BIOSENSE

User Guide

VA, DOD, LABCORP VERSION 2.05

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Introduction

Background Information

The vision for BioSense is to build a national, real-time biosurveillance system that can be used for early event detection and health situational awareness by all levels of public health and the health care community. Specifically, BioSense focuses on:

- **Data transmission**: assuring the secure, timely, routine receipt of health data for public health surveillance
- **Data analysis**: utilizing advanced analytic methods to detect events and to enable cities and states to use these methods to interpret results in as close to real-time as possible
- **Data reporting**: on a near real-time basis, providing useful views of the data, including time-series analysis and geospatial displays, for colleagues in state and local health departments as well as for Centers for Disease Control and Prevention (CDC) program staff
- **Public Health Response**: providing local data to state and local public health officials and supporting their use and interpretation of the data for investigations, outbreak responses, and public health interventions

BioSense Access

- BioSense is intended for use by local, state, and federal public health officials and hospital partners.
- Users could include epidemiologists, bioterrorism response coordinators, and hospital infection control personnel.
- Each public health jurisdiction or facility has a BioSense Administrator to authorize access to BioSense for appropriate staff within their jurisdiction or hospital.
- Users access BioSense through the CDC Secure Data Network which requires a digital certificate.
- A user profile is established authorizing access to data pertaining to the specified jurisdiction.
- Data from a given facility is viewable by personnel at the facility.
- State or metropolitan area officials may view data for all facilities in their jurisdiction.

BioSense Data Sources

Department of Defense (DoD)

- Ambulatory care
- Medical Treatment Facilities (MTFs)
- Daily national data feed
- International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) and Current Procedural Terminology (CPT) codes, demographics, location

Department of Veterans' Affairs (VA)

- Ambulatory care
- Hospitals (172) and clinics (650)
- Batched national data feed
- ICD-9-CM and CPT codes, demographics, location

Laboratory Corporation of America (LabCorp)

- Batched national feed
- Test order codes (Logical Observations Identifiers, Names, Codes [LOINC] and local), ICD-9-CM reason for test order, demographics, location

Syndrome Groups

Overview

Codes (ICD-9-CM, CPT, and lab test orders) are each mapped to a syndrome, but only one count per syndrome is generated per visit. For example, if three procedures were performed, but two are mapped to the same syndrome, then there will be only one count for each of the two syndromes for that visit. Single codes can map to multiple syndrome groups.

Data in the BioSense application are organized into the following 11 syndromes:

1. Botulism-like
2. Fever
3. Gastrointestinal
4. Hemorrhagic Illness
5. Localized Cutaneous Lesion
6. Lymphadenitis
7. Neurological
8. Rash
9. Respiratory
10. Severe Illness/Death
11. Specific Infection*

Codes are divided into three categories based on overall association with a syndrome or a specific disease and by observed frequency of code usage in three clinical data sources (representing discharge diagnoses for outpatient visits and emergency department visits). The following categories within syndrome groups were defined:

- **Category 1 –** Codes that reflect general symptoms of the syndrome group including codes for bioterrorism diseases of highest concern or diseases highly approximating them.
- **Category 2 –** Codes that might normally be placed in the syndrome group but for which daily volume could overwhelm or otherwise detract from the signal generated from the Category 1 code set.
- **Category 3 –** Specific diagnoses that fit into the syndrome category but that occur infrequently or have very few counts. These codes may be excluded to simplify syndrome category code sets.

*Specific Infection contains all Category 3 codes, while Category 1 and Category 2 codes are placed into their respective syndrome groups.

Syndrome Groups for VA and DoD ICD-9-CM Codes

Descriptions of ICD-9-CM syndrome groups are available at:
http://www.bt.cdc.gov/surveillance/syndromedef/index.asp

Syndrome Groups for LabCorp Test Orders

A working group of experts participated in mapping lab order codes to syndrome groups included in BioSense (Table 1). Mapping results were consistent within the same LabCorp lab order panel or profile group (e.g., different components in the Hepatitis profile were mapped in the same way). Mapping results were made to be consistent with LabCorp's documentation of test use and specimen (e.g., some pathogens could appear in multiple organ systems; if the specimen was specified as "stool," it was mapped to the gastrointestinal syndrome group). Lab order code taxonomy was created to classify lab

order codes; the lab order codes classified in the same disease or pathogen group were mapped in the same way.

Table 1: LabCorp Test Order Syndrome Groups

Syndrome Selection

Order Code	Order Code Name	Fever	Gastro	Lesion	Lymph	Neuro	Rash	Resp	Sp Inf
008649	Aerobic Bacterial Culture	1	0	0	0	0	0	0	0
008904	Anaerobic Culture	1	0	0	0	0	0	0	0
008003	Anaerobic and Aerobic Culture	1	0	0	0	0	0	0	0
008300	Blood Culture, Routine	1	0	0	0	0	0	0	0
008573	Viral Culture, General	1	0	0	0	0	0	0	0
183111	Anaerobic/Aerobic/Gram's Stain	1	0	0	0	0	0	0	0
138552	Febrile Agglutinin Panel	1	0	0	0	0	0	0	0
015271	Lyme Ab/Total Immunoglobulins	0	0	0	0	1	1	0	0
161653	LYME/SYPHILIS AB DIFF PROFILE	0	0	0	0	1	1	0	0
223586	Lyme Ab, Total/IgM Responses	0	0	0	0	1	1	0	0
258004	Lyme Ab/Western Blot Reflex	0	0	0	0	1	1	0	0
138685	Lyme Disease(B.Burgdorferi)PCR	0	0	0	0	1	1	0	0
550012	Lyme PCR, Borrelia burgdorferi	0	0	0	0	1	1	0	0
160333	Lyme, IgM, Early Test/Reflex	0	0	0	0	1	1	0	0
160325	Lyme, Total Ab Test/Reflex	0	0	0	0	1	1	0	0
163600	Lyme, Western Blot, Serum	0	0	0	0	1	1	0	0
162263	Lyme, Western Blot, Syn Fluid	0	0	0	0	1	1	0	0
008185	Malarial Smear	1	0	0	0	0	0	0	0
164722	Ehrlichia Ab Panel	1	0	0	0	0	0	0	0
164763	Human Gran. Ehrlichiosis (IgG)	1	0	0	0	0	0	0	0
138168	Human Monocytic Ehrlich-PCR	1	0	0	0	0	0	0	0
164680	E. chaffeenis-HME (Monocytic)	1	0	0	0	0	0	0	0
138412	Ehrlichia Detection by PCR	1	0	0	0	0	0	0	0
164672	Human Granulocytic Ehrlich-HGE	1	0	0	0	0	0	0	0
008540	Gram's Stain	1	0	0	0	0	0	0	0
182261	Aerobe ID & Suscept	1	0	0	0	0	0	0	0
182345	Anaerobe Identification Only	1	0	0	0	0	0	0	0
183129	MRSA Culture Only	1	0	0	0	0	0	0	0
182253	MRSA Culture/Susceptibility	1	0	0	0	0	0	0	0
182360	Vancomycin-Resist Enterococcus	1	0	0	0	0	0	0	0
008870	MIC/Min Bactericidal Conc	1	0	0	0	0	0	0	0
182675	AFB Cult/Smear, Broth, Suscep	1	0	0	0	0	0	1	0
182402	AFB Culture and Smear, Broth	1	0	0	0	0	0	1	0
008466	Organism ID, Mycobacteria	1	0	0	0	0	0	1	0
550087	M tuberculosis Detection, PCR	1	0	0	0	0	0	1	0
188540	M tuberculosis, PCR/Culture	1	0	0	0	0	0	1	0
086876	Mycoplasma pneumoniae Culture	0	0	0	0	0	0	1	0
138420	Mycoplasma Pneumoniae, PCR	0	0	0	0	0	0	1	0
163758	Mycoplasma pneu. IgG/IgM Abs	0	0	0	0	0	0	1	0
163741	Mycoplasma pneumoniae, IgG Ab	0	0	0	0	0	0	1	0
163212	Mycoplasma pneumoniae, IgM Ab	0	0	0	0	0	0	1	0

Syndrome Selection

Order Code	Order Code Name	Fever	Gastro	Lesion	Lymph	Neuro	Rash	Resp	Sp Inf
096065	Adenovirus Group Ab, Qn	1	0	0	0	0	0	1	0
138164	Adenovirus Detection by PCR	1	0	0	0	0	0	1	0
185033	Virus, Adenovirus by DFA	1	0	0	0	0	0	1	0
086173	B pertussis Smear, DFA	0	0	0	0	0	0	1	0
164384	B pertussis IgA Ab, Quant	0	0	0	0	0	0	1	0
164541	B pertussis IgG/M/A Ab, Quant	0	0	0	0	0	0	1	0
180224	B pertussis, Nasophar Culture	0	0	0	0	0	0	1	0
138677	Bordetella Para&Pertussis PCR	0	0	0	0	0	0	1	0
161745	B pertussis IgG Ab, Quant	0	0	0	0	0	0	1	0
163030	B pertussis IgG/IgM Ab, Quant	0	0	0	0	0	0	1	0
161752	B pertussis IgM Ab, Quant	0	0	0	0	0	0	1	0
008169	Beta-Hemolytic Strep, A Only	0	0	0	0	0	0	1	0
018788	Streptococcus pneumoniae Ag	0	0	0	0	1	0	1	0
018804	Beta Strep (Group B) Antigen	0	0	0	0	0	0	1	0
008532	Chlamydia psittaci Culture	0	0	0	0	0	0	1	0
138263	Chlamydia Pneumoniae PCR	0	0	0	0	0	0	1	0
018762	Haemophilus influenzae B Ag	0	0	0	0	0	0	1	0
138271	Haemophilus influenzae B IgG	0	0	0	0	0	0	1	0
182295	Influenza A Only by Direct EIA	0	0	0	0	0	0	1	0
186023	Viral Culture,Rapid,Influenza	0	0	0	0	0	0	1	0
096487	Influenza A/B Ab, Quant	0	0	0	0	0	0	1	0
186064	Influenza A & B, Immunoassay	0	0	0	0	0	0	1	0
096214	Parainfluenza Virus Antibody	0	0	0	0	0	0	1	0
086868	Legionella Species Culture	1	0	0	0	0	0	1	0
182246	Legionella pneumophila Ur Ag	1	0	0	0	0	0	1	0
085506	Legionella pneumophila by DFA	1	0	0	0	0	0	1	0
188227	Legionella pneumophila/Culture	1	0	0	0	0	0	1	0
096131	RSV Ab, Quant	0	0	0	0	0	0	1	0
185017	Virus, RSV by DFA	0	0	0	0	0	0	1	0
014548	RSV by EIA	0	0	0	0	0	0	1	0
008342	Upper Respiratory Culture	0	0	0	0	0	0	1	0
180810	Lower Respiratory Culture	0	0	0	0	0	0	1	0
186015	Viral Culture,Rapid,Respirator	0	0	0	0	0	0	1	0
164608	Brucella abortus IgG, EIA	1	0	0	0	0	0	1	0
164624	Brucella abortus IgM, EIA	1	0	0	0	0	0	1	0
163709	Diphtheria Antitoxoid Ab	0	0	0	0	0	0	1	0
016774	Q Fever Antibodies, IgG	1	0	0	0	0	0	1	0
058503	RESPIRATORY INFECTION PROF A	0	0	0	0	0	0	1	0
057877	RESPIRATORY INFECTION PROF B	0	0	0	0	0	0	1	0
058669	Respiratory Infection Prof D	0	0	0	0	0	0	1	0
091454	Fungal Antibodies, Quant	0	0	0	0	0	0	1	0
164319	Histoplasma Abs, Qn, DID	0	0	0	0	0	0	1	0
180885	Helicobacter pylori Culture	0	1	0	0	0	0	0	0
163683	H PYLORI, IGM, IGG, IGA AB	0	1	0	0	0	0	0	0
162289	H. pylori IgG, Abs	0	1	0	0	0	0	0	0

Syndrome Selection

Order Code	Order Code Name	Fever	Gastro	Lesion	Lymph	Neuro	Rash	Resp	Sp Inf
180764	H. pylori Stool Antigen	0	1	0	0	0	0	0	0
163170	Helicobacter pylori, IgA	0	1	0	0	0	0	0	0
163204	Helicobacter pylori, IgM Ab	0	1	0	0	0	0	0	0
086181	C difficile Toxin A	0	1	0	0	0	0	0	0
180448	C difficile, Toxin B/Cytotoxin	0	1	0	0	0	0	0	0
008045	Clostridium difficile Culture	0	1	0	0	0	0	0	0
180141	Campylobacter Culture	0	1	0	0	0	0	0	0
180356	Enterohemorrhagic E coli Cult	0	1	0	0	0	0	0	0
187013	Adenovirus (40/41)/Rotavirus	0	1	0	0	0	0	0	0
185041	Adenovirus (40/41), Direct EIA	0	1	0	0	0	0	0	0
138307	Norovirus, RT-PCR	0	1	0	0	0	0	0	0
006866	Rotavirus Detection by EIA	0	1	0	0	0	0	0	0
008755	Cryptosporidium Smear, Stool	0	1	0	0	0	0	0	0
006874	Amebiasis Antibodies	0	1	0	0	0	0	0	0
183145	Cyclospora Smear, Stool	0	1	0	0	0	0	0	0
182204	Giardia lamblia, Direct, EIA	0	1	0	0	0	0	0	0
188110	Giardia, EIA; Ova/Parasites	0	1	0	0	0	0	0	0
008144	Stool Culture	0	1	0	0	0	0	0	0
182410	Stool Culture, Yersinia Only	0	1	0	0	0	0	0	0
182311	Stool Culture, Vibrio Only	0	1	0	0	0	0	0	0
008656	White Blood Cells (WBC), Stool	0	1	0	0	0	0	0	0
008607	Occult Blood, Stool	0	1	0	0	0	0	0	0
008623	Ova/Parasites Exam, Routine	0	1	0	0	0	0	0	0
016766	Fecal Reducing Substances	0	1	0	0	0	0	0	0
002048	Glucose, Cerebrospinal Fluid	0	0	0	0	1	0	0	0
002055	Protein, Total, CSF	0	0	0	0	1	0	0	0
006890	Bacterial Antigens	0	0	0	0	1	0	0	0
005256	Cell Count, CSF	0	0	0	0	1	0	0	0
162016	Calif Encephalitis Ab, IgG	0	0	0	0	1	0	0	0
162313	Calif Encephalitis Ab, IgM	0	0	0	0	1	0	0	0
008672	India Ink Preparation	0	0	0	0	1	0	0	0
082891	Cryptococcus Antibodies, Quant	0	0	0	0	1	0	0	0
160747	Cryptococcus Antigen, CSF	0	0	0	0	1	0	0	0
006551	Cryptococcus Antigen, Serum	0	0	0	0	1	0	0	0
162024	East Eq Encephalitis Ab, IgG	0	0	0	0	1	0	0	0
162321	East Eq Encephalitis Ab, IgM	0	0	0	0	1	0	0	0
162032	St Louis Enceph V Ab, IgG	0	0	0	0	1	0	0	0
162339	St Louis Enceph V Ab, IgM	0	0	0	0	1	0	0	0
162040	Western Equine Enceph Ab, IgG	0	0	0	0	1	0	0	0
162347	Western Equine Enceph Ab, IgM	0	0	0	0	1	0	0	0
138842	West Nile Virus Antibody,Serum	1	0	0	0	1	0	0	0
138834	West Nile Virus, RT-PCR	1	0	0	0	1	0	0	0
138966	West Nile Virus Antibody, CSF	1	0	0	0	1	0	0	0
162305	Arboviral Encephalitis Ab, IgM	0	0	0	0	1	0	0	0
162008	Arboviral Encephalitis Ab, IgG	0	0	0	0	1	0	0	0

Syndrome Selection

Order Code	Order Code Name	Fever	Gastro	Lesion	Lymph	Neuro	Rash	Resp	Sp Inf
138293	JC/BK Virus DNA PCR	0	0	0	0	1	0	0	0
138636	Enterovirus RT-PCR	1	0	0	0	1	0	0	0
008201	Cytomegalovirus (CMV) Culture	1	0	0	1	0	0	0	0
185025	Virus, Cytomegalovirus by DFA	1	0	0	1	0	0	0	0
138610	Cytomegalovirus Quant. PCR	1	0	0	1	0	0	0	0
096727	Cytomegalovirus (CMV) Ab, IgM	1	0	0	1	0	0	0	0
138693	CMV PCR Southern Blot	1	0	0	1	0	0	0	0
550905	CMV DNA Probe, Paraffin	1	0	0	1	0	0	0	0
138701	CMV PCR Detect.,Amniotic Fluid	1	0	0	1	0	0	0	0
186049	Viral Culture, Rapid, CMV	1	0	0	1	0	0	0	0
006536	Mono Qual W/Rflx Qn	1	0	0	1	0	0	0	0
006189	Mononucleosis Test, Qual	1	0	0	1	0	0	0	0
096230	EBV Ab VCA, IgG	1	0	0	1	0	0	0	0
160739	EBV Early Antigen Ab Prof, Qn	1	0	0	1	0	0	0	0
096248	EBV Early Antigen Ab, IgG	1	0	0	1	0	0	0	0
096735	EBV Ab VCA, IgM	1	0	0	1	0	0	0	0
138289	Epstein-Barr Virus Real Time	1	0	0	1	0	0	0	0
138230	Epstein-Barr DNA PCR Real Time	1	0	0	1	0	0	0	0
550913	Epstein-Barr Virus, DNA Probe	1	0	0	1	0	0	0	0
096552	Mumps Antibodies, IgG	0	0	0	1	0	0	0	0
006742	Tularemia Agglutinins	0	0	1	1	0	0	1	0
006478	Toxoplasma gondii Ab, IgG, Qn	0	0	0	1	0	0	0	0
138602	Toxoplasma Gondii PCR	0	0	0	1	0	0	0	0
016592	Rocky Mtn Spotted Fev, IgG, Qn	1	0	0	0	0	1	0	0
016667	Rocky Mtn Spotted Fever, IgM	1	0	0	0	0	1	0	0
096537	Rubella Antibodies, IgM	1	0	0	0	0	1	0	0
006197	Rubella Antibodies, IgG	1	0	0	0	0	1	0	0
500199	Human Papillomavirus, Biopsy	0	0	0	0	0	1	0	0
550020	Human Papillomavirus, PCR	0	0	0	0	0	1	0	0
186031	Viral Culture,Rapid,Varicella	0	0	0	0	0	1	0	0
185009	Virus, Varicella Zoster by DFA	0	0	0	0	0	1	0	0
096776	Varicella-Zoster Ab, IgM	0	0	0	0	0	1	0	0
096206	Varicella-Zoster V Ab, IgG	0	0	0	0	0	1	0	0
138313	VZV Real Time PCR	0	0	0	0	0	1	0	0
138719	Parvovirus B19 PCR Amn. Fl Det	1	0	0	0	0	1	0	0
138644	Parvovirus B19 PCR Detection	1	0	0	0	0	1	0	0
057851	RASH PROFILE B	0	0	0	0	0	1	0	0
057844	Rash Profile A	0	0	0	0	0	1	0	0
058495	Measles/Mumps/Rubella Immunity	0	0	0	0	0	1	0	0
096560	Rubeola Antibodies, IgG	0	0	0	0	0	1	0	0
161075	HHV-6, IgG Antibodies, Quant	0	0	0	0	0	1	0	0
186056	Viral Culture,Rapid,Lesion	0	0	1	0	0	1	0	0
008508	Virus, HSV by DFA	0	0	1	0	1	1	0	0
138651	HSV 1/2 PCR	0	0	1	0	1	1	0	0
008250	HSV Culture and Typing	0	0	1	0	0	1	0	0

Syndrome Selection

Order Code	Order Code Name	Fever	Gastro	Lesion	Lymph	Neuro	Rash	Resp	Sp Inf
164020	HSV I/II, IgG/Rfx Type II IgG	0	0	1	0	0	1	0	0
163147	HSV Type 2-Specific Ab, IgG	0	0	1	0	0	1	0	0
164806	HSV, IgM I/II Combination	0	0	1	0	0	1	0	0
550921	Herpes Simplex Virus, DNA	0	0	1	0	0	1	0	0
186072	HSV Culture Without Typing	0	0	1	0	0	1	0	0
163014	Herpes Simplex Virus I/II, IgG	0	0	1	0	0	1	0	0
182337	Dermatophyte Only, Culture	0	0	0	0	0	1	0	0
008664	Organism ID, Bacteria	0	0	0	0	0	0	0	1
182212	Organism Identification, Yeast	0	0	0	0	0	0	0	1
008334	Genital Culture, Routine	0	0	0	0	0	0	0	1
008086	Urine Culture, Comprehensive	0	0	0	0	0	0	0	1
008458	Reference Bacterial Culture ID	0	0	0	0	0	0	0	1
008680	Susceptibility, Aer & Anaerob	0	0	0	0	0	0	0	1
008219	Parasite Identification	0	0	0	0	0	0	0	1
008482	Fungus (Mycology) Culture	0	0	0	0	0	0	0	1
008136	Fungus Stain	0	0	0	0	0	0	0	1
188243	Fungus Culture With Stain	0	0	0	0	0	0	0	1
096719	Candida Antibodies, Qual	0	0	0	0	0	0	0	1
096289	Anti-DNase B Strep Antibodies	0	0	0	0	0	0	0	1
163253	Tetanus/Diphtheria Ab	0	0	0	0	0	0	0	1
096180	Chlamydia Antibodies, IgG	0	0	0	0	0	0	0	1
182550	Chlamydia trach.Swab/Urine,PCR	0	0	0	0	0	0	0	1
096149	Chlamydia trachomatis Ab, IgM	0	0	0	0	0	0	0	1
008565	Chlamydia trachomatis Culture	0	0	0	0	0	0	0	1
138768	Echinococcus Antibody	0	0	0	0	0	0	0	1
006734	Hep A Ab, IgM	0	0	0	0	0	0	0	1
006726	Hep A Ab, Total	0	0	0	0	0	0	0	1
016881	Hep B Core Ab, IgM	0	0	0	0	0	0	0	1
006718	Hep B Core Ab, Tot	0	0	0	0	0	0	0	1
006395	Hep B Surface Ab	0	0	0	0	0	0	0	1
006510	Hep B Surface Ag	0	0	0	0	0	0	0	1
006635	Hep Be Ab	0	0	0	0	0	0	0	1
006619	Hep Be Ag	0	0	0	0	0	0	0	1
140608	Hep C Virus Ab	0	0	0	0	0	0	0	1
058552	HAV/HBV (Profile VII)	0	0	0	0	0	0	0	1
098418	HBV Core Ab, IgG/IgM Diff	0	0	0	0	0	0	0	1
255505	HBV/HCV (Profile VIII)	0	0	0	0	0	0	0	1
550033	HCV QuantaSure Plus (Serial)	0	0	0	0	0	0	0	1
550027	HCV QuantaSure Plus(Non-Graph)	0	0	0	0	0	0	0	1
551879	HCV RNA by PCR, Qn Rfx Geno	0	0	0	0	0	0	0	1
550400	HCV RNA, PCR, Qualitative	0	0	0	0	0	0	0	1
028928	Hepatitis A (Prof V)	0	0	0	0	0	0	0	1
058545	Hepatitis B Virus (Profile VI)	0	0	0	0	0	0	0	1
550475	Hepatitis C Virus Genotyping	0	0	0	0	0	0	0	1
046938	Hepatitis Follow-Up (Prof II)	0	0	0	0	0	0	0	1

Syndrome Selection

Order Code	Order Code Name	Fever	Gastro	Lesion	Lymph	Neuro	Rash	Resp	Sp Inf
322744	Hepatitis Panel (4)	0	0	0	0	0	0	0	1
045849	Hepatitis Pt Mgmnt (Prof III)	0	0	0	0	0	0	0	1
058560	Hepatitis, Diagnostic (Prof I)	0	0	0	0	0	0	0	1
140615	NGI HBV SuperQuant	0	0	0	0	0	0	0	1
140622	NGI HBV UltraQual	0	0	0	0	0	0	0	1
140639	NGI HCV QuantaSure	0	0	0	0	0	0	0	1
140612	NGI HCV SuperQuant	0	0	0	0	0	0	0	1
140609	NGI HCV UltraQual	0	0	0	0	0	0	0	1
058537	HAV/HBV Immune Status (Pro IV)	0	0	0	0	0	0	0	1
551432	HBV DNA, Qualitative PCR	0	0	0	0	0	0	0	1
091108	HBV Follow-Up (Profile XII)	0	0	0	0	0	0	0	1
235473	HBV Prevaccination (Profile X)	0	0	0	0	0	0	0	1
265389	HBV Vaccine Follow-Up (Pro XI)	0	0	0	0	0	0	0	1
551242	HCV RNA Det Ql Rfx Gen	0	0	0	0	0	0	0	1
551221	HCV RNA by PCR, Qn Rfx Geno	0	0	0	0	0	0	0	1
550146	HCV RNA, PCR, Ql (Quant Rflx)	0	0	0	0	0	0	0	1
265397	Hepatitis B, Prenatal (Prof X	0	0	0	0	0	0	0	1
138800	Strep pneumo IgG Ab (6 Sero)	0	0	0	0	0	0	0	1
138177	Strep pneumo IgG Ab (7 Sero.)	0	0	0	0	0	0	0	1
138704	Strep. pneumo.IgG Ab (4 Sero.)	0	0	0	0	0	0	0	1
138210	Strep.pneumo.IgG Ab (14 Sero)	0	0	0	0	0	0	0	1
038109	Prenat Infect Dis Ab, IgG, Qn	0	0	0	0	0	0	0	1
211581	Prenat Infect Dis Ab, IgM, Qn	0	0	0	0	0	0	0	1
163246	HTLV-I/II Antibodies, Qual	0	0	0	0	0	0	0	1
086884	Ureaplasma/Mycoplasma hominis	0	0	0	0	0	0	0	1

Syndrome Groups for CPT Procedure Codes

Table 2 contains the syndrome groups for CPT procedure codes.

Table 2: CPT Procedure Codes Syndrome Groups

CPT	Description	Resp	Fever	Lymph	Neuro	GI	Spec Inf
71010	Radiologic examination, chest; single view, frontal	X					
71015	Radiologic examination, chest; stereo, frontal	X					
71020	Radiologic examination, mastoids; less than three views per side	X					
71021	Radiologic examination, chest, two views, frontal and lateral; with apical lordotic procedure	X					
71022	Radiologic examination, chest, two views, frontal and lateral; with oblique projections	X					
71023	Radiologic examination, chest, two views, frontal and lateral; with fluoroscopy	X					
71030	Radiologic examination, mastoids; complete, minimum of three views per side	X					
71034	Radiologic examination, chest, complete, minimum of four views; with fluoroscopy	X					
71035	Radiologic examination, chest, special views (e.g., lateral decubitus, Bucky studies)	X					
85004	Blood count; automated differential white blood cell (WBC) count		X	X			
85007	Blood count; blood smear, microscopic examination with manual differential WBC count		X	X			
85008	Blood count; blood smear, microscopic examination without manual differential WBC count		X	X			
85009	Blood count; manual differential WBC count, buffy coat		X	X			
85032	Blood count; manual cell count (erythrocyte, leukocyte, or platelet) each		X	X			
85048	Blood count; leukocyte (WBC), automated		X	X			

CPT	Description	Resp	Fever	Lymph	Neuro	GI	Spec Inf
87040	Culture, bacterial; blood, aerobic, with isolation and presumptive identification of isolates (includes anaerobic culture, if appropriate)		X	X			X
87045	Culture, bacterial; stool, aerobic, with isolation and preliminary examination (e.g., Kliger iron agar [KIA], Lysine iron agar [LIA]), Salmonella and Shigella species					X	
87046	Culture, bacterial; stool, aerobic, additional pathogens, isolation and presumptive identification of isolates					X	
87070	Culture, bacterial; any other source except urine, blood or stool, aerobic, with isolation and presumptive identification of isolates				X		
87075	Culture, bacterial; any source, except blood, anaerobic with isolation and presumptive identification of isolates				X		
87076	Culture, bacterial; anaerobic isolate, additional methods required for definitive identification, each isolate				X		
87077	Culture, bacterial; aerobic isolate, additional methods required for definitive identification, each isolate				X		
87081	Culture, presumptive, pathogenic organisms, screening only				X		
87084	Culture, presumptive, pathogenic organisms, screening only; with colony estimation from density chart				X		
89055	Leukocyte assessment, fecal, qualitative or semiquantitative					X	
89350	Sputum, obtaining specimen, aerosol induced technique (separate procedure)	X					

Data Analysis

SMART

Small Area Regression and Testing (SMART)[1] is a regression analysis adapted from the work of Ken Kleinman. The SMART model includes approximately two years of baseline data and parameters for day of the week, holiday, day after a holiday, and sine and cosine seasonal terms. The same parameters are used to fit the data for each set of zip codes (with an intercept difference) within a metropolitan area or for a state exclusive of metropolitan areas. The model generates a predicted value for a source-syndrome-zip code-day combination, and the difference between the predicted and the observed values is transformed into a statistical measure of the time period in which you would expect to observe such an observed count or the recurrence interval (RI) for the observed count. RIs are then entered into SMART score groups to determine low to high SMART scores (Table 3). A threshold count of 5 has been set such that any count less than 5 will not be indicated as being statistically significant in the BioSense application. This threshold was set to correct for sparse data.

Table 3: SMART Score Groupings

Group	RI
0 (low)	<100
1	100 - 500
5	>500 - 1000
100 (high)	> 1000

Consolidated SMART Score

To create a consolidated syndrome SMART score for display in the BioSense Analytical Summary, the set of individual scores from each source and zip code is combined. The steps are as follows:

1. A SMART score is computed for each source-syndrome-zip code-day combination.
2. Each SMART score is grouped based on the RI (Table 3).
3. The number and percent of zip codes that fall into each SMART group are calculated.
4. A score is computed by multiplying the group by the percentage of zip codes.
5. All the scores for a single day are summed to produce a total score.
6. The daily average score is computed by dividing the total score by the number of data sources reporting.
7. The daily average score is plotted on a scale of 0 to 1000 with 0 being low and 1000 being high.

[1] Lazarus, Ross et al. *Use of automated ambulatory-care encounter records for detection of acute illness clusters, including potential bioterrorism events*. Emerging Infectious Diseases 8.8 (2002): 753-60.

Table 4: SMART Example
(Assuming DoD and VA diagnoses are the only data sources, and the number of zip codes for the region equals 10)

Date	Source	Syndrome	Group	# Zip Codes	% Zip Codes	Score
6/19/2004	DoD diagnoses	Gastro	0	7	70	0
6/19/2004	DoD diagnoses	Gastro	1	1	10	10
6/19/2004	DoD diagnoses	Gastro	5	2	20	100
6/19/2004	DoD diagnoses	Gastro	100	0	0	0
6/19/2004	VA diagnoses	Gastro	0	3	30	0
6/19/2004	VA diagnoses	Gastro	1	3	30	30
6/19/2004	VA diagnoses	Gastro	5	3	30	150
6/19/2004	VA diagnoses	Gastro	100	1	10	1000

Total Score = 1290
Daily average score = 1290/2 = 645 (medium)

CuSum

CuSum[2] has been adapted from the CDC Early Aberration Reporting System (EARS) program. CuSum indicates recent changes in the data by comparing it to a seven-day moving average. In BioSense, CuSum is applied at the metropolitan area or state level. There are three different CuSum calculations (C_1, C_2, and C_3) included in BioSense (Table 5). C_1, C_2, and C_3 are calculated separately for each source-syndrome-day combination. In BioSense, CuSum has been modified such that weekdays are compared to a seven-day moving average that includes only weekdays, and weekends/holidays are compared to a seven-day moving average that includes only weekends/holidays.

Table 5: CuSum Methods

$C_1 = \frac{count - (MA_1 + s_1)}{s_1}$	C1 is a deviation (scaled in standard deviations) of the count from one standard deviation away from a 7 day moving average.
$C_2 = \frac{count - (MA_3 + s_3)}{s_3}$	C2 is a deviation (scaled in standard deviations) of the count from one standard deviation away from a 7 day moving average with a 3 day lag.
$C_3 = \sum_{day=-2}^{0} \frac{count - (MA_3 + s_3)}{s_3}$	C3 is the sum of the current and previous two days for the C2 score.

MA_1 = seven-day moving average with a one-day lag
MA_3 = seven-day moving average with a three-day lag
s_1 = seven-day moving standard deviation with a one-day lag
s_3 = seven-day moving standard deviation with a three-day lag

[2] Hutwagner, Lori et al. *The Bioterrorism Preparedness and Response Early Aberration Reporting System (EARS).* J Urban Health 80 (2003): 89i-96i.

Consolidated CuSum Score

To create a consolidated syndrome CuSum score for display in the BioSense Analytical Summary, the set of individual scores from each source and CuSum method are combined. The steps are as follows:
For a specific source-syndrome-day,

- If only C_1 is above the threshold, then the assigned score is 250.
- If only C_2 is above the threshold, then the assigned score is 500.
- If C_2 and C_3 are above the threshold, then the assigned score is 750.
- If all three CuSum methods are above the threshold, then the assigned score is 1000.

The daily overall CuSum score is calculated by averaging across all data sources reporting and is plotted on the same scale as the SMART scores, where low=0 and high=1000.

Table 6: CuSum Example
(Assuming DoD and VA diagnoses are the only data sources)

Date	Source	Syndrome	Significant CuSum	Score
6/19/2004	DoD diagnoses	Gastro	C_1	250
6/19/2004	VA diagnoses	Gastro	C_2, C_3	750

Total Score = 1000
Daily average score = 1000/2 = 500 (medium)

BioSense Application

BioSense Home Page

The BioSense home page allows you to access various application modules.

Analytical Summary Page

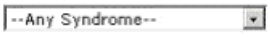
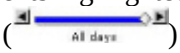
The Analytical Summary page has three general content areas: (1) the Region Selection and Data Transmission section located on the left, (2) the Analytic Summary section in the center, and (3) the Percentage of Records Received table at the bottom.

Region Selection and Data Transmission

The Region Selection option allows you to select a different jurisdiction for review (from among jurisdictions to which you have access). The Data Transmission section lists whether there are problems with the data loading process.

Analytic Summary

Analytic Summary provides an overview of analytic results for each syndrome. SMART and CuSum qualitative results, consolidated across all sources for each syndrome for the past ten days, are displayed in punch cards at the top of the page.

- The map and table display in the center of the page present syndrome and zip code-specific results. The drop-down menu () above the table allows you to select a specific syndrome for display.
- The map presents highlighted zip codes with elevated SMART score results.
- The slide bar () above the map allows you to view geographical distribution of elevated scores for all days within the 10-day time frame or for a specific day. The selected date and day of the week appear under the slide bar.
- Hovering over a zip code with the mouse will produce a pop-up legend that indicates the zip code number.
- When any syndrome is selected, the table indicates those zip codes with elevated SMART scores over the five-day window with an "X." When a specific syndrome is selected, the table lists count information for each data source and day within the 10-day window. The upper portion of the table lists count information for the entire jurisdiction and highlights counts that triggered an elevated CuSum score. The lower portion of the table lists count information only for those zip codes that triggered an elevated SMART score and highlights counts that triggered an elevated SMART score.

Syndrome Specific Analytical Summary

Each punch card provides a link to the Syndrome Specific Analytical Summary for the selected syndrome. At the top of the Syndrome Specific Analytical Summary are line graphs displaying CuSum results for the past 14 days for each data source. Elevated CuSum scores are indicated by red stars and labeled as C1, C2, or C3 (or a combination) on the x-axis of the graph. On each graph, the colored line represents regional data, the black line represents national data, and the dashed line represents the seven-day moving average used in the CuSum calculation.

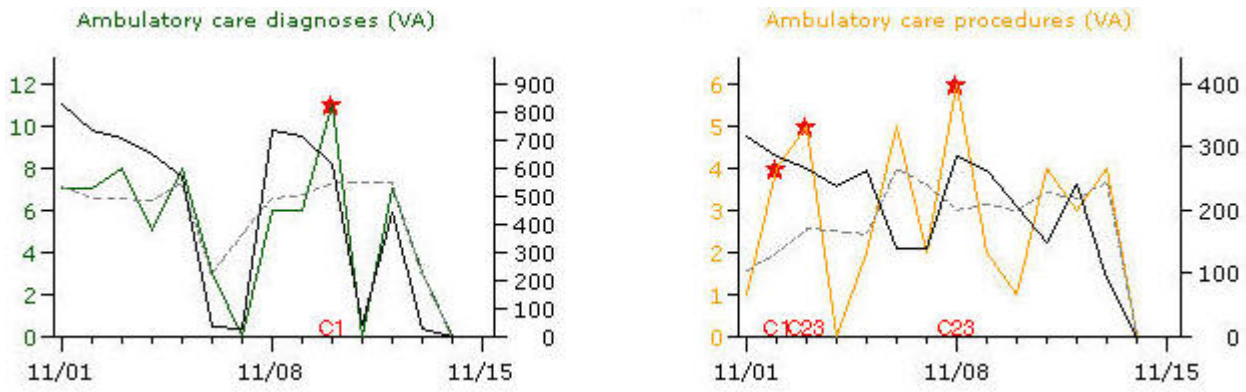


Figure 1: Syndrome Specific Analytical Summary CuSum Graphs
(demonstration data)

Beneath the graphs of CuSum results, SMART score results are presented in a map highlighting the zip codes where elevated SMART results were found for the particular syndrome on any day within the 14-day window.

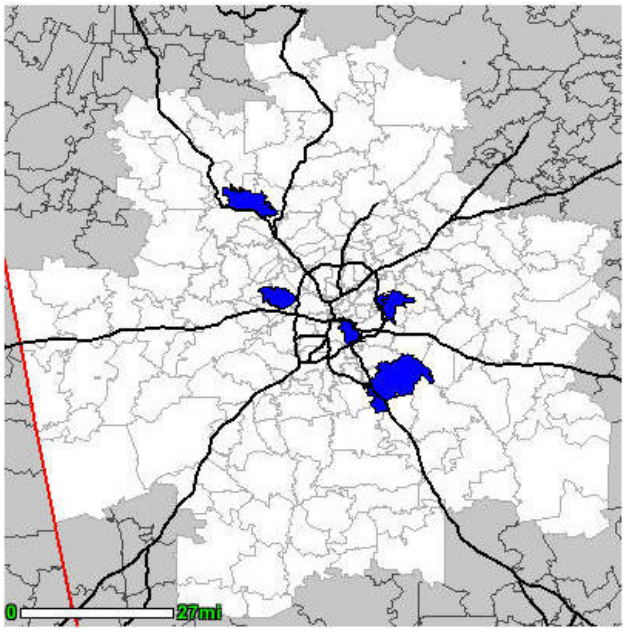


Figure 2: Syndrome Specific Analytical Summary SMART Map
(demonstration data)

Below the map display, a line graph for each zip code/data source shows elevated SMART score results over the past 14 days (indicated by red boxes). On these graphs, the colored line indicates regional data, the black line indicates national data, and the dashed gray line indicates the predicted value used in the SMART score calculation. *Note: Line graphs are not presented for zip codes/data sources that do not have elevated SMART scores.*

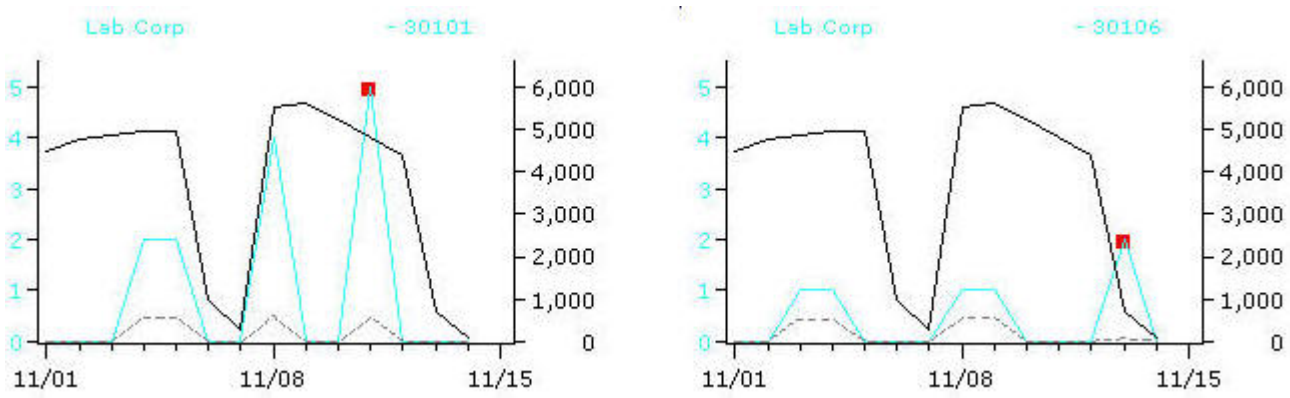


Figure 3: Syndrome Specific Analytical Summary Smart Graphs
(demonstration data)

At the bottom of the Syndrome Specific Analytical Summary, there is a table of counts by Data Source, Date, and Zip Code. Regional counts are highlighted if associated with an elevated CuSum score, and zip code counts are highlighted if associated with an elevated SMART score.

Ambulatory care diagnoses (VA)

Date	National	Regional	30101	30106	30111	30281	30310	30329
11/01/04	837	7	0	0	0	0	0	0
11/02/04	740	7	0	0	0	0	0	0
11/03/04	715	8	0	0	0	0	0	0
11/04/04	652	5	0	0	0	0	0	0
11/05/04	576	8	0	0	0	0	0	0
11/06/04	38	3	0	0	0	0	0	0
11/07/04	27	0	0	0	0	0	0	0
11/08/04	741	6	0	0	0	0	0	0
11/09/04	722	6	0	0	0	0	0	0
11/10/04	625	11	0	0	0	0	0	0
11/11/04	46	0	0	0	0	0	0	0
11/12/04	449	7	0	0	0	0	0	0
11/13/04	29	3	0	0	1	0	0	0
11/14/04	0	0	0	0	0	0	0	0
11/15/04	0	0	0	0	0	0	0	0

Figure 4: Syndrome Specific Analytical Summary Table
(demonstration data)

Percentage of Records Received

Percentage of Records Received lists data receipt status, by data source, for the past 10 days. Information is shown as a percentage of the records received versus the number expected to be received for the day of the week. Thus, low percentages indicate that full data delivery has not occurred, while percentages well above 100% could indicate that data may have been duplicated in the transmission process or that there has been a recent increase in the number of facilities reporting data. These examples are presented to illustrate that unusual analytical results may be due to data transmission issues rather than to outbreaks of disease.

Percentage of Records Received (from eventual estimate total)

	Mon 01/17	Tue 01/18	Wed 01/19	Thu 01/20	Fri 01/21	Sat 01/22	Sun 01/23	Mon 01/24	Tue 01/25	Yesterday Wed 01/26	
OTC											Store Reports
DOD	20%	120%	113%	107%	111%	187%	86%	102%	86%	82%	Encounters
VA	93%	100%	97%	98%	116%	123%	85%	101%	78%	22%	Encounters
LabCorp	150%	148%	161%	163%	180%	176%	168%	159%	149%	156%	Encounters

Percent
≥ 175
≥ 150
≥ 125
≥ 75
≥ 50
≥ 25
> 0

Figure 5: Record Percentages
(demonstration data)

Consolidated Line Graphs

Consolidated Line Graphs include a time series for each syndrome plotting all sources onto one graph per syndrome. To navigate to syndrome-specific pages, click a consolidated graph or choose a syndrome from the left sidebar. Syndrome-specific pages present detailed data for the selected syndrome in three different presentation formats (select from a drop-down menu located in the side bar navigation):

- line graphs
- maps
- tables

Customizing Consolidated Line Graphs

1. From the Consolidated Line Graphs page, click [Display Options].
2. Click the [Consolidated Graph | Line Graph | Map | Tabular | Display Order] tab.
3. From here you can:
   - Change the size of the graph with the **Height** and **Width** options
   - Select a method of **Data Transformation**
   - Change the **Vertical Axis**
   - Change the **Horizontal Axis**
   - Change **Legend Placement** or remove the legend
   - Change the **Date Range** to be included in the display. *Note: When changing a date range,you may check* [☐ All displays use same dates]*, so that the other single syndrome views (line graph, map, and tabular) will utilize the same date range.*
4. Click [Save].

Syndrome Specific Line Graphs

The Syndrome Specific Line Graph displays the same consolidated graph as the one on the Consolidated Line Graph page (for the selected syndrome) as well as an individual line graph for each of the data sources. Single-source graphs show the count of records (by default; however, transformation options are available) for a particular data source both for the specified jurisdiction and the nation. This allows you to determine if the data pattern for your jurisdiction matches the pattern for the nation. A time-shift feature for a single-source graph allows a forward or backward shift in the viewing-time window a day at a time for a given data source. The line graph for that source also shifts in the consolidated graph. This is a visual mechanism to check correlations among data sources, since a health-related event might have different latency in different data sources.

Customizing Syndrome Specific Line Graphs

1. From the Syndrome Specific Line Graphs page, click Display Options.
2. Click the Consolidated Graph | Line Graph | Map | Tabular | Display Order tab.
3. From this tab you can:
   - Change the size of the graph (in pixels) with the **Height** and **Width** options
   - Select a method of **Data Transformation**
   - Change information in the **Vertical Axis**
   - Change information in the **Horizontal Axis**
   - Change the **Date Range** to be included in the display. *Note: When changing a date range,you may check* ☐ All displays use same dates*, so that the other single syndrome views (line graph, map, and tabular) will utilize the same date range.*
4. Click Save.

Syndrome Specific Maps

The Syndrome Specific Maps page includes a map of the jurisdiction for each data source. Zip codes are color-coded based on the range of syndrome health events occurring in the zip code for the specific data source. The maps feature zoom capabilities allowing you to zoom in on a specific area to better discriminate between zip codes within small geographic boundaries. Mouse-over functions are also available to provide descriptive information including post office name, zip code, population, and record counts for the specified zip code.

Customizing Syndrome Specific Maps

1. From the Syndrome Specific Maps page, click Display Options.
2. Click the Consolidated Graph | Line Graph | Map | Tabular | Display Order tab.
3. To alter the size of your map view, change the **Height** and **Width** numeric values.
4. Select a type of **Data Transformation**.
5. To select additional **Map Layers**, click the associated check boxes.
6. Select **Map Values** and **Number of Levels** to which the map values will be binned.
7. Change the **Date Range** to be included in the display. *Note: When changing a date range, you may check* ☐ All displays use same dates*, so that the other single syndrome views (line graph, map, and tabular) will utilize the same date range.*
8. Click Save.

Syndrome Specific Tables

The Syndrome Specific Tables page contains a summary table of the number of syndrome health events by date and by data source. These tables provide drill-down levels and filtering capability. To sort a table, click a Column Header. Within the Syndrome Specific Tables, the information available for each patient will vary by source. Rows in the table may be filtered in three ways:

1. **Include**: Only display rows containing the entered value in the selected column.
2. **Exclude**: Only display rows that do not contain the entered value in the selected column.
3. **Clear**: Clear values and show all rows.

DoD Diagnoses

- Syndrome – One of eleven syndrome categories
- Date – Dates selected in display options
- Zip – Zip code for the region
- State – State tracking for the syndrome
- Organization – DoD facility (More information regarding DoD facilities' reporting data can be found at the DoD MTF website, which is updated monthly with organization codes and facility information, **http://www.dmisid.com/cgi-dmis/download**)
- Age – Age of patient
- Gender – Gender of patient
- ICD-9 – ICD-9-CM code for diagnosis
- ICD-9 Description – Text description of the ICD-9-CM diagnosis
- Disposition
  1 = Released without limitations
  2 = Released with work/day limitations
  3 = Sick at home/quarters
  4 = Immediate referral
  5 = Left without being seen
  6 = Left against medical advice
  7 = Admitted
  8 = Expired
  A = Transferred to another hospital
  B = Transferred to an SNF (Skilled Nursing Facility)
  C = Transferred to another clinical service
  D = Continued stay
  E = Left against medical advice
  F = Discharged home
  G = Expired
- Organization Code – DoD facility
- Patient Type
  I = Inpatient
  O or Null = Outpatient
- Appointment Type
  1 = Appointment scheduled
  3 = Walk-in
  4 = Sick call
  6 = Telephone consultation
  8 = Cancelled by facility
  9 = Cancelled by patient
- Appointment Prefix

C = Composite Health Care System
a = Ambulatory Data System
P = Clinical Integrated Workstation

- Message ID – Unique identifier for the record

DoD procedure data includes all of the above information with the exception of the ICD-9 and ICD-9 Description. Instead, CPT and CPT description are included, which indicates the clinical procedure code associated with the record.

VA Diagnoses

- Syndrome – One of eleven syndrome categories
- Date – Dates selected in display options
- Zip – Zip code for the region
- State – State tracking for the syndrome
- Facility ID – VA facility to which the patient is assigned (More information about the VA facilities' reporting data can be found at the VA website, **http://www1.va.gov/directory/guide/home.asp?isFlash=1**)
- Age – Age of patient
- Gender – Gender of patient
- ICD-9 – ICD-9-CM code for diagnosis
- ICD-9 Description – Text description of the ICD-9-CM diagnosis
- Servicing Facility ID – VA facility where the patient-provider encounter occurred
- Visit ID – Unique identifier for the patient visit
- Message ID – Unique identifier for the record

VA procedure data includes all of the above information with the exception of the ICD-9 and ICD-9 Description. Instead, CPT and CPT description are included, which indicates the clinical procedure code associated with the record.

LabCorp Test Orders

- Syndrome – One of eleven syndrome categories
- Date – Dates selected in display options
- Zip – Zip code for the region
- State – State tracking for the syndrome
- Zip Code Indicator
  P = patient
  F = facility
- Age – Age of patient
- Gender – Gender of patient
- Facility – Facility name
- Test Group Code – Code associated with the test group (basis for syndrome mapping); (More information about these codes can be found on the Laboratory Corporation of America website, **http://www.labcorp.com/dos/index.html** by navigating to the "Numerical Index")
- Test Group Description – Text description of the test group code
- Message ID – Unique identifier for the record; a link that provides further information regarding the record including all tests associated with it and ICD-9-CM codes associated with the reason for the test order

Customizing Syndrome Specific Tables

1. From the Syndrome Specific Tables page, click [Display Options].
2. To view customizations options, click the [Consolidated Graph | Line Graph | Map | Tabular | Display Order] tab.
3. Select a type of **Data Transformation**.
4. Change the **Date Range** to be included in the display. *Note: When changing a date range, you may check* ☐ All displays use same dates*, so that the other single syndrome views (line graph, map, and tabular) will utilize to the same date range.*
5. Click [Save].

Negative BioWatch Results

BioWatch is an initiative involving deployment of environmental samplers in key locations to detect releases of certain biological agents. The Negative BioWatch Results section presents non-reactive laboratory tests for these environmental samplers.

At the top of the Negative BioWatch Results home page, a table lists each collector ID, the collector's range of operation, and the number of non-reactive specimens tested. Each collector ID provides a link to a table presenting a historical record of all non-reactive tests for that collector including:

- collection date
- external specimen ID (usually the unique ID that the Environmental Protection Agency [EPA] has assigned to filters collected from BioWatch air samplers or a lab-generated unique ID)
- specimen ID (unique ID the lab assigns to a sample), order ID
- lab test performed
- lab reporting non-reactive tests

Filtering and column sorting options are available.

- At the bottom of the BioWatch home page, a histogram displays a daily count of the number of non-reactive laboratory results for each day in the past two months.
- To produce a pop-up window indicating the date, hover the mouse over a bar on the graph.
- There are drill-down capabilities for each bar on the graph.
- Each histogram bar provides a link to a table that lists all non-reactive tests for that date.

Data Customization

Data Selection Button

The [Data Selection] button allows you to choose which data sources will be included in your line graphs, maps, and tables. By using this button, you can see more detail about states or regions with issues and can focus down to the zip-code level.

Customizing Data Sources

1. From the Consolidated Line Graphs page or the Syndrome Specific page, click [Data Selection].
2. Click the **Data Source** tab.
3. Click the data sources you want to include.

4. To adjust displayed values so that averages for each day of the week are aligned, check the ☐ Adjust for day of week box.
5. Click Save.

Customizing Regions

1. From the Consolidated Line Graphs page or the Syndrome Specific page, click Data Selection.
2. Click the **Region** tab.
3. Select a **Region Type** from the drop-down menu.
4. Select a **Region** from the drop-down menu.
5. To view more specific information, enter selected zip codes separated by commas in the **Zips** text area.
6. Click Save.

Customizing Demographics

1. From the Consolidated Line Graphs page or the Syndrome Specific page, click Data Selection.
2. Click the **Demographic** tab.
3. Select an **Age** group.
4. Select a **Gender**.
5. Click Save.

Display Options Button – Customizing Graph Order and Legend Colors

1. From the Consolidated Line Graphs page or the Syndrome Specific page, click Display Options.
2. Click the **Display Order** tab.
3. To change the order of the graphs, click a **Syndrome,** then click the Up (↑) or Down (↓) arrows.
4. To change the order of a data source, click a source, then click the Up (↑) or Down (↓) arrows.
5. To change legend colors, click a color box, then click the desired color.
6. Click Save.