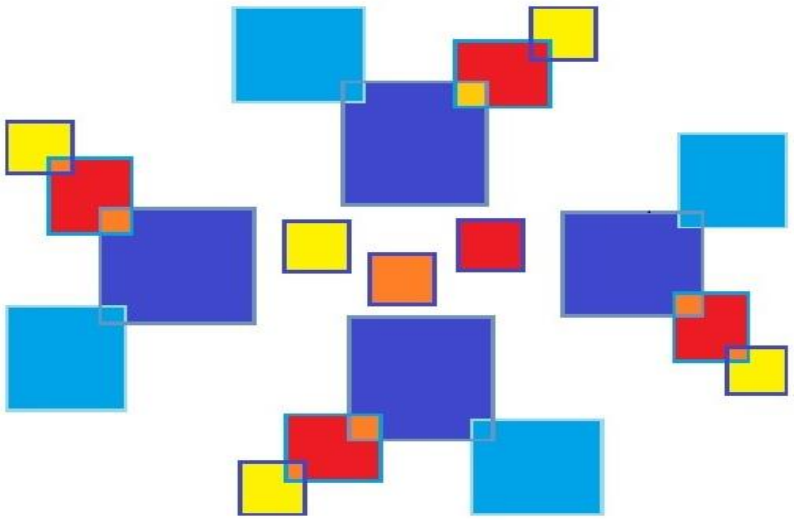
2014

Evaluating Connecticut's Health Information Technology Exchange

Laboratory Survey Report



Prepared for

Connecticut Department of Public Health

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Executive Summary

In 2010, the Connecticut Department of Public Health (DPH) entered into a Cooperative Agreement with the Office of National Coordinator for Health Information Technology (ONC), to create and implement a State Health Information Exchange (HIE). DPH received an award of $7.3 million to initiate and sustain HIE activities in the state of Connecticut.[1,2] The Health Information Technology Exchange of Connecticut (HITE-CT), a quasi-public agency, was created by Public Act 10-117, "*An Act Concerning Revisions to Public Health Related Statutes and the Establishment of the Health Information Technology Exchange of Connecticut,*" Sec. 82-90,96 (codified at CGS §19a-750(c)(1)), by the 2010 Connecticut General Assembly and Governor Rell. HITE-CT received $4.3 million over the course of three years to create and implement an HIE infrastructure and facilitate exchange activities in the state. Additionally, DPH contracted with the University of Connecticut Health Center (UCHC) to evaluate the ongoing development and implementation of Connecticut's Health Information Exchange (CT-HIE).

This report summarizes the results of 2011-12 (N=58) and 2013 (N=34) statewide surveys administered to licensed laboratories in Connecticut that were classified as hospital-based or independent laboratories by the Centers for Disease Control. These 92 surveys represent 66 unique labs. The goal of the survey was to measure the extent of lab interoperability, measured by the percent of labs sending electronic lab results to providers in a structured format and the adoption of LOINC terminology.

Even though we do not have an operational statewide Health Information Exchange in the state of Connecticut (CT-HIE) as of March 14, 2014, this report does demonstrate that 77% of the Connecticut's hospitals are sharing lab results electronically which is higher than the national average of 56%. Due to the low number of labs that responded to our survey, the results should be interpreted with caution.

Key Findings

Descriptive Characteristics of Laboratories

Location

- In 2013, Hartford and New Haven counties accounted for 64.7% of the labs and urban-periphery and urban-core represented 82.4% of the labs that responded to our survey.

Type of Laboratory

- In 2011-12 survey, responding labs were almost equally divided between hospital (53%) and independent (47%) labs. In comparison, the majority (71%) of labs surveyed in 2013 identified themselves as hospital-based and 29% identified themselves as independent.

Laboratory Volume

- Almost half the respondents (45.0%) accounted for up to 499,999 billable tests per year in 2011-12 compared to 59% in 2013.
- The number of physician practices submitting orders to the surveyed labs ranges from 0 to 1,000 practices, with a median of 45 practices.
- About a third of labs (35%) reported that over 100 physicians submit orders to them.

Electronic Capabilities

- In 2011-12, 57% of laboratories surveyed sent results in structured format to ambulatory providers outside of their organization compared to 59% in 2013.
- The percentage of laboratories sending laboratory results to web portals was 24% in 2011-12; this increased to 33% of labs in 2013.
- In 2011-12, 34% of laboratories reported sending final laboratory results to EHRs; this decreased to 30% of labs in 2013.

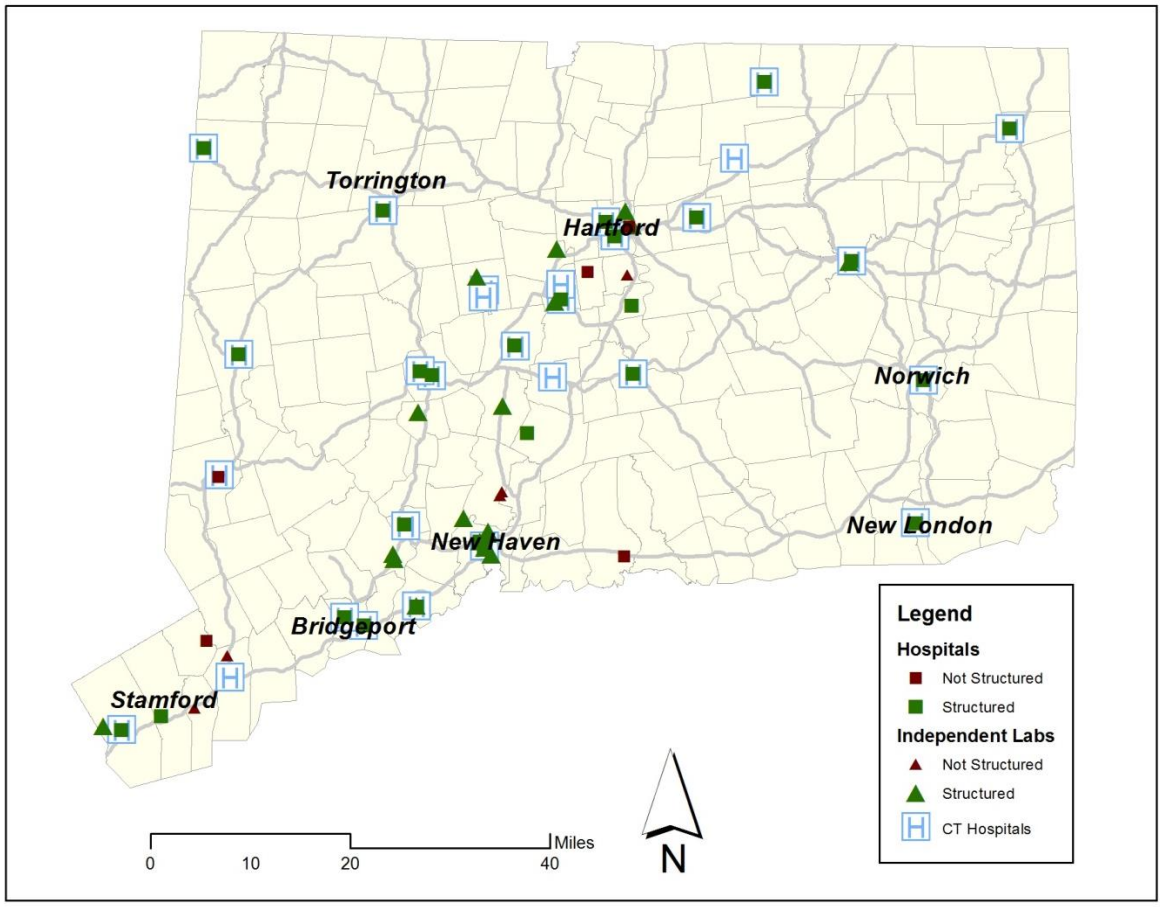
Adoption of Standards

- LOINC - In 2011-12, only 10.3% of the labs were sending results to ambulatory providers using LOINC standards, this increased to 27% in 2013. Of these 2% of labs sent all of their lab results to ambulatory providers using LOINC in 2011-12; this increased to 12% in 2013.
- LRI Guide - In 2011-2012, 38% (35% did not know) of labs had not implemented the LRI Guide, compared to 68% (29% did not know) of labs in 2013.
- HL7 - Use of any HL7 version increased from 22% of respondents in 2011-2012 to 41% in 2013. In 2011-2012, 71% of labs did not know whether they used HL7 standards; this decreased to 47% of labs in 2013. Two labs reported that they used both HL7 version 2.5.1 and HL7 2.3.1 in 2011-2012.
- Direct messaging – In 2013, only 9% (N=3) of the laboratories mentioned using Direct messages for sending lab results while 82% of laboratories (N=27) reported not using Direct messaging.

Differences in electronic reporting by lab affiliation, volume, and socioeconomic grouping

- In 2011-12, 77% of hospital labs sent structured electronic results compared to 63% in 2013. This compares with 37% of independent labs in 2011-2012 and 50% in 2013. This difference was statistically significant, that is the proportion of hospital labs with electronic capability was significantly higher than independent labs during 2011-12 but not in 2013.
- Labs that processed a higher volume of tests were more likely to send results electronically. In 2011-2012, 80% of labs receiving over one million billable tests per year sent results electronically.
- In 2011-12, 52% of independent labs processed fewer than 100,000 billable tests annually compared to 16% of hospital labs, this difference is significant and held for 2013 also hospitals processed higher number of billable tests in a year.

Location of hospital-based and independent labs that send structured data



Introduction

In 2009, Congress passed the American Reinvestment and Recovery Act (ARRA). Under the ARRA, the Health Information Technology for Economic and Clinical Health Act of 2009 (the HITECH Act) outlines a plan for improving the appropriate use of health information technology to improve patients' quality of care. The HITECH Act created the Office of the National Coordinator for Health Technology (ONC) within the U.S. Department of Health and Human Services (HHS). It also authorized new grant programs, including state grants to promote the use of health information technology (HIT). These grants were known as the State Health Information Exchange Cooperative Agreements Program.[1] This program's goal is to "facilitate and expand the secure, electronic movement and use of health information among organizations according to nationally recognized standards."[2] The Cooperative Agreements Program's Funding Opportunity Announcement defines health information exchange (HIE) as "the electronic movement of health-related information among organizations according to nationally recognized standards."[1]

The Connecticut Department of Public Health (DPH) was awarded $7.29 million through the HITECH Act in 2010 and entered into a four-year cooperative agreement with ONC from July 01, 2010 through March 14, 2014.[3] Through a contract with the DPH, the University of Connecticut Health Center (UCHC) was responsible for evaluating the statewide HIE's ongoing development and implementation. This evaluation used mixed methods, namely survey research and in-depth interviews. The surveys comprising this research were administered statewide. These surveys were designed to measure the adoption of health information technology functions and overall opinions about health information technology within Connecticut. UCHC's Institutional Review Board (IRB) deemed the surveys and interviews as non-human subjects research.

All states were required to track the progress of their efforts to enable HIE in program priority areas, namely e-prescribing, receipt of structured lab results, and sharing of patient care summaries across unaffiliated organizations. ONC measures assessed in this report include the percent of labs sending electronic results to providers in a structured format, the number of labs using HL7 messaging standards, and the percent of labs sending electronic results to providers using Logical Observation Identifiers Names and Codes (LOINC) terminology standards.[4,5]

Background

Definition

According to the Department of Health and Human Services, a laboratory information management system (LIMS) is "a collection of computerized methods to acquire, analyze, store, and report laboratory data." A LIMS is used to track lab processes such as test processing and scheduling; tracking specimens and samples; inventory control; reporting lab data; quality control and quality assurance management; and statistical analysis and surveillance. [6]

History

In the 1970s, the idea to automate laboratory data handling first became popular. Papers were published on automated laboratory techniques created by using computers and programming languages. The first LIMSs were commercially released by three vendors in 1982: LIMS 2000 from Perkin-Elmer, a 'Turnkey LIMS' by Purvis Systems, and Spectrogram Corporation introduced a LMIS (laboratory management information system).[7] The systems were developed with the ability to collect, record, present, organize, and archive laboratory results; they served mainly to facilitate labs' financial management.[8]

Technology developed in the 1980s was not widely used. As a result, the majority of labs continued using paper-based methods. In the 1990s, the use of personal computers facilitated LIMS adoption; the transmission of lab orders and result data began shifting from paper to electronic PDFs. As technology continues to advance in the 21st century, the electronic capabilities of LIMS expand and adoption continues to increase.

Adoption rates

The ONC has compiled data from the American Hospital Association's (AHA) Annual Survey IT Supplement to the AHA Annual Survey on HIT adoption and use by U.S. hospitals. In the U.S., 56% of non-federal acute care hospitals shared lab results electronically with providers outside their system in 2012. **Table 1** shows the percentage of hospitals that shared lab results with outside providers in 2012. Connecticut had 77% of hospitals sharing results electronically, more than the national average (56%).[9] A complete list of states and their level of sharing lab results electronically is summarized in **Table 1**.

Connecticut had 77% of hospitals sharing results electronically compared to the national average of 56%.

Table 1. Percentage of hospitals sharing lab results electronically with providers outside their systems, 2012[9]

16-39%	40-49%	50-58%	59-70%	71-100%	No data
Alaska	Nebraska	Alabama	Idaho	Colorado	District of Columbia
North Dakota	Arkansas	Hawaii	West Virginia	New York	Puerto Rico
Kansas	Minnesota	California	North Carolina	Ohio	Virgin Islands
Mississippi	Montana	New Mexico	Utah	Maine	
Iowa	Texas	Arizona	Virginia	New Hampshire	
Oklahoma	Nevada	Kentucky	Oregon	**Connecticut**	
Wyoming	Florida	New Jersey	Vermont	Washington	
South Dakota	Louisiana	Pennsylvania	Michigan	Indiana	
Georgia	South Carolina	Illinois	Tennessee	Massachusetts	
Missouri	Wisconsin		Maryland	Rhode Island	
				Delaware	

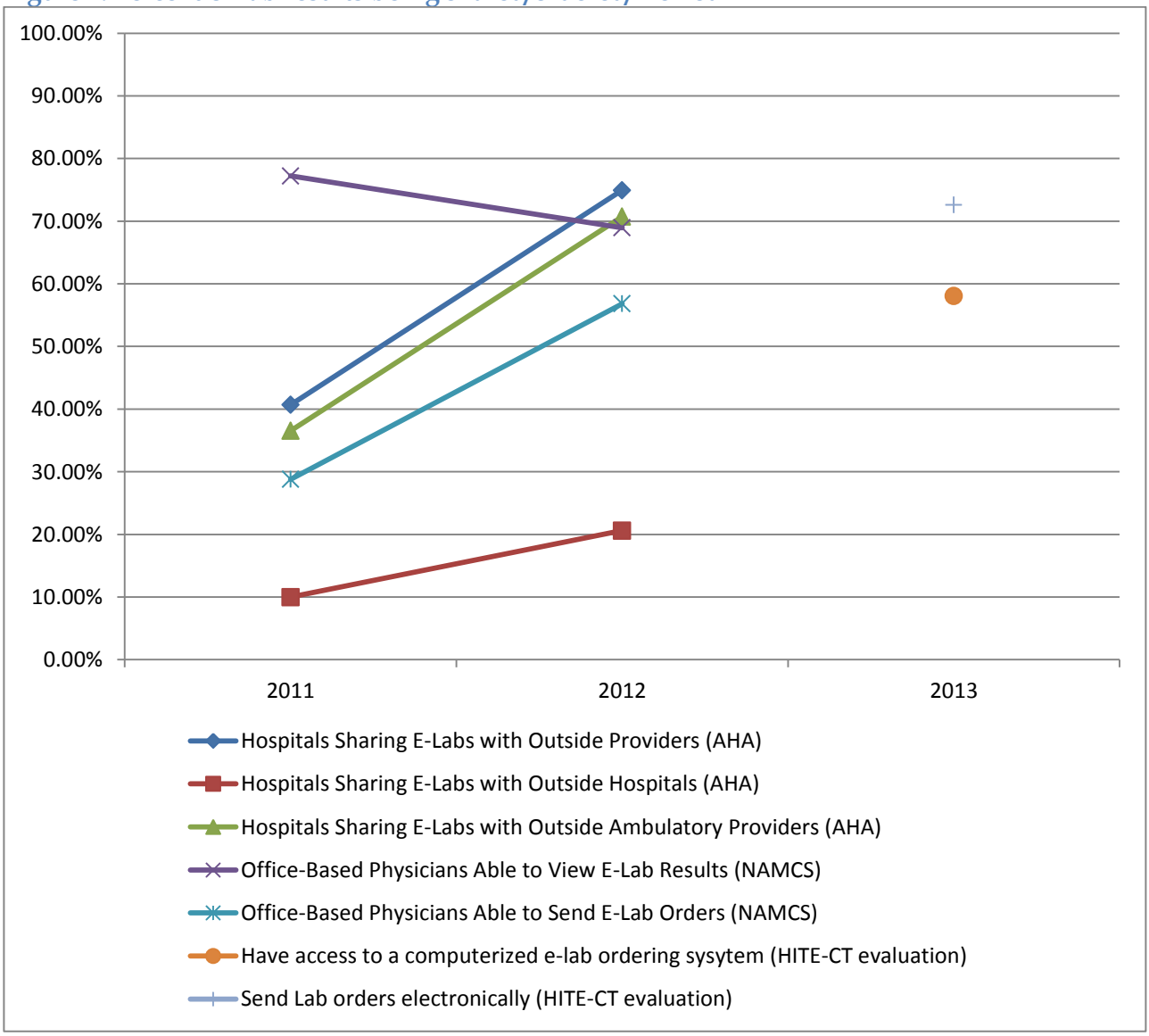
Data on Connecticut's lab exchange were made available by ONC. Figure 1 summarizes the data made available from the American Hospital Association's (AHA) Annual Survey IT Supplement and the National Ambulatory Medical Care Survey (NAMCS), and results from the physician surveys. The questions which were reviewed are as follows:

- AHA
  - Percent of hospitals sharing laboratory results electronically with providers outside their system
  - Percent of hospitals sharing laboratory results electronically with hospitals outside their system
  - Percent of hospitals sharing laboratory results electronically with ambulatory providers outside their system
- NAMCS
  - Percent of office-based physicians able to view lab results electronically
  - Percent of office-based physicians able to send lab orders electronically
- HITE-CT Evaluation
  - Does your main practice site have a computerized system for ordering laboratory tests?
  - Are orders sent electronically?

The ability of office-based physicians to send lab orders electronically increased from 28.8% in 2011 to 56.8% in 2012 though there was a reported reduction in their ability to view the lab results electronically from 77.2% in 2011 to 68.9% in 2012 (NAMCS data).
We found similar results 58.1% of the physicians report having access to an electronic lab ordering system and of those that had access to a lab ordering system 72.6% report sending orders electronically (HITE-CT Evaluation).

According to the results from the AHA survey, there was an increase in the percent of hospitals sharing laboratory results electronically with the providers outside their system from 40.6% in 2011 to 74.9% in 2012. This increase was lower for hospitals (9.9%) to hospital sharing (9.9% vs 20.6%) but higher for hospital to ambulatory provider (36.5% vs. 70.7%). Comparing the NAMCS data for 2011 and 2012, the ability of office-based physicians to send lab orders electronically increased from 28.8% in 2011 to 56.8% in 2012 though there was a reported reduction in the percent of office-based physicians that were able to view the lab results electronically from 77.2% in 2011 to 68.9% in 2012. These data are similar to those reported on the 2013 physician survey, 58.1% of the physicians report having access to an electronic lab ordering system and of those that had access to a lab ordering system 72.6% report sending orders electronically.

Figure 1. Percent of lab results being shared/ordered/viewed



Standards

Developing national standards for health technology interoperability is important for the adoption of new technologies. Health care organizations do not always use the same data standards, and therefore cannot exchange data with each other. In order for any HIE to function successfully, participating organizations must be capable of exchanging standardized data.

Interoperability is defined as the ability to communicate data across software and hardware from multiple vendors in a way that data recipients can understand and utilize the data that other entities send.[10] Interoperability requires the use of standards to ensure that data from one organization are available and meaningful to other organizations. These standards are rules or guidelines that dictate how patient data is stored electronically and exchanged between organizations and are used to facilitate the capture and storage of clinical data. "Semantic interoperability takes advantage of both the structuring of the data exchange and the codification of the data including vocabulary so that the receiving information technology systems can interpret the data. This level of interoperability supports the electronic exchange of patient summary information among caregivers and other authorized parties via potentially disparate electronic health record (EHR) systems and other systems to improve quality, safety, efficiency, and efficacy of healthcare delivery."[10]

Adoption and implementation of content and transport standards are most likely to increase interoperability. A few examples of standards being used to move health information are:

- Direct Messaging is a standard for the encryption of data so that it can be securely exchanged electronically. Direct Messaging was developed in 2010 in order to address issues with sharing patient health care data between organizations.[11]
- Health Level 7 (HL7) is a Standards Developing Organization (SDO) founded in 1987. This SDO developed HL7 messaging standards for data exchange between health care organizations. HL7 standards are nationally recognized guidelines for the format and content to be used in automated messages containing health care data. By defining the syntax for constructing messages and describing the standard vocabulary used in the messages, HL7 facilitates the exchange of data between organizations.[12]

Many terminology standards provide codes for clinical data such as diseases, allergies, medications, problem lists, and diagnoses that can have multiple descriptions. Terminology standards help to ensure that data retain a consistent meaning as they are shared.[13] Standards used by labs include, but are not limited to, Logical Observation Identifiers Names and Codes (LOINC), Systematic Nomenclature for Medicine (SNOMED), International Classification of Diseases (ICD10/ICD), and Current Procedural Terminology (CPT).[13] Not all labs or EHR systems are equipped to understand multiple standards, so uniform adoption of national standards is necessary for interoperability.

LOINC standards were initiated by the Regenstrief Institute in 1994 "as a response to the demand for electronic movement of clinical data from laboratories that produce the data to hospitals, physician's offices, and payers who use the data for clinical care and management purposes. The purpose of the LOINC® database is to facilitate the exchange and pooling of results for clinical care, outcomes management, and research."[14]

Standardizing the formatting and coding of electronic messages exchanged between laboratories and EHRs increases providers' access to timely, accurate clinical information. Electronic transmission of standardized laboratory test results to EHRs allows ordering providers to review results along with other pertinent patient history. Real-time access to lab results can help providers make better-informed decisions to provide quality patient care.

Policies impacting lab data

Electronic sharing of laboratory data is impacted by federal laws such as the Health Insurance Portability and Accountability Act of 1996 (HIPAA) and Clinical Laboratory Improvement Amendments of 1988 (CLIA), as well as state-specific medical release and laboratory licensing laws.[15]

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- CLIA regulations allow labs to release results to individuals authorized under state law. In the absence of state guidance, CLIA regulations permit laboratories to release test results to the individuals responsible for using them and to laboratories that originally requested the test.[15]
- HIPAA allows the release of health information for treatment, payment, and health care operations without patient permission. Under HIPAA regulations, patients have the right to access their protected health information upon request. HIPAA does not overrule CLIA's limitations on laboratories' ability to release test results.[15] State laws generally define who can control who receives lab test results.

In Connecticut, clinical laboratories are permitted to release test results to authorized health care provider who requested the test. Labs can also release results to persons who are authorized to use or receive them or who are responsible for using or receiving the test results. This mainly comprises providers treating the patient. Laboratories can release results directly to a patient only with the permission of the ordering provider.[16,17] Department of Public Health regulations allow lab test results to be reported directly to patients with the written request of the authorized provider who ordered the test.[17]

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Policies and laws governing patients' consent to disclose health information vary between states. In an interstate transaction, the releasing state must comply with local law regardless of the receiving state's policies and laws.[18] Regional and national policies are needed to resolve conflicting state laws to allow for sharing of lab results electronically between neighboring states to improve coordination of care. Laws pertaining to lab exchange are

summarized in Table 2.

Table 2

Table 2. Connecticut and federal laws on releasing clinical laboratory test results[16,17]

Statute	Enacted	Summary
Connecticut Laws		
Conn. Agencies Regs. § 19a-36-D29(a)	2008	• Laboratories may accept specimens only upon request of licensed physician or other persons authorized by law to make diagnoses.
Conn. Agencies Regs. § 19a-36-D32(a)	2008	• Laboratory findings on a specimen shall be reported directly to the licensed provider who ordered the testing pursuant to authority granted to such provider by chapter 370 [medical doctors & surgeons], 372 [chiropractic], 373 [naturopathy], 375 [podiatry], 377 [midwifery], 378 [nursing], 379 [dentistry], 380 [optometry] or 400j [pharmacy] and may be provided by laboratories other than the department...[of public health's] laboratory to lay persons upon the written request of the provider who ordered the testing. Laboratories other than the department... [of public health's] laboratory may also provide findings upon the written request of providers who did not order the testing, so long as the requesting provider is also statutorily authorized to order such testing pursuant to chapter 370, 372, 373, 375, 377, 378, 379, 380 or 400j of the Connecticut General Statutes, and is providing care to the patient who is the subject of the testing.
Conn. Agencies Regs. § 19a-36-D38(a)	2008	• The clinical laboratory shall be operated in compliance with all applicable state and federal laws and regulations, including but not necessarily limited to CLIA Title 42 Part 493 of the code of federal regulations.
Conn. Gen. Stat. § 19a-583(a)(4)	2008	• No person who obtains confidential HIV-related information may disclose or be compelled to disclose such information, except to a health care provider or health facility when knowledge of the HIV-related information is necessary to provide appropriate care or treatment to the protected individual . . . or when confidential HIV-related information is already recorded in a medical chart or record and a health care provider has access to such record for the purpose of providing medical care to the protected individual.
Federal Regulation		
42 C.F.R. § 493.1291(a) and (f)[19]	Aug. 22, 2003	• The laboratory must have an adequate manual or electronic system(s) in place to ensure test results and other patient-specific data are accurately and reliably sent from the point of data entry (whether interfaced or entered manually) to final report destination, in a timely manner. • Test results must be released only to authorized persons and,

Statute	Enacted	Summary
		if applicable, the individual responsible for using the test results and the laboratory that initially requested the test.
42 C.F.R. § 493.1299(a)[19]	Aug. 22, 2003	• The laboratory must establish and follow written policies and procedures for an ongoing mechanism to monitor, assess and, when indicated, correct problems identified in the post analytic systems specified in Sec. § 493.1291.
45 C.F.R. § 164.506(c)[20]	Jan. 25, 2013	• Permits covered entities, including health care providers such as clinical laboratories, to disclose protected health information for treatment, payment, and health care operations without a patient's permission to other persons and entities when certain additional circumstances are met.
45 C.F.R. § 164.524(a)(1)(iii)(A) and (B)[20]	June 7, 2013	• Under the HIPAA Privacy Rule, patients do not have the right of access to protected health information that is held by a clinical laboratory that is subject to CLIA to the extent the provision of access to the individual would be prohibited by law or that is exempt from CLIA. • Patients' rights to access their test results directly from a clinical laboratory generally depend on whether state law permits such access.

Importance of LIMS

LIMSs have many features that improve labs' efficiency and timeliness and that facilitate data exchange between labs and providers. LIMS allows for fewer manual errors and faster processing of results. Johansen et al. (2010) found that, after switching to electronic systems, manual handling was reduced from 17% of tests ordered on paper to 1% of electronically-ordered tests. They also found that electronic lab results were available 1-2 days earlier than paper results, and that the transmission time of results between laboratories dropped by two minutes per result, or 1,800 hours per month.[21] Blaya et al. found that receiving drug susceptibility test and culture results via a web-based lab information system took significantly less time than receiving paper results.[22] Another study showed that automated electronic laboratory reporting (ELR) of notifiable diseases to public health departments identified more cases than did spontaneous, paper-based reporting, and that ELR produced more complete reports in a timelier manner.[23]

Computerized provider order entry (CPOE) systems allow providers to use a computer, instead of paper, to enter orders such as for laboratory tests, medications, and radiology. CPOE systems improve efficiency by decreasing the time required by staff to clarify illegible handwriting on paper orders. Computerization of ordering can also eliminate medical errors resulting from poor penmanship.[24]

LIMS use has been shown to increase laboratory test monitoring and to improve patient safety. Laboratory monitoring errors are a cause of potential adverse events (AEs) and may be reduced through the use of health technology. Introduction of LIMS decreased errors in communicating tuberculosis lab test results from district laboratories to health centers when compared to paper reporting of results.[25] An automated system to detect and grade lab-based AEs during cancer clinical trials accurately detected all AEs, while manual grading

was inaccurate 15% of the time.[26] Use of a LIMS to automatically grade AEs also improved timeliness; the LIMS saved an average time of 5.5 minutes per treatment course over manual grading.[26]

Evidence of HIT's effect on patient safety in regards to laboratory test monitoring has been mixed. Studies have shown that electronic reminders sent to physicians through EHRs increased laboratory test monitoring compared with usual care.[27,28] Electronic notification of overdue recommended laboratory monitoring to pharmacists, who followed up with outreach to encourage testing, increased patients' rates of recommended laboratory monitoring compared to usual care.[27,29,30] Additionally, medication orders that triggered an alert for drug-laboratory interactions increased recommended lab ordering, while abnormal lab alerts decreased ordering of the drug.[31] Palen et al. (2006) found that computerized physician order entry had no effect on physicians' overall rates of ordering recommended laboratory monitoring for patients taking diuretics.[32] Other studies showed that alerts or electronic reminders to providers did not increase rates of recommended laboratory monitoring.[33,34]

Challenges

Several challenges impact adoption of lab information management systems, like funding, incomplete or inconsistent adoption of standard by the vendor system, security and other features available, limited adoption of EHRs by practitioners.

- Limited funding to support the development and testing of standards and to sustain the certification and adoption of standards-based IT products in health care settings.[35]
- Increased connectivity of laboratory information systems to the internet creates security concerns for storing and sharing lab data.[36] Lab results need to be securely transported from the lab to the provider to protect patient privacy. HIE or LIMS vendors need to provide secure encrypted transportation of data in order to eliminate this challenge to sharing results.[5]
- Many LIMS vendors have developed systems with different features to be used by specific types of labs. Many public health labs have reporting systems using non-standardized information systems; this makes electronic communication with an LIMS difficult.[35] In order to create a fully-functional, clinically-useful LIMS, features from currently available systems need to be incorporated into a comprehensive system.[8]
- A lack of adoption of EHRs by providers compromises electronic communication between providers and labs.[35] Providers may also have difficulty using new EHR technology right after adoption. The multiplicity of lab test names can make it difficult for physicians to order the correct lab test.[37] While many LIMS systems have automated alerts of abnormal lab tests, providers do not always acknowledge or follow-up on alerts sent through an EHR.[38] The use of new health technology requires educating all users to respond to all alerts.[35]
- Challenges to interoperability occur due to laboratories' incomplete and inconsistent adoption of existing standards.[35] Receiving organizations cannot understand lab results unless they adopt the transmitting laboratory's standards; this is impossible if organizations use multiple standards.[39] The other option is to map data from each sending laboratory to standard codes.[40,41] Mapping laboratory data to standards such as LOINC can take up to an average of 15 minutes per lab test term; it is also possible

that not all tests can be mapped to standard codes.[42] The adoption of commonly-used standards minimizes the need for mapping and increases interoperability between systems.

To address the lack of funding to support interoperability issues related with labs, the Centers for Disease Control and Prevention (CDC) have provided grants through the new Prevention and Public Health Fund created by the Affordable Care Act to help increase adoption of health information technology. One of these grants is the Capacity Building Assistance to Strengthen Public Health Infrastructure and Performance initiative. This initiative funds nonprofit organizations in order to build public health agencies' and systems' capacity and infrastructure. These nonprofit organizations provide guidance, support, and technical assistance to support the efforts of state, tribal, local, and territorial health departments in adopting HIT.[43] Additionally, the CDC has provided grants to increase epidemiology, laboratory, and health information systems capacity at health departments nationwide. This involves hiring and training of staff, increasing LIMS use to share data between labs and public health departments, and developing capacity for public health departments to implement the HITECH Act. These funding opportunities allow health departments to better respond to disease outbreaks, to monitor trends, and to evaluate the impact on interoperability. Investments in information systems will position health departments to better engage effectively in this modern era of HIE and evolving EHRs.[44]

Value of HIE to lab exchange

HIE is a way for organizations such as physician offices, hospitals, clinics, labs, radiology centers, public health departments, and other health care institutions to share health information on a secure, electronic network. HIE can assist in the delivery of important health information in a timely and efficient manner. An operational HIE can increase a laboratory's efficiency by allowing for automated sharing of results, fewer repeat tests and procedures, less paperwork, and faster access to information.[45]

HIEs can allow health care providers to access a patient's information from his/her other providers. Access to a complete and updated patient health record allows providers to make informed treatment decisions.[45] Laboratory data from clinical information systems vary in their completeness; data important to public health reporting is often missing. Using data from an HIE in addition to lab data increased the overall data's completeness.[46] Integration of a lab system and an HIE allows for additional clinical data from the HIE to be added to lab reports. Surveyed providers thought that the enhanced reports would save time, improve quality of care, and reduce the need to search for information compared to traditional lab reports.[47]

Since laboratory results can represent about 70-80% of all health care information for patients and providers, it is important that this data be easily exchangeable.[5] Two studies showed that, following the implementation of a regional HIE, clinicians increasingly viewed laboratory results.[48,49] An HIE can also be used to examine patient cross over. Gichoya et al. found that 19.5% of patients in a hospital network had notifiable disease data at more than one institution and 11.3% of patients had two or more reportable reports.[50]

Effective exchange of data by providers may help curtail repeat ordering of tests, and the costs associated with these redundant tests.[5] Several studies have found that after adoption of an HIE the number of laboratory tests ordered decreased[51-53], but there was no significant decrease in imputed charges for laboratory testing.[53] McCormick et al. analyzed data from the 2008 National Ambulatory Medical Care Survey and found that physicians' access to computerized imaging results was associated with a 40–70 percent greater likelihood of imaging test ordering.[54] Another study also found the number of ordered laboratory tests significantly increased after implementing a regional HIE in Finland.[55]

HIE also benefits labs by providing services to all participating organizations. Establishing and maintaining interfaces between LIS and multiple different EMR systems requires numerous steps and resources.[56] Services provided by HIE can help maintain interface and include electronic connectivity across areas, data repositories and data mapping, data translational services, decision support capability, and IT infrastructure (i.e. servers, bandwidth, data and document storage, and processing capability).[35] Barbarito et al. found that adoption of HL7 messaging standards and the provision of a technological infrastructure for data sharing based on regional interoperability specifications facilitated implementation of an HIE.[57] Table 3 provides a list of benefits and challenges associated with adoption of LIMS.

Table 3. Laboratory and state HIE benefits and challenges

Benefit/ Challenge	Details
Interoperability/standards	
Challenge	Many organizations do not store data using common standards for laboratory reporting and clinical results. Data aggregation may require mapping data to standard codes.[40,41]
Challenge	Mapping laboratory tests to standard codes is labor intensive (average 15 min per lab test term to LOINC code) and not all tests are able to be mapped to standard codes.[42]
Challenge	Datasets created from the same EHR system each contain unique observations due to discrepancies in mapping, downloading, and cleaning processes.[58]
Challenge	EHR meaningful use requirements increase expectations for LIS-EHR interface that require technical support for interfacing, create expenses for labs, and make labs responsible for accuracy of data.[59]
Challenge	For public health laboratory reporting between local health departments and state agencies, 29.1% of data sharing relationships were data gaps.[60]
Challenge	Establishing and maintaining interfaces between LIS and multiple different EMR systems requires numerous steps and resources.[56]
Challenge	Increased connectivity of laboratory information systems to the internet creates security concerns for storing and sharing lab data.[36]
Benefit	Adoption of HL7 and providing a technological infrastructure for data sharing based on regional interoperability specifications facilitated implementation of an HIE in Italy.[57]
Quality of Care	
Challenge	Health care providers do not always acknowledge or follow-up on automated alerts of abnormal lab tests sent through EHR.[38]

Benefit/ Challenge	Details
Benefit	Implementation of a laboratory data exchange interface within an existing EHR at an AIDS clinic significantly improved the time required to make therapy changes after important HIV-specific changes in lab test results.[61]
Patient safety	
Benefit	Automated system to detect and grade lab-based adverse events during cancer clinical trials identified all true adverse events while manual grading was inaccurate 15% of the time.[26]
No association	Non-interruptive medication laboratory monitoring alerts in an ambulatory setting had no effect on improving physician ordering of recommended baseline laboratory test monitoring for newly prescribed medications.[34]
Benefit	Introduction of lab information system decreased errors in communicating tuberculosis lab test results from district laboratories to health centers compared to paper reporting.[25]
No association	Computerized physician order entry had no effect on physicians in the overall rate of ordering recommended laboratory monitoring for patients taking diuretics.[32]
No association	Electronic reminders to physicians through EHRs did not increase the rates of appropriate laboratory monitoring within 14 days following an outpatient clinic visit.[33]
Benefit	Electronic reminders sent to physicians through EHRs increased monitoring laboratory testing compared to usual care.[27,28]
Benefit	Electronic notification of overdue recommended laboratory monitoring to pharmacists who followed-up with outreach to encourage testing increased patients' rates of recommended laboratory monitoring compared to usual care.[27,29,30]
Benefit	Medication orders that triggered an alert for drug-laboratory interactions increased recommended lab ordering and abnormal lab alerts decreased ordering of the drug.[31]
Efficiency	
Benefit	Laboratory data from clinical information systems vary in their completeness and data important to public health reporting is often missing. Using data from HIE to add information to lab data increased the completeness.[46]
Benefit	Use of a Computerized Provider Order Entry system improved the provision of clinical information provided for wound and stool specimens that were useful for processing/interpretation of results by lab staff.[62]
Benefit	Automated electronic laboratory reporting (ELR) of notifiable-diseases to public health departments identified more cases than spontaneous, paper-based reporting. ELR produced more complete reports in a timelier manner.[23]
Benefit	Use of automated system to grade adverse events saved an average time of 5.5 min per treatment course over manual grading.[26]
Benefit	Change from paper-based workflow to electronic between laboratories: Manual handling reduced from 17% of paper ordered tests to 1% of electronically ordered tests; Results were ready 1-2 days earlier than by paper mail; Reduced sending/receiving time by 2 min/result, or 1800

Benefit/ Challenge	Details
	hours/month.[21]
Benefit	Health centers in Peru that used a web-based lab information system took significantly less time to receive drug susceptibility tests and culture results than paper based results.[22]
Challenge	Hospitals that implemented electronic lab order entry management systems on a one-year pilot program then moved to widespread use had higher short-term productivity than hospitals who fully implemented all at once.[63]
Challenge	After implementing a regional HIE in Finland the number of ordered laboratory tests significantly increased.[55]
Benefit	Number of laboratory tests performed for new patients, when recent laboratory results were available from another institution, decreased by about half after introduction of internal HIE.[52]
Benefit	HIE access resulted in fewer lab tests being ordered at an emergency department.[51]
Benefit	Integrated lab system with HIE generated data enhanced lab reports. Surveyed providers thought the enhanced reports would save time, improve quality of care, and reduce the need to search for information compared to traditional lab reports.[47]
Benefit	An HIE was used to examine patient cross over at 43 hospitals. Data showed that 19.5% of patients in the network have notifiable disease data at more than one institution and 11.3% of patients have 2 or more reportable reports.[50]
Challenge	In order to create a fully-functional, clinically useful LIS, features from currently available LISs need to be incorporated into one comprehensive LIS.[8]
Costs	
Benefit/ No association	After ambulatory HIE adoption a decrease in the rate of lab testing was observed. There was no significant decrease in imputed charges for laboratory testing.[53]
Provider Utilization	
Benefit	Following the implementation of a regional HIE, viewing of laboratory results by clinicians increased.[48,49]
Challenge	Multiplicity of lab test names is problematic for physicians in ordering the right lab test.[37]

Summary

In order to improve electronic exchange of data and further HIE efforts, it is necessary to exchange laboratory test results in a standardized format. The uniform adoption of messaging and terminology standards will facilitate interoperability efforts. Laboratories' inability to exchange electronic data can negatively impact meaningful use of health information technologies by providers and other organizations. Meaningful electronic exchange amongst laboratories, providers, and HIE, providers can access patients' test results faster and provide evidence-based care to their patients. The goal of the laboratory survey was to measure the extent of lab interoperability in Connecticut. Two cross-sectional surveys to measure change over time and the impact of HIE on lab interoperability.

Methodology

Study design

We conducted a cross-sectional survey of Connecticut laboratories' adoption of health information technology and awareness of CT-HIE. Laboratories with English-speaking representatives were eligible to participate. The study was reviewed by the UCHC Institutional Review Board (IRB) on April 4, 2011 and determined to not constitute human subjects research.

Survey instrument

Four survey instruments were utilized for the evaluation of Connecticut laboratories. The initial laboratory survey was developed by investigators in October of 2010 and was intended for hospital laboratories only. A second survey instrument, designed for use with hospital, independent clinical, and physician office laboratories, was modeled after a laboratory survey instrument used by Tennessee. Tennessee granted permission to use its survey as a model for the Connecticut laboratory survey on October 27, 2011. This second survey was lengthier than the first survey and was approved by the UCHC IRB on November 3, 2011. After receiving a low response rate to the second laboratory survey, UCHC followed guidance issued on March 2, 2012 by the ONC. This guidance recommended the use of a short laboratory survey directed at hospital and independent clinical labs; it included lists of recommended questions for each lab type. In response to ONC's guidance, the UCHC evaluation team designed a third abbreviated hospital/independent laboratory survey using ONC's recommended questions.

In 2013, the UCHC evaluation team added the following three questions to the follow-up lab survey instrument: estimated number of physicians that submit orders to the lab; estimated number of physician practices that submit orders to the lab; and does the lab use Direct messaging to transmit electronic lab test results? The survey instruments are available in Appendix A.

Survey administration

Three attempts were made to collect data at Time 1 (2011-2012) and one attempt was made to collect Time 2 (2013) data from hospital and independent labs. Data were collected using web-based and phone surveys.

The first administration of the laboratory survey was conducted from April 25, 2011 through June 10, 2011. We obtained contact information for 33 hospital-based laboratory managers from the Connecticut Hospital Association (CHA) on February 8, 2011. Three attempts were made to collect data via the web-based survey; the first survey invitation was sent out via e-mail, a second follow-up attempt was made in May, 2011 and a third in June, 2011. Of the 24 hospitals, UCHC received responses from 15, resulting in a response rate of 62.5%. The 2011 DPH list and 2012 CDC list were combined to generate a master list of laboratories active in Connecticut in 2012 (see Figure 2). Two other attempts were made to collect Time 1 data using a modified instrument. Overall, there were 85 surveys completed during the first three administrations of the laboratory survey; these surveys covered 66 unique laboratories.

Fifty-eight unique hospital and independent labs out of 103 unduplicated labs on the CDC list for which we could find phone numbers (56.3%) responded to the third survey attempt.

The Time 2 laboratory survey was administered from February 25, 2013 through March 26, 2013. Of the 165 hospital and independent-laboratories, 9 (5.5%) referred the caller to a parent laboratory within the same institution, 2 (1.8%) claimed that there was no laboratory at the location called, 4 (3.6%) claimed that there was no laboratory manager at the location called, and 1 (0.9%) claimed that the laboratory was no longer in business. In addition, we did not call 16 Clinical Laboratory Partners, LabCorp, and Quest Diagnostics labs. Of the remaining 133 laboratories, 10 (7.5%) refused to participate in the survey and 35 (26.3%) completed the survey.

For ease of response rate calculation please refer to Table 4 which is based on the count of hospital-based and independent labs in 2011-12 (Figure 2) and 2013 (Figure 3) dataset. Please see Appendix B List of Tables for further details regarding the procurement and merging of the contact lists.

Figure 2. Laboratory survey universe data flow: 2012

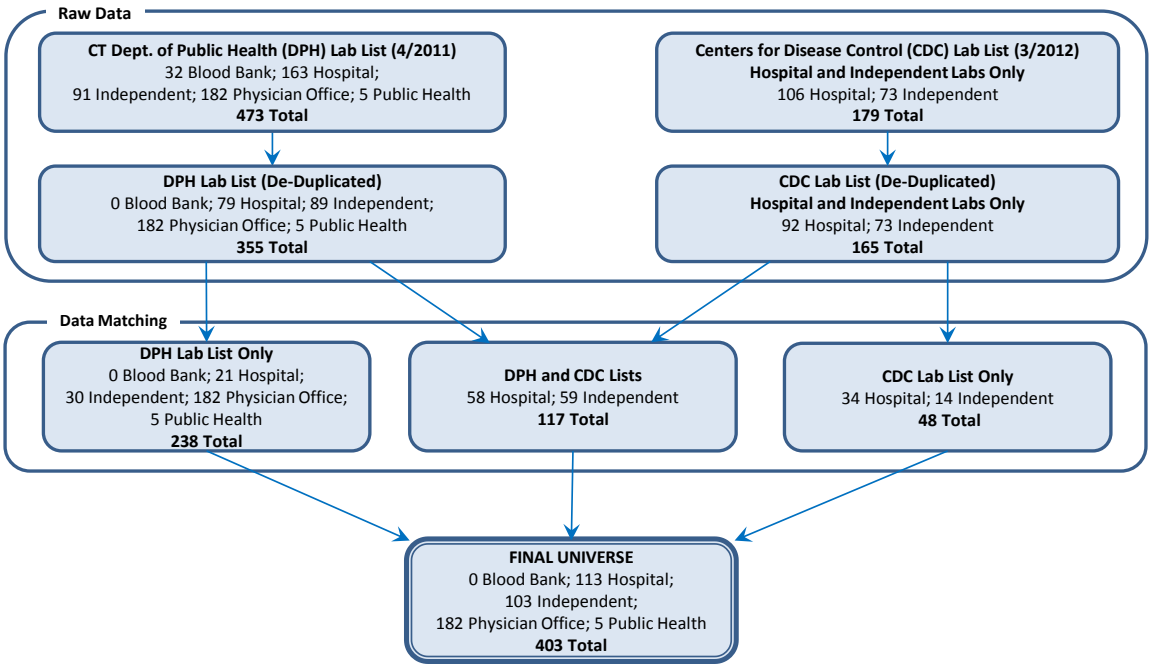
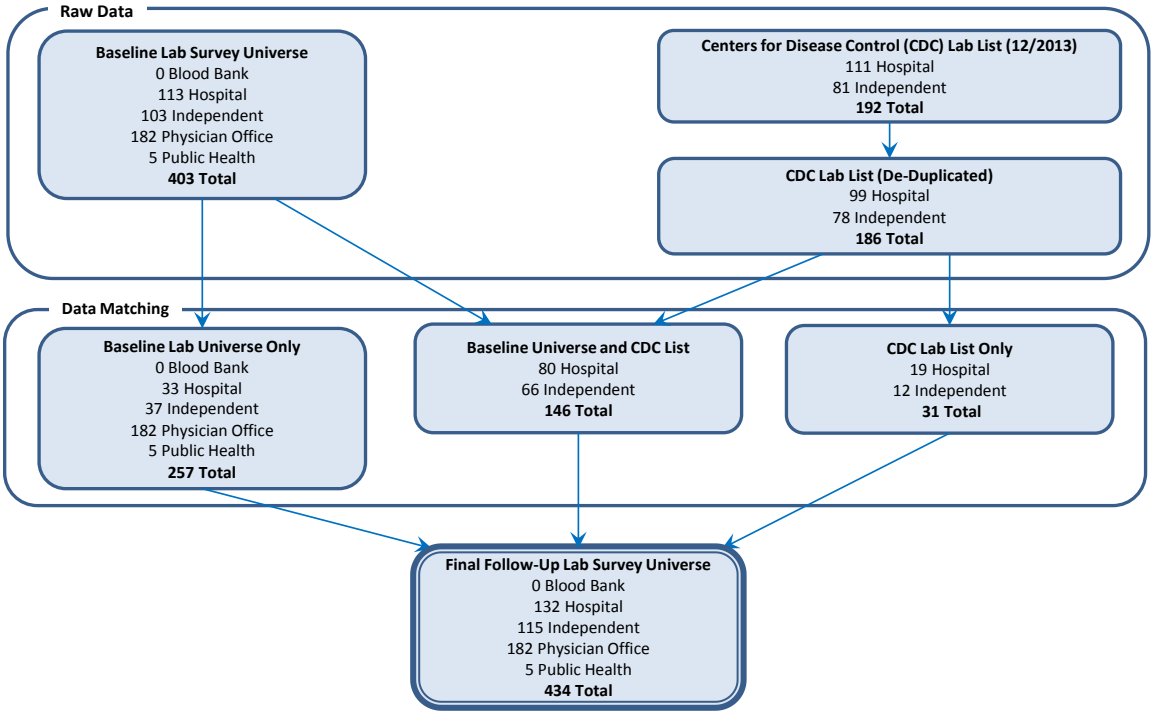


Figure 3. Laboratory survey universe data flow: 2013



Only Hospital and non-chain Independent Labs (e.g. non- LabCorp/Clinical Lab Partners/Quest labs) were called for the follow-up survey.

Table 4. Response rates

	2011-12			2013		
	Hospital	**Independent**	**TOTAL**	**Hospital**	**Independent**	**TOTAL**
Lab Universe	**113**	**103**	**216**	**132**	**115**	**247**
Not listed by CDC as a Hospital/Independent Lab	21	30	51	33	37	70
CDC Hospital/Independent Lab Calling List	92	73	165	99	78	177
Lab Claimed to Be a Duplicate	4	0	4	9	0	9
Claimed That No Lab Existed at Location	4	6	10	1	1	2
Claimed That No Lab Manager Was On-Site to Take Survey	0	12	12	0	4	4
Claimed That Lab Was No Longer in Business	1	0	1	1	0	1
Clinical Lab Partners				0	4	4
LabCorp				0	2	2
Quest Diagnostics				0	10	10
Initial List of Potential	**83**	**55**	**138**	**88**	**57**	**145**

	2011-12			2013		
	Hospital	**Independent**	**TOTAL**	**Hospital**	**Independent**	**TOTAL**
Respondents Based on CDC List						
Couldn't Find Valid Phone Number	25	10	35			
Final List of Potential Respondents	**58**	**45**	**103**	**88**	**57**	**145**
Refused	20	13	33	3	7	10
Respondents	31	29	60	25	10	35
Respondents Excluded from Final Dataset	0	2	2	1	0	1
Final disposition						
Respondents in Final Hospital/Independent Dataset	31	27	58	24	10	34
Hospital/Independent Survey Response Rate (No Exclusions)	**53.4%**	**64.4%**	**58.3%**	**28.4%**	**17.5%**	**24.1%**
Hospital/Independent Survey Response Rate (With Exclusions)	**53.4%**	**60.0%**	**56.3%**	**27.3%**	**17.5%**	**23.4%**

Analytic sample

The first survey was approved in paper form but was later created using SurveyGizmo, an online survey host. Data were downloaded from the SurveyGizmo site into an Excel file for analysis. For the second, third and fourth administrations of the survey, data were collected using REDCap (Research Electronic Data Capture), a secure web-based application hosted at UCHC.

The final analytic dataset was constructed by cross-walking data from the four survey instruments. It contained 92 surveys covering 66 unique laboratories. These included 32 laboratories that only completed the first, second or third administration of the survey in 2011- 2012, eight laboratories that only completed the fourth survey administration in 2013, and 26 laboratories that completed a survey in both 2011-2012 and 2013.

Analytic approach

Descriptive statistics were used to summarize the distribution of the survey variables. Variables were compared by laboratory characteristics using chi-squared and Fisher's exact tests. All tests were two-sided and considered significant at $p < .05$. We used IBM SPSS Statistics 20 for all statistical analyses.

Limitations

This evaluation resulted in a small sample size which may not be representative of all labs in Connecticut. Survey data is self-reported and cannot be verified. It is possible that the individual taking the survey may not have known the technical details of their laboratory operations.

Results

In 2013, Hartford and New Haven counties accounted for 63.6% of the labs and Urban-Periphery and Urban-Core represented 81.8% of the labs that responded to our survey.

Descriptive characteristics

Location of laboratory

As shown in Table 5, during both the 2011-2012 and 2013 survey rounds, nearly 40% of the surveyed labs were located in New Haven County. Hartford and Fairfield Counties also had higher representation in the survey sample than did Litchfield, Middlesex, New London, Tolland, and Windham Counties.

Table 5. Laboratory responses by county and socioeconomic grouping

	2011-2012 (N=58)		2013 (N=34)	
	N	**%**	**N**	**%**
Connecticut Counties				
New Haven	24	41.4%	13	38.2%
Hartford	13	22.4%	9	26.5%
Fairfield	11	19.0%	5	14.7%
Windham	4	6.9%	1	2.9%
New London	2	3.4%	2	5.9%
Litchfield	2	3.4%	2	5.9%
Middlesex	1	1.7%	1	2.9%
Tolland	1	1.7%	1	2.9%
Socioeconomic Groupings*				
Urban core	26	44.8%	17	50.0%
Urban periphery	20	34.5%	11	32.4%
Wealthy	5	8.6%	3	8.8%
Rural	4	6.9%	3	8.8%
Suburban	3	5.2%	0	0.0%

*Socioeconomic groupings from "The Five Connecticuts" report[64]

Using the laboratory address, each lab was categorized as one of five socioeconomic categories; urban periphery, urban core, suburban, rural or wealthy. These categories are defined in the 2004 state of Connecticut report, "The Changing Demographics of Connecticut-1990-2000, Part 2: The Five Connecticuts", that classifies each Connecticut town based on its average income, poverty level and population density.[64] In 2013, 82% of the surveys were completed by labs located in urban areas compared with 79% of labs surveyed in 2011-2012 (Refer Table 5).

Type of laboratory

During the 2011-2012 data collection period, surveyed labs were almost equally divided between hospital (47%) and independent (53%) labs. In contrast, the majority of labs surveyed during 2013 (71%) identified themselves as hospital-based labs (Refer Table 6).

Table 6. Laboratory type and affiliation

	2011-2012 (N=58)		2013 (N=34)	
	N	**%**	**N**	**%**
Hospital	**31**	**53.4**	**24**	**70.6**
Affiliated with a University/Academic Center	2	6.5%	2	8.3%
Hospital or Health System	19	61.3%	22	91.7%
Non-Academic Affiliated Laboratory	0	0.0%	0	0.0%
Other	1	3.2%	0	0.0%
Missing	9	29.0%	0	0.0%
Independent	**27**	**46.6**	**10**	**29.4**
Affiliated with a University/Academic Center	5	18.5%	1	10.0%
Clinic or Group Practice	4	14.8%	4	40.0%
Health System	3	11.1%	3	30.0%
Laboratory Corporation of America (LabCorp)	2	7.4%	0	0.0%
Quest Diagnostics	1	3.7%	0	0.0%
Other	4	14.8%	2	20.0%
Unknown	3	11.1%	0	0.0%
Missing	5	18.5%	0	0.0%

Hospital laboratory affiliation

For 2011-2012, the majority of hospital labs reported being affiliated with a hospital or health system (61%), with a smaller percentage being affiliated with a university/academic center (7%). The lab classified as "Other" is a satellite lab for Yale-New Haven Hospital. The percentages were much different in 2013; 92% of the hospital labs surveyed were affiliated with a hospital or health system and 8% were affiliated with a university/academic center (Refer Table 6).

Independent laboratory affiliation

In 2011-2012, 15% of independent labs surveyed were affiliated with a clinic or group practice, 19% were affiliated with a university/academic center, 11% were affiliated with a health system, 11% were affiliated with a private laboratory company (i.e. LabCorp or Quest Diagnostics), and 15% had another affiliation. Two of the seven labs who reported an "Other" affiliation identified themselves as a genetics lab and an independent lab. In 2013, most independent labs (40%) affiliated themselves with a clinic or group practice, with 30% being affiliated with a health system and 10% with a university/academic center (Refer Table 6).

In 2013 the majority (60%) of independent lab respondents said that their lab could be best described as an independent/commercial laboratory in comparison with 70% of labs surveyed in 2011-2012. Reference laboratories comprised 7% of the respondents in 2011-2012 and 10% in 2013.

Table 7. Independent laboratory type

	2011-2012 (N=27)		2013 (N=10)	
	N	%	N	%
Independent/Clinical Laboratory	19	70.4%	6	60.0%
Reference Laboratory	2	7.4%	1	10.0%
Other	1	3.7%	1	10.0%
Unknown	1	3.7%	0	0.0%
Missing	4	14.8%	2	20.0%

Laboratory volume

In the 2011-2012 sample, 33% of labs reported receiving fewer than 100,000 billable tests from ambulatory providers, 12% reported between 100,000 and 499,999 billable tests, 7% reported between 500,000 and 999,999, and 17% reported over 1,000,000. Approximately 31% of the respondents either did not know their lab's test volume or did not answer the question.

The 2013 sample was mostly comprised of small- to medium-sized labs. Approximately 27% of labs received fewer than 100,000 billable tests from ambulatory providers, while 32% reported between 100,000 and 499,999 billable tests, 18% reported between 500,000 and 999,999 tests, and 12% reported over 1,000,000. The remaining 12% of labs did not know the annual number of billable tests they received.

The percentage of labs receiving fewer than 100,000 billable tests decreased from the baseline percentage of 33% in 2011-2012 to 24% in 2013. The percentage of labs receiving 100,000 to 499,999 billable tests increased from 12% in 2011-2012 to 32% in 2013. Lab volume results are summarized in Table 8.

Table 8. Number of test orders received from ambulatory providers per year

	2011-2012 (N=58)		2013 (N=34)	
	N	%	N	%
Fewer than 100,000 billable tests	19	32.8%	9	26.5%
100,000 - 499,999 billable tests	7	12.1%	11	32.4%
500,000 - 999,999 billable tests	4	6.9%	6	17.6%
1,000,000 billable tests	10	17.2%	4	11.8%
Unknown	15	25.9%	4	11.8%
Refused	2	3.4%	0	0.0%
Missing	1	1.7%	0	0.0%

The 2013 version of the survey added questions about physicians' ordering of laboratory tests. The number of physician practices submitting orders to the surveyed labs ranges from 0 to 1,000 practices, with a median of 45 practices. Labs most commonly reported that fewer than 50 practices (41%) submitted orders to them. The number of individual physicians submitting orders to the surveyed labs ranges from 4 to 2,561 physicians, with a median of 200 physicians. About a third of labs (35%) reported that over 100 physicians submit orders to them (Refer Table 9).

Table 9. Number of physician practices and physicians submitting orders to lab*

	2013 (N=34)	
Number of practices	**N**	**%**
1-25	7	20.6%
26-50	6	17.6%
51-100	2	5.9%
101-500	6	17.6%
500+	1	2.9%
Missing Data	12	35.3%
Number of physicians		
1-7	1	2.9%
8-100	8	23.5%
101-300	5	14.7%
300+	7	20.6%
Missing	13	38.2%

*Question only asked on 2013 survey.

Electronic capabilities

In 2011-2012 57% of laboratories surveyed sent results in structured format to ambulatory providers outside of their organization. This increased slightly to 59% in 2013 (Refer Table 10).

Table 10. Laboratories sending laboratory results in a structured format to ambulatory providers outside of their organization

	2011-2012 (N=58)		2013 (N=34)	
	N	**%**	**N**	**%**
Yes	33	56.9%	20	58.8%
No	19	32.8%	14	41.2%
Don't Know	5	8.6%	0	0.0%
Missing Data	1	1.7%	0	0.0%

As demonstrated in Table 11 labs sent results to EHRs less frequently than they did to a web portal or via another method. In 2011-2012, 19% of labs reported making at least 75% of their results available on a web portal, 23% of labs sent at least 75% of their results via other method, and only 16% sent 75% or more of their results to EHRs. For 2013, 24% of labs surveyed made 75% or more of their results available on web portals, 15% sent 75% or more of their results via other methods, and 12% sent 75% or more of their results to an EHR. Labs also reported sending results via LIMS, fax, mail, and paper-based methods.

The percentage of laboratories sending any percentage of their final laboratory results to web portals was 24% in 2011-12; this increased to 33% of labs in 2013. In 2011-12, 34% of laboratories reported sending final laboratory results to EHRs; this decreased to 30% of labs in 2013. The percentage of laboratories sending final laboratory results via other methods was 42% in 2011-12 and 27% in 2013.

Table 11. Methods of sending laboratories results by percent of laboratory results

	0%	1-24%	25-49%	50-74%	75-99%	100%	Don't Know	Missing
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Sent Electronically to EHR								
2011-12 (N=58)	3 (5%)	5 (9%)	4 (7%)	1 (2%)	4 (7%)	5 (9%)	7 (12%)	29 (50%)
2013 (N=34)	3 (9%)	3 (9%)	2 (6%)	1 (3%)	3 (9%)	1 (3%)	5 (15%)	16 (47%)
Available on Web Portal								
2011-12 (N=58)	13 (22%)	2 (3%)	0	1 (2%)	4 (7%)	7 (12%)	3 (5%)	28 (48%)
2013 (N=34)	2 (6%)	1 (3%)	1 (3%)	1 (3%)	2 (6%)	6 (18%)	2 (6%)	19 (56%)
Sent via Other Method								
2011-12 (N=58)	1 (2%)	4 (7%)	3 (5%)	4 (7%)	9 (16%)	4 (7%)	1 (2%)	32 (55%)
2013 (N=34)	1 (3%)	3 (9%)	1 (3%)	0	5 (15%)	0	4 (12%)	20 (59%)

Standards

LOINC

Over two-fifths of labs (41%) were not sending results to ambulatory providers using LOINC standards in 2011-12 (Refer Table 12). In 2013 this increased to 53% of labs not using LOINC. In 2011-12, 9% of surveyed labs sent 1-24% of their results using LOINC; in 2013, 12% of labs sent results using LOINC. In 2011-12, 2% of labs sent all of their lab results to ambulatory providers using LOINC; this increased to 12% in 2013. Since these Ns are small, comparisons need to be made with caution.

Laboratory results interface (LRI) guide

The majority of respondents had not implemented the ONC's LRI Guide for lab result content and format at the time of the survey (Refer Table 12). In 2011-2012, 38% of labs had not implemented the LRI Guide, compared to 68% of labs in 2013.

Health level 7 (HL7) messaging standards

A large proportion of labs surveyed did not know which HL7 standards their organizations currently used to send electronic lab results to ambulatory care providers. In 2011-2012, 71% of labs did not know whether they used HL7 standards; this decreased to 47% of labs in 2013. Use of any HL7 version increased from 22% of respondents in 2011-2012 to 41% in 2013. Two labs reported that they used both HL7 version 2.5.1 and HL7 2.3.1 in 2011-2012.

For labs that reported sending results electronically outside of their organization in 2013, 38% reported using HL7 2.3.1 message standards, 3% used HL7 2.5.1 message standards, 12% used other message standards, and 47% did not know which version of HL7 their organization was using. HL7 adoption results are presented in Table 12.

Table 12. Laboratories using LOINC, HL7 standards & the LRI guide

	2011-12 (N=58)		2013 (N=34)	
Use of LOINC Standards	**N**	**%**	**N**	**%**
0%	24	41.4%	18	52.9%
1% - 24%	5	8.6%	4	11.8%
25% - 49%	0	0.0%	0	0.0%
50% - 74%	0	0.0%	1	2.9%
75% - 99%	0	0.0%	0	0.0%
100%	1	1.7%	4	11.8%
Don't Know	25	43.1%	7	20.6%
Missing Data	3	5.2%	0	0.0%
Laboratories that implemented the ONC's LRI guide				
Yes	5	8.6%	1	2.9%
No	22	37.9%	23	67.6%
Don't know	20	34.5%	10	29.4%
Missing	11	19.0%	0	0.0%
Laboratories currently using HL7 standards*				
HL7 version 2.3.1	11	19.0%	13	38.2%
HL7 version 2.5.1	2	3.4%	1	2.9%
Other	3	5.2%	4	11.8%
Don't know	41	70.7%	16	47.1%
Missing	1	1.7%	0	0.0%

Direct messaging

Only 9% (N=3) of the laboratories mentioned using Direct messages for sending lab results while 82% of laboratories (N=27) reported not using Direct messaging to send lab results electronically in 2013.

Differences in e-Lab Capabilities

Further analyses were done to see if electronic capabilities differed by lab characteristics.

Socioeconomic grouping by electronic capability

Rural locations had the highest percentage of labs sending electronically outside of their organization. In 2011-2012, 100% of rural labs surveyed sent results electronically; 67% of rural labs sent electronic results in 2013. Since our sample contains low numbers of laboratories classified as wealthy, suburban, or rural, the percentages contained in Table 13 should be interpreted with caution.

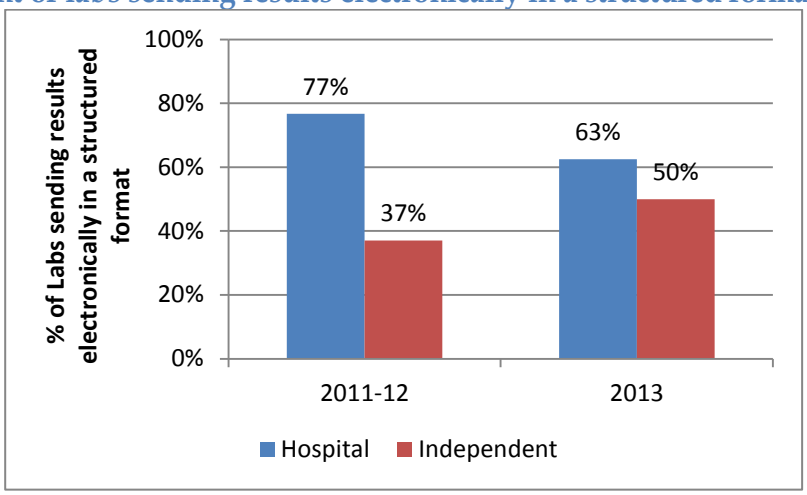
Table 13. Socioeconomic groups by percent of laboratories sending results electronically in a structured format to ambulatory providers outside their organization

	2011-2012			2013		
	# labs sending electronically	Total # labs surveyed	%	# labs sending electronically	Total # labs surveyed	%
Wealthy	2	5	40.0	0	3	0.0
Suburban	1	3	33.3	0	0	0.0
Rural	4	4	100.0	2	3	66.7
Urban Periphery	12	19	63.2	7	11	63.6
Urban Core	14	26	53.8	11	17	64.7

Laboratory type by electronic capability

Compared to independent labs, a higher percentage of hospital labs sent structured results electronically in a structured format to ambulatory providers outside their organization. Seventy-seven percent of hospital labs sent structured electronic results in 2011-2012, and 63% sent structured results in 2013. This compares with 37% of independent labs in 2011-2012 and 50% in 2013. (See Figure 4) Using a Fisher's Exact test, the proportion of labs with electronic capability was significantly different for hospital and independent labs (p=0.005) surveyed during 2011-2012 but not in 2013.

Figure 4. Percent of labs sending results electronically in a structured format



Volume by electronic capability

Laboratories that processed a higher volume of tests were more likely to send results electronically. Eighty percent of labs in 2011-2012 and 75% of labs in 2013 receiving over one million billable tests per year sent results electronically. During 2013 medium-sized labs also had high percentages with 73% of labs receiving 100,000 - 499,999 billable tests and 67% of labs receiving 500,000 - 999,999 billable tests sending results electronically (Refer Table 14).

Table 14. Volume of tests received from ambulatory providers by laboratories sending structured results outside their organization

	2011-2012			2013		
	# labs sending electronically	Total # labs surveyed	%	# labs sending electronically	Total # labs surveyed	%
<100,000 billable tests	10	19	52.6	4	9	44.4
100,000 - 499,999 billable tests	3	7	42.9	8	11	72.7
500,000 - 999,999 billable tests	4	4	100.0	4	6	66.7
1,000,000+ billable tests	8	10	80.0	3	4	75.0
Unknown	8	15	53.3	1	4	25.0
Refused	0	1	0.0	0	0	0.0
Missing	2	2	100.0	0	0	0.0

Socioeconomic grouping by laboratory type

Further analyses were done to see if lab characteristics differed by lab type. Laboratories self-identified as either hospital-affiliated or independent laboratories. Please see Table 15.

Table 15. Socioeconomic groups by laboratory type[64]

	2011-2012		2013	
	Hospital labs	Independent labs	Hospital labs	Independent labs
Wealthy	1 (3.2)	4 (14.8)	1 (4.2)	2 (20.0)
Suburban	2 (6.5)	1 (3.7)	0 (0.0)	0 (0.0)
Rural	4 (12.9)	0 (0.0)	3 (12.5)	0 (0.0)
Urban Periphery	9 (29.0)	11 (40.7)	7 (29.2)	4 (40.0)
Urban Core	15 (48.4)	11 (40.7)	13 (54.2)	4 (40.0)

Volume by laboratory type

More than half of independent labs processed fewer than 100,000 billable tests annually. Only 19% of hospital labs processed fewer than 100,000 billable tests in a year. Using a Fisher's Exact test, the difference between hospital and independent lab test volumes is significant (p=0.031) for 2011-2012. The difference between lab volume for hospital and independent labs is also significant (p=0.003) for 2013.

Table 16. Volume of tests received from ambulatory providers by laboratory type

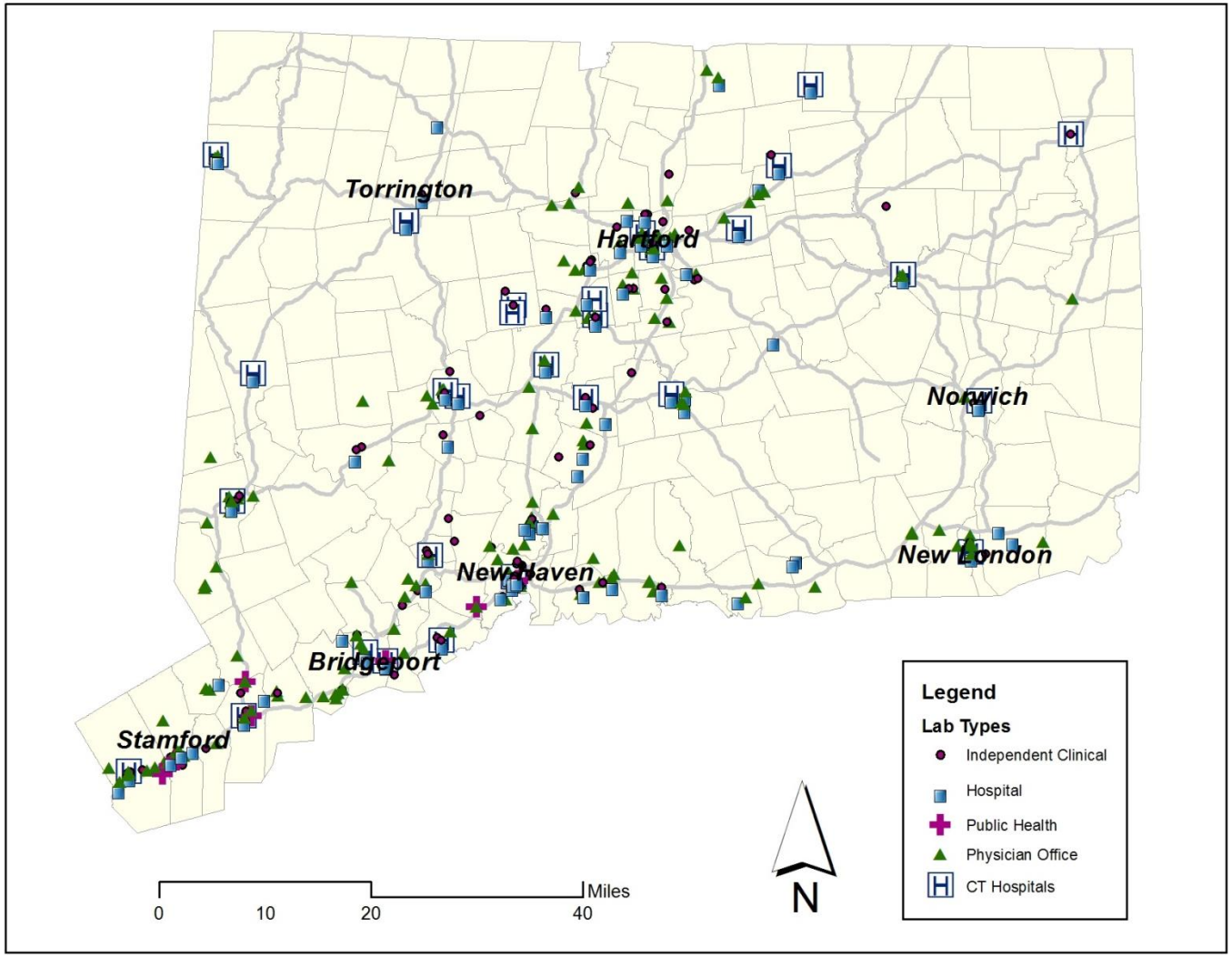
	2011-2012		2013	
	Hospital labs	**Independent labs**	**Hospital labs**	**Independent labs**
<100,000 billable tests	5 (16.1)	14 (51.9)	2 (8.3)	7 (70.0)
100,000 - 499,999 billable tests	5 (16.1)	2 (7.4)	8 (33.3)	3 (30.0)
500,000 - 999,999 billable tests	4 (12.9)	0 (0.0)	6 (25.0)	0 (0.0)
1,000,000+ billable tests	7 (22.6)	3 (11.1)	4 (16.7)	0 (0.0)
Unknown	9 (29.0)	6 (22.2)	4 (16.7)	0 (0.0)
Refused	1 (3.2)	1 (3.7)	0 (0.0)	0 (0.0)
Missing	0 (0.0)	1 (3.7)	0 (0.0)	0 (0.0)

Location of Hospital and Independent Laboratories

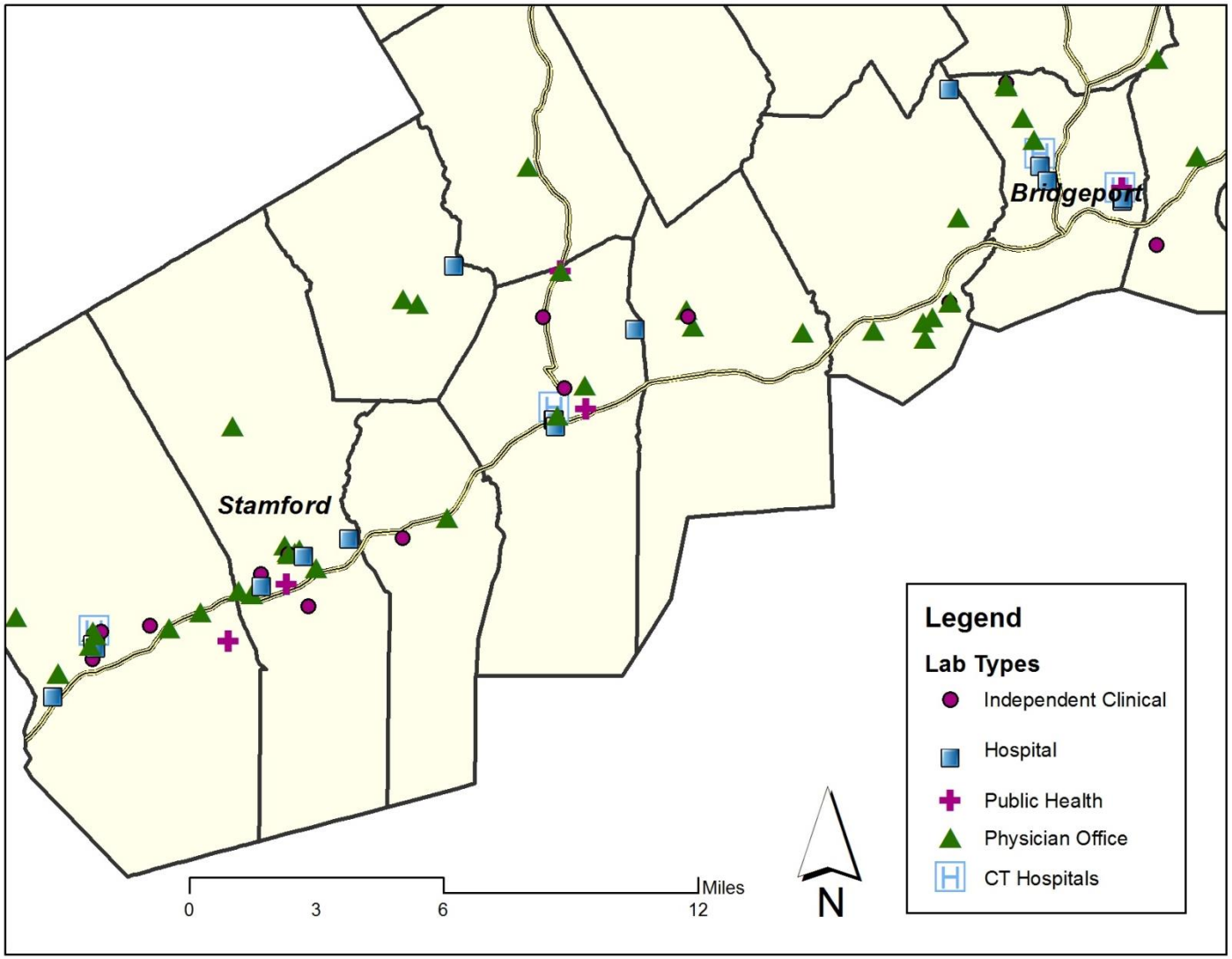
Even though we had only 66 unique laboratories respond, Map 1 presents a picture of all the 434 labs represented by with 132 hospital-based, 115 independent, 182 physician office-based, and 5 public health labs, in Connecticut. Map 2 presents the cities of Stamford and Bridgeport to show the laboratories at the larger scale.

The 66 laboratories from the 2013 final universe of Connecticut laboratories were mapped to show structured data lab exchange capability among labs that responded to our survey (Refer Map 2). The number of laboratories by town varied from 0 to 13. New Haven had 13 laboratories, followed by 4 in Hartford.

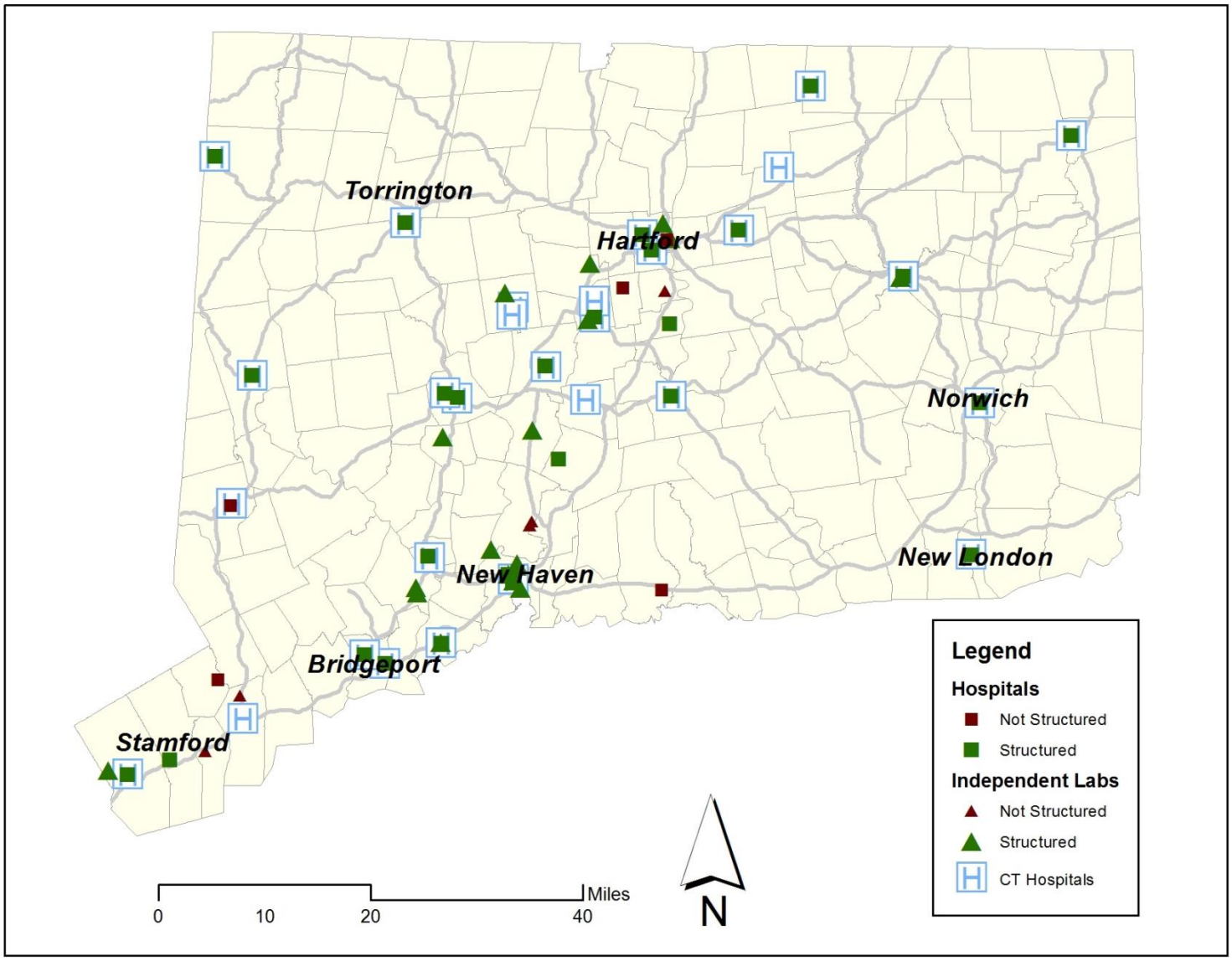
Map 1. Location of Hospital and Independent Laboratories in Connecticut



Map 2. Location of Hospital and Independent Laboratories in Bridgeport and Stamford



Map 3. Location of Hospital and Independent Laboratories that exchange structured lab data in Connecticut



Discussion

Based on this survey's results, in Connecticut, laboratories' current capacity to exchange test results in a structured format is limited. Our survey's response rate was low; the small sample size requires caution when interpreting results about labs' electronic capabilities. In order for providers to achieve high rates of meaningful use of EHRs, organizations must be able to electronically-exchange structured lab data. If most labs in Connecticut share similar electronic capabilities to those who responded to the survey, assistance will be needed to accelerate the pace of lab interoperability.

Most state laws governing the release of laboratory test results pre-date the use of EHRs, LIMS, and other technologies that electronically exchange health data, and are potential barriers to interoperability. In Connecticut, the General Statutes Section 19a-2a and Section 19a-36-A2 of the Public Health Code regulate the release of laboratory test results. These regulations limit the release of test results to the ordering provider and individuals authorized to use or receive or responsible for using or receiving test results. Clinical laboratories can release test results to patients only with permission of the person who ordered the test. Once a statewide HIE has been implemented, amending state regulations to address HIE as an entity authorized to use or receive lab results will facilitate lab exchange. As use of HIEs and EHRs increases, federal and state laws will need to be revised to support the growth of electronic data exchange.

Lab survey data are publically available online from 16 other states. In Connecticut, 58.8% of labs reported sending results electronically in a structured format outside of their organization in 2013. Similarly, around half of labs in Kentucky, Iowa, New Hampshire, Rhode Island, Oregon, and Florida reported sending results electronically.[65-70] In California, Alabama and Nebraska about a third of surveyed labs reported sending results electronically.[71-73] Of other states surveyed, Wisconsin (87%) had the highest reported electronic capability, followed by Pennsylvania (80%), Minnesota (70%), Illinois (61%), and Arkansas (59%).[74-78]

Labs that processed a higher volume of tests also sent more lab results electronically. In Rhode Island, 50% of lab results were sent electronically; large labs sent 80% of their results electronically.[68] Florida also found that electronic transmission of results had a positive correlation with labs reporting a million or more billable tests.[70]

For laboratories surveyed in Connecticut, 34% were sending results to EHRs in 2011-2012 and 30% in 2013. Much higher interface with EHRs was reported by Oregon, Nebraska, and New Hampshire; around 90% of their surveyed labs delivered electronic lab results to EHRs.[67,69,73] Sixty-two percent of labs in Tennessee reported EHR use. Kentucky reported that 44% of its surveyed labs sent structured results electronically.[65,79]

Among labs in Connecticut, 24% were sending results electronically to a web portal in 2011-2012 and 33% in 2013. Nebraska (57%) and Oregon (58%) reported more than half of their labs sending results electronically to web portals.[69,73] Pennsylvania had a slightly higher

percentage, with 78% of labs electronically exchanging results using a web portal.[75] Kentucky reported that 42% of labs made results available on a web portal.[65]

The majority of laboratories in Connecticut do not report using standards to send lab results electronically. The percentage of laboratories sending any proportion of their laboratory test results to ambulatory providers outside their organization using LOINC standards increased from 10.3% of labs in 2011-2012 to just over a quarter of labs (26.5 %) in 2013.

Use of LOINC varies greatly by state. As of 2013, 26.5% of labs in Connecticut were sending any of their lab results using LOINC standards. Usage of LOINC was most similar among labs in Kentucky (27.5%), while New Hampshire (21%), Alabama (20%), Oregon (17.3%) and Nebraska (19.7%) had slightly lower reported usage.[65,67,69,72,73] Higher usage of LOINC was reported in surveys conducted in California (31%) and Pennsylvania (37%) and Illinois and Wisconsin both reported that the majority of their respondents were using LOINC.[71,74,75,77] Use of terminology, such as CPT, was reported in other states, with only 4% of labs in Minnesota using LOINC and none of the labs in Arkansas.[76,78]

Like Connecticut, most other states have had low implementation of the LRI guide. None of the labs surveyed in North Dakota, and New Hampshire had implemented the LRI guide.[67,80] In Connecticut, 3% of labs were using the LRI guide, while use varied from 3-6% in California, Alabama, Kentucky, Nebraska, and Oregon.[65,69,71-73]

As of 2013, about 40% of labs in Connecticut reported using HL7 messaging standards. New Hampshire, also a small northeastern state, had similar use of HL7 compared to Connecticut with 42% of labs reporting use of any version of HL7 standards.[67] Pennsylvania (94%) had the highest reported use of HL7 standards.[75] About two-thirds of labs in both Tennessee and Minnesota reported HL7 use, and Iowa (60%) and Oregon (57.7%) all had higher usage of HL7 messaging standards than Connecticut.[66,69,76,79] California (33.5%), Kentucky (24.3%), and Nebraska (18%) had low percentages of labs reporting HL7 use.[65,71,73] Like in Connecticut, most states that reported on HL7 use by version reported higher use of version 2.3.1 than version 2.5.1.

Next steps

More research needs to be done into the current state of HIT adoption among labs. The small sample size for this evaluation makes it difficult to truly assess adoption. As we found while creating the sample universe, identifying all labs in the state is challenging given there is no complete list available at this point in time. Generating a complete list of labs in Connecticut with contact information and clearly identifying independent labs can help to connect services available in the state with labs that require interoperability support.

Current Connecticut legislation prohibits lab results to be shared without the ordering provider's consent. While CLIA and HIPAA laws on releasing results are less restrictive, state laws are the deciding factor on the ability to report results. Labs may be overly cautious about to whom they release results unless they are aware that results can be sent to outside providers with the ordering provider's permission.

Lab interoperability must increase in order for any improvements to occur. Laboratory awareness and adoption of commonly-used standards, such as LOINC and HL7, can facilitate the electronic exchange of data between organizations. LIMS and EHR vendors need to add to their products built-in capabilities for exchanging data in standardized formats, such as Direct messaging.

Increasing provider adoption of EHRs may lead to increased electronic sharing of data. If more providers can receive results electronically, then there will be more demand for labs to send results electronically in a standardized format. Outreach and guidance to providers could increase adoption rates. Understanding the barriers to adoption for organizations of various sizes may help to create incentives to improve adoption. Stage 2 Meaningful Use requires that at least 55% of lab test results for ordering providers be delivered to providers' EHRs as structured data.

At the end of the grant period Connecticut does not have an operational HIE. Maintaining awareness of national HIE activities and comparing Connecticut's efforts to those of other states can help Connecticut to move toward a successful HIE implementation. Currently, there is no plan for integrating lab data into a discussion on HIEs.

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Appendix A

First Survey - Hospital Laboratory Survey

LABORATORY SURVEY: BASELINE

Health Information Technology Exchange of Connecticut: UCHC Evaluation

I. Practice Characteristics

1. Which title best describes your position?
   _____

2. What is the name of your organization (i.e. Greenwich Hospital Blood Bank)?
   _____

3. What is the location of your practice site in the state of Connecticut?
   _____ (Town)

4. What is the approximate number of individuals you serve?

   _____ Individuals

5. Roughly, what percentage of individuals served by your practice belongs to one of the following? (Percentage should total 100%).

   _____ Medicare
   _____ Medicaid
   _____ Private Insurance
   _____ Patient payments
   _____ Other: _____

II. Use of e-Prescribing and Health IT

6. Does your practice use standards for e-prescribing?
   - ☐ Yes
   - ☐ No
   - ☐ Don't know

7. If yes, are these standards outlined in the Final Rule issued by the Department of Health and Human Services (42 CFR Part 423)? If you answered 'no' or 'don't know' to the previous question, please select N/A.
    - ☐ Yes
    - ☐ No
    - ☐ Don't know
    - ☐ N/A

8. Which terminology do you use to code and communicate data?
    - ☐ CPT
    - ☐ LOINC
    - ☐ SNOMED
    - ☐ Other: _____ (please specify)

9. Is the system used within your laboratory compatible with HL7 standards?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know

10. What version of HL7 do you use?

    _____

    - ☐ Don't know

11. Does your practice exchange any clinical data with physicians?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know

12. Does your practice exchange any clinical data with the following? (Please check all that apply).
    - ☐ Independent clinical laboratories (e.g. Quest)
    - ☐ Hospital laboratories
    - ☐ Physician office laboratories
    - ☐ Blood bank laboratories
    - ☐ Public health laboratories
    - ☐ None of the above

13. Does your practice exchange any clinical data with pharmacies?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know

14. Does your practice exchange any clinical data with insurance companies?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know

15. Does your practice submit any information to an electronic health information exchange (HIE)? *An HIE refers to the movement of healthcare information electronically across organizations within a region or community.*
    - ☐ Yes
    - ☐ No
    - ☐ Don't know

16. If yes, what is the name of the organization or agency that sponsors the HIE?

    _____

    - ☐ Don't know

17. Does your practice give or share data electronically with the patient?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know

18. If yes, what is the approximate percentage of patients whose data are shared?

    _____ %

19. Does your practice give or share data electronically with a personal health record (PHR)? *A PHR is an electronic application through which individuals can maintain and manage their health information (and that of others for whom they are authorized) in a private, secure, and confidential environment.*
    - ☐ Yes
    - ☐ No
    - ☐ Don't know

20. If yes, what is the approximate percentage of patients whose data are shared?

    _____ %

21. What concerns do you have relating to security and the HIE?
    Comment:

    _____

    _____

22. What concerns do you have relating to privacy and the HIE?
    Comment:

23. Overall, please rate how useful you believe a health information exchange (HIE) could be within the state of Connecticut:

Not useful at all Somewhat useful Very useful

Comment:

24. Overall, please rate your level of satisfaction with the Connecticut Health Information Exchange (HIE) Initiative:

Very dissatisfied Dissatisfied Neutral Satisfied Very satisfied

☐ Not applicable

Comment:

25. In your opinion, will Connecticut be successful in implementing a statewide health information exchange (HIE) by 2014?

☐ Yes
☐ No

26. If yes, why?
Comment:

27. If no, why not?
Comment:

28. Lastly, please describe any additional comments you may have:
Comment:

Second Survey – Hospital, Independent, Clinical and Physician Office Laboratories

LABORATORY SURVEY

Last year the Connecticut Department of Public Health (DPH) was awarded $7.29 million from the Office of the National Coordinator for Health Information Technology (ONC) through the State Health Information Exchange Cooperative Agreement Program. The State HIE Program's purpose is to enable states to implement a health information exchange (HIE) within their health care systems. As an integral member of your laboratory, your views are of great importance to this initiative.

The Health Information Technology Exchange of Connecticut (HITE-CT) is a recently-established quasi-public agency whose primary role is to work with DPH to promote the development of health information technology. This authority will assist providers in meeting meaningful use criteria for electronic health record adoption and will support health care organizations participating in the health information exchange. A critical next step in this initiative is to evaluate its development; this is required in order to provide ONC with information about Connecticut's current health information technology landscape.

Through a contract with the state Department of Health, the University of Connecticut is responsible for evaluating the statewide Health Information Exchange's ongoing development and implementation. The surveys comprising this research will be administered statewide. These surveys attempt to measure the adoption of health information technology functions and overall opinions about health information technology within Connecticut. The survey should take approximately 15-20 minutes of your time, and will be of great value to Connecticut's leaders in health information technology. Since these surveys will be administered repeatedly, our evaluation would benefit most from your willingness to participate in the follow-up survey.

Your participation in this survey is voluntary. You do not have to answer any question for which you do not want to share a response.

If you have any questions about the survey, or would like more information about the evaluation, please do not hesitate to contact us. The primary investigator's contact information is below. Thank you for your time.

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I. Laboratory Facility Information

1. Please enter your survey identification number

   _____

2. Facility Name

   _____

3. Facility License Number

   _____

4. Address

   _____

5. Address 2

   _____

6. City/Town

   _____

7. State

   _____

8. ZIP

   _____

9. County

   _____

10. Phone Number

    _____

11. Fax Number

    _____

12. Contact Name

    _____

13. Position/Title

    _____

14. E-Mail

    _____

15. Contact Phone Number

    _____

16. Are you the designated contact person for Lab Health Information Exchange/Meaningful Use implementation at your facility?

    - ☐ Yes
    - ☐ No
    - ☐ Don't know

17. Lab HIE Implementation Contact Name

_____

18. Lab HIE Implementation Contact Position/Title

_____

19. Lab HIE Implementation Contact E-Mail

_____

20. Lab HIE Implementation Contact Phone Number

_____

21. Which of the following most accurately describes this laboratory facility?
    - ☐ Hospital Lab
    - ☐ Private/Independent Lab
    - ☐ Physician Office Laboratory
    - ☐ Reference Lab
    - ☐ Public Health Laboratory
    - ☐ Regional Blood Center
    - ☐ Other (Please Specify)

22. Please describe your laboratory facility type.

_____

23. Is this laboratory affiliated with a hospital, group practice, or other entity?
    - ☐ Yes
    - ☐ No

24. Please list the hospital, group practice, or affiliated entity name.

_____

25. What type of lab testing is performed? (Check all that apply)
    - ☐ Hematology (Basic CBC Analytes)
    - ☐ Immunohematology (Blood Banking)
    - ☐ Clinical Chemistry
    - ☐ Serology
    - ☐ CD_4 and Other Similar Hematology Testing
    - ☐ Blood Lead
    - ☐ Microbiology (Including but Not Limited to Bacteriology, Virology, Mycobacteriology, Molecular Biology, Parisitology, and Mycotics)
    - ☐ Other (Please Specify)

26. Other Types of lab testing performed

_____

27. What is the number of completed orders that this laboratory averages per year?

_____

28. What current LIS (Laboratory Information System) is used at your facility to manage lab results?
    - ☐ None
    - ☐ In-House/Home-Grown

- ☐ Cerner Citation
- ☐ Cerner Classic
- ☐ Cerner Millennium
- ☐ Cerner Path Net HNA Classic
- ☐ E-Micro
- ☐ HBO C
- ☐ LabCorp
- ☐ McKesson
- ☐ MediTech MAGIC LIS
- ☐ Quest
- ☐ Other (Please Specify)

29. Other Laboratory Information System (LIS) In Use

_____

II. Baseline of Electronic Capability

30. Does the lab currently have the capability to send 'structured electronic lab results'? (Reminder: 'electronic' refers to an electronic means of messaging, not using a fax, scanner, or PDF)
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know

31. Is the lab currently utilizing a 'structured electronic' means of lab reporting?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know

32. Please check all that apply:
    - ☐ Currently able to receive lab orders electronically from an ordering physician's EHR
    - ☐ Currently able to receive lab results electronically from other labs
    - ☐ Currently able to submit lab results electronically to an ordering physician's EHR
    - ☐ Other Electronic Capability (Please Specify)

33. Other Electronic Lab Reporting

_____

34. What are the major barriers to structured 'electronic' lab reporting?
    - ☐ Cost
    - ☐ Broadband Internet Access
    - ☐ Lack of Healthcare Providers with E-Lab Abilities
    - ☐ Lack of Expertise in Establishing an Electronic Reporting System
    - ☐ HIPAA Compliance
    - ☐ Other (Please Specify)

35. Other Barrier to Structured Electronic Lab Reporting
    _____

III. Electronic Health Records (EHRs)

36. Does this facility currently have a 'certified' EHR? ('Certified' means deemed acceptable by the Office of the National Coordinator (ONC) and by CMS for Meaningful use and included in the Certified HIT Product List)
    - ☐ Yes
    - ☐ No
    - ☐ Not Applicable

37. Initial Go-Live Month for EHR
    - ☐ 1
    - ☐ 2
    - ☐ 3
    - ☐ 4
    - ☐ 5
    - ☐ 6
    - ☐ 7
    - ☐ 8
    - ☐ 9
    - ☐ 10
    - ☐ 11
    - ☐ 12

38. Initial Go-Live Year for EHR
    _____

39. Other Go-Live Timeframe for EHR
    _____

40. Anticipated Go-Live Month for EHR
    - ☐ 1

- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10
- ☐ 11
- ☐ 12

41. Anticipated Go-Live Year for EHR
    _____
42. Other Anticipated Go-Live Timeframe for EHR
    _____

43. Which certified EHR product vendor is this laboratory utilizing or planning to utilize?
    _____

44. Which certified EHR product name is this laboratory utilizing or planning to utilize?
    _____

45. Which certified EHR product version is this laboratory utilizing or planning to utilize?
    _____

46. Additional details about certified EHR product that laboratory is utilizing or planning to utilize?
    _____

47. Does the selected certified EHR for this facility use or plan to use the following terminology and standards for coding and communicating lab data? Check all that apply.
    - ☐ CPT
    - ☐ LOINC (Logical Observation Identifiers Names and Codes)
    - ☐ SNOMED (Systematized Nomenclature for Medicine)
    - ☐ Other (Please Specify)

48. Other Terminology/Standards Used by Selected Certified EHR
    _____

IV. Health Information Exchange (HIE)

49. Does your laboratory submit any information (or is connected) to an electronic Health Information Exchange (HIE) or a Regional Health Information Organization (RHIO)? An HIE refers to the movement of healthcare information (data) electronically across organizations within a region or community.
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know
50. Name of HIE/RHIO to which Lab/Facility is connected
    _____
51. Is lab data currently being shared with any other HIE or RHIO?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know

52. Name of HIE/RHIO to which lab data is being shared
    _____
53. Does your practice give or share data electronically with the patient?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know

54. Approximate percentage of patients with whom electronic data are shared
    _____
55. Does your practice give or share data electronically with a personal health record (PHR)? A PHR is an electronic application through which individuals can maintain and manage their health information (and that of others for whom they are authorized) in a private, secure, and confidential environment.
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know
56. Approximate percentage of patients whose data are shared with PHR
    _____
57. How familiar are you with the Connecticut Health Information Exchange (HIE) initiative?
    - ☐ Very Familiar
    - ☐ Somewhat Familiar
    - ☐ A Little Familiar
    - ☐ Not Familiar at All

58. Overall, please rate how useful you believe a Health Information Exchange (HIE) could be within the state of Connecticut?

Not Useful at All Somewhat Useful Very Useful

59. Comments on usefulness of Health Information Exchange (HIE) within Connecticut

_____

60. Overall, please rate your level of satisfaction with the Connecticut Health Information Exchange (HIE) initiative.
    - ☐ Very Dissatisfied
    - ☐ Dissatisfied
    - ☐ Neutral
    - ☐ Satisfied
    - ☐ Very Satisfied
    - ☐ Not Applicable
61. Comment on satisfaction with Health Information Exchange (HIE) within Connecticut

_____

62. In your opinion, will Connecticut be successful in implementing a statewide Health Information Exchange (HIE) by 2014?
    - ☐ Yes
    - ☐ No
63. If yes, why?

_____

64. If no, why not?

_____

65. What concerns, if any, do you have relating to the HIE?

_____

V. Reference Labs

66. Please list the reference labs that this lab uses.

_____

67. Is this lab able to submit lab orders electronically to the reference labs? (Reminder: 'electronic' refers to HL7 v2.x messages/CDA documents, preferably via an EHR – not manually through a portal or via fax)
    - ☐ Yes
    - ☐ No
    - ☐ Not Applicable (Do Not Use Reference Labs)
68. Is this lab able to receive lab orders electronically (via HL7 v2.x messages/CDA documents) from reference labs?
    - ☐ Yes
    - ☐ No
    - ☐ Not Applicable (Do Not Use Reference Labs)

VI. Affiliated Physicians

69. Can physicians electronically order lab tests from this laboratory using their EHR systems?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know
70. What percent of physician practices connected to this laboratory are able to receive structured electronic laboratory results?
    - ☐ None
    - ☐ >0% and <100% (Specify Percent Below)
    - ☐ Don't Know
71. Percent of physician practices connected to lab who can receive structured electronic laboratory results

    _____

VII. Lab Orders

72. Is this lab able to receive lab orders electronically (from an EHR to its LIS)?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know
73. If you can receive lab orders electronically, what electronic standard are you using? Check all that apply.
    - ☐ HL7 v.2.3.1
    - ☐ HL7 v.2.5.1
    - ☐ Continuity of Care Document (CCD)
    - ☐ Continuity of Care Record (CCR)
    - ☐ Other (Please Specify)
74. Other electronic standard used for receiving lab orders

    _____
75. Do any providers currently submit lab orders to this lab electronically?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know
76. Approximate percentage of providers who submit lab orders to this lab electronically

    _____
77. Are lab orders input via Computerized Provider Order Entry (CPOE)?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know

VIII. Lab Results

78. Is this lab able to produce structured lab results (using a LIS software product)?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know
79. If yes, do the structured lab results include LOINC and SNOMED standards?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know
80. Is this lab able to accurately report and successfully transmit lab results electronically from the laboratory LIS system to the ordering provider's EHR system, module, or other results receiver?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know
81. Does this lab have the capacity to submit structured results electronically to any health agencies? Check all that apply.
    - ☐ Yes: For state public health agencies
    - ☐ No: For state public health agencies
    - ☐ Yes: For federal health agencies (i.e. Centers for Disease Control)
    - ☐ No: For federal health agencies
    - ☐ Other (Please Specify)
    - ☐ Don't Know
82. Other health agency to which lab can submit structured results

    _____
83. Is this lab currently submitting structured results electronically to any health agencies? Check all that apply.
    - ☐ Yes: For state public health agencies
    - ☐ No: For state public health agencies
    - ☐ Yes: For federal health agencies (i.e. Centers for Disease Control)
    - ☐ No: For federal health agencies
    - ☐ Other (Please Specify)
    - ☐ Don't Know
84. Other health agency to which lab currently submits structured results

    _____
85. Does this agency have the capacity to electronically submit structured lab data to the following? Check all that apply.
    - ☐ Connecticut Department of Health
    - ☐ Providers
    - ☐ Payers
    - ☐ Other Labs

- ☐ No: We do not have the capacity
- ☐ Other (Please Specify)

86. Other entity to which lab can electronically submit structured lab data

_____

87. Approximately what percent of test results are not reported back to ordering providers?

_____

88. Approximately what percent of test results are reported back to ordering providers via mail?

_____

89. Approximately what percent of test results are reported back to ordering providers via fax?

_____

90. Approximately what percent of test results are reported back to ordering providers electronically?

_____

91. Approximately what percent of test results are reported back to ordering providers via other means (please specify)?

_____

92. Other method by which lab reports test results back to ordering providers

_____

93. If this lab is submitting structured results electronically, what mode is being utilized?

- ☐ VPN
- ☐ FTP
- ☐ HTTP
- ☐ SMTP
- ☐ Disk
- ☐ Don't Know
- ☐ Other (Please Specify)

94. Other mode used to submit structured results electronically

_____

95. How many outbound result interfaces is this lab currently supporting, if any?

- ☐ None
- ☐ >0 (Please provide numerical answer below)
- ☐ Don't Know

96. Number of outbound result interfaces currently supported by lab

_____

97. For any electronic reporting (submission) of lab results, what electronic standard is this lab using? Check all that apply.

- ☐ HL7 v.2.3.1
- ☐ HL7 v.2.5.1
- ☐ Continuity of Care Document (CCD)
- ☐ Continuity of Care Record (CCR)
- ☐ Other (Please Specify)

98. Other electronic standard used for reporting of lab results

_____

IX. Reportable Lab Results

99. Are you aware of the regulations governing the control and reporting of communicable diseases in Connecticut?

- ☐ Yes
- ☐ No
- ☐ Don't Know

100. Does this laboratory perform tests that require reporting to the CT Department of Public Health?

- ☐ Yes
- ☐ No
- ☐ Don't Know

101. What method does this lab use to send reportable test results/diagnostic results to the CT Department of Public Health?

- ☐ Not Applicable: lab does not perform reportable tests
- ☐ Mail
- ☐ Fax
- ☐ Electronic
- ☐ Other (Please Specify)
- ☐ Don't Know

102. Other method used to send reportable test/diagnostic results to CT DPH

_____

103. If you selected 'electronic', what is the approximate percentage of all results sent electronically?

_____

104. Name of lab's contact for submitting reportable lab data to CT DPH

_____

105. Role/Title of lab's contact for submitting reportable lab data to CT DPH
_____

106. Street Address of lab's contact for submitting reportable lab data to CT DPH
_____

107. City/Town of lab's contact for submitting reportable lab data to CT DPH
_____

108. ZIP of lab's contact for submitting reportable lab data to CT DPH
_____

109. County of lab's contact for submitting reportable lab data to CT DPH
_____

110. E-Mail of lab's contact for submitting reportable lab data to CT DPH
_____

111. Phone Number of lab's contact for submitting reportable lab data to CT DPH
_____

X. Electronic Eligibility

112. Does this lab receive electronic eligibility claim data (i.e. Medicare, Blue Cross, etc.)?
- ☐ No
- ☐ Yes: By logging into a separate portal for each payer
- ☐ Yes: By logging into a multi-payer portal
- ☐ Yes: Directly through an interface to my EHR
- ☐ Other (Please Specify)
- ☐ Don't Know

113. Other method by which lab receives electronic eligibility claim data
_____

114. With what entities does this lab have the capacity to exchange electronic eligibility information? Check all that apply.
- ☐ Not Applicable
- ☐ Medicaid
- ☐ Medicare
- ☐ Blue Cross/Blue Shield
- ☐ Cigna
- ☐ United Healthcare
- ☐ Other (Please Specify)

115. Other entities with which lab can exchange electronic eligibility information
_____

116. If there is any capacity to electronically submit claim data to payers, to whom does this lab currently submit electronic eligibility information?
- ☐ Not Applicable
- ☐ Medicaid
- ☐ Medicare
- ☐ Blue Cross/Blue Shield
- ☐ Cigna

- ☐ United Healthcare
- ☐ Other (Please Specify)

117. Other entities to whom lab currently submits electronic eligibility information

_____

XI. Meaningful Use

118. According to CMS requirements, does this facility qualify to apply for Meaningful Use incentives?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know
119. If you answered yes, under what category does this facility apply?
    - ☐ Eligible Provider (EP)
    - ☐ Eligible Hospital (EH)
    - ☐ Both
120. Has this facility registered (or is it going to register) as an EP or EH?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know
121. If you answered yes, under what program did (or will) this facility register?
    - ☐ Medicaid
    - ☐ Medicare
    - ☐ Both
122. Is this lab able to transmit structured lab results electronically (using HL7 2.3.1 or 2.5.1 messages)?
    - ☐ Yes
    - ☐ No
    - ☐ Don't Know
123. Are providers able to receive structured lab results electronically from this facility?
    - ☐ Yes: At Least Some Are
    - ☐ No
    - ☐ Don't Know
124. If you answered yes, please list the percentage of providers that are able to receive structured lab results electronically from this lab.

_____

125. If you answered yes, please list the names of providers that are able to receive structured lab results electronically from this lab.

_____

126. Comments

_____

Third Survey - Abbreviated hospital/independent laboratory survey (used for Round 3 2011-2012 administration and 2013 administration)

Laboratory survey

In 2010 the Connecticut Department of Public Health (DPH) was awarded $7.29 million from the Office of the National Coordinator for Health Information Technology (ONC) through the State Health Information Exchange Cooperative Agreement Program. The State HIE Program's purpose is to enable states to implement a health information exchange (HIE) within their health care systems. As an integral member of your laboratory, your views are of great importance to this initiative.

The Health Information Technology Exchange of Connecticut (HITE-CT) is a recently-established quasi-public agency whose primary role is to work with DPH to promote the development of health information technology. This authority will assist providers in meeting meaningful use criteria for electronic health record adoption and will support health care organizations participating in the health information exchange. A critical next step in this initiative is to evaluate its development; this is required in order to provide ONC with information about Connecticut's current health information technology landscape.

Through a contract with the state Department of Health, the University of Connecticut is responsible for evaluating the statewide Health Information Exchange's ongoing development and implementation. The surveys comprising this research will be administered statewide. These surveys attempt to measure the adoption of health information technology functions and overall opinions about health information technology within Connecticut. The survey should take approximately 5 minutes of your time, and will be of great value to Connecticut's leaders in health information technology. Additionally, if you agree to participate in a follow-up survey, we will contact you again next year. Since these surveys will be administered repeatedly, our evaluation would benefit most from your willingness to participate in the follow-up survey,

Your participation in this survey is voluntary. You do not have to answer any question for which you do not want to share a response.

If you have any questions about the survey, or would like more information about the evaluation, please do not hesitate to contact us. The primary investigator's contact information is below. Thank you for your time.

Contact Information:
Minakshi Tikoo, Ph.D.
Director of Evaluation and Program Development
Biomedical Informatics Center (BMIC)
Connecticut Institute for Clinical and Translational Science (CICATS)
University of Connecticut Health Center
263 Farmington Avenue
Farmington, CT 06030-6233
860-679-5559
tikoo@uchc.edu

Lab ID number	
What title best describes your position?	
Lab Type	□ Hospital □ Independent
Survey round	□ Round 2 (Feb 2013)
Which option below best describes your laboratory's organizational affiliation or ownership	□ Affiliated with University/Academic Center □ Hospital or health system □ Non-Academic Affiliated laboratory □ Other (Please specify) □ Unknown □ Refused
If laboratory then, Which of the following best describes your laboratory type?	□ Independent/Commercial Laboratory □ Reference laboratory □ Other (Please specify) □ Unknown □ Refused
Please estimate the total of all billable tests your laboratory received from ambulatory providers during calendar year 2012.	□ Fewer Than 100,000 □ 100,000 – 499,999 □ 500,000 – 999,999 □ 1,000,000+ □ Unknown □ Refused
Please estimate the number of physician practices that submit orders to your lab **(Added in Round 2)**	
Please estimate the number of physicians represented by these practices that submit orders to your lab **(Added in Round 2)**	
During calendar year 2012, did your laboratory send lab results to ambulatory providers outside your organization electronically in a structured format? (Do not include fax machines)	□ Yes □ No □ Don't Know □ Refused
Please estimate the proportion of final lab results sent via electronic delivery to an electronic health record.	□ 0% □ 1% - 24% □ 25% - 49% □ 50% - 74% □ 75% - 99% □ 100% □ Don't Know □ Refused
Please estimate the proportion of final lab results available on a web portal	□ 0% □ 1% - 24% □ 25% - 49% □ 50% - 74% □ 75% - 99%

	□ 100% □ Don't Know □ Refused
Please estimate the proportion of final lab results sent via other method. Please specify the other method	□ 0% □ 1% - 24% □ 25% - 49% □ 50% - 74% □ 75% - 99% □ 100% □ Don't Know □ Refused
Please estimate the proportion of test results that your laboratory sent to ambulatory providers outside your organization following Logical Observation Names and Codes (LOINC) standards. Consider only results during calendar year 2012.	□ 0% □ 1% - 24% □ 25% - 49% □ 50% - 74% □ 75% - 99% □ 100% □ Don't Know □ Refused
Has your laboratory implemented the Office of the National Coordinator's Laboratory Results Interface (LRI) guide for lab result content and format?	□ Yes □ No □ Don't Know □ Refused
Please indicate which of the following Health Level 7 (HL7) message standards are currently used by your organization to send lab results to ambulatory care providers.	□ HL7 2.3.1 □ HL7 2.5.1 □ Other (Please specify) □ Don't Know □ Refused
Do you use Direct messaging to send lab results electronically? **(Added in Round 2)**	□ Yes □ No □ Don't Know □ Refused

Appendix B

Procurement of laboratory contact lists

On February 8, 2011, the Connecticut Hospital Association (CHA) provided contact information for laboratory managers at 24 Connecticut hospitals. This list contained contact information for 33 individuals, with multiple contacts listed for Bridgeport Hospital, Day Kimball Hospital, John Dempsey Hospital, Greenwich Hospital, New Milford Hospital, and the Hospital of Saint Raphael. The contact information included the names of each hospital's laboratory director or manager and his/her phone number, fax number, and e-mail address. The 33 lab managers received survey invitations via e-mail.

On April 4, 2011, DPH provided the UCHC Evaluation team with a list of 473 public health, blood bank, hospital, independent clinical, and physician office laboratories in Connecticut. This list contained 84 duplicate hospital laboratory listings; and 2 duplicate independent laboratory listings. Thirty-one of the 32 blood bank laboratories duplicated a listing for a hospital laboratory, and one blood bank lab listing duplicated a listing for an independent lab. The final unduplicated DPH laboratory list comprised 355 Connecticut laboratories. The second survey (based on Tennessee's Lab Survey) was administered to the raw list of 473 contacts; the phone calls were conducted before the UCHC survey team became aware of the duplicates in the DPH laboratory list.

The second administration of the laboratory survey occurred from November 15, 2011 through March 2, 2012. We obtained a list of 473 public health, blood bank, hospital, independent, clinical, and physician office Connecticut laboratories from DPH. Each laboratory was asked whether it wanted to take the survey on-line, take it over the phone, receive a faxed survey, or receive a mailed survey. Of the 473 laboratories on the DPH list, 152 (32.1%) labs either duplicated another laboratory listing on the DPH list or the respondent referred the UCHC caller to a parent lab within the same institution. In 113 (23.9%) of the cases the respondent claimed that no laboratory existed at the location being called. Of the 208 remaining laboratories, 25 (12.0%) refused to participate in the survey, 53 (25.5%) requested a link to an on-line survey, 15 (7.2%) requested a mailed survey, 86 (41.3%) requested a faxed survey, and 2 (1.0%) requested that the survey be administered to them over the phone. No contact was made with the remaining 27 (13.0%) laboratories from the DPH list. Twenty-one laboratories responded to the survey.

The third administration of the survey, which was the abbreviated hospital/independent laboratory instrument, occurred from April 11, 2012 through June 5, 2012. In March 2012 we downloaded a list of 106 hospital and 73 independent laboratories from the Centers for Disease Control (CDC) website. These surveys were only administered over the phone; no e-mailing or mailing of surveys to respondents occurred. Of the 179 hospital and independent laboratories on the CDC list, 18 (10.1%) were duplicates, 10 (5.6%) claimed that no laboratory existed at the location being called, 12 (6.7%) claimed that there was no laboratory manager on-site to take the survey, and 1 (0.6%) claimed that the lab was no longer in business. Of the 138 remaining laboratories, valid phone numbers could not be found for 35 labs (25.4%). Of the 103 callable labs, 33 (32.0%) refused to take the survey and 60 (58.3%) completed the

survey (two of these survey responses were ultimately excluded from the analytic data set). No contact was made with the remaining 10 (9.7%) laboratories.

The DPH and CDC laboratory lists were combined to generate an overall universe of laboratories within Connecticut in 2012. Laboratories in the de-duplicated DPH and CDC lists were matched on facility name, street address, and town. This process yielded 117 hospital and independent laboratories appearing in both lists. Fifty-one hospital and independent laboratories from the DPH list did not appear in the CDC list, while 48 hospital/independent laboratories from the CDC list did not appear in the DPH list. The final 2012 laboratory universe contained 403 laboratories. These comprised 5 public health, 113 hospital, and 103 independent laboratories. In addition, the universe contained 182 physician office laboratories appearing in the DPH list.

The UCHC survey team experienced difficulty in obtaining an updated laboratory list for the 2013 hospital/independent laboratory survey, which was conducted beginning on February 25, 2013. At this time, DPH no longer maintained a comprehensive list of Connecticut laboratories. The UCHC survey team was directed to the Connecticut Department of Consumer Protection (DCP). The DCP laboratory list, however, consisted primarily of police department and school laboratories used for controlled substance testing; this list was therefore not used for survey purposes and the 2012 CDC list was re-used.

An up-to-date CDC list of Connecticut laboratories was downloaded in December 2013, after the 2013 laboratory survey calling was complete. This updated CDC list significantly overlapped the 2012 CDC list. The list contained a total of 111 hospital labs and 81 independent laboratories. Of the 111 hospital laboratories in the follow-up CDC list, 80 (72.1%) also appeared in the 2012 CDC list. Of the 31 hospital laboratories not matched to the 2012 laboratory list on facility name and address, 12 (48.0%) had the same address as a matched hospital laboratory listing; for example, the CDC list contained several listings for various Yale New Haven Hospital laboratories located at 1450 Chapel Street in New Haven. Of the 78 independent laboratories in the 2013 CDC list, 66 (84.6%) also appeared in the 2012 CDC list. Figure 3 illustrates the process used to generate the final universe of Connecticut hospital/independent laboratories.

Chain labs (e.g. Clinical Laboratory Partners, LabCorp, Quest Diagnostics) comprised a meaningful percentage of the labs on the 2011-2012 CDC hospital/independent calling list. For the 2011-2012 long REDCap survey, chain laboratories comprised 28 of the 208 unduplicated lab listings where respondents didn't refer staff to a parent laboratory or claim that there was no laboratory or laboratory manager at the location. This represents a 13.5% rate of chain laboratories. For the 2011-2012 abbreviated REDCap hospital/independent survey, chain laboratories represented 16 of the 55 CDC independent listings where respondents didn't refer staff to a parent laboratory at the same facility or claim that there was no laboratory or laboratory manager at the location; this represents a 29.0% rate of chain laboratories among independent labs appearing on the CDC list that had managers on-site.

Details regarding construction of analytic sample

The final analytic dataset, which consisted of a 2011-2012 dataset and 2013 dataset, was constructed by cross-walking data from the four survey instruments. For the 2011-2012 dataset, responses from the SurveyGizmo hospital instrument, the initial long REDCap

instrument, and the abbreviated REDCap hospital/independent survey instrument were combined. Several laboratories completed multiple surveys; the final 2011-2012 dataset contained only one response in the Hospital/Independent survey format for each unique laboratory. To accomplish this, the UCHC survey team mapped labs' responses to the baseline SurveyGizmo and long surveys to the format used in the Hospital/Independent survey instrument. If a lab answered the Hospital/Independent survey and another of the baseline instruments, then values from the other baseline instrument were used for elements in the Hospital/Independent survey that were missing. If a lab answered only the SurveyGizmo and long surveys, then responses from the long survey were mapped to the Hospital/Independent survey format, with missing responses being filled in from the SurveyGizmo response.

This combination yielded a total of 58 laboratory survey responses included in the 2011-2012 analytic dataset. The 2013 dataset included responses from the fourth administration of the survey, which yielded 34 survey responses.

In order to create a consistent final analytic data set, responses to the SurveyGizmo and long REDCap instruments needed to be mapped to the elements and allowable values used in the abbreviated REDCap hospital/independent survey instrument. Since the abbreviated hospital/independent instrument was substantially shorter than either of the two other instruments, this meant that only a minority of the SurveyGizmo and long REDCap survey elements could be used in the final dataset. The hospital/independent survey elements in the final analytic data set, and the SurveyGizmo and long REDCap instrument elements used as proxies are presented in Table 17.

The final combined analytic data set contained 92 surveys covering 66 unique laboratories. These included 32 laboratories that only completed the first, second or third survey administration in 2011 or 2012, 8 laboratories that only completed the fourth survey administration in 2013, and 26 laboratories that completed a survey in both 2011-2012 and 2013.

Table 17. Survey elements included in final analytic data set

Final Short Form	RedCap Long Survey	SurveyGizmo
Lab ID		
What title best describes your position?		
Lab Type	Which of the following most accurately describes this laboratory facility (page 2)	
Which option below best describes your laboratory's organizational affiliation or ownership?		
Please specify other affiliation		
Which of the following best describes your laboratory type?		
Please estimate the total of all billable tests your laboratory received from ambulatory providers during calendar year 2012.	What is the number of completed orders that this laboratory averages per year? (page 3)	What is the approximate number of individuals you serve per year?
Please estimate the number of physician practices that submit orders	Affiliated Physicians (page 9)	

Final Short Form	RedCap Long Survey	SurveyGizmo
to your lab.		
Please estimate the number of physicians represented by these practices that submit orders to your lab.	Affiliated Physicians (page 9)	
During calendar year 2012, did your laboratory send lab results to ambulatory providers outside your organization electronically in a structured format? (Do not include fax machines)		Does your practice exchange any electronic clinical data with physicians?"
Please estimate the proportion of final lab results sent via electronic delivery to an EHR	Currently able to submit lab results electronically to an ordering physician's EHR (pages 4 &11) Percent of physician practices connected to lab who can receive structured electronic results (page 9)	Does your practice exchange any electronic clinical data with physicians?
Please estimate the proportion of final lab results available on a web portal		Does your practice give or share data electronically with a personal health record (PHR)?
Please estimate the proportion of final lab results sent via other method	Other Electronic Capability Please Specify (page 4)	
Please estimate the proportion of test results that your laboratory sent to ambulatory providers outside your organization following Logical Observation Names and Codes (LOINC) standards. Consider only results during calendar year 2012.	Is the lab currently utilizing a 'structured electronic' means of lab reporting? (page 4) Does the selected certified EHR for this facility use or plan to use the following terminology and standards for coding and communicating lab data? (page 5).	Which terminology do you use to code and communicate data Does your practice exchange any electronic clinical data with physicians?
Has your laboratory implemented the Office of the National Coordinator's Laboratory Results Interface (LRI) guide for lab result content and format?	Not asked	Not asked
Please indicate which of the following Health Level 7 (HL7) message standards are currently used by your organization to send lab results to ambulatory care providers.	For any electronic reporting (submission) of lab results, what electronic standard is this lab using? (page 12)	Is the system used within your laboratory compatible with HL7 standards?
Do you use Direct messaging to send lab results electronically?	Not asked	Not asked