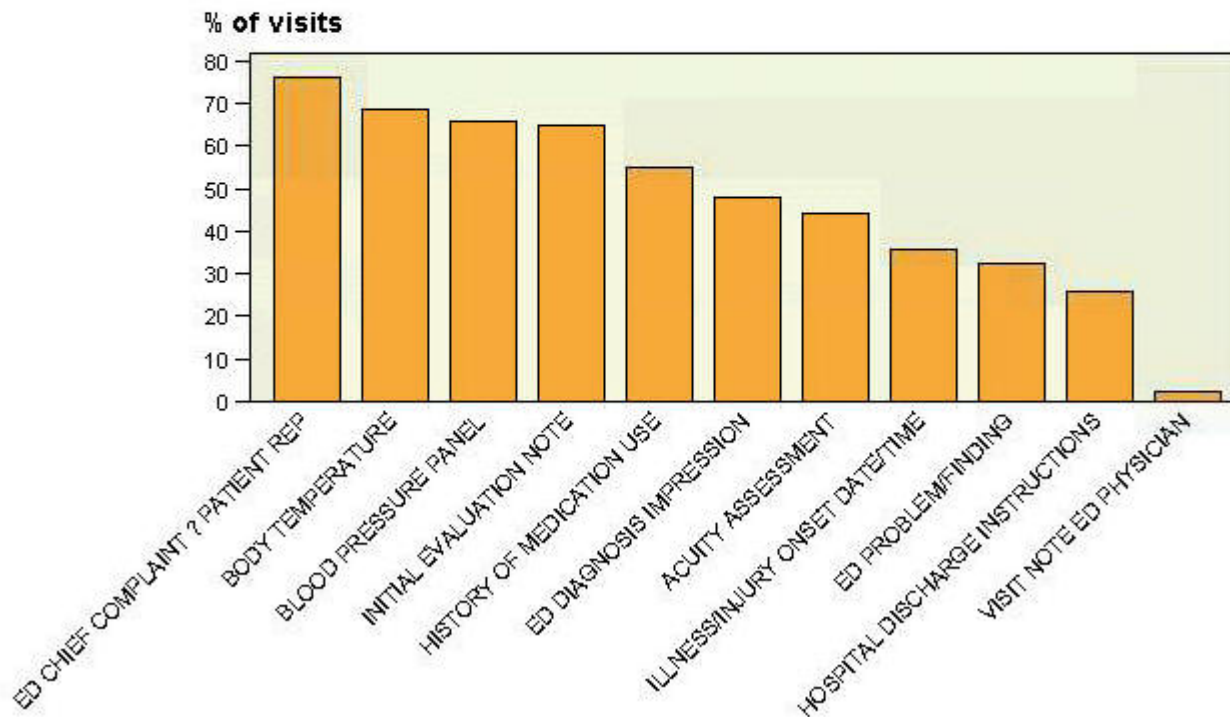
SR: Serology

VR: Virology



# ED Clinical Feeds Observation Messages (OBR/OBX)-Tied to ER systems Influences Binning

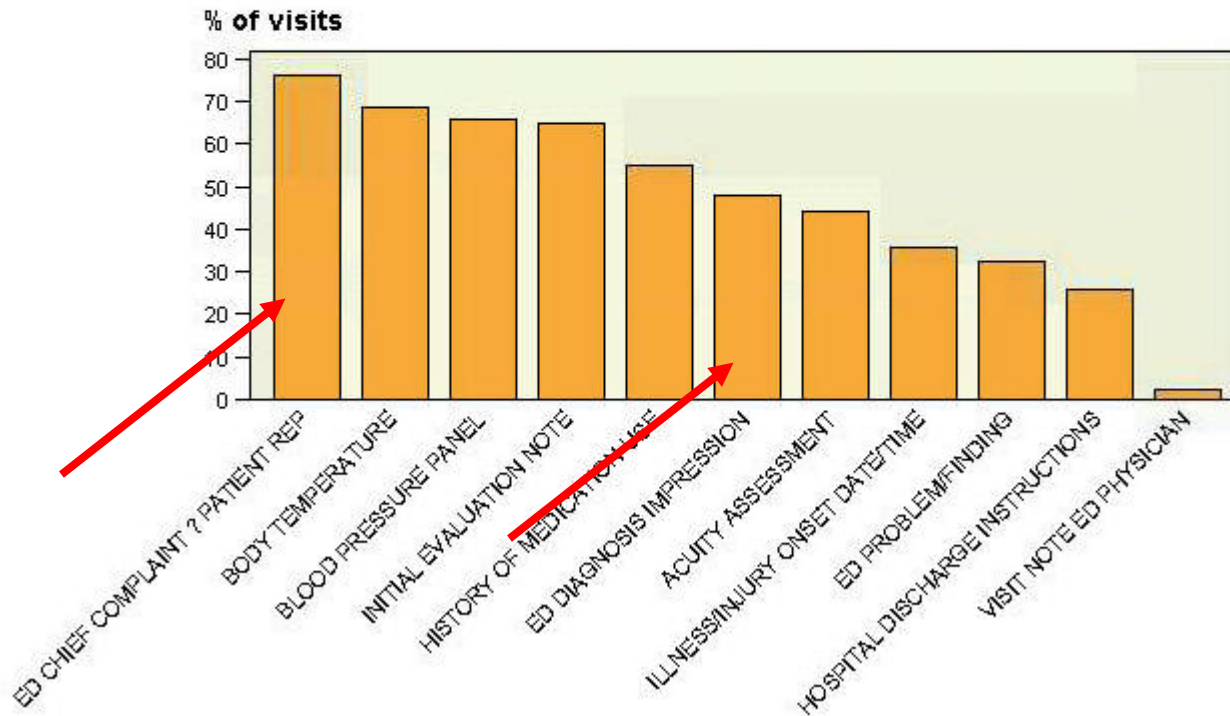
**Biosense ED Clinical Feeds  
Emergency Class only  
Percent of visits per each ED Clinical Category  
Based on Visits in July 2007  
All ED Clinical Feed sites (n=26)**



# ED Clinical Feeds Observation Messages (OBR/OBX) Tied to ER systems

**Biosense ED Clinical Feeds  
Emergency Class only  
Percent of visits per each ED Clinical Category  
Based on Visits in July 2007  
All ED Clinical Feed sites (n=26)**

*Used in parsing/binning to Emergency Chief Complaint and Emergency Final Diagnosis Buckets*



# Percent of Visits with non-blank values Based on Visits July 2007 (all RT sites)

• Patient Class	95%	• Admit Date	87%
• Patient Zip	98%	• Medical Specialty	44%
• Patient State	92%	• Admit Source	35%
• *Patient County	92%	• Discharge Disposition	26%
• Birth yr/mo	94%	• Discharge Date	30%
• *Age	90%	• POC	25%
• Gender	99%	• Admit Type	24%
• Race	44%	• Acuity	3%
• Ethnicity	19%	• Work Related	<1%
		• Admit Level of Care	0%
		• Occupation	
		- Site 1	73%
		- Site 2	48%
		- Others	0%
		• Industry	0%
		• Identity Unknown	0%

\*Calculated via internal CDC process if not reported



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Percent of Visits with non-blank values  
Based on Visits July 2007  
Excluding State Syndromic Sites  
(noted differences)

- Medical Specialty 78%
- Admit Source 61% (96% in Inpatient setting)
- POC 44% (94% in Inpatient setting)
- Admit Type 43% (67% in Inpatient setting)
- Discharge Disposition 45% (71% in Inpatient setting)
- Discharge Date 51% (76% in Inpatient setting)



# Mortality Data

- Facility Counts/Visits Counts

- Facilities sending Visits: 366
  - Sending Census Death Indicator 77
  - Sending one or more Visits Death Indictors 72
  
- Total 17 million visits
  - Deaths indicated in Census: 19,098
  - Deaths Indicated in Visits: 22,021



# Mortality Data

## Visits Death Indicators

- Two Core Indicators in Visits data
  - Disposition Code
  - Patient Death Indicator



# Mortality Data

Parent Name	# of Deaths- Consolidated Visits Death Marker	Disposition Based Death Indicated	# of Deaths- Patient Death Flag Indicated	Sub Syndrome Death	Syndrome Death
<b>TOTAL</b>	<b>22093</b>	<b>20170</b>	<b>10755</b>	<b>575</b>	<b>2250</b>
Aurora Health Care Corporate Office	3570	3205	2782	57	493
BJC Healthcare	1492	1491	1487	46	213
Banner Health	3158	2788	749	157	309
Children's Hospital Boston	224	161	219	2	16
Children's Hospital Los Angeles	106	95	79	2	6
Cook County Bureau of Health	623	623	0	7	22
Cook County Department of Public Health	6	0	6	3	3
Denver Health and Hospital Authority	306	0	306	9	39
Gwinnett Health System	1072	1000	268	30	40
Johns Hopkins Hospital and Health System	330	330	0	1	71
MedStar Health	1461	1461	0	11	113
Methodist Healthcare	1024	1024	0	32	144
Mount Carmel Health System	1944	1921	240	121	235
Oregon Health Sciences University	3	0	3	0	1
Saint Luke's Health System	598	542	569	21	104
Sharp HealthCare	2240	1827	1648	41	71
Sierra Providence Health Network	842	842	691	14	137
Tenet Healthcare Corporation	399	399	397	5	73
Thomas Jefferson University Hospital	1110	942	1015	1	25
University Medical Center Las Vegas	1138	1072	296	9	127
University of California San Diego Healthcare	447	447	0	6	8

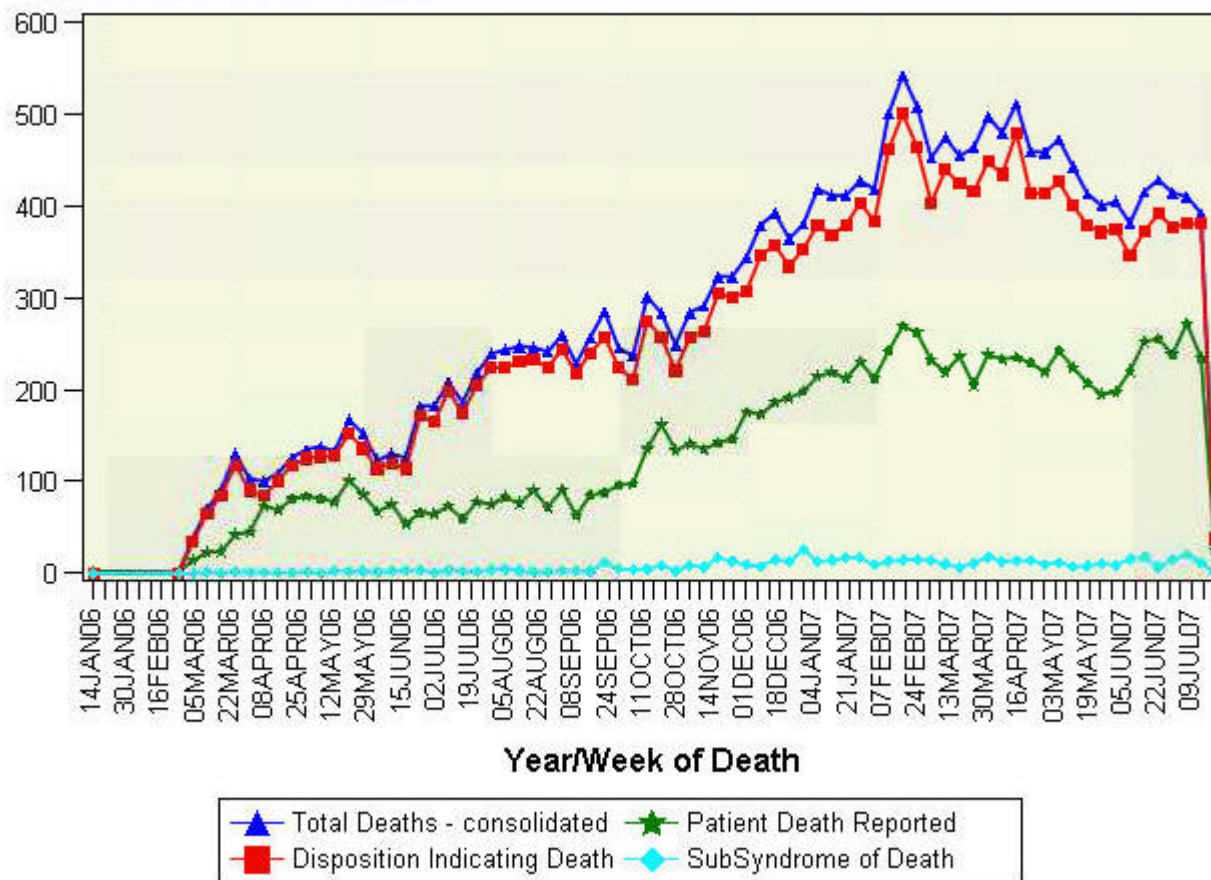


# Mortality Data

## # of Deaths

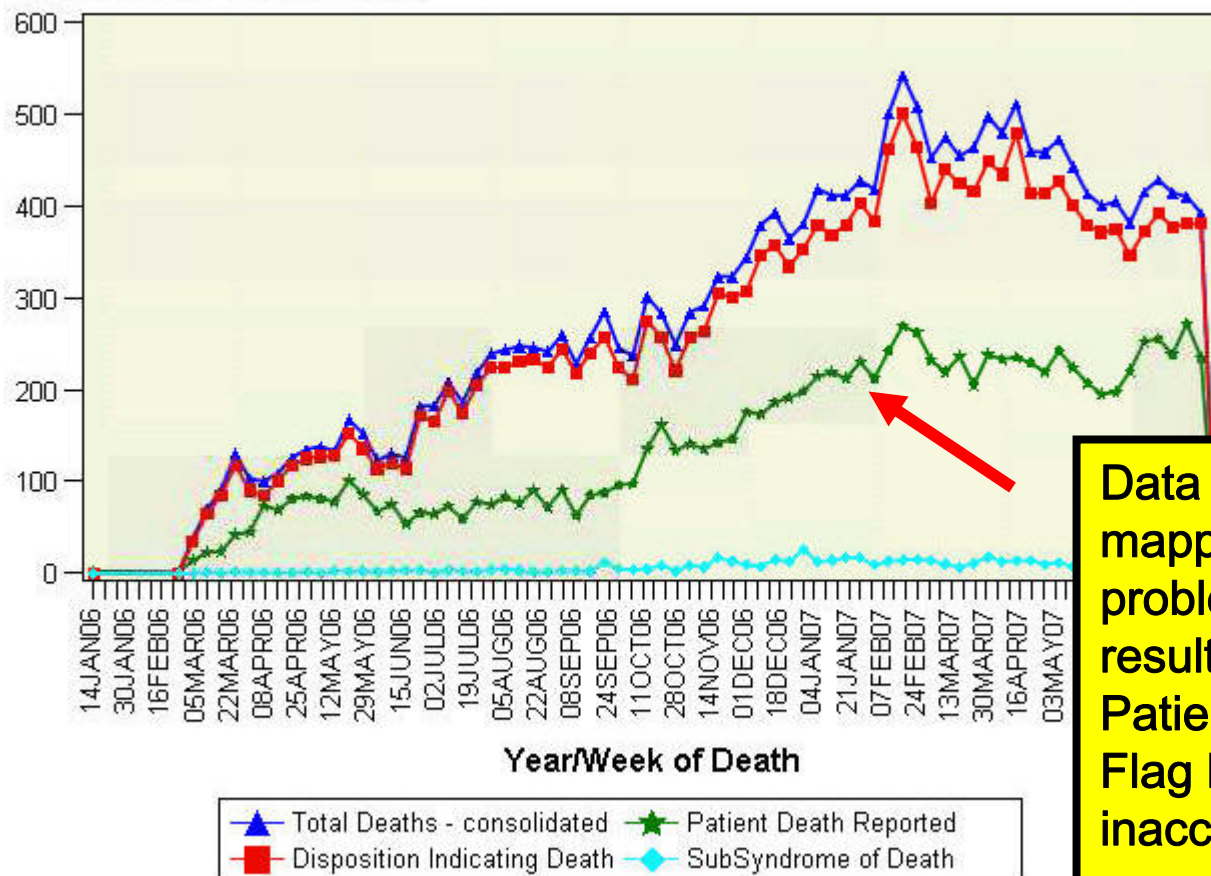
### Stratified by various Visits Death Indicators

Total Deaths - consolidated



# Mortality Data # of Deaths Stratified by various Visits Death Indicators

Total Deaths - consolidated



Data Feed mapping problems result in Patient Death Flag being inaccurate





## **Syndrome Definitions for Diseases Associated with Critical Bioterrorism-associated Agents**

### ***Participating Agencies:***

National Center for Infectious Diseases and Epidemiology Program Office, Centers for Disease Control and Prevention, Atlanta, Georgia

Division of Preventive Medicine, Walter Reed Army Institute of Research, Silver Spring, Maryland

Emergency Medical Associates of New Jersey Research Foundation, Livingston, New Jersey

Bureau of Epidemiology Services, New York City Department of Health and Mental Hygiene, New York City, New York

Harvard Medical School and Harvard Pilgrim Health Care, Boston, Massachusetts

**Botulism-like**

**Hemorrhagic Illness**

**Lymphadenitis**

**Localized Cutaneous Lesion**

**Gastrointestinal**

**Respiratory**

**Neurological**

**Rash**

**Specific Infection**

**Fever**

**Severe Illness or Death**



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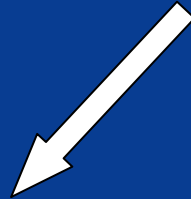
### **Resp ICD-9-CM Code List**

<b>ICD9CM</b>	<b>ICD9DESCR</b>	<b>Consensus</b>
020.3	PRIMARY PNEUMONIC PLAGUE	1
020.4	SECONDARY PNEUMON PLAGUE	1
020.5	PNEUMONIC PLAGUE NOS	1
021.2	PULMONARY TULAREMIA	1
022.1	PULMONARY ANTHRAX	1
460	NASOPHARYNGITIS, ACUTE	1
462	PHARYNGITIS, ACUTE NOS	1
463	TONSILLITIS, ACUTE	1
464.00	LARYNGITIS, AC.W/O OBSTRU	1
464.01	LARYNGITIS, AC.W/OBSTRUCT	1
464.10	TRACHEITIS W/O OBSTRUCTIO	1
464.11	AC TRACHEITIS W OBSTRUCT	1
464.20	LARYNGOTRACHEITIS W/O OBS	1
464.21	AC LARYNGOTRACH W OBSTR	1
464.30	EPIGLOTTITIS ACUTE W/O OB	1
464.31	AC EPIGLOTTITIS W OBSTR	1
464.4	CROUP	1
464.50	SUPRAGLOTTIS,UNS.W/O OBST	1
464.51	SUPRAGLOTTIS,UNS.W/ OBST	1
465.0	LARYNGOPHARYNGITIS, ACUTE	1
465.8	URI, OTHER MULT. SITES	1
465.9	URI, ACUTE NOS	1
466.0	BRONCHITIS ACUTE	1

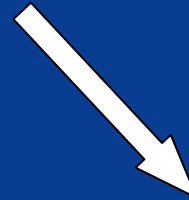




**Syndrome**



**Sub-syndrome**



**Sub-syndrome**

**Sub-syndrome**



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# Data Types Mapped to Syndromes and Sub-syndromes

- Outpatient
  - Reason for visit
  - Working diagnosis
  - Final diagnosis
- ED
  - Chief complaint
  - Working diagnosis
  - Final diagnosis
- Inpatient
  - Reason for admit
  - Working diagnosis
  - Final diagnosis

Note: Data must have a valid patient class (Outpatient, ED, or Inpatient) and data type (Reason for Visit, Chief Complaint, Reason for Admit, Admit Diagnosis, Working Diagnosis, Final Diagnosis) to be visualized in the application.



# Sub-syndrome to Syndrome Mapping

- Botulism-like

- Paralysis
- Speech disturbance
- Dysphagia

- Fever

- Fever
- Septicemia and bacteremia
- Viral infection, unspecified

- Gastrointestinal

- Abdominal pain
- Anorexia
- Diarrhea
- Food poisoning
- Intestinal infections, ill-defined
- Nausea and vomiting



# Sub-syndrome to Syndrome Mapping

- **Hemorrhagic**
  - Coagulation defects
  - Gastrointestinal hemorrhage
  - Hemorrhage
  - Purpura and petechia
- **Cutaneous lesion**
  - Insect bites
  - Skin infection
- **Lymphadenitis**
  - Lymphadenopathy
- **Neurological**
  - Alteration of consciousness
  - CNS, inflammatory disease
  - Convulsions
  - Gait abnormality
  - Headache
  - Meningismus
  - Photophobia



# Sub-syndrome to Syndrome Mapping

- **Respiratory**
  - Asthma
  - Bronchitis and bronchiolitis
  - Chest pain
  - Cough
  - Cyanosis and hypoxemia
  - Dyspnea
  - Influenza-like illness
  - Otitis media
  - Pleurisy
  - Pneumonia and lung abscess
- **Respiratory (continued)**
  - Respiratory failure
  - RSV
  - Upper respiratory infections
  - Hemoptysis
- **Rash**
  - Rash
- **Severe Illness and Death**
  - Coma
  - Death
  - Shock



# Other Sub-syndromes (Not Mapped to Syndromes)

- Bites, animal
- Burns
- Carbon monoxide poisoning
- Falls
- Fractures and dislocation
- Heat, excessive
- Injury, NOS
- Motor vehicle traffic accidents
- Open wound
- Poisoning by medicines
- Sprains and strains
- Cerebrovascular disease
- COPD
- Diabetes mellitus
- Heart disease, ischemic
- Hypertension
- Neoplasms
- Allergy
- Anemia
- Cardiac dysrhythmias
- Dehydration
- Dizziness
- Edema
- Hypotension
- Jaundice
- Malaise and fatigue
- Mental disorders
- Migraine
- Myalgia
- Numbness
- Pregnancy, childbirth complications
- Syncope and collapse
- Urinary tract infection
- Visual impairment



**Syndrome**

**Sub-syndrome**

**Diagnosis  
Keywords**

**Chief  
Complaint  
Keywords**

**ICD-9-CM**

**ICD-9-CM**



# ICD-9 to Sub-syndrome: Pneumonia and Lung Abscess

- ICD-9-CM
  - 480.X Viral Pneumonia
  - 481 Pneumococcal Pneumonia
  - 482.X Other bacterial pneumonia
  - 483.X Pneumonia due to other specified organism
  - 484.X Pneumonia in other infectious disease
  - 485 Bronchopneumonia, organism unspecified
  - 486 Pneumonia, organism unspecified
  - 513.X Abscess of lung and mediastinum





# Free Text CC to Sub-syndrome: Pneumonia and Lung Abscess

atelectasis	w
empyema	w
infiltr	w
infiltrate	w
lung problem	i
pna	w
pne	w
pnemonia	i
pneumonia	i
pnumonia	i
pneumonitis	w

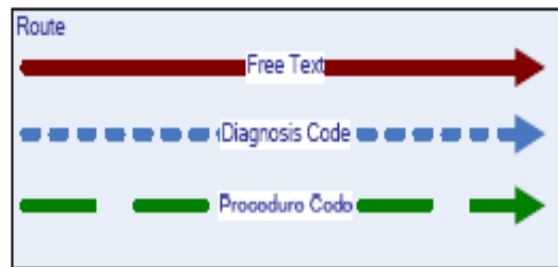
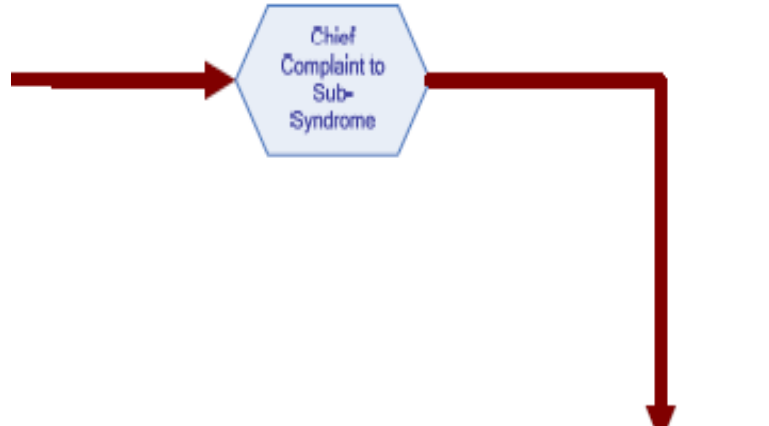


# Free Text Diagnosis to Sub-syndrome: Pneumonia and Lung Abscess

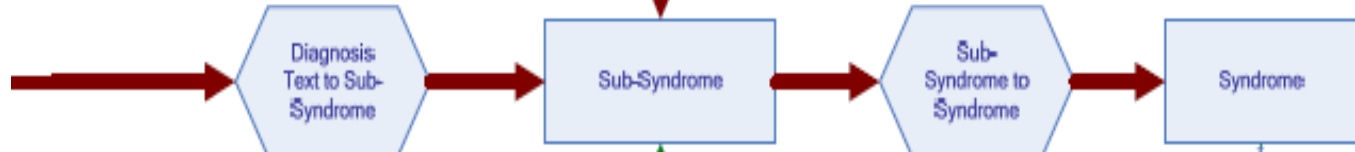
abscess + lung	i
abscess + pulmonary	i
bronchiectasis	i
bronchopneumonia	i
lung + inflam	i
mediasti + inflam	i
pneumonia	i
pneumonitis	i
pulmonary + inflam	i



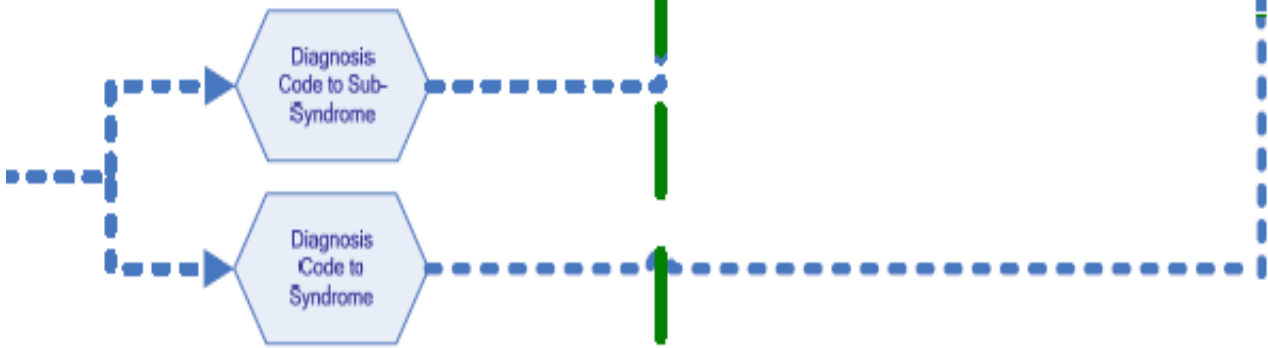
Free Text Chief Complaint



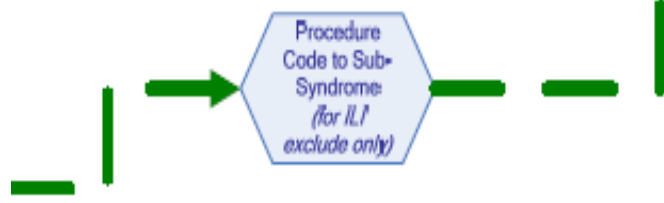
Free Text Diagnosis



ICD-9 Coded Diagnosis



CPT Code



Emergency: Chief Complaint  
Outpatient: Reason for Visit

Free Text  
Chief  
Complaint

Inpatient: Reason for Admit

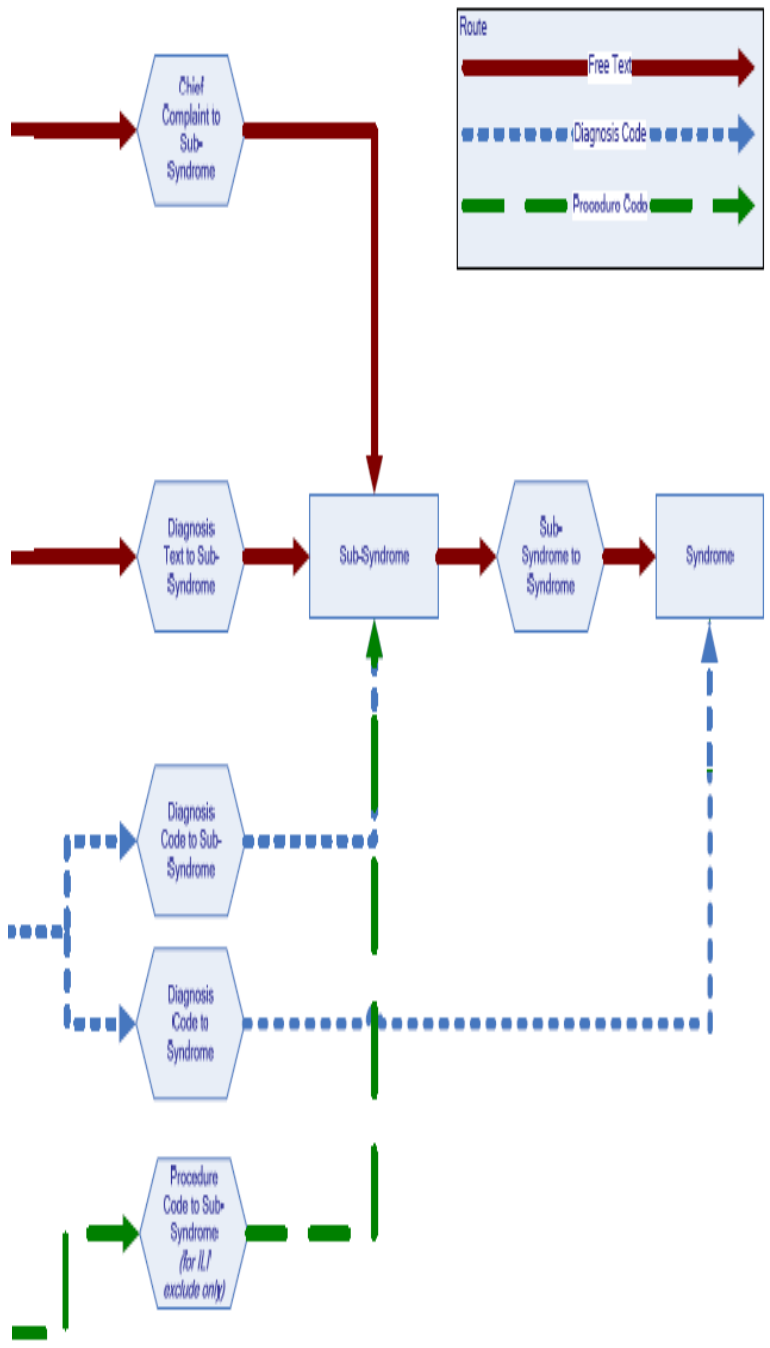
Free Text  
Diagnosis

Emergency, Outpatient, Inpatient  
• Working Diagnosis  
• Final Diagnosis  
• Other Diagnosis

ICD-9  
Coded  
Diagnosis

Emergency, Outpatient, Inpatient

CPT Code



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# Accounting for Vaccinations

- We want to exclude vaccination events from contributing to syndromes and sub-syndromes
  - Ex: A patient is vaccinated for anthrax and receives a final ICD-9 code for anthrax, as well as an ICD-9 or CPT code indicating that the patient also received an anthrax vaccination. If we use our mapping rules as they are, this patient will be mapped to a syndrome based on their anthrax diagnosis. Since this was really a vaccination event, we do not want to count this patient as meeting our syndrome definition. We need to exclude this patient based on a defined set of rules.
- Completed for the VA and DoD data for all vaccine preventable diseases
- Completed for the hospital data for influenza only
  - More complicated due to both free text and coded data
  - Full implementation targeted for a future release



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