BioSense: Developing Nearly Real-Time Laboratory Surveillance Capacities for Emergency Preparedness and Response

Nikolay Lipskiy, DrPH, Jerome I. Tokars, MD, MPH, Armen Asatryan, MD, MPH and Roseanne English. Division of Emergency Preparedness and Response, National Center for Public Health Informatics, CDC

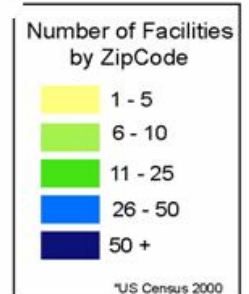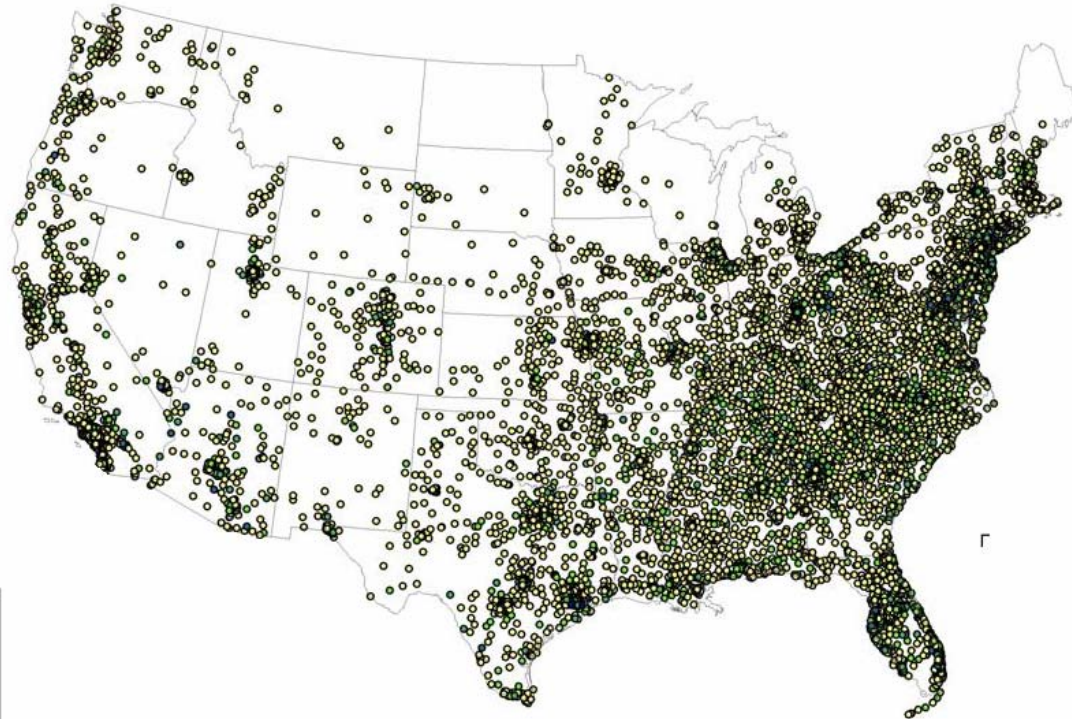**SAFER • HEALTHIER • PEOPLE™**

Background

- BioSense is a national program intended to improve the nation's capabilities for conducting real-time biosurveillance and health situational awareness through access to existing data from healthcare organizations.

- Chief complaint and/or diagnosis data are received from over 360 federal hospitals.

- Currently BioSense collects laboratory results from 30 hospitals in 9 states (mostly inpatient visits).

- BioSense collects microbiological results from outpatient visits in 49 states (w/o Hawaii) and Puerto Rico through one of national laboratories

- All providers send data to CDCusing the Public Health Information Network Messaging System (PHINMS) and HL7 standards.

SAFER • HEALTHIER • PEOPLE™

Data Sources for the National Laboratory

Number of Facilities by ZipCode

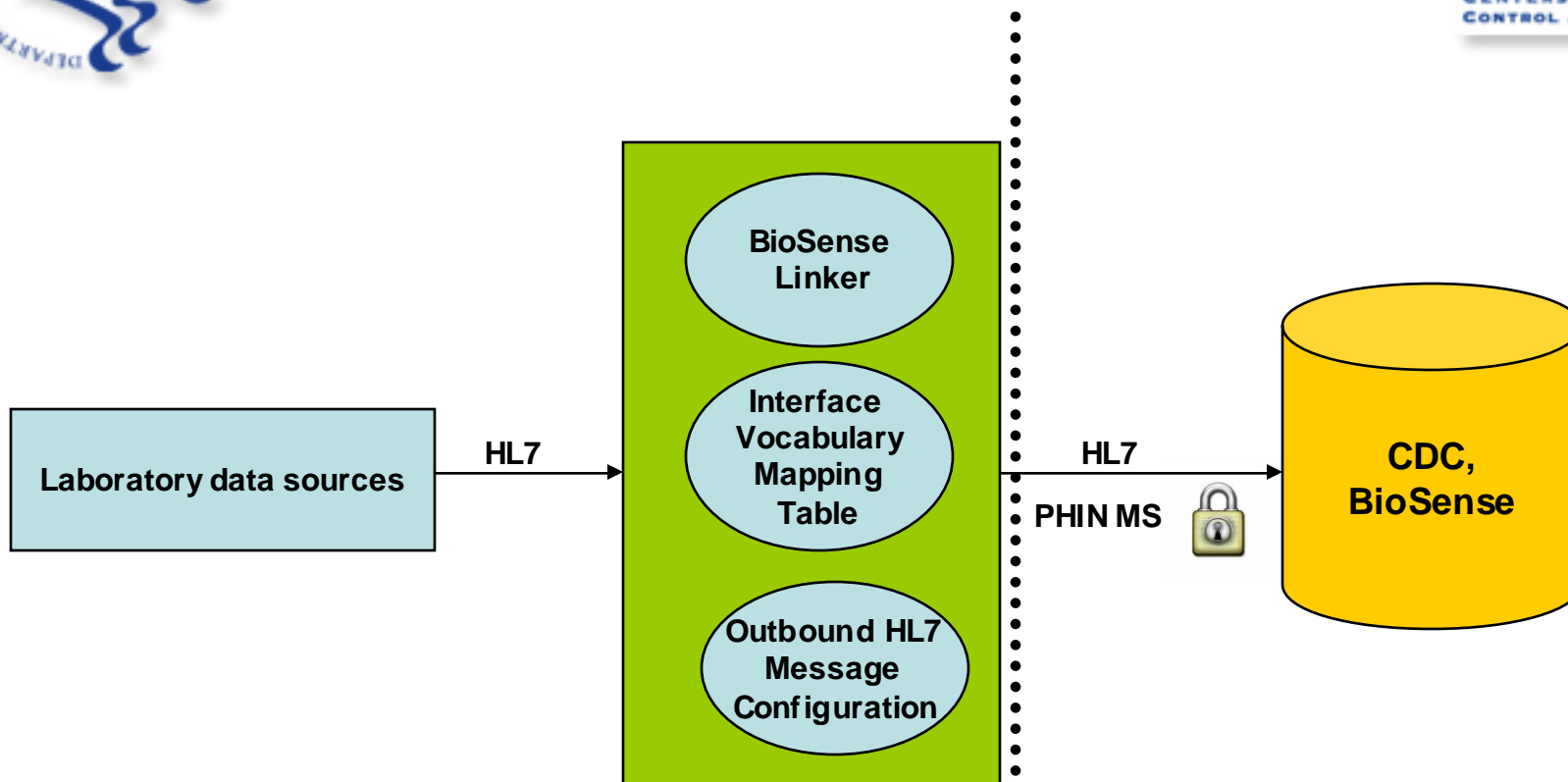|	
	1 - 5
	6 - 10
	11 - 25
	26 - 50
	50 +

*US Census 2000

SAFER • HEALTHIER • PEOPLE™

AL • CHRONIC DISEASE PREVENTION • INFECTIOUS DISEASE PROTECTION • IMMUNIZATION • INJURY PREVENTION • PRI
CHILD HEALTH • GLOBAL PARTNERSHIPS • MINORITY OUTREACH • MONITORING HEALTH • COMMUNITY PARTNERSHIPS
SAFER • HEALTHIER • PEOPLE • SAFER • HEALTHIER • PEOPLE • SAFER • HEALTHIER • PEOPLE • SAFER • HEA
HEALTH EDUCATION • EPIDEMIOLOGY • WORKPLACE HEALTH • IMMUNIZATION • WORKPLACE SAFETY • TRAINING • C
LTH • PREVENTION RESEARCH • PRIVATE SECTOR PARTNERSHIPS • PUBLIC HEALTH WORKFORCE • WOMEN'S HEALTH

BioSense Laboratory Data Provisioning

PHIN Vocabulary Access and Distribution System (VADS)

SAFER • HEALTHIER • PEOPLE™

Utilization of Vocabulary Mapping Tools

Flowchart Displaying Processes for a Semi-automated Retrieval of Microorganisms
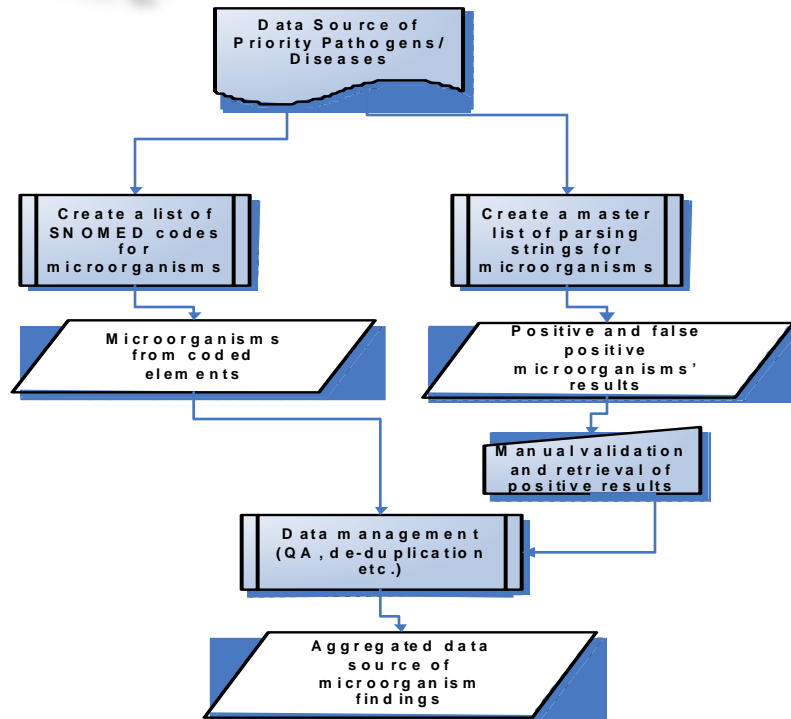
- ❖ **automated retrieval of microorganisms from coded elements;**

- ❖ **automated retrieval of free-text records containing parsing words-targets;**

- ❖ **manual analysis of records from the task #2 and validation of positive findings, and**

- ❖ **automated aggregation of results from tasks 1 and 3.**

SAFER • HEALTHIER • PEOPLE™

HL7 Version 2.x : is it the Best Solution for Laboratory Data Users?

Version 2.x	Version 3.x
Focus: Syntax, and Communications	Focus: Semantics, and **use** of information at the receiving end
Less explicit; free	More explicit; formal
Lacks models and vocabulary	Based on conceptual models and vocabulary
Bar-encoded syntax (EDI, +XML alternative)	XML syntax, (XML schemas enforce concept definitions)

Source: http://www.dhs.ca.gov/dcdc/disb/nedss/docs/Nancy%20v1%20CCLHDM%20NEDSS%20102202.ppt

SAFER • HEALTHIER • PEOPLE™

Tracking Microorganisms by Parsing OBX Messages : Examples

1. Example of a real message (OBX 5)

PROCEDURE: PEDIATRIC BLOOD CULTURE COLLECTED: 11/27/2006 10:30
SOURCE: BLOOD-Peripheral STARTED: 11/27/2006 11:46 BODY SITE: ACCESSION:
06-331-01714 FREE TEXT SOURCE: *** STAINS / PREPARATIONS *** Gram Stain
Report Verified:11/28/2006 21:19 Gram Negative Bacilli Phoned Gram Stain results to:
MJ REILLY, RN PEDS 11/28/2006 9:19:01 PM BY CBEALS Read back was completed
*** FINAL REPORT *** Final Report Verified:12/05/2006 20:37 Salmonella species
SEROTYPE PARATYPHI B Organi sm sent to ### for confirmation. Called to H.Dias
/peds 11/30/2006 8:03:16 AM D.Hall *** SUSCEPTIBILITY RESULTS *** Salmonella
species MDIL MINT Ampicillin <=0.25 S Cefotaxime <=4 S Ci profloxacin <=0.5 S
Trimethoprim/Sulfa <=10 S S=Susceptible, I=Intermediate, R=Resistant, N/A=Not
Applicable _____

2. Dealing with direct and indirect negations in text strings:

- "BACILLUS SPECIES, NOT BACILLUS ANTHRACIS"

- "BACILLUS SP., NOT B. CEREUS OR ANTHRACIS"

SAFER • HEALTHIER • PEOPLE™

AL • CHRONIC DISEASE PREVENTION • INFECTIOUS DISEASE PROTECTION • IMMUNIZATION • INJURY PREVENTION • PRI
CHILD HEALTH • GLOBAL PARTNERSHIPS • MINORITY OUTREACH • MONITORING HEALTH • COMMUNITY PARTNERSHIPS
SAFER • HEALTHIER • PEOPLE • SAFER • HEALTHIER • PEOPLE • SAFER • HEALTHIER • PEOPLE • SAFER • HEA
HEALTH EDUCATION • EPIDEMIOLOGY • WORKPLACE HEALTH • IMMUNIZATION • WORKPLACE SAFETY • TRAINING • C
LTH • PREVENTION RESEARCH • PRIVATE SECTOR PARTNERSHIPS • PUBLIC HEALTH WORKFORCE • WOMEN'S HEALTH

Dealing with Cases of Incomparability of Local Codes for Laboratory Procedures and LOINC Standards

Example of local codes for laboratory procedures

OrderedTest CodeLocal	Ordered TestNameLocal
MICV	METHOD MICV
GPMIC	METHOD GPMIC
MICVF	METHOD MICVF
MICVN	METHOD MICVN
SMIC	METHOD SMIC
UPMIC	METHOD UPMIC
WAMIC	METHOD WAMIC
WAMICU	METHOD WAMICU
BCQ	BRONCHIAL CULT,QUANT
CAFBS	MYCOBACTERIA CUL/SMR
CDAB	C.DIFFICILE TOXINS
CLOBX	H.PYLORI UREASE TEST
DD	METHOD DD
DISK	METHOD DISK
ENPCS	ENTERIC PATH CUL/SMR
ETESTA	METHOD ETESTA
FUSM	FUNGAL SMEAR
GIARDI	GIARDIA/CRYPTO DFA
GRAS	GRAM SMEAR
NCP	METHOD NCP
QTIS	QUANT TISSUE CULTURE

Local susceptibility tests

SAFER • HEALTHIER • PEOPLE™

Using Standard Codes for Microorganisms vs. Parsing Text Strings: Are Standard Codes a Panacea?

Example: Findings for Nontyphoidal Salmonellosis in 2006

Results from Coded Elements (N=42)

Results from Text Strings (N=28)

Results from Coded Elements pie chart:
- 26% — Specific Taxonomic Categories of Salmonella
- 74% — Salmonella Species

Results from Text Strings pie chart:
- 25% — Salmonella, serogroup D
- 75% — S. typhimurium

SAFER · HEALTHIER · PEOPLE™

Comparing Results from Hospital Laboratories and a National Laboratory

• **Most frequently hospital laboratories are suppliers of results from inpatient and ER visits. In a contrast, the national laboratory is processing samples from outpatient visits**

• **In most cases the "strength" of clinical symptoms of outpatient patients is lower than inpatient patients. Probably, it explains a phenomenon that microorganisms with the highest toxicity intend to be more frequently in inpatient results while outpatient results incline to report results regarding a commensal flora**

• **Testing of microorganisms for a resistance to antibiotics in outpatient settings is less common than in hospitals**

SAFER • HEALTHIER • PEOPLE™

AL • CHRONIC DISEASE PREVENTION • INFECTIOUS DISEASE PROTECTION • IMMUNIZATION • INJURY PREVENTION • PRI
CHILD HEALTH • GLOBAL PARTNERSHIPS • MINORITY OUTREACH • MONITORING HEALTH • COMMUNITY PARTNERSHIPS
SAFER • HEALTHIER • PEOPLE • SAFER • HEALTHIER • PEOPLE • SAFER • HEALTHIER • PEOPLE • SAFER • HEA
HEALTH EDUCATION • EPIDEMIOLOGY • WORKPLACE HEALTH • IMMUNIZATION • WORKPLACE SAFETY • TRAINING • C
LTH • PREVENTION RESEARCH • PRIVATE SECTOR PARTNERSHIPS • PUBLIC HEALTH WORKFORCE • WOMEN'S HEALTH
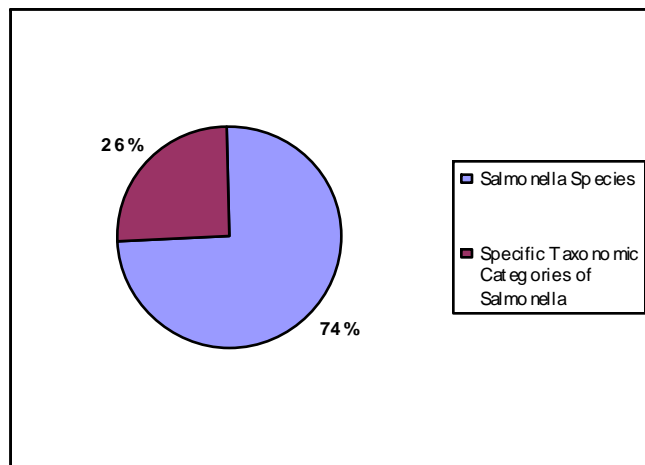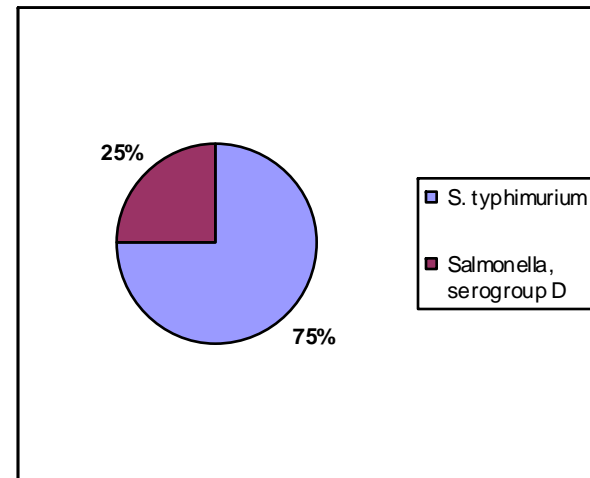
Development of Case Definitions for the Electronic Laboratory Surveillance of Notifiable Diseases
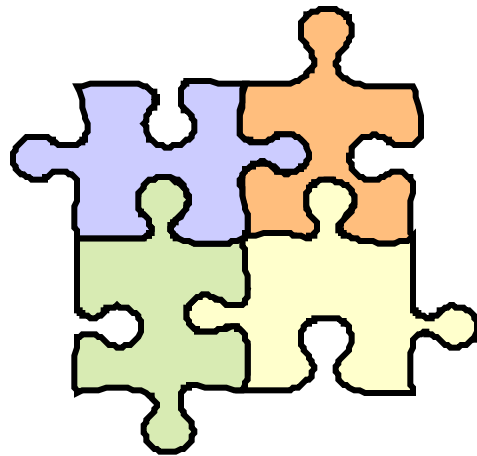
Vol. 46 / No. RR-10   MMWR   5

Laboratory HL7 Messages

Electronic Cases

Definition of Terms Used in Case Classification

Clinically compatible case: a clinical syndrome generally compatible with the disease, as described in the clinical description.

Confirmed case: a case that is classified as confirmed for reporting purposes.

Epidemiologically linked case: a case in which a) the patient has had contact with one or more persons who either have/had the disease or have been exposed to a point source of infection (i.e., a single source of infection, such as an event leading to a foodborne-disease outbreak, to which all confirmed case-patients were exposed) and b) transmission of the agent by the usual modes of transmission is plausible. A case may be considered epidemiologically linked to a laboratory-confirmed case if at least one case in the chain of transmission is laboratory confirmed.

Laboratory-confirmed case: a case that is confirmed by one or more of the laboratory methods listed in the case definition under Laboratory Criteria for Diagnosis. Although other laboratory methods can be used in clinical diagnosis, only those listed are accepted as laboratory confirmation for national reporting purposes.

Probable case: a case that is classified as probable for reporting purposes.

Supportive or presumptive laboratory results: specified laboratory results that are consistent with the diagnosis, yet do not meet the criteria for laboratory confirmation.

Suspected case: a case that is classified as suspected for reporting purposes.

SAFER • HEALTHIER • PEOPLE™

AL • CHRONIC DISEASE PREVENTION • INFECTIOUS DISEASE PROTECTION • IMMUNIZATION • INJURY PREVENTION • PRI
CHILD HEALTH • GLOBAL PARTNERSHIPS • MINORITY OUTREACH • MONITORING HEALTH • COMMUNITY PARTNERSHIPS
SAFER • HEALTHIER • PEOPLE • SAFER • HEALTHIER • PEOPLE • SAFER • HEALTHIER • PEOPLE • SAFER • HEA
HEALTH EDUCATION • EPIDEMIOLOGY • WORKPLACE HEALTH • IMMUNIZATION • WORKPLACE SAFETY • TRAINING • C
LTH • PREVENTION RESEARCH • PRIVATE SECTOR PARTNERSHIPS • PUBLIC HEALTH WORKFORCE • WOMEN'S HEALTH

Working with Laboratory Data : Several Tips for Improvement of Efficiency.

1. Regenstrief LOINC Mapping Assistant Software*, RELMA: Defining Laboratory Codes for Microorganisms (Example)

Source: http://www.regenstrief.org/medinformatics/loinc/relma

SAFER • HEALTHIER • PEOPLE™

Working with Laboratory Data : Several Tips for Improvement of Efficiency.

2. HL7 Messaging Workbench: Parsing Original Messages*

Working with Laboratory Data : Several Tips for Improvement of Efficiency.

3. HL7 Messaging Workbench: Validating Definitions of Messages*
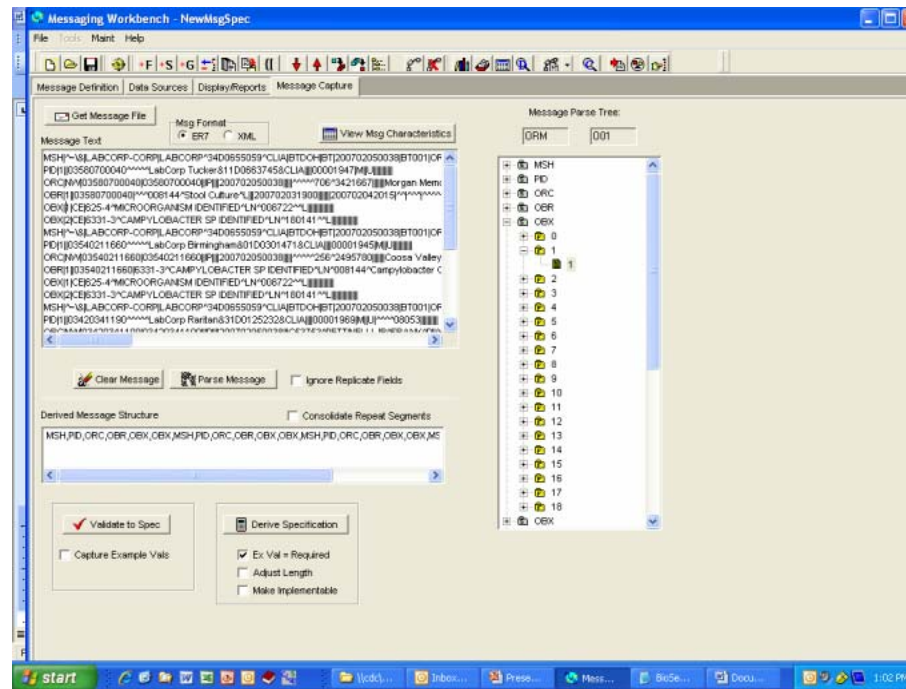
* Messaging WorkBench, version 1.6.6.20, author Peter Rontey, at:
http://www.hl7.org/lib_admin/docs.cfm?dir=library/committees/conf&comm=conf

Working with Laboratory Data : Several Tips for Improvement of Efficiency.

4. HL7 Messaging Workbench: Creating Error Reports*

SAFER • HEALTHIER • PEOPLE™

Working with Laboratory Data : Several Tips for Improvement of Efficiency.

5. Using Microorganism Browsers for validation of SNOMED codes. Example: NCI Terminology Browser*

Streptococcus (organism)
- Anaerobic streptococcus (organism)
- Carbon dioxide-dependent streptococcus (organism)
- Hemolytically variant streptococcus (organism)
  - Beta-hemolytic streptococcus (organism)
  - Non-Beta-hemolytic Streptococcus (organism)
    - Alpha non-hemolytic streptococcus (organism)
    - Alpha prime hemolytic streptococcus (organism)
    - Alpha-hemolytic streptococcus (organism)
      - Streptococcus mitis group (organism)
      - Streptococcus pneumoniae (organism)

Concept Details

Bookmark this page

Streptococcus pneumoniae (organism)   Printable Page   History

Identifiers:

name	Streptococcus pneumoniae (organism)
code	L-25116

Information about this concept:

Code in Source	9861002
Concept Status	Current
NHS Clinical Terms Version 3	X73GQ
SNOMED Legacy-style Code	L-25116
SNOMED_PREFERRED_TERM	Streptococcus pneumoniae
SNOMED_TERM	Diplococcus pneumoniae
SNOMED_TERM	Pneumococcus
SNOMED_TERM	Streptococcus pneumoniae (organism)
UMLS CUI	C0038410
UMLS Semantic Type	Bacterium
subset	H
subset	NAV_CTV3

Superconcepts

- Alpha-hemolytic streptococcus (organism)
- Gram-positive diplococcus (organism)

Source:
http://nciterms.nci.nih.gov/NCIBrowser/Connect.do?bookmarktag=1&dictionary=SNOMED_CT&licensetag=true&code=null
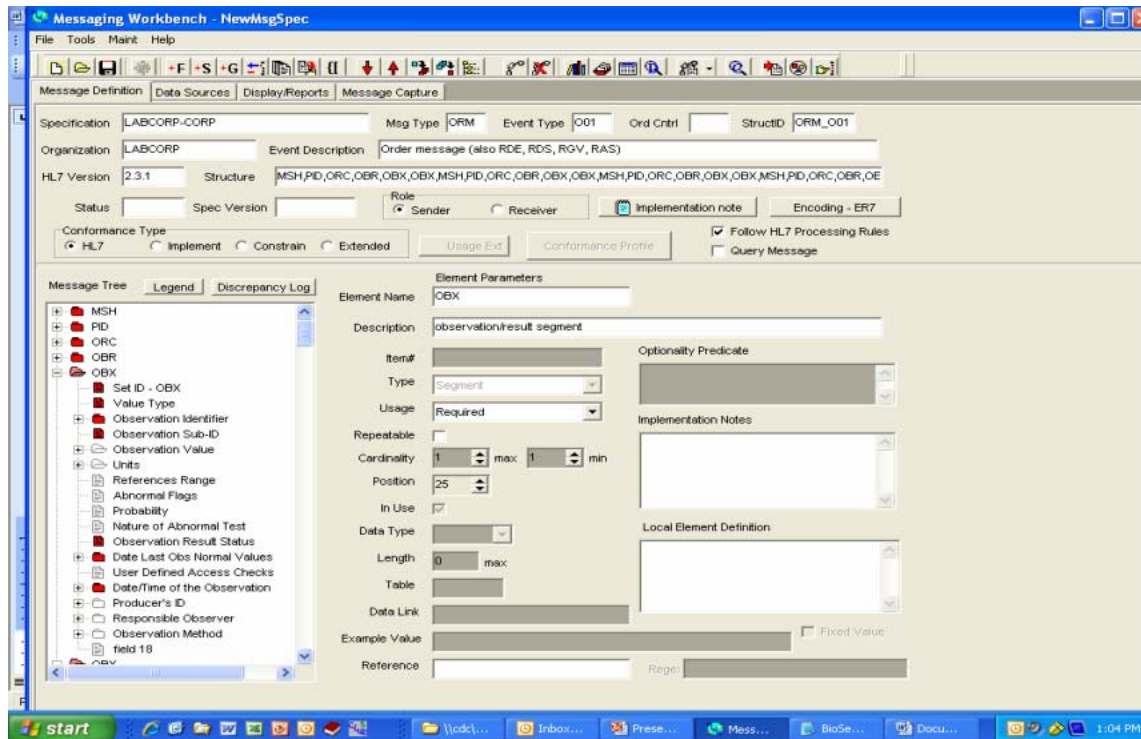
SAFER • HEALTHIER • PEOPLE™

AL • CHRONIC DISEASE PREVENTION • INFECTIOUS DISEASE PROTECTION • IMMUNIZATION • INJURY PREVENTION • PRI CHILD HEALTH • GLOBAL PARTNERSHIPS • MINORITY OUTREACH • MONITORING HEALTH • COMMUNITY PARTNERSHIPS SAFER • HEALTHIER • PEOPLE • SAFER • HEALTHIER • PEOPLE • SAFER • HEALTHIER • PEOPLE • SAFER • HEA HEALTH EDUCATION • EPIDEMIOLOGY • WORKPLACE HEALTH • IMMUNIZATION • WORKPLACE SAFETY • TRAINING • C LTH • PREVENTION RESEARCH • PRIVATE SECTOR PARTNERSHIPS • PUBLIC HEALTH WORKFORCE • WOMEN'S HEALTH
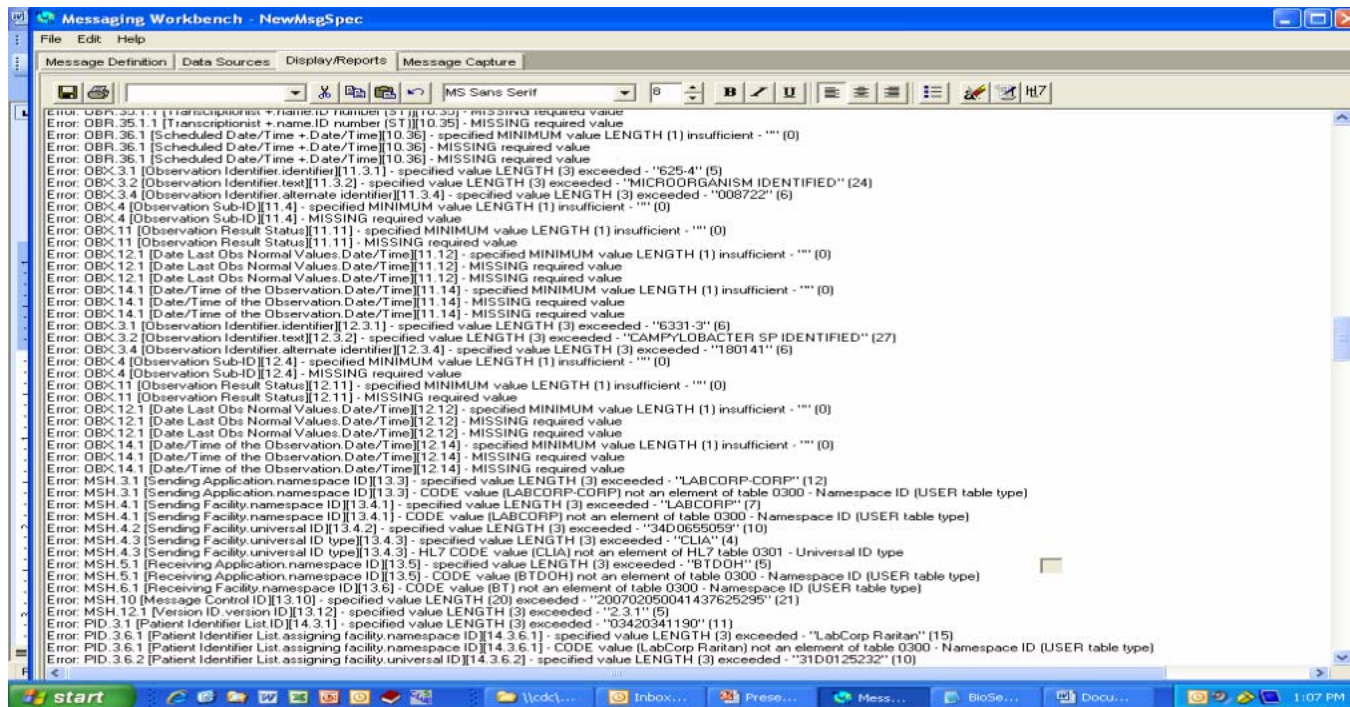
Conclusions

- **Lack of standardization continues to be the major challenge in a development of laboratory biosurveillance**

- **Development and implementation of automated and semi-automated algorithms for data processing significantly reduce a burden of tracking of pathogenic microorganism from various data sources**

- **Further efforts should be undertaken for a promotion and utilization HL7 v.3.x messages**

- **BioSense continues to be one of major tools for investigation and testing of further public health laboratory activities**

SAFER · HEALTHIER · PEOPLE™

Questions?

??????????????

Contact us:

Nikolay Lipskiy, DrPH, Division of Emergency Preparedness and Response, National Center for Public Health Informatics, CDC

E-mail: dgz1@cdc.gov

SAFER • HEALTHIER • PEOPLE™

AL • CHRONIC DISEASE PREVENTION • INFECTIOUS DISEASE PROTECTION • IMMUNIZATION • INJURY PREVENTION • PRI
CHILD HEALTH • GLOBAL PARTNERSHIPS • MINORITY OUTREACH • MONITORING HEALTH • COMMUNITY PARTNERSHIPS
SAFER • HEALTHIER • PEOPLE • SAFER • HEALTHIER • PEOPLE • SAFER • HEALTHIER • PEOPLE • SAFER • HEA
HEALTH EDUCATION • EPIDEMIOLOGY • WORKPLACE HEALTH • IMMUNIZATION • WORKPLACE SAFETY • TRAINING • C
LTH • PREVENTION RESEARCH • PRIVATE SECTOR PARTNERSHIPS • PUBLIC HEALTH WORKFORCE • WOMEN'S HEALTH