

A Case Study of the Cost to Develop and Maintain a State Biosurveillance System*

Introduction

To assist states that may be developing biosurveillance capabilities and need some estimates of costs involved, the following summarizes some of the expenses associated with building and maintaining components of biosurveillance systems. Estimating such costs is difficult because they depend on specific design features of each system developed, and the features in turn are specific to each jurisdiction in which surveillance is conducted. Furthermore, system components are designed and built within existing information technology environments, which vary among jurisdictions, and in incremental stages over time. Because of these circumstances, it is difficult to estimate typical costs for developing and maintaining surveillance systems, and it would be inappropriate to generalize such estimates for all jurisdictions. Nevertheless, providing an example, or case study, of the costs for one state to develop several biosurveillance system components within their existing technology infrastructure can provide an idea of the costs involved for others trying to plan such systems.

This report summarizes the experience of the New York State Department of Health (NYSDOH) in developing four biosurveillance components: Electronic Clinical Laboratory Reporting, Communicable Disease Reporting, Syndromic Surveillance Reporting, and Public Health Laboratory Reporting. Each section describes the information technology environment at the NYSDOH in which these biosurveillance systems were developed and then how they evolved. Costs are only approximate since the systems were developed over many years and may not reflect costs in today's dollars.

New York's Public Health Information Infrastructure

The NYSDOH developed and enhanced four essential systems that support biosurveillance: the Electronic Clinical Laboratory Reporting System (ECLRS), the Communicable Disease Electronic Surveillance System (CDESS), the Electronic Syndromic Surveillance System (ESSS), and the Wadsworth Public Health Laboratory's Clinical Laboratory Information Management System (CLIMS). These systems operate within the NYSDOH Health Commerce System (HCS), a large scale, web based public health infrastructure for reliable, redundant, secure health information exchange and communications between public health and external partners. The HCS is an integral component of the NYSDOH's emergency response plan, with partners including local health departments (LHDs), acute and long term care facilities, clinical laboratories, pharmacies and health care practitioners. The HCS supports some 40,000 organizations and over 100,000 users, accessing the system on a routine basis for day-to-day

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information exchange, routine disease surveillance, and situational awareness for emergency preparedness.

As described below, the cost of *building* each of the first three systems--ECLRS, CDESS, and ESSS--is hard to separate out because they were built during the same time period with shared staff. Overall, New York staff estimate that the cost to *maintain and enhance* all three systems is over \$1 million per year.

The Electronic Clinical Laboratory Reporting System (ECLRS)

The electronic laboratory reporting initiative in New York was undertaken with the goal of providing a single system for clinical laboratories to meet their public health reporting requirements, by securely and rapidly transmitting laboratory results to the NYSDOH, New York's 57 local health departments (LHDs), and the New York City Department of Health and Mental Hygiene (NYCDOHMH). A Request for Proposal was issued in December 1998 and a five year, state-funded contract was executed with a vendor in March 2000. By March 2001, the Electronic Clinical Laboratory Reporting System (ECLRS) was built using the HCS infrastructure, and user acceptance testing was completed. The first laboratory started reporting for patients outside New York City (NYC) via the ECLRS in July 2001. Initially, the system was used by clinical laboratories to report only communicable disease test results; in subsequent years, reports for HIV, cancer, heavy metals and congenital malformations were added. The ECLRS was also enhanced to build automated, unattended process-to-process capability to transmit NYC patient laboratory results to the NYCDOHMH. Laboratories send reports using an ASCII or HL-7 file or online data entry and use LOINC (Logical Observation Identifier Names and Codes) and SNOMED (Systematized Nomenclature Of human and veterinarian MEDicine) coding schemes. The reports are automatically distributed to the appropriate public health authorities in the NYSDOH, LHDs, and NYCDOHMH.

Since the implementation of the ECLRS in 2001, there have been 570 reporting laboratories. The number of laboratories using the HL7 standard is 121 for communicable, 40 for lead, 40 for HIV, and 58 for cancer. A total of 113 labs use the LOINC/SNOMED coding scheme, and 217 laboratories use New York State-developed software for data transport.

Development: The cost of the five year contract was approximately \$6.8 million, from which \$200,000 was spent on hardware and software for the first year and the remaining \$6.6 million funded 11 consultants, including 7 developers, 3 business analysts, and 1 project manager to build ECLRS, CDESS and ESSS .

Maintenance/Enhancement: After the 5 year contract, there have been 2 state-funded contract developers (\$350,000/year), 0.5 state-funded contract business analyst (\$80,000/year), and 3 grant supported staff (2 developers and 1 business analyst, \$500,000/year) to maintain, monitor, and enhance the ECLRS, with all these personnel also working on redesigning and migrating databases from Sybase to Oracle in 2012.

Communicable Disease Electronic Surveillance System (CDESS)

The CDESS is a single, secure application for staff in the 57 upstate New York LHDs, the NYSDOH, and infection control programs in hospitals, to collect, integrate, analyze, and report data from various sources for infectious disease surveillance. The CDESS was developed in 2005 to integrate with the ECLRS so that laboratory reports of

general communicable diseases, sexually transmitted diseases, and tuberculosis (TB) could trigger public health case investigations. The CDESS eliminates redundant data entry, provides LHDs the capability to forward a case to another county to investigate as appropriate, has a person-centric, flexible architecture, and provides tracking and case management functions for hepatitis, STD, and other selected diseases. It also provides contact tracing capability for TB, hepatitis, vaccine preventable diseases, and pandemic influenza.

Development: The building of the CDESS occurred during the building of the ECLRS, and CDESS development costs are difficult to separate from the ECLRS development costs. The initial development of CDESS was completed in November 2005 and placed into production in February 2006.

Maintenance/Enhancement: After the implementation of CDESS, there have been 2 state-funded contract programmers (\$320,000/year), 1 state-funded contract project manager (\$170,000/year), 0.5 state-funded contract business analyst (\$80,000/year), 1.5 grant-funded programmers (\$230,000/year), and 1 state-funded programmer (\$100,000/year) involved in the development and maintenance of CDESS since 2005. These developments largely consist of the following disease specific modules: a syphilis serology registry to capture all syphilis serology data (2007); a foodborne module to facilitate monthly data extraction and transmission to the Foodnet Program at the Centers for Disease Control and Prevention (CDC) (2007); a perinatal hepatitis B module to allow LHDs to identify and manage infants born to HBsAG positive mothers in delivery hospitals (2008); a TB module to replace the former TB Information Management System (TIMS) and allow weekly case notification messages to be extracted and transmitted to CDC via PHINMS (2009); a vaccine preventable disease supplement module with contact tracing (2010); a hepatitis tracking system (2011); a rabies reporting system to link to the public health laboratory Clinical Laboratory Information Management System (CLIMS) to collect information on humans and animals that may have had contact with possibly rabid animals (2011) and to allow LHDs to manage financial reimbursement for specific rabies prevention activities (2012); a new CDESS Sexually Transmitted Disease Management Information System (STD MIS) to replace the old CDC STD MIS for case management and partner services (2012-2013); a refugee health assessment module to provide health assessments to refugees arriving in New York (2013-2014); and an epidemiologic problem alert system to communicate among NYSDOH and LHDs to improve surveillance and provide current information and guidance to communicable disease control staff (2013-2014).

Electronic Syndromic Surveillance System (ESSS)

The New York State Electronic Syndromic Surveillance System (ESSS) monitors near-real-time, health-related data to indicate possible outbreaks and monitor health events. The goals of the system include: (1) monitoring general community health trends, (2) recognizing outbreaks before physician diagnosis and laboratory reports are available, (3) providing objective evidence that an outbreak may not be occurring, and (4) characterizing the geographic and temporal spread of an outbreak after initial detection.

Development: The technical infrastructure for the ESSS is the same as for the ECLRS, and therefore the ESSS development costs are difficult to separate from the ECLRS development costs. The system was developed and implemented in 2005 and

currently monitors data from two sources: 1) emergency department (ED) records submitted daily (about 10,000 ED visits per day) by 135 of the 144 (94%) New York hospitals outside of NYC, containing chief complaint (a free-text field listing the reason for the patient's visit), and 2) Medicaid over-the-counter (OTC) and prescription medication data, transmitted daily by NYSDOH's Medicaid Program, providing the count of all Medicaid-paid pharmaceuticals dispensed in 18 categories by ZIP code of patient address, 5 age groups, and gender.

ED chief complaint data from the previous day are electronically submitted by participating hospitals via the ECLRS to the NYSDOH. ED chief complaints are categorized under one or more syndromes (Asthma, Fever, Gastrointestinal, Neurological, Rash, Respiratory, Carbon Monoxide Poisoning, Hypothermia, Heat Wave, or Synthetic Drug) by text-string searches for key terms. Unusually high numbers of complaints within a syndrome are identified by a modified 28-day CuSum method as described by the CDC's Early Aberration Reporting System (EARS).

Counts of medications in each category from the Medicaid over-the-counter and prescription data are aggregated by county and surveillance region using the same method as the ED chief complaint data to generate alerts for investigation.

Maintenance/Enhancement: Since the ESSS infrastructure is the same as the ECLRS infrastructure, maintenance costs for ESSS are contained in the above estimate for ECLRS maintenance.

Information Infrastructure for New York's Public Health Laboratory: Wadsworth Center Laboratory Information Management System (CLIMS)

CLIMS is a laboratory information management system, used for sample tracking and reporting by the Wadsworth Center, NYSDOH's public health laboratory. It centralizes data management within a relational database for all of the infectious disease laboratories at Wadsworth Center, including:

- Arbovirus Reference and Surveillance
- Bacteriology
- Biodefense Laboratory
- Bloodborne Viruses Laboratory
- CDC Serological Testing Algorithm for Recent HIV Seroconversion (STARHS) Lab
- Chlamydia
- Diagnostic Immunology
- Gonorrhea
- Mycobacteriology
- Mycology
- Parasitology
- Rabies Diagnostic Laboratory
- Syphilis
- Viral Encephalitis Lab
- Virus Reference and Surveillance

These laboratories are required to communicate legally-reportable test results to the NYSDOH Division of Epidemiology and to county health departments. CLIMS provides

an essential, common, centralized data platform for electronically sending all of Wadsworth's reportable results to the Division of Epidemiology and to counties without requiring software modifications with each new reportable result, test or coding term encountered. Configuring new results, tests, or vocabulary for electronic reporting is generally simple. LOINC and SNOMED mapping tables are established within CLIMS.

Incremental Cost of Establishing Electronic Laboratory Reporting from Wadsworth Center

The following describes the added cost of actually establishing electronic laboratory reporting using the CLIMS baseline infrastructure described above.

Development: The first ECLRS reports from Wadsworth Center were generated in January 2003. A rough estimate of the level of effort to complete the transition from paper to electronic reporting is 4 FTEs, over a period of 2 years (2001-2003).

Maintenance/Enhancement: Since initial deployment, Wadsworth has reorganized the infrastructure to enhance messaging capability, including:

- Networking/messaging infrastructure changes
- Database upgrades/changes
- Software enhancements as well as major architectural reorganization of software components responsible for HL7 code generation
- Review and implementation of evolving HL7 standards
- Modifications to automated algorithms and workflows for identifying test results to be sent to ECLRS.

On average over the last ten years, a rough estimate of the level of effort for enhancing electronic reporting has been 1 FTE / year. The estimate for routine maintenance of vocabulary terms and mappings, configuring the messaging aspects of new tests, training and help desk/technical support for users, and troubleshooting and correcting problems encountered during production is 1 FTE / year (i.e., costs not associated with software or infrastructure modifications needed for electronic reporting).

Important disclaimers about these estimates include the following:

- There are additional personnel and non-personnel related costs associated with building, maintaining and enhancing the CLIMS application and infrastructure which are not reflected here because they are not specific to electronic reporting to the Division of Epidemiology and the county health departments.
- These estimates are only for communicating laboratory results within New York State and do not include costs of reporting to other partners, such as CDC.
- These estimates include staff costs only within the CLIMS team, and not those for the numerous Wadsworth Center laboratory staff and other external stakeholders who were involved in project meetings, in specifying requirements, and in evaluating and validating solutions.
- The average FTE estimates for enhancing and supporting electronic reporting after its initial deployment do not include additional technology staff, experienced and trained in the support and development of CLIMS, who have been available for re-allocation as needed and who have spent a portion of their time—time that is difficult to estimate—on electronic reporting development and maintenance.