



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

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## Background



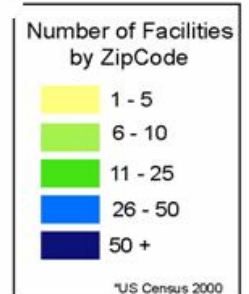
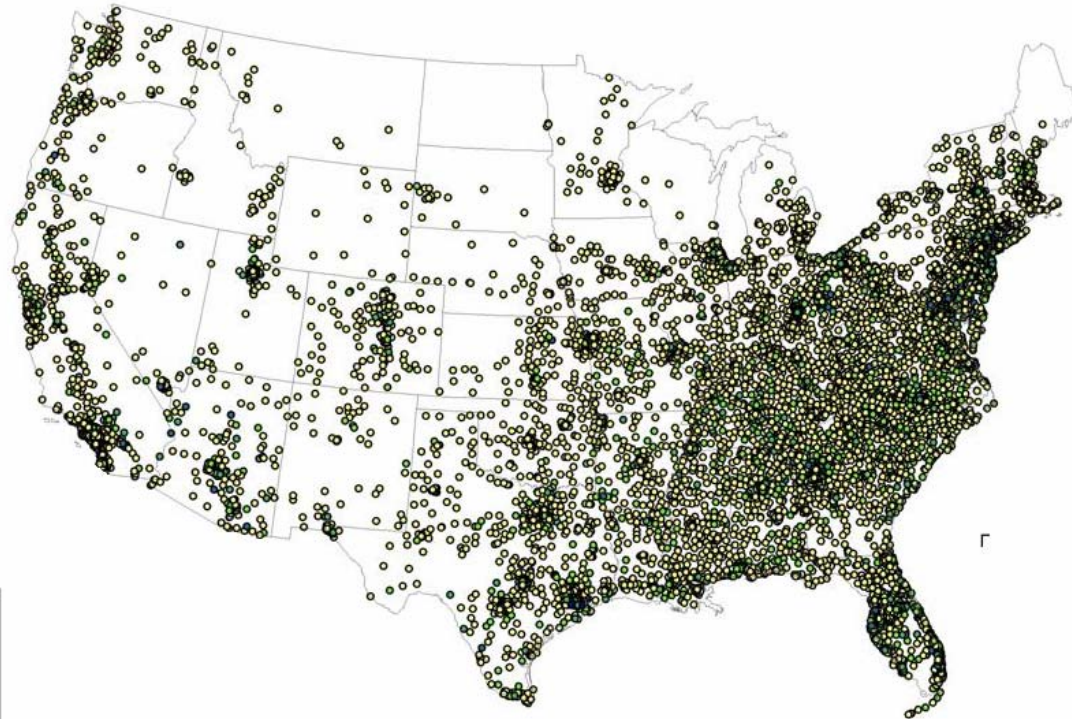
- BioSense is a national program intended to improve the nation's capabilities for conducting real-time biosurveillance and health situational awareness through access to existing data from healthcare organizations.
- Chief complaint and/or diagnosis data are received from over 360 federal hospitals.
- 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 CDC using the Public Health Information Network Messaging System (PHINMS) and HL7 standards.

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## Data Sources for the National Laboratory

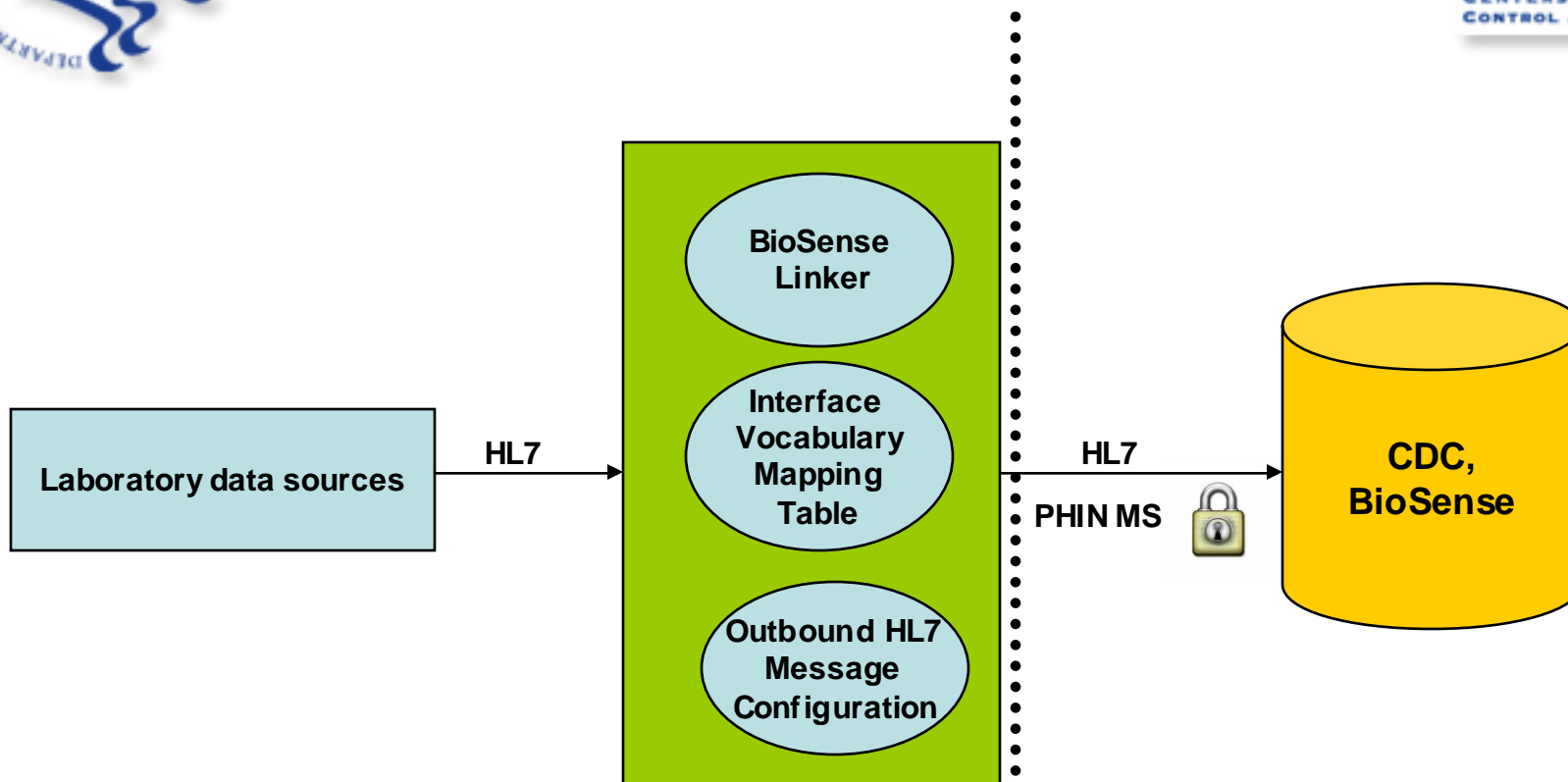


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# BioSense Laboratory Data Provisioning



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# PHIN Vocabulary Access and Distribution System (VADS)



Source:

<http://www.cdc.gov/PhinV5Browser/StrutsController.do>

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# Utilization of Vocabulary Mapping Tools



Microsoft Excel - CDC BS Vocab Map Tool - v1.04a.xls

File Edit View Insert Format Tools Data Window Help Adobe PDF

Type a question for help

C95 Test code/description as known by the laboratory; identifies individual drugs tested at this level

| 1  | Data Type         | Data Element                                  | Description  | HL7 Context Segment/File                   | Datatype | Translation complexity | Recommended Vocabulary                 | TRANSLATION Requirement | Send Local codes |
|----|-------------------|---|--|--|----------|------------------------|--|-------------------------|------------------|
| 78 | Lab Micro Results | BioSense Patient ID                           | Unique identifier created by the BioSense integrator application to allow the healthcare facility to track non-identified BioSense data back to a patient's medical record within the healthcare facility.   | PID-3 Patient Identifier List              | CX       |                        |  |                         |                  |
| 79 | Lab Micro Results | BioSense Visit ID                             | Unique identifier created by the BioSense integrator application to allow the healthcare facility to track non-identified BioSense data back to the corresponding visit record or records within the facility.   | PID-18 Account Number                      | CX       |                        |  |                         |                  |
| 80 | Lab Micro Results | Reporting laboratory                          | Reporting laboratory identifier and name   | MSH-3 Sending Application                  | HD       |                        | CLIA number if available               | None                    | Yes              |
| 81 | Lab Micro Results | <a href="#">Diagnostic Service Section ID</a> | Identifies the department that performed the service.  | OBR-24 Diagnostic Service Section ID       | ID       |                        | PHVS_DiagnosticServiceSectionID_HL7_2x | None                    | Yes              |
| 82 | Lab Micro Results | Performing laboratory                         | Performing laboratory id and name (may be different for referral lab testing)  | OBX-15 Producer's ID                       | CE       |                        | CLIA number if available               | None                    | Yes              |
| 83 | Lab Micro Results | <a href="#">Result Status</a>                 | Status of the report (preliminary, final, corrected). This field is required in a result message, and is typically used where the level of detail does not need to be at the individual observation level (OBX-11). This element was added to support the B.xid. | OBR-25 Result Status                       | ID       |                        | PHVS_ResultStatus_HL7_2x               | Mandatory               | No               |
| 84 | Lab Micro Results | Report date/time                              | Report Date - applies to entire message as a report, not to individual results   | OBR-22 Results Rpt/Status Change Date/Time | TS       |                        |  |                         |                  |
| 85 | Lab Micro Results | Collection date                               | Sample collection date   | OBR-7 Observation Date/Time                | TS       |                        |  |                         |                  |
| 86 | Lab Micro Results | Collection method                             | Specimen collection method, e.g. (swab, bronchoscopy, phlebotomy), if present in the   | OBR-15.3 Collection Method                 | TX       |                        |  |                         |                  |

Filter Mode

NUM

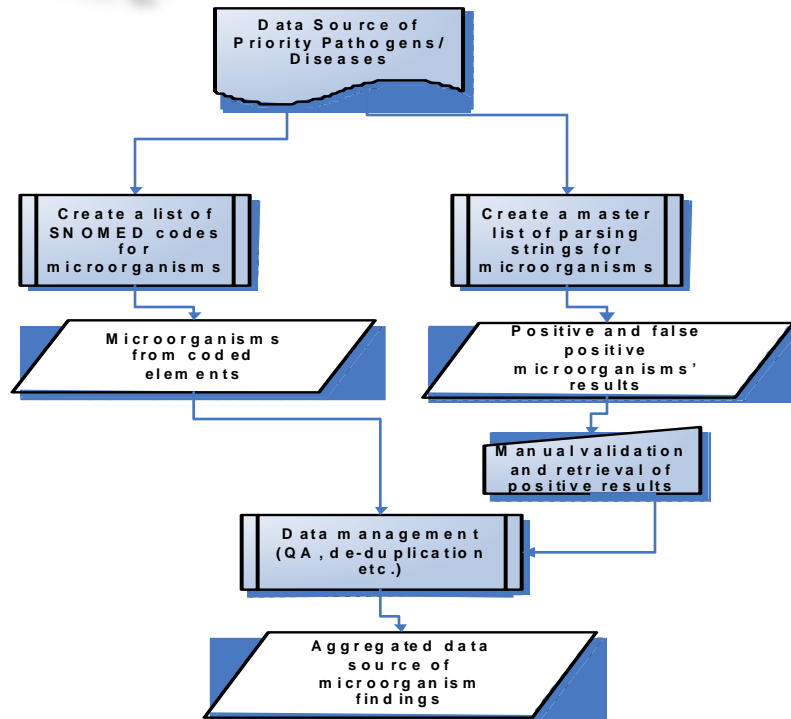
start | L:\Data Sources | Inbox - Micros... | Presentation1... | Microsoft Excel... | 10:25 AM

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## 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.

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## 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 <u>use</u> 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>

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# 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 PARATYPHIB** Organism 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 Ciprofloxacin <=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”

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



Example of local codes for laboratory procedures

| OrderedTest CodeLocal | OrderedTestNameLocal |
|-----------------------|----------------------|
| 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

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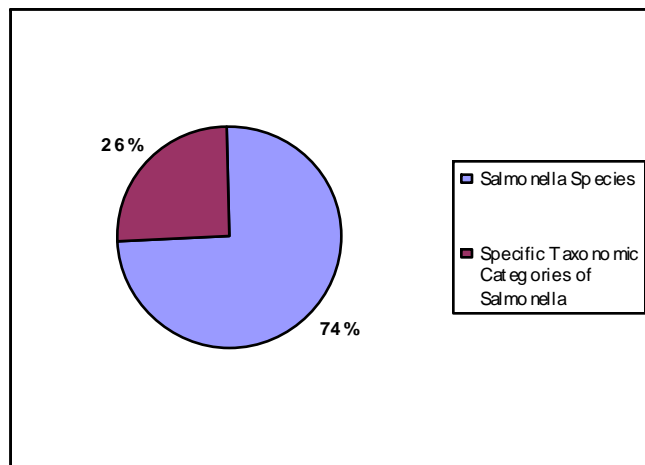


# Using Standard Codes for Microorganisms vs. Parsing Text Strings: Are Standard Codes a Panacea?

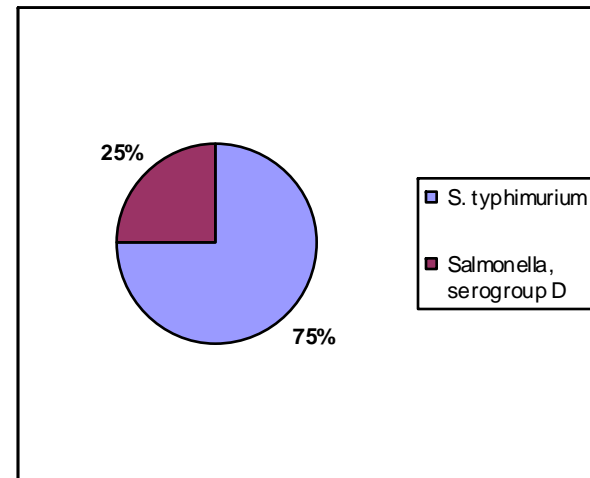


Example: Findings for Nontyphoidal Salmonellosis in 2006

Results from Coded Elements (N=42)



Results from Text Strings (N=28)



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## 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

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# Development of Case Definitions for the Electronic Laboratory Surveillance of Notifiable Diseases

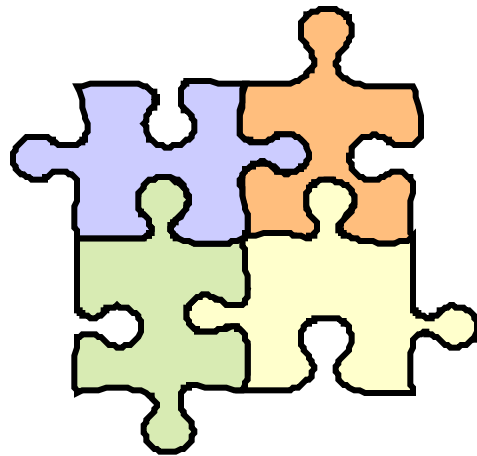


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## Laboratory HL7 Messages



## 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.

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



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

The screenshot shows the 'Map Local Terms - SAMPLE' software interface. The search term 'ANTHRAX' is entered in the 'Extra Search Words' field. The results table below shows 15 rows of data:

| Row | Short Common Name           | LOINC # | Component             | Property | Time | System  | Scale |
|-----|-----------------------------|---------|-----------------------|----------|------|---------|-------|
| 1   | B anthracis Ab Ser IB-aCnc  | 11467-8 | Bacillus anthracis Ab | ACnc     | Pt   | Ser     | Qn    |
| 2   | B anthracis Ab XXX IF-aCnc  | 11468-6 | Bacillus anthracis Ab | ACnc     | Pt   | XXX     | Qn    |
| 3   | B anthracis XXX QI Cult     | 11469-4 | Bacillus anthracis    | ACnc     | Pt   | XXX     | Ord   |
| 4   | B anthracis Ab XXX-aCnc     | 22109-3 | Bacillus anthracis Ab | ACnc     | Pt   | XXX     | Qn    |
| 5   | B anthracis Ab Titr Ser     | 22859-3 | Bacillus anthracis Ab | ACnc     | Pt   | Ser     | Qn    |
| 6   | B anthracis Ab Ser QI       | 22860-1 | Bacillus anthracis Ab | ACnc     | Pt   | Ser     | Ord   |
| 7   | B anthracis Ab Ser QI ID    | 22861-9 | Bacillus anthracis Ab | ACnc     | Pt   | Ser     | Ord   |
| 8   | B anthracis Ab Ser QI Aggl  | 22862-7 | Bacillus anthracis Ab | ACnc     | Pt   | Ser     | Ord   |
| 9   | B anthracis Ab Ser QI EIA   | 22863-5 | Bacillus anthracis Ab | ACnc     | Pt   | Ser     | Ord   |
| 10  | B anthracis Ab Ser QI CF    | 22864-3 | Bacillus anthracis Ab | ACnc     | Pt   | Ser     | Ord   |
| 11  | B anthracis Ab Titr Ser ID  | 22865-0 | Bacillus anthracis Ab | ACnc     | Pt   | Ser     | Qn    |
| 12  | B anthracis Ag Tissue QI IF | 22866-8 | Bacillus anthracis Ag | ACnc     | Pt   | Tiss    | Ord   |
| 13  | B anthracis Ag XXX QI IF    | 22867-6 | Bacillus anthracis Ag | ACnc     | Pt   | XXX     | Ord   |
| 14  | B anthracis Ag XXX QI       | 31726-3 | Bacillus anthracis Ag | ACnc     | Pt   | XXX     | Ord   |
| 15  | B anthracis Ag Titr QI IF   | 33697-4 | Bacillus anthracis Ag | ACnc     | Pt   | Isolate | Ord   |

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

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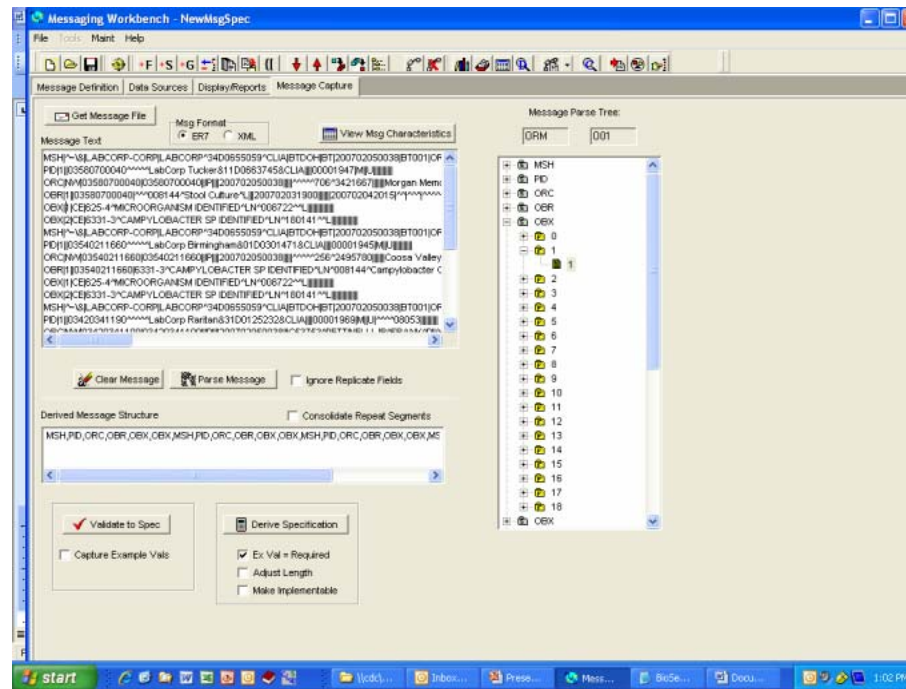
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# Working with Laboratory Data : Several Tips for Improvement of Efficiency.



## 2. HL7 Messaging Workbench: Parsing Original 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](http://www.hl7.org/lib_admin/docs.cfm?dir=library/committees/conf&comm=conf)

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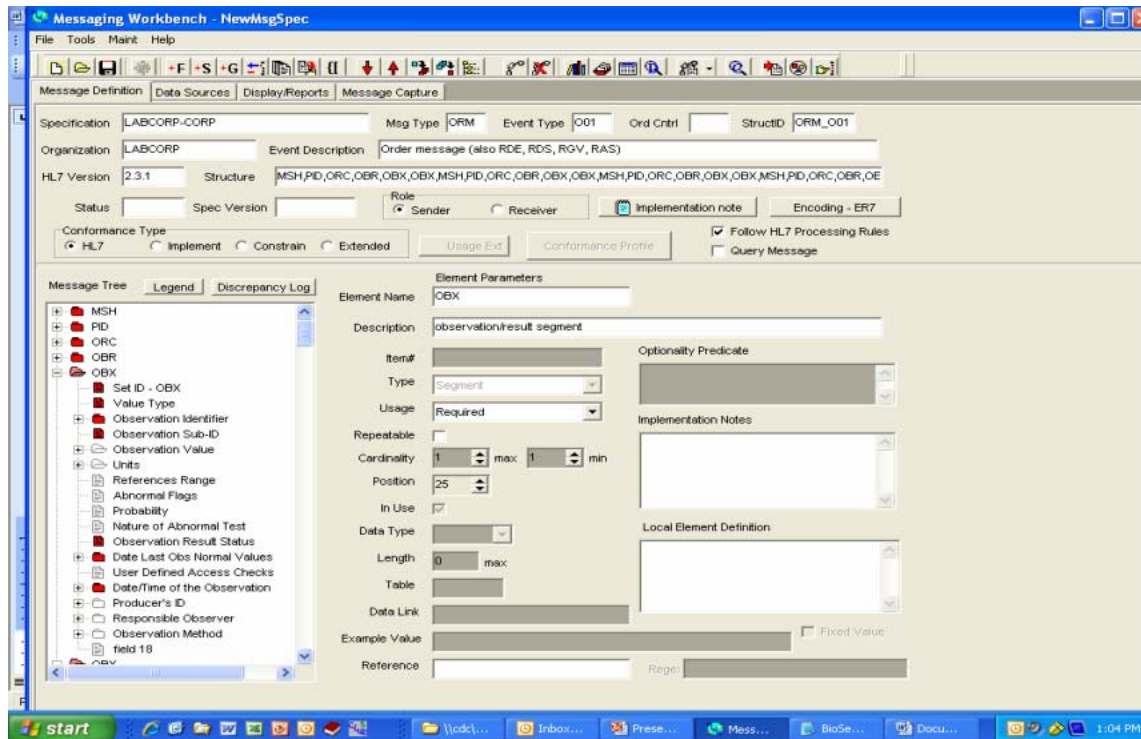
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# Working with Laboratory Data : Several Tips for Improvement of Efficiency.



## 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](http://www.hl7.org/lib_admin/docs.cfm?dir=library/committees/conf&comm=conf)

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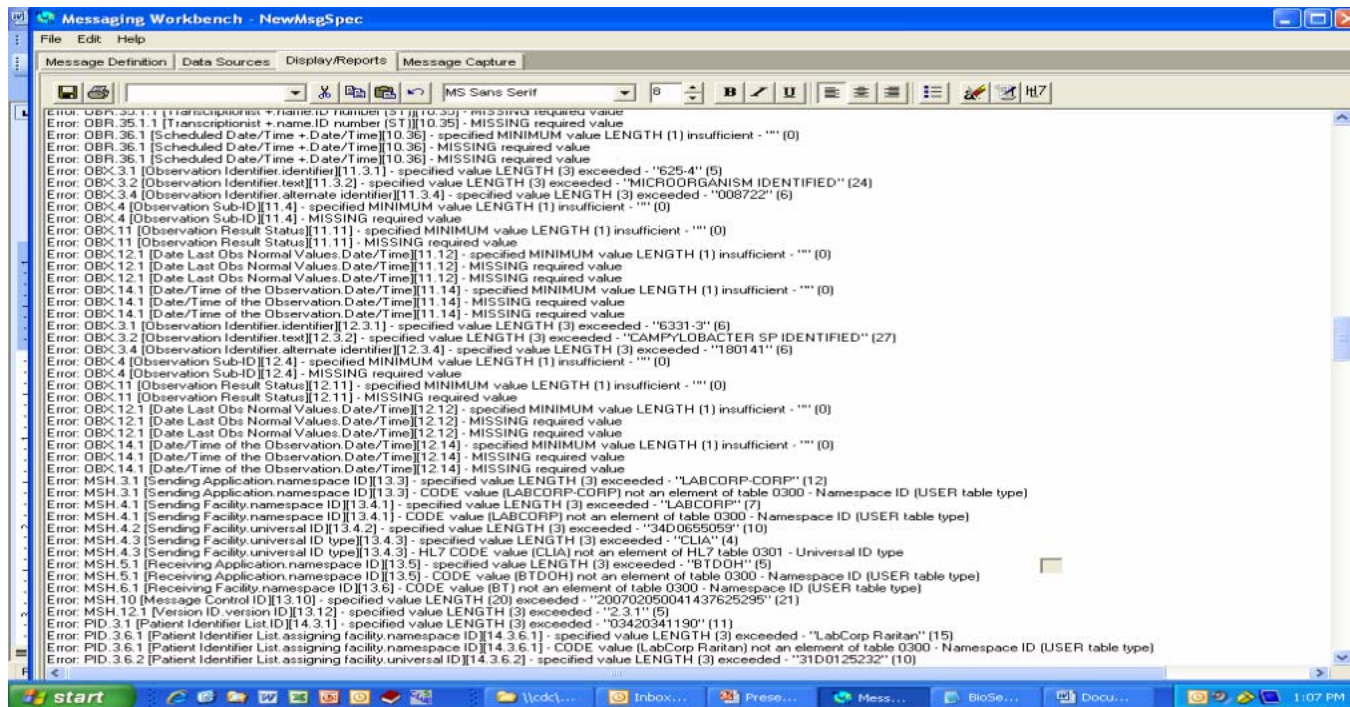




# Working with Laboratory Data : Several Tips for Improvement of Efficiency.



## 4. HL7 Messaging Workbench: Creating Error Reports\*



\* 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](http://www.hl7.org/lib_admin/docs.cfm?dir=library/committees/conf&comm=conf)

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# 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)

Source:

[http://nciterns.nci.nih.gov/NCIBrowser/Connect.do?bookmarktag=1&dictionary=SNOMED\\_CT&licensetag=true&code=null](http://nciterns.nci.nih.gov/NCIBrowser/Connect.do?bookmarktag=1&dictionary=SNOMED_CT&licensetag=true&code=null)

Concept Details

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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)     |  |

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## 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

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Questions?



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