



Public Health Data Standards Consortium

Developing a Vision for Functional Requirements Specification for
Electronic Data Exchange between Clinical and Public Health Settings:
Examples of School Health and Syndromic Surveillance
in New York City

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ATTACHMENT 1: Form Inventory

ATTACHMENT 2: System Development Steps, Timeline and Deliverables

GLOSSARY [1]
(in alphabetical order)

Actors	Entities that interact with the system, e.g., users
Data Flow	The sequence in which data is collected, transferred, managed, stored and used by actors
Requirement Elicitation	An activity during which project participants (users and developers) define the purpose of the system.
Requirements Specification	A complete and precise description of the system from the user's point of view
Unified Modeling Language (UML)	A standard set of notations for representing the system in a graphical way
Use Case	A general sequence of interactions between one or more actors and the system. Use case describes a function of the system in terms of a sequence of interactions between an actor and the system
Use Case Diagram	A product of the requirement elicitation process (UML notation) that depicts graphical (symbolic) description of the functionality of the system for the selected use case
Scenario	Instance of a use case that represent a concrete sequence of interactions between one or more actors of the system
Work Flow	A sequence of activities by actors within a selected use case that generate, manage and use data within the system
System	An organized set of communicating parts organized for a specific purpose

EXECUTIVE SUMMARY

The goal of public health is to protect public's health. In fulfilling this goal, public health agencies and health care providers need to be capable of exchanging pertinent information about individuals and communities. Traditional public health data gathering activities have been limited by the paper-based reporting burden imposed on providers.[2] With the spread of Electronic Health Record Systems (EHRS) [3] and ability to connect them to public health agency's programmatic data systems and registries, the burden to report similar data on multiple paper forms to multiple programs can be reduced. [4] The EHRS-based electronic connectivity will enable real-time population health assessments and reporting of the outcomes of aggregated data analysis back to providers for clinical decision support, care coordination, health threats alerts and patient health education. One can envision an era of electronic exchange in which:

- Clinical information can be transmitted in real-time directly into multiple public health programmatic data systems for public health reporting [5];
- Public health can more efficiently conduct public health investigations and case management through real-time communication with providers;
- Public health programs can have access to detailed individual patient information contained in the EHRs for population health assessments and research;
- Public health agencies can use this fund of information from across the healthcare community to inform the development of health promotion interventions and guidelines to support clinical practice that improves patient care delivery, public health practice outcomes and the public's health;
- Providers will receive from the health department more complete and up to date information about health issues in their immediate community that enables them to practice in a more community-oriented manner.

Standards are one of the stumbling blocks in health information exchanges as existing systems both in clinical care and public health often use non-interoperable standards. To date the main focus of the standard development activities was on data standards (vocabularies and terminologies), information content standards (data representation, i.e., paper forms, data analysis algorithms, data displays, data reports, etc.), and information exchange standards. It has been recognized [6], that in addition to these categories of standards, the functional standard is a necessary vehicle to assure that work processes of users related to the EHRS data exchange are agreed upon and well described by users, and then communicated clearly to the developers as functional requirements for the interoperable EHRS. The functional standard (workflow/process standard) serves as a basis for the implementation of all other standards.

This project represents the first attempt to develop a vision for a functional standard for EHR-Public Health (EHR-PH) electronic data exchange - a *Functional Requirements Specification document* - to inform the development of the functional standards for the electronic data interchange between clinical care and public health.

The two public health application domains - school health and syndromic surveillance in New York City Department of Health and Mental Hygiene were selected as examples of public health programs involved in the EHR-PH data exchange. The developed specifications represent the end user perspectives (clinical and public health staff) for the electronic communications based

on the EHR systems installed in a clinical setting. The domain-specific information for the specification has been obtained via the *requirement elicitation process*, i.e., informal interviews with clinical and public health staff on their work processes and data management activities. The specifications were developed in the format of the *Requirement Analysis Document (RAD)*. [1]

We demonstrated that the RAD format can be successfully used to describe work processes and interactions between users-participants in the electronic data exchanges in the selected two public health domains. We believe that the same approach can be used to describe electronic data exchanges between clinical settings and public health agency in other public health domains (e.g., communicable disease reporting, immunization, chronic disease care, etc. So, we *propose to view these two examples of functional requirement specifications in a RAD format as prototypes of functional standards (workflow/process standards) for EHR-PH systems for the selected domains.*

To build a consensus on the functional standards for the EHRS-based data exchanges between clinical and public health settings for the selected domains, there is a need to validate the developed specifications by public health & clinical communities. There is also a need to further validate the same approach and format to describe EHRS-based data exchanges in other public health programs/domains. These validation efforts will help to

- (1) assure generalizability and acceptability of the proposed approach for the development of the functional standards across stakeholders,
- (2) develop a functional standard for the clinical care/public health electronic data exchanges, and as the result,
- (3) build interoperable clinical and public health systems.

As a next step toward developing EHR-PH functional standards, we propose to conduct a validation of the two examples of the functional requirements specifications developed under this project by relevant public health agencies programs staff and clinicians to build a consensus on the format and content of the requirements specification for these two domains/programs and other public health programs.

INTRODUCTION

On July 21, 2004 the Department of Health and Human Services (DHHS) announced the decade of health information technology (HIT) for “delivering consumer–centric and information-rich health care.”[7] The vision is to build a National (Nationwide) Health Information Network (NHIN) of regional health information organizations (RHIO). This will support regional health information exchanges (RHIE) across health care providers (HCPs) integrated via electronic health record systems (EHRS). The goal of a NHIN is to enable electronic access to health information where it is needed when it is needed by those who need to know. The challenge of NHIN interoperability is to devise systems that embrace all loci of care and legitimate users of data. To build a NHIN, the Office of National Coordinator for Health Information Technology, Department of Health and Human Services recently awarded contracts to harmonize existing standards for health information exchanges, develop certification criteria for EHR systems and build Nationwide Health Information Network prototypes. [8]

Although most graphic representations illustrating the NHIN display a box labeled *public health*, much work remains to be done in specifying the meaning behind the arrows going to and from that box. The bi-directional data conversation between public health and primary care providers (PCP) is integral to any future NHIN participants whose aim is to improve patient safety, quality of care and public’s health. Timely exchange of information has the potential for improving how public health and primary care can mutually support each other’s jobs.

Traditional public health data gathering activities have been limited by the reporting burden imposed on providers. With the spread of EHRS and ability to connect them to public health agency’s programmatic data systems and registries, the burden to report similar data on multiple paper forms to multiple programs can be reduced. [4] In addition, the burden of double data entry, i.e. the need to enter data into a provider’s system and then into a public health system, will be eliminated. In the future, the EHRS-based electronic connectivity will enable real-time aggregate data reporting back to providers for clinical decision support, care coordination, health threats alerts and patient health education. One can envision an era of electronic exchange in which:

- Clinical information can be transmitted in real-time directly into multiple public health programmatic data systems for public health reporting [5];
- Public health can more efficiently conduct public health investigations and case management through real-time communication with providers;
- Public health programs can have access to individual patient information contained in the EHRSs for population health assessments and research;
- Public health agencies can use this fund of information from across the healthcare community to inform the development of health promotion interventions and guidelines to support clinical practice that improves patient care delivery, public health practice outcomes and the public’s health;
- Providers will receive from the health department more complete and up to date information about health issues in their immediate community that enables them to practice in a more community-oriented manner.

Clearly, the ability to exchange data does not automatically mean that it will happen unfettered. There will be constraints regarding data warehousing, data and information management, system security, patient privacy and public acceptance of the use of information technology for maintaining personal health information, and acceptance by both public health practitioners and clinicians of their changing roles in public health and the care-giving community interaction.

Standards are one of the stumbling blocks in health information exchanges as existing systems both in clinical care and public health often use non-interoperable standards. To date the main focus of the standard development activities was on data standards (vocabularies and terminologies), information content standards (data representation, i.e., paper forms, data analysis algorithms, data displays, data reports, etc.), and messaging standards. It has been recognized [6], that in addition to these categories of standards, the functional standard is a necessary vehicle to assure that work processes of stakeholders related to the EHR electronic data exchange are well understood and agreed upon across stakeholders themselves. Then it is communicated clearly to the developers as functional requirements for the interoperable EHR systems. The functional specification standard (workflow/process standard) serves as a foundation for the implementation of data, information and messaging standards.

This project represents the first attempt to develop a vision for a functional standard for EHR-PH electronic data exchange - a *System Functional Requirements Specification document* - to inform the development of the functional standards for the electronic data interchange between clinical care and public health.

We examined two real world examples of what occurs when a public health department starts to implement an expanded vision of information exchange through HIT. Two use cases (public health application domains) - school health and syndromic surveillance in New York City - were selected to demonstrate that the work processes that support electronic data exchange between clinicians and public health practitioners can be described in an organized way to depict the specificity of the data exchange in terms of goals, participants, functions and data sources; what procedures and policies are put in place; what the benefits to public health, clinical care and consumers are; and what the stumbling blocks are, e.g., in terms of deficits in the current use of standards and system architecture.

The ability to describe the functionality of the two different public health domains in the same format can help formulate functional requirements standards for electronic communication between clinical and public health settings, so that the EHR-PH data/information exchange deployed at one clinical setting to transmit data to a public health agency can be replicated at other clinical facilities.

METHODS

This report includes two sections developed in the format of a functional requirements specification document (specification) also known as a functional specification that describes systems for electronic data exchange between clinical and public health settings as applicable to the two selected public health programs (domains), i.e., school health and syndromic surveillance. The specifications represent the user's point of view of these two systems. Each specification includes the description of the following components of the EHR-PH system of electronic data exchange:

- goals of the system (exchange) to be developed;
- participants (actors), i.e. users who will interact with the system;
- description of the use cases – real-life scenarios that describe actors actions related to the system, i.e., actors actions and interactions and data generation/exchange activities;
- functional requirements (user actions) that the system will support;
- data sources included in the system;
- diagrams that describe the system in a graphical way, i.e., use case diagram and dataflow/workflow diagrams;
- standards needed for data exchange, privacy protection and data exchange protocols; system development stages, timeline and deliverables.

To develop these specifications, we followed the requirement elicitation process used in the software engineering development activities where users and developers define the goals of the system, its participants (actors), use case scenarios that represent actor's workflow and interactions, data sources and dataflow and functions that the EHR-PH system will support. [1]

The requirement elicitation for this project was conducted during the site visit of the Principal Investigator and HRSA's representatives (project team) at the New York City (NYC) Department of Health and Mental Hygiene (DOHMH) and NYC Institute for Urban Family Health - a Community Health Center (CHC) - in late September 2005 via formal presentations by the DOHMH' programs directors (Bureau of School Health, Immunization program, Take Care New York program and Syndromic Surveillance program) and the CHC medical director. These formal presentations helped select the two domains for this project. The informal interviews/discussions with members of the program staff of the selected domains further informed the requirement elicitation process. This methodology was earlier deployed by the Public Health Informatics Institute to elicit requirements for the public health laboratory information management system (LIMS). [9]

Unified modeling language (UML) diagrams were used to depict system components and actors interactions in a graphical format. [10]

The report was reviewed by HRSA, NYC DOHMH and PHDSC staff.

RESULTS

OVERVIEW OF NYC DOHMH ELECTRONIC DATA EXCHANGE ACTIVITIES

New York City Department of Health and Mental Hygiene was selected for this project because it represents a place that has taken an early lead in electronic data exchange between clinical care settings and public health programs. This affords an opportunity to examine why such an agency undertook these activities and to learn from their experiences.

Spurred by the events of September 11, DOHMH launched an effort to use both clinical data from emergency departments and non-clinical data sources for on-going syndromic surveillance that monitors emergency department visits to detect disease outbreaks. [11] Another DOHMH priority is to streamline ambulatory care data from community health centers into an on-going epidemiological surveillance and care coordination. This is particularly important because of the 2 million encounters recorded at CHCs annually as well as the newly announced NYC Mayor's \$25 million initiative to deploy the EHRs in all CHCs across the city.

The DOHMH plans for broader use for the EHRs-based system's bi-directional data exchange with public health systems to carry out a fuller array of public health and clinical care functions. For example, over the last year, the DOHMH and a large multi-site CHC network in Lower Manhattan (The Institute for Urban Family Health) have been working on an EHR-PH electronic data exchange for syndromic surveillance of risks of tobacco use. This allowed DOHMH to feedback to clinical sites the results of the aggregated data analysis for the communities served.[12] The DOHMH also envisions that in addition to rapidly alerting practitioners about detected health threat events, e.g., gastroenterological (GT) illnesses, influenza, etc., the EHR-PH system can be further used for sending instructions back to providers to activate procedures relevant to the event detection, monitoring and response as well as to care coordination between clinical and public health staff as it relates to an individual patient care.

The DOHMH is focusing on the four areas of EHR-PH bidirectional data exchange as follows:

- (1) syndromic surveillance for disease outbreak detection, e.g., for GT illnesses, respiratory illnesses, etc.;
- (2) monitoring progress on community health benchmarks for the city-wide Take Care NY program [13] to identify needs and priorities for care delivery resources allocation and health education, e.g. for chronic disease management;
- (3) building a city-wide e-prescribing data interchange; and
- (4) school health care.

The sections that follows present the description of functional requirements specifications for the design of the EHR-PH electronic data exchange in two of the four priority areas stated above – school health and syndromic surveillance.

EHR-PH SYSTEM FUNCTIONAL REQUIREMENTS SPECIFICATION:
NEW YORK CITY SCHOOL HEALTH SYSTEM

The New York City School Health program is administered by the Bureau of School Health (BSH) as a joint program of the NYC Department of Education and the DOHMH. Its mission is to promote the health of the 1.3 million schoolchildren that includes the ages kindergarten through 21 enrolled in approximately 1,800 public schools. Services to students include preventive health screenings, case management of chronic health problems, urgent care, medication administration, preventive counseling, health education, referral for care and assurance of ongoing effective treatment. BSH has been the provider of public health services in the schools for 100 years. [14]

To assure the provision of these services each child who enters the school system has to have his/her health information available for the school nurse. Child's health care provider has to complete numerous paper forms describing child's health status and special medical needs if any. These forms then are hand delivered by a parent/caregiver to the school official before child can enter the school system.

a. Goal of the electronic data exchange

The vision is to enable electronic transmission of data on child's health status (school health data) from the EHRS in an ambulatory provider office, e.g., Community Health Center, to a school nurse via the BSH Automated Student Health Record system – a city-wide school health record system.

The goals of the EHR-based electronic data/information exchange is to maximize the learning experience of a child by sending real-time electronic data on a child's physical examination from a community health center's provider to a school's nurse via a city-wide school health record system.

b. Participants in electronic data exchange (Actors)

The following stakeholders (actors) will participate in the electronic data exchange:

- Bureau of School Health, NYC DOHMH
- Community Health Center (CHC)
- Primary Care Provider employed at the CHC
- Parent/Guardian
- Student
- Official and/or nurse of a public school

Bureau of School Health, NYC DOHMH, maintains a city-wide Automated Student Health Record (ASHR) system that serves as a data repository for the health data on all students in the NYC public school system. The system is currently unable to capture information for students in private schools.

A physical exam is required for all students entering the NYC public school system. This exam must be conducted within a year prior entering the school. The results of the exam are recorded on a New Admission Examination Form (211S) (Attachment 1).

In addition to the 211S Form, the NYC Department of Education and the DOHMH developed guidelines [15] to ensure that children with special needs can fully participate in the educational settings. The following forms are completed by a provider to request in school direct health and educational services (Attachment 1):

1. Request for Educational Services(s)
2. Multi-Use Medication Form – Medication Administration Form
3. Provision of Medically Prescribed Treatment (Non-Medication) to request special procedures such as bladder catheterization, postural drainage, tracheal suctioning, gastronomy tube feeding, etc.
4. Glucose Monitoring Form for students with diabetes
5. Insulin Pump Form – for students using insulin pump

Please note that only 211S Form, Request for Educational Services(s) and Multi-Use Medication Form – Medication Administration Form will be included in this specification as there are no current plans to incorporate other forms into ASHR.

The 211S and other forms help the BSH to determine which students have (1) disease or physical conditions that would preclude a student from participating fully in school activities or (2) chronic illnesses that would need in school medication or other direct health services. The forms are completed by a primary care provider. The completed forms are delivered to the child's school by a parent/guardian. A school official or nurse receives the forms and data is entered into the ASHR by a school nurse or a BSH regional staff member.

Approximately 100,000 new 211S forms are entered on a yearly basis into the ASHR. Because these forms are currently hand delivered by parent/caregiver, BSH staff has concerns regarding the completeness of the records in the ASHR, e.g., forms might not be delivered to school because parents were not able to make additional trips to doctor's office to pick-up the form(s) if it was not completed on the same day as exam done. In case of a child with in school needs timeliness and completeness of forms is particularly important. Also, average tenure for a student in school is three years. Every time a student changes schools there is a risk that forms will get misplaced or they will be delayed in reaching a new school.

EHRIS will enable to transmit student data into the ASHR in real-time and will improve completeness of the ASHR records.

Community Health Center is represented by The Institute for Urban Family Health that includes 12 sites with 55 primary care providers. It serves about 70,000 patients with an average of 180,000 visits per year including pediatric patients. For more than three years this CHC used fully operational EHRIS (EPIC™) for routine healthcare. The CHC uses paper-based communication only for referral to specialists, radiology and public health reporting.

The CHC EHRS has a patient interface – My Chart - that serves as a patient’s personal health record (PHR) and allows for eConsult services, e.g., medication refills. The CHC has the ability to electronically receive discharge data for Beth Israel Hospital via the EPIC™ access terminal. The CHC collaborated with NYC DOHMH on several electronic data exchange projects including the syndromic surveillance project on smoking and the diarrhea outbreak detection in the Bronx that allowed for timely alerts of CHC providers about this outbreak.

Primary Care Provider (PCP) is the NYC licensed physician or nurse practitioner at the CHC that serves as a student’s primary medical caregiver. In case of a child with chronic conditions, PCP is the one who will be actively managing the conditions for which in school special direct health and educational services are requested.

The list of forms to be completed by a primary care provider prior to a child entering school is described above and provided in the Attachment 1: Form Inventory.

Using the EHRS, a PCP will enter visit data in the patient’s electronic health record that will automatically populate 211S Form and other appropriate forms. In turn, data from these forms will be automatically transmitted to the ASHR.

Parent/Guardian is a person who provides care for a student. Parent/guardian is currently responsible for delivering completed paper-based 211S Form and other forms to the child’s school.

Using the EHRS, a parent/guardian will authorize the submission of student’s health data to the ASHR and will no longer hand deliver health forms to school.

Student is a child at the age of five who is entering a NYC school system or any newly registered student regardless of their age who are required to submit 211S Form and other forms as needed.

School official and/or nurse is a school representative who is designated to receive forms from a parent/guardian on a student. A nurse or BSH regional staff member enters data into the ASHR system. The nurse maintains student school health record within the school. In a case of a child with special direct health and/or educational needs, the nurse provides direct health services prescribed by a primary care provider.

Using the EHRS, a nurse will receive student’s health data from a provider electronically.

c. Benefits of Electronic Data Exchange by Stakeholder

The ability to electronically transmit student’s health data from the EHRS in a provider's office to ASHR will provide the following benefits for school health stakeholders:

BSH and DOHMH

- receive 211S Forms in real-time
- maximize number of 211S and special service requests forms in the system, i.e. improve ASHR completeness

- maximize number of children who have had physical exams by identifying children and families who are unable to get exams by primary care providers; referring them to school health doctors for the initial exam; and to work with family to refer them for insurance as needed or to a nearby provider who can become their medical home
- initiate prompt case management activities as needed
- identify those students who have special needs for program planning and resource allocation.

Providers and CHC

- eliminate duplicative patient visits to obtain the form that was lost when provider conducts exam on a child who already had it
- eliminate need to see patient for just completing school forms if child had a complete physical examination within the previous year
- increase productivity of providers by eliminating
 - manual completion of the 211S and special needs forms that will be automatically populated from the patient's EHR and
 - duplicative re-completion of the forms that have been lost
- improve care coordination for children with chronic disease conditions by exchanging health care information with school nurses

Parents/guardians and students

- eliminate need to make additional visits to a provider if child had a complete physical examination within the previous year
- eliminate duplicative visits to obtain the forms that were lost
- eliminate duplicative visits to a provider if 211S form is not completed on the day of the visit
- have less missed work days
- have less missed school days
- have school system and healthcare system that are more responsive to their health needs

School nurse

- eliminate data entry of 211S and special needs forms
- coordinate care for a child with special needs with a primary care provider

d. Use cases description

The following two scenarios were developed to describe the work processes and the data flow related to school health's patient visits. Scenario 1 describes the visit of a healthy child.

Scenario 2 describes the visit of a child that has asthma. An example of asthma was selected to demonstrate applicability of the electronic data exchange to the provision of in school healthcare services, i.e., medication administration. Asthma is a common disease among New York City's children and adults. People with asthma have chronic lung inflammation and episodes of airway tightening that cause symptoms such as wheezing, coughing, and shortness of breath. Asthma is a leading cause of missed school among children and is the most common cause of hospitalization for children 14 years and younger. Asthma can be controlled both by avoiding

exposure to triggers and by taking anti-inflammatory medicines. One of the goals of the New York City Asthma Initiative is to create “asthma friendly” schools and daycare settings.[16]¹ Electronic transmission of health care services requests by provider in real-time to a school nurse, e.g., medication administration schedule, can help healthcare services delivery in school as needed.

The asthma example may be also used in the future to conduct aggregated data analysis on asthma cases for public health surveillance and healthcare services assessments. Please note, however, that school health data analysis is not in the scope for this functional requirements specification.

Scenario 1: *Healthy Child*

1. Billy Johns is 5 years old. He is being seen at a New York City Community Health Center that has an operational EHRS which allows for the transmission of data electronically to the ASHR system. Billy is a patient of Dr. Health at the CHC. Billy visits Dr. Health today with his mother, Mrs. Johns, for his school physical examination.
2. Dr. Health conducts an examination and determines that Billy is healthy.
3. Dr. Health inputs exam data in to Billy’s Electronic Health Record in the CHC EHRS that automatically populates ASHR’s 211S Form for Billy.
4. Dr. Health verifies the 211S Form.
5. Dr. Health prints a hard copy of the 211S form for Billy’s parents paper records (upon the request from Mrs. Johns).
6. Dr. Health updates Billy’ Personal Health Record – My Chart.
7. Dr. Health exports Billy’s 211S Form to ASHR.
8. ASHR receives the 211S Form for Billy.
9. ASHR appends the 211S to Billy’s health profile
10. The School Nurse (Ms. Care) at the school is able to view Billy’s 211S Form from ASHR from the computer on her desk.
11. Ms. Care reviews the 211S Form and determines that Billy does not require any special interventions.
12. *Ms. Care communicates to Billy’s parent/guardian and provider via ASHR and CHC EHRS regarding student health concerns if needed (to be included in the future).*

Please note that step 12 represents a vision for the future functions of the electronic data exchange between the school health system and provider and will not be included in the specification at this time. Inclusion of this function is not currently possible because nurses have email accounts that are separate from ASHR.

Fig. 1 depicts the UML diagram for the Use Case Scenario 1: Healthy Child to present interactions between actors in the work process and data exchange.

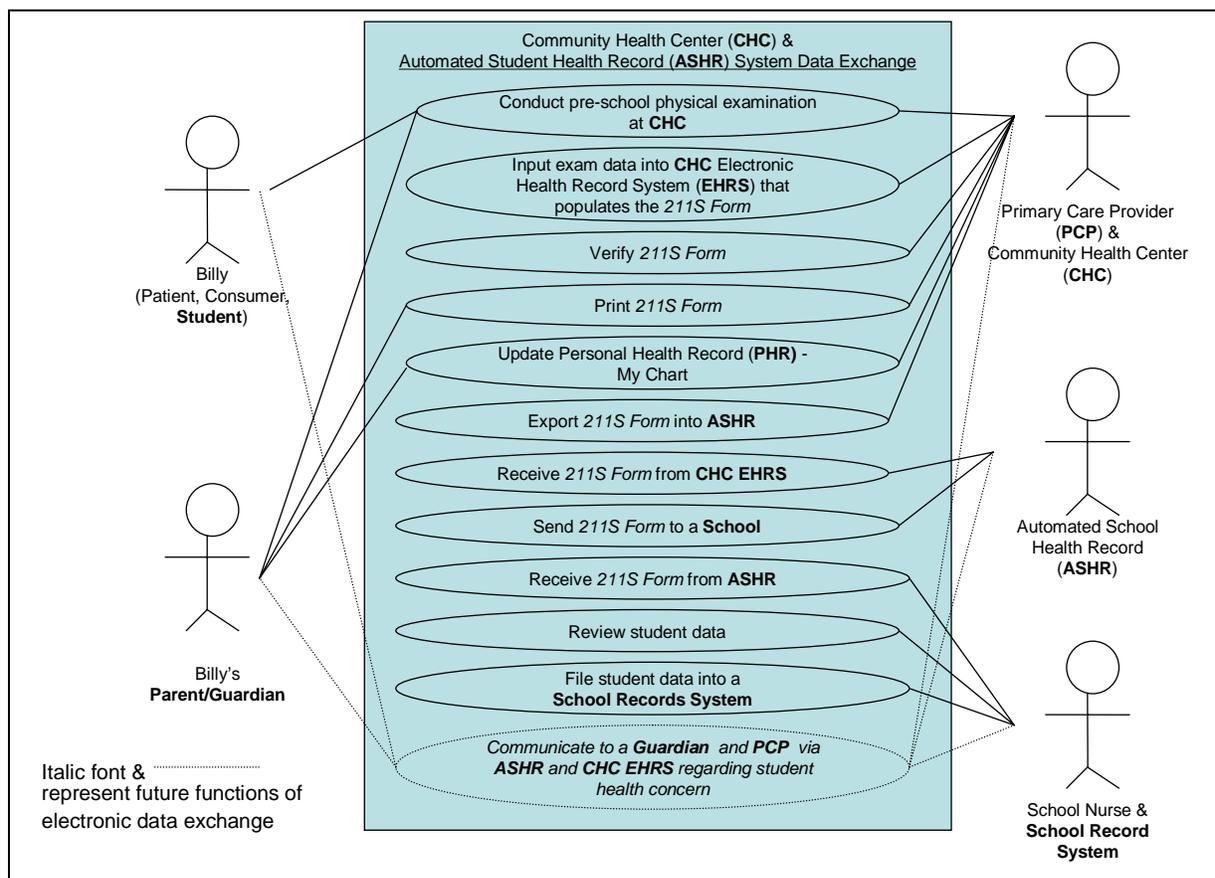


Fig.1. UML Use Case Diagram – Scenario 1: Healthy Child

Scenario 2: Child Has Asthma

1. Amy Smith is 5 years old. She is being seen at the same CHC as Billy. She is also a patient of Dr. Health. Amy visits Dr. Health today with her mother, Mrs. Smith, for her school physical examination. Dr. Health is aware that Amy was diagnosed with asthma several years ago. He has been Amy's primary care provider since she was diagnosed with asthma.
2. Dr. Health conducts an examination and confirms Amy's diagnosis of asthma. Amy will need to receive her albuterol medication in school.
3. Dr. Health inputs exam data into Amy's EHR in the CHC EHRS that automatically populates ASHR's 211S Form for Amy.
4. Dr. Healthy verifies Amy's 211S - Amy's diagnosis is automatically indicated on the 211S Form.
5. The ASHR's Request for Educational Services (RES) Form automatically appears on the screen. Dr. Health verifies Amy's RES Form.
6. The electronic Provision of Medically Prescribed Treatment: Parent/Guardian's Consent, Authorization and Release (Consent Form) in the CHC EHRS automatically appears on the screen after Dr. Health verifies the RES Form. Ms. Smith completes the electronic

Consent Form that authorizes treatment in school and sharing of information between Dr Health and BSH.

7. The ASHR's Multi-Use Medication Form – Medication Administration Form (MAF) automatically appears on the screen after Ms. Smith completes the Consent Form. Dr. Health verifies Amy's MUM Form.
8. Dr. Health prints hard copies of Amy's 211S, RES and MUM Forms and the Consent Form for Amy's parents paper records (upon the request from Mrs. Smith).
9. Dr. Health updates Amy's Personal Health Record – My Chart.
10. Dr. Health submits Amy's 211S, RES and MUM Forms and the Consent Form to ASHR.
11. ASHR receives Amy's forms (211S, RES and MUM Forms and the Consent Form).
12. ASHR appends Amy's forms (211S, RES and MUM Forms and the Consent Form) to the her school profile .
13. The school nurse (Ms. Care) receives Amy's form from ASHR: 211S, RES and MUM Forms and the Consent Form.
14. Ms. Care reviews the forms and stores Amy's data in the School's Special Needs Database.
15. Ms. Care administers albuterol medication to Amy as prescribed by Dr. Health on the ASHR's MUM Form.
16. Ms. Care updates Amy's record in the School's Special Needs Database.
17. *Ms. Care submits Amy's record to the CHC EHRS via ASHR.*
18. *Dr. Health reviews Amy record in ASHR to monitor medication administration and Amy's conditions in school and provide recommendations to Ms. Care and Amy's parent/guardian as needed.*

Please note that steps 17 & 18 represents the vision for the future functions of the by-directional electronic data exchange between the school health system and provider.

Fig. 2 depicts interactions between actors in the work process and data exchange as it relates to the Scenario 2: Child Has Asthma.

e. Functions to be supported by data exchange

The EHR-PH electronic data exchange will support the following functions:

Clinical Setting: Primary Care Provider

1. Complete forms related to school health for reporting to a public health agency's program, i.e., BSH.
2. Electronically submit forms to a public health program's system, i.e., BSH's ASHR System.
3. *Electronically receive data on an individual patient with special needs from ASHR regarding direct health services provided by a school nurse.*
4. *Electronically communicate with a school nurse regarding course of treatment.*

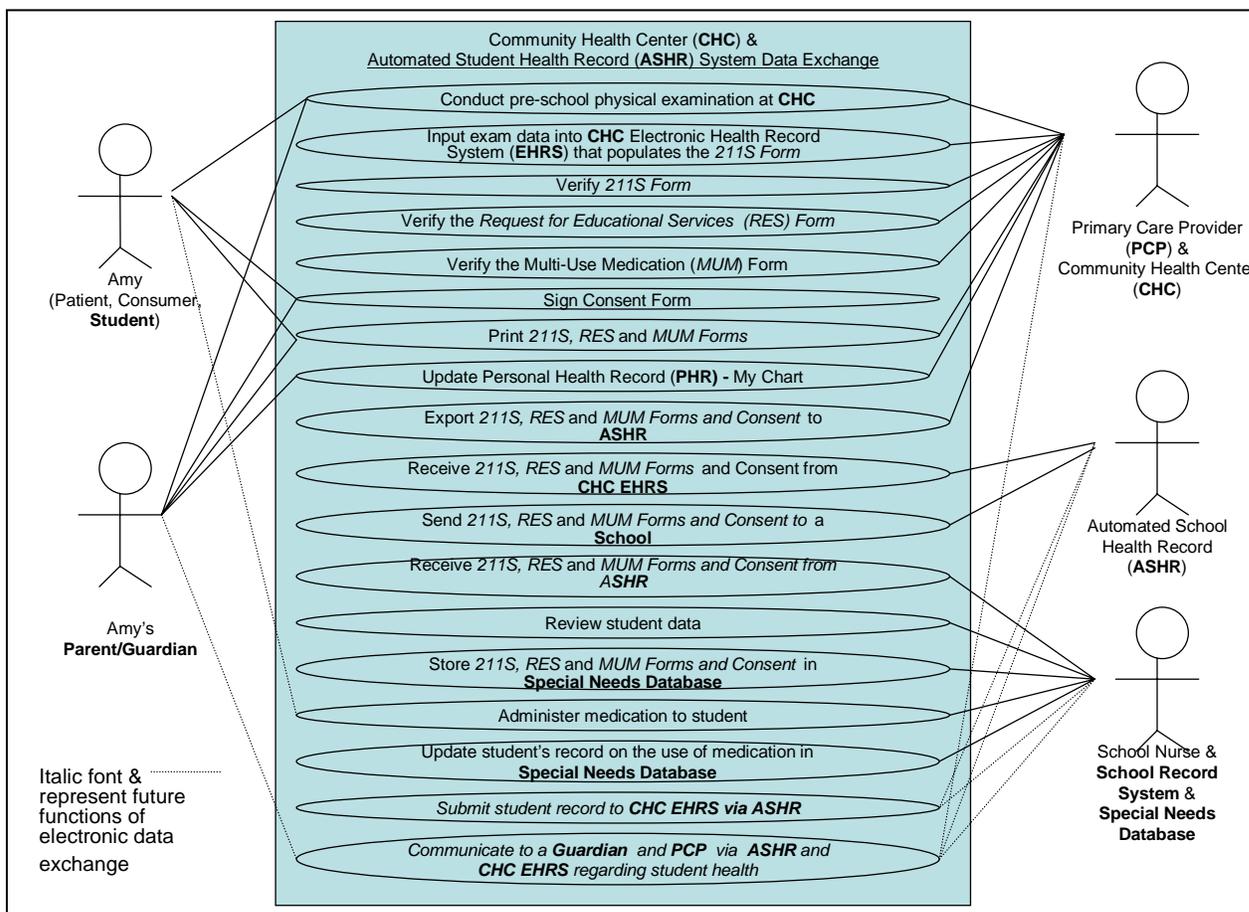


Fig.2. UML Use Case Diagram – Scenario 2: Child Has Asthma

BSH – ASHR System

5. Electronically receive 211S and special needs forms, as needed, from a provider's EHR.
6. Electronically submit 211S and special needs forms, as needed, to an individual school health record system.
7. *Provide communication channels to report data on direct healthcare services provided by a school nurse to a student as prescribed by a provider back to the provider's EHR.*

School Nurse

8. Electronically receive 211S and special needs forms, as needed, from ASHR.
9. Electronically update a student's record in a school's Special Needs Database regarding direct health procedures administered in school as prescribed by a provider, i.e., administering medication to a child with asthma.
10. *Submit student data regarding direct health procedures administered in school as prescribed by a provider, i.e., administering medication to a child with asthma, to the provider's EHR via ASHR.*
11. *Receive directions for child care from a provider via ASHR.*

Please note that functions 3,4,7, 10 and 11 related to by-directional electronic communication between a school nurse and a provider are not included in the functional requirements at this time.

f. Data sources included in data exchange

The following data sources are included in the electronic data exchange:

ASHR System, BSH, DOHMH:

1. New Admission Examination Form (211S)
2. Request for Educational Services Form (RES)
3. Multi-Use Medication Form – Medication Administration Form (for students with chronic conditions – case of Asthma) (MUM)

Community Health Center's EHRS

4. EHR
5. Personal Health Record (My Chart)

Parent/Guardian

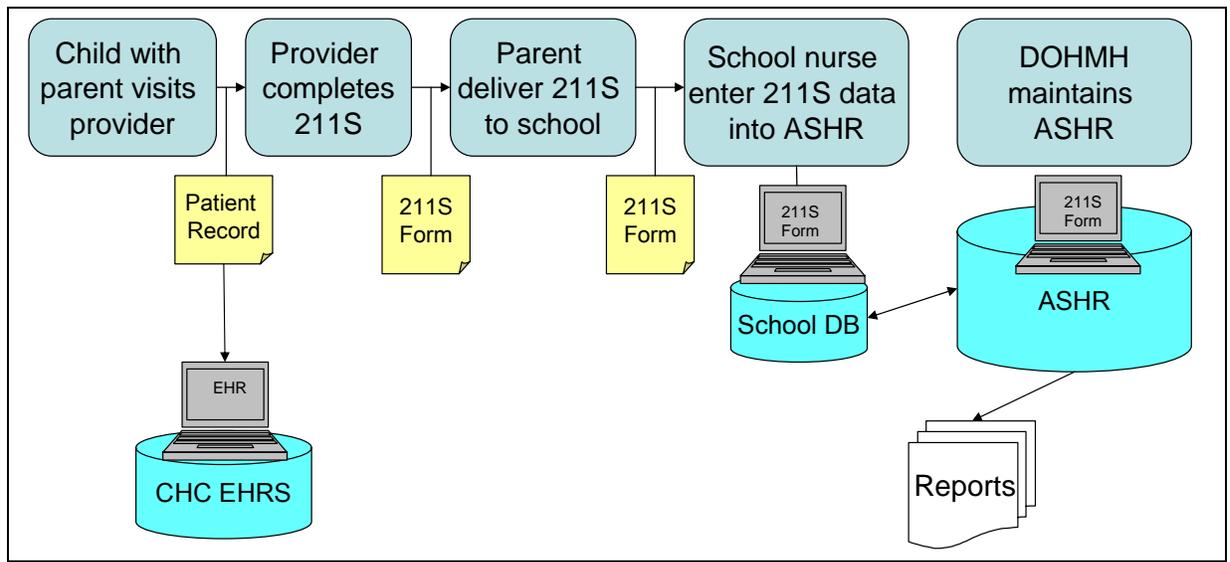
6. Provision of Medically Prescribed Treatment: Parent/Guardian's Consent, Authorization and Release

Please see Attachment 1 for the form inventory.

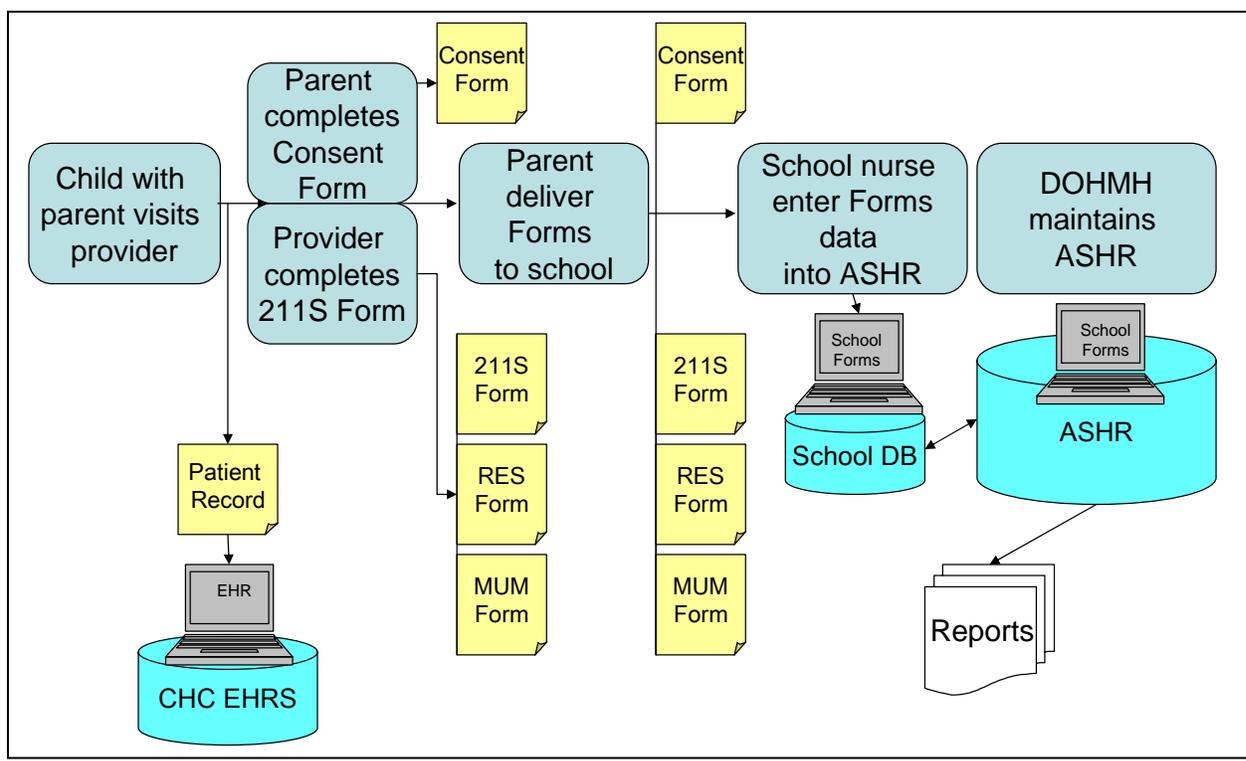
g. Description of the workflow and dataflow used to support the data exchange

Currently most paper forms are brought by a parent/caregiver from a provider office to a school nurse or official. Patient visit data is entered in a patient database at every clinical setting and data from the school health forms is entered into ASHR at each school. These duplicative data entry activities cause errors and inefficient use of resources. Currently clinical settings deploy customized patient data systems that utilize their own data formats, vocabularies, and often software products and cannot be interoperable to transmit data across these systems. Fig.3 presents the current work flow and data flow for data reporting from clinical setting (CHC's provider) to a school system (BSH' ASHR System).

EHR-PH systems will enable electronic data transmission from a provider office to ASHR via a Web-based interface. Data entry will be done once at the point of data generation, i.e., clinical setting, where EHR system will be installed. The school nurse will be able to focus on programmatic activities, e.g., case management, care coordination, health education for prevention, and not data management activities. Systems across providers and ASHR will be interoperable because they will utilize standardized data formats and vocabularies, messaging standards and software products that support interoperable EHR systems. Fig. 4 represents the proposed high level schema for electronic data exchange between CHC EHRS and ASHR system.



a



b

Fig.3. School Health: Current Work Flow and Data Flow Model:
a – Scenario 1: Healthy Child; b - Scenario 2: Child Has Asthma

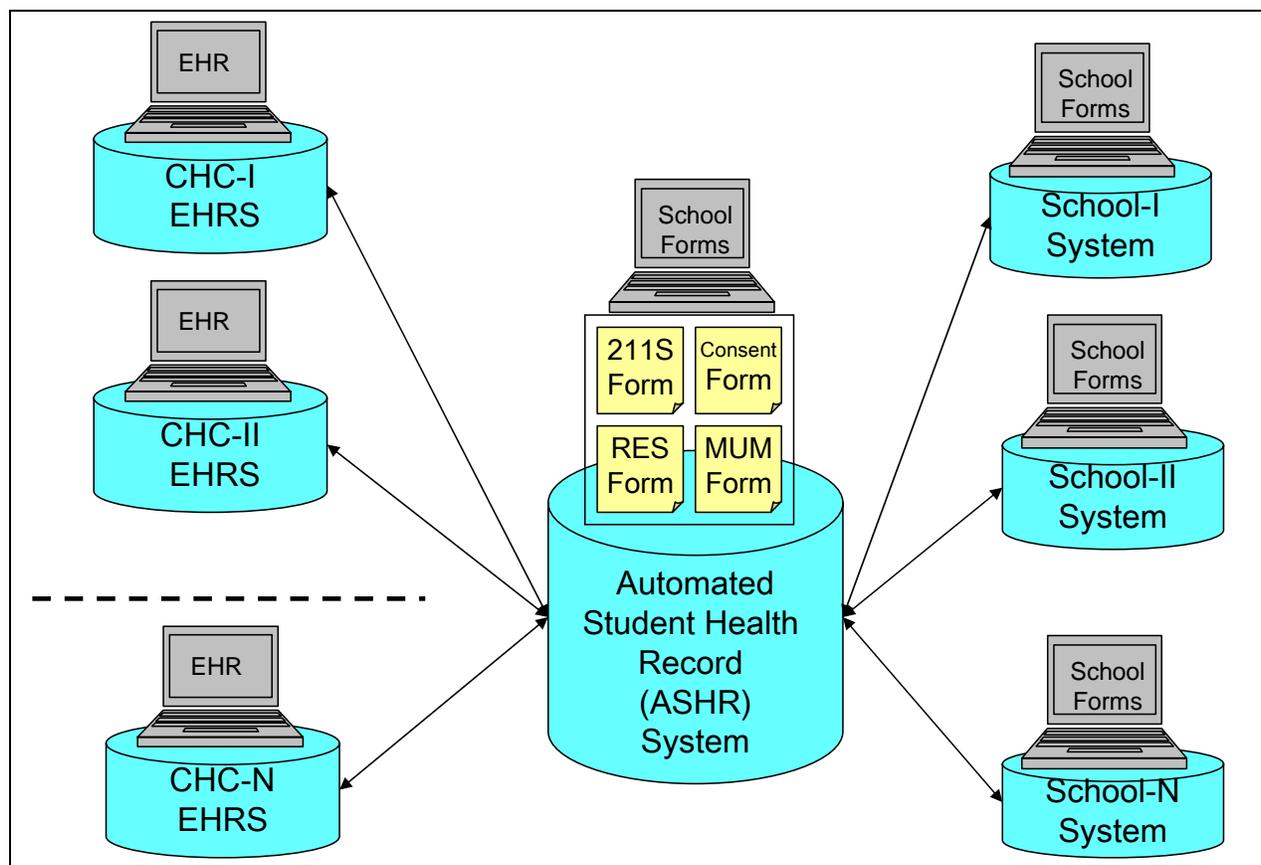


Fig.4. High Level Schema for Electronic Data Exchange between Community Health Centers and School System.

h. List of data elements to be exchanged

A list of data elements (fields) needed for the electronic data exchange between EHRs and ASHR is limited to those on the 211S Form. Cross-mapping of data elements across 211S, Request for Educational Services and Multi-Use Medication Forms (for students with chronic conditions – case of asthma) to the CHC’s EPIC™ EHR and the Personal Health Record (My Chart) will be conducted by the BSH staff.

i. Standards needed to support the data exchange, issues in the implementation of the standards, implications for standards bodies and others that might fill identified gaps.

The Healthcare Information Technology Standards Panel (HITSP, Panel)[6], established in September 2005 under the standards harmonization contract from the DHHS Office of National Coordinator for Health Information Technology, identified the following categories of standards:

- Vocabulary and terminology standards (e.g., SNOMED [17], LOINC [18], HL7 [19], X12 [20], NCPDP [21], CCR [22]; Personal Health Record [23])

- Content standards (e.g., HL7 Reference Information Model (RIM))
- Information exchange standards (e.g., HL7)
- Identifier standards (e.g., National Provider Identifier, Master Patient Index)
- Privacy standards (HIPAA guidelines)
- Functional standards (e.g., HL7 EHR Functional Model [24])

All these categories of standards are needed to be considered in the standards pool for the EHR-PH school health electronic data exchange.

Efforts are needed to identify specific standards to support school health electronic data exchanges. For example, the functional requirement specification developed under this project can inform the development of the functional standard for the school health electronic data exchange. The HITSP standards harmonization methodology can be used in harmonizing standards that are currently used by the ASHR and the CHC EHRS with nationally recognized standards relevant to this domain. Standards harmonization includes (1) the assessment of gaps and overlaps across existing standards maintained by the standards development organizations, (2) development of new standards as needed and synchronization of identified duplicative standards; (3) development of the implementation guides for implementing harmonized standards.

Currently, the HITSP work is focused on the three domains (use cases) as follows: Biosurveillance; Consumer Empowerment (Personal Health Record) (focus on patient registration and medication history); and Electronic Health Record (focus on laboratory data reporting to a provider and interpretation). The HITSP Consumer Empowerment use case standards can be directly relevant to the school health data exchange within the scope of this project, e.g., student registration and medication information exchange between EHRS and ASHR.

To assure interoperability of the proposed system with the future electronic data exchanges in NYC, the development of the EHR-PH exchanges under this specification should be conducted in close coordination with HITSP standard harmonization work.

j. Process issues encountered (e.g., privacy/security procedures, projects steps, timeline and deliverable)

Protecting Patient's Privacy in Electronic Data Exchange

The NYC DOHMH practices require minimization of privacy risks to persons and institutions involved in the electronic data exchange²². Special considerations must be given to protecting student' health information related to school health electronic data exchange as follows.

Currently, unless parent/guardian requests otherwise, consent for information disclosure on the child's health status on the paper 211S Form is implied. Parent/guardian may ask provider not to include certain information on the paper 211S Form. In electronic data exchange, specific checks can be built into EHRS prompting parent's authorization to populate 211S Form and to transmit it to ASHR.

For a child with the need for special direct health and educational services a parent/guardian has to sign the appropriate consent forms (Attachment 1) that he/she currently has to bring to the school with other forms as follows:

- Provision of Medically Prescribed Treatment: Parent/Guardian Consent, Authorization and Release. *Please note that this form will be included in this specification as it is related to the asthma medication administration.*
- Monitoring Blood Sugar and Dietary Needs: Parent/Guardian Consent, Authorization and Release. *Please note that this form is not included in this specification as it is for children with diabetes only.*

Electronic parental consents must be built into the EHRS authorizing the submission of the forms to request in school services.

Considerations must be given to secure electronic communication of student's health data from school nurse back to PCP including information on in school services. Currently, under Family Educational Rights and Privacy Act (FERPA) [25] no information can be release from school without parental consent. So, the EHRS must include parental consent for information exchange between school nurse and PCP related to administering in school services and/or in school acute care episodes.

With respect to adolescent care, the following privacy protection measures must be considered. Currently, mental health and reproductive care services are not provided in school and are not required to be recorded in school health records. In addition to mental health and reproductive care, substance (both legal and illegal) use/abuse is another issue that needs to be addressed in the development of the electronic data sharing capabilities. Protection of information release to ASHR on these services from patient's EHR should be built in EHRS unless otherwise requested by a student.

In general, efforts will be made to limit access to individual student information in EHRS-ASHR data exchange to authorized users, e.g., parent/guardian, PCP, school nurse, student at appropriate age.

Considerations must be given to protect privacy of individual's health information if it is used in AHSR for aggregated data analysis for public health surveillance. Only de-identified data can be used for these purposes. Consideration of informing parents and students regarding possible use of individual's information for public health surveillance purposes is needed during the initial consent process.

Lastly, harmonization of state and local policies is needed to enable electronic health information exchange related to school health. For example, the NYC law requires physical examination for **all** children entering the public school system but the NY State law does not allow excluding a child from the school system if the physical exam is not done. Additional efforts are needed to examine local and state policies that may impact electronic school health data exchange.

Data agreements for electronic data exchanges across participants will be developed to assure measures to protect privacy and confidentiality of individual records.

System Development Steps, Deliverables and Timeline

In order to enable electronic data exchange between the CHC EHRS and ASHR, the following phases in the system development processes are needed to be completed:

- *System Design Phase (Months: 1-3)*
- *System Development Phase (Months: 4-12)*
- *System Implementation Phase I (Months: 12-18)*
- *System Implementation Phase II (Months: 19-24)*

Please see examples of system development steps, deliverables and project timeline in the Attachment 2.

The development of the EHR-PH data exchanges under this project should to be consistent with the national NHIN development activities including standards harmonization, EHRS certification, assessment of the state privacy and security regulation and business practices related to electronic health information exchanges, and NHIN prototypes development.

EHR-PH SYSTEM FUNCTIONAL REQUIREMENTS SPECIFICATION:
NEW YORK CITY SYNDROMIC SURVEILLANCE SYSTEM

“The New York City DOHMH has established a syndromic surveillance system that monitors emergency department visits to detect disease outbreaks. Routinely collected chief complaint information is transmitted electronically to the health department daily and analyzed for temporal and spatial aberration. Respiratory, fever, diarrhea, and vomiting are the key syndromes analyzed. Statistically significant aberrations or “signals” are investigated to determine their public health importance.”[11]

Currently, the NYC syndromic surveillance system (NYC SSS) enables the electronic transmission of data from hospitals emergency departments. The vision is to expand NYC SSS capabilities by including electronic data exchanges between NYC SSS and ambulatory care (CHCs) and laboratories within DOHMH jurisdiction to support public health response activities. These activities include the following five phases:

- Phase 1: Detect a public health threat event
- Phase 2: Monitor the event
- Phase 3: Manage public health response activities
- Phase 4: Evaluate response activities
- Phase 5: Improve response activities as needed

This document is focused on the Phase 1: Detect a public health threat event.

a. Goals of the electronic data exchange

The goals of the EHR-based electronic data/information exchange is (1) to maximize public health agency’s capacities to detect a public health threat event via analyzing real-time electronic data on an individual patient from a community health center’s providers, hospital emergency departments and laboratories by the agency’s syndromic surveillance system and (2) to enhance the ability of clinicians and public health staff to respond to such threats appropriately.

b. Participants in electronic data exchange (Actors)

The following stakeholders (actors) will participate in the electronic data exchange:

- NYC DOHMH Syndromic Surveillance System staff
- Health Care Providers
 - Ambulatory settings (Community Health Centers)
 - Hospital Emergency Departments
- Laboratories (public health laboratory or private laboratories) staff

c. Benefit of electronic data exchange by stakeholder

Electronic data exchange via NYC SSS provides the following benefits to stakeholders:

NYC DOHMH Syndromic Surveillance System

- eliminate manual entry of data from paper forms received from providers on reportable conditions
- access patient visit data on suspicious symptoms (e.g., cough, fever, etc.) and presumptive diagnosis in real-time to detect a suspicious event.
- communicate with providers on clinical decision support issues to help event detection such as:
 - send notifications to providers regarding suspicious patterns of public health threat events in their community, e.g., increased number of cases with similar symptoms
 - send instructions/requests to providers to activate certain procedures determined by the public health response protocol, e.g., activate certain lab tests, ask certain questions during the visit
- receive additional clinical data in real time to help identify the nature of the event, e.g. lab results, questionnaire data, etc.
- send health alerts to providers regarding the detected event via electronic means
- notify higher public health authorities, responders and authorities of the neighboring jurisdictions regarding the detected event via electronic means.

Health Care Providers (ambulatory settings and hospital emergency departments)

- support clinical decision processes by:
 - accessing community-level information on potential public health threat events, e.g., increased number of cases with similar symptoms
 - receiving instructions/requests to activate certain procedures determined by the public health response protocol, e.g., activate certain lab tests, ask certain questions during the visit
 - receiving notifications about suspected event and health alerts in real time
- increase productivity of providers by eliminating manual completion of paper forms for public health reporting and
- improve communication with public health agency and clinicians as responders regarding the event detection and response activities

Laboratory

- increase productivity of laboratory staff by eliminating manual completion of paper forms for public health reporting and
- improve communication with provider, public health agency and responders regarding the event detection and response activities

d. Use case description

The section below describes the influenza-like illness clinical scenario. Other clinical conditions will have different workflow/dataflow scenarios.

1. Patient visits care setting (ambulatory or emergency room) with certain symptoms, e.g., fever, cough, etc.
2. Provider conducts an exam.
3. Provider staff enters exam data (symptoms, diagnosis, medication prescriptions, etc.) into the Electronic Health Record System (EHRS).
4. EHRS submits or NYC SSS staff retrieves / mines data on symptoms, diagnosis, medication prescriptions, etc. from EHRS.
5. NYC SSS staff analyzes data from multiple EHRs.
6. NYC SSS staff investigates suspected cases to establish a pattern.
7. NYC SSS staff notifies providers via phone and electronic means about the suspected pattern, e.g. increased number of similar cases across the area.
8. NYC SSS staff sends instructions to providers to activate specific procedure(s) to verify the event and to determine the cause of the event, e.g., order a laboratory test.
9. Provider orders procedure(s) following NYC SSS instructions, e.g. lab tests.
10. Laboratory staff analyzes the specimen and enters result data in the Laboratory Information Management Systems (LIMS).
11. LIMS staff submits to NYC SSS or NYC SSS staff retrieves / mines data from LIMS.
12. NYC SSS staff analyzes additional data and confirms the event.
13. NYC SSS sends health alerts regarding the detected event to providers, higher public health authorities and neighboring jurisdictions as determine by the event detection protocol.

Fig. 6 depicts interactions between actors in the work process and data exchange as it relates to the Event Detection Phase under the NYC SSS.

e. Functions to be supported by electronic data exchange

The EHR-PH electronic data exchange will support the following functions:

NYC SSS

1. Electronically daily receive/retrieve/mine individual patient data from clinical settings (ambulatory settings and hospital emergency departments) EHRs. This includes data on symptoms, diagnosis, medication prescriptions, etc..
2. Support event detection algorithms.
3. Analyze individual patient data across providers to establish pattern of suspected public's health threat event as needed.
4. Generate daily community health status assessments.
5. Provide electronic access for providers to the daily community health status assessments.
6. Electronically notify providers regarding the suspected pattern as needed.
7. Electronically send instructions to providers to activate specific procedures to help determine the nature of the suspected pattern, e.g., order specific lab tests, ask certain questions during the exam.

8. Electronically daily receive additional data related to the activated specific procedures, e.g., laboratory data, data from questionnaires administered by providers, etc..
9. Electronically send health alerts to providers regarding the detected event.
10. Electronically communicate with higher public health authorities (state, federal) regarding the suspicious pattern and detected event as determined by the public health response protocols.
11. Electronically send health alerts to responders and to the authorities of neighboring jurisdictions regarding the detected event as determined by the public health response protocols.

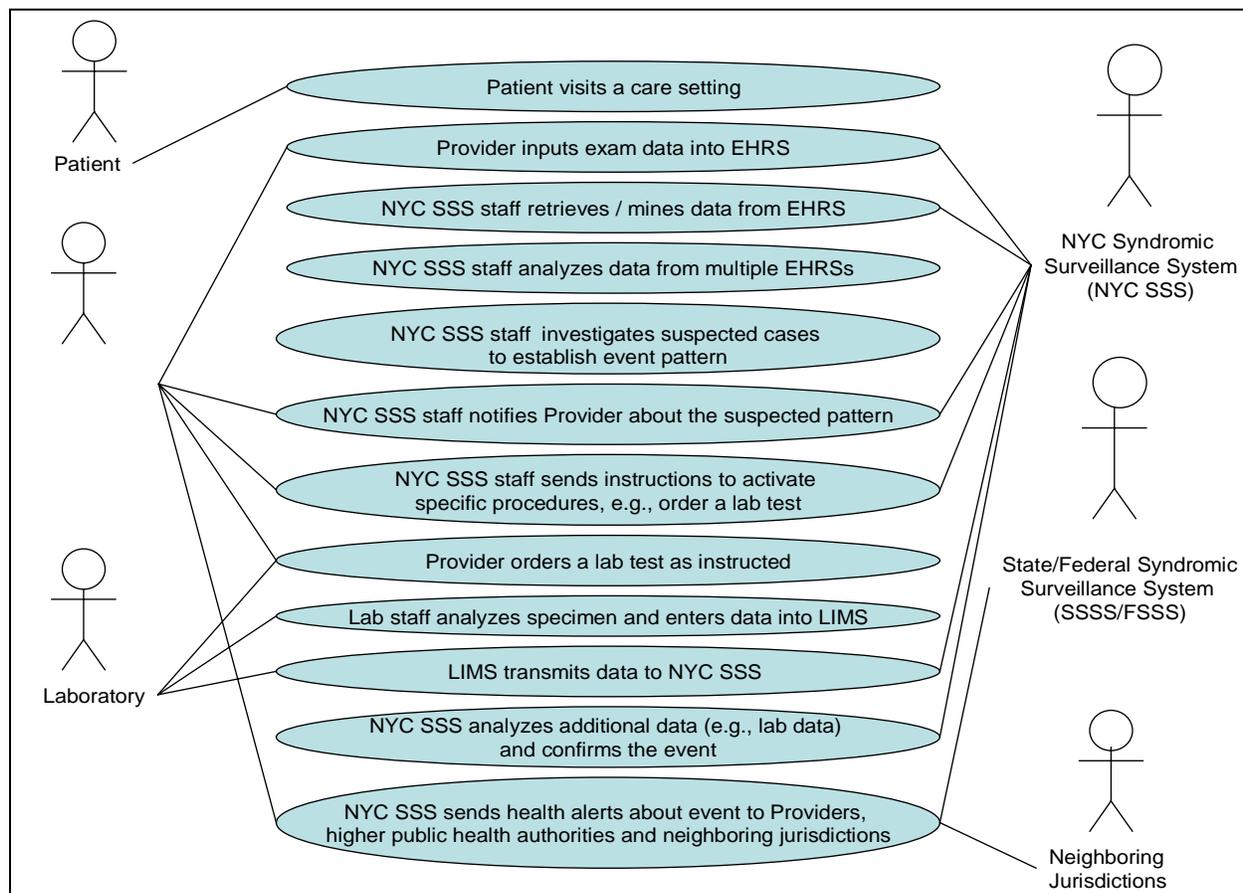


Fig.6. UML Use Case Diagram for Syndromic Surveillance System: Event Detection

Health Care Provider (ambulatory care and hospital emergency departments)

12. Support electronic reporting of individual patient data to NYC SSS.
13. Inform clinical decision-support by receiving the following information from the NYC SSS:
 - aggregated data on the health status of the community
 - notifications on a suspicious event
 - instructions to activate certain procedures related to the detection of the public 's health threat event as determined by the public health response protocols

- health alerts regarding a detected public's health threat event

Laboratory

14. Support electronic reporting of laboratory results data to providers and NYC SSS.
15. Electronically receive instructions from NYC SSS activate certain procedures that include laboratory testing.
16. Electronically receive health alerts regarding a detected public's health threat event.

f. Data sources included in electronic data exchange

The following data sources are included in the NYC SSS:

Health Care Provider (ambulatory settings):

EHRs

Health Care Provider (hospital emergency department):

EHRs and/or Chief Complaint Data

Laboratory:

NYC DOHMH Lab Data Reporting Forms

NYS SSS:

Suspected Event Notification Forms
 Detected Event Notification Forms
 Health Alert Forms

g. Description of the workflow and dataflow used to support electronic data exchange

Fig.7 presents the example of the work flow and data flow for NYC SSS electronic data exchange. Numbers on the diagram correspond with the Use Case steps order number.

h. List of data elements to be exchanged

The specific data elements to be exchanged will be determined based on the selected event scenario, e.g., flu, GT illness, etc.

i. Standards needed to support the data exchange, issues in the implementation of the standards, implications for standards bodies and others that might fill identified gaps.

As described in the section on standards in the School Health chapter above, the HITSP efforts are underway to determine standards for the Biosurveillance Use Case. Over 570 standards have been identified to date by HITSP that are relevant to Biosurveillance in general. They include 180 standards needed to support the scope of the Use Case. These standards should be considered for the scope of the electronic data exchange for the event detection phase under the NYC SSS. In addition, standards identified by the HITSP EHR Use Case that focuses on

laboratory data reporting, should be considered. The selection of standards to support NYC SSS electronic data exchanges should be conducted in coordination with the HITSP process.

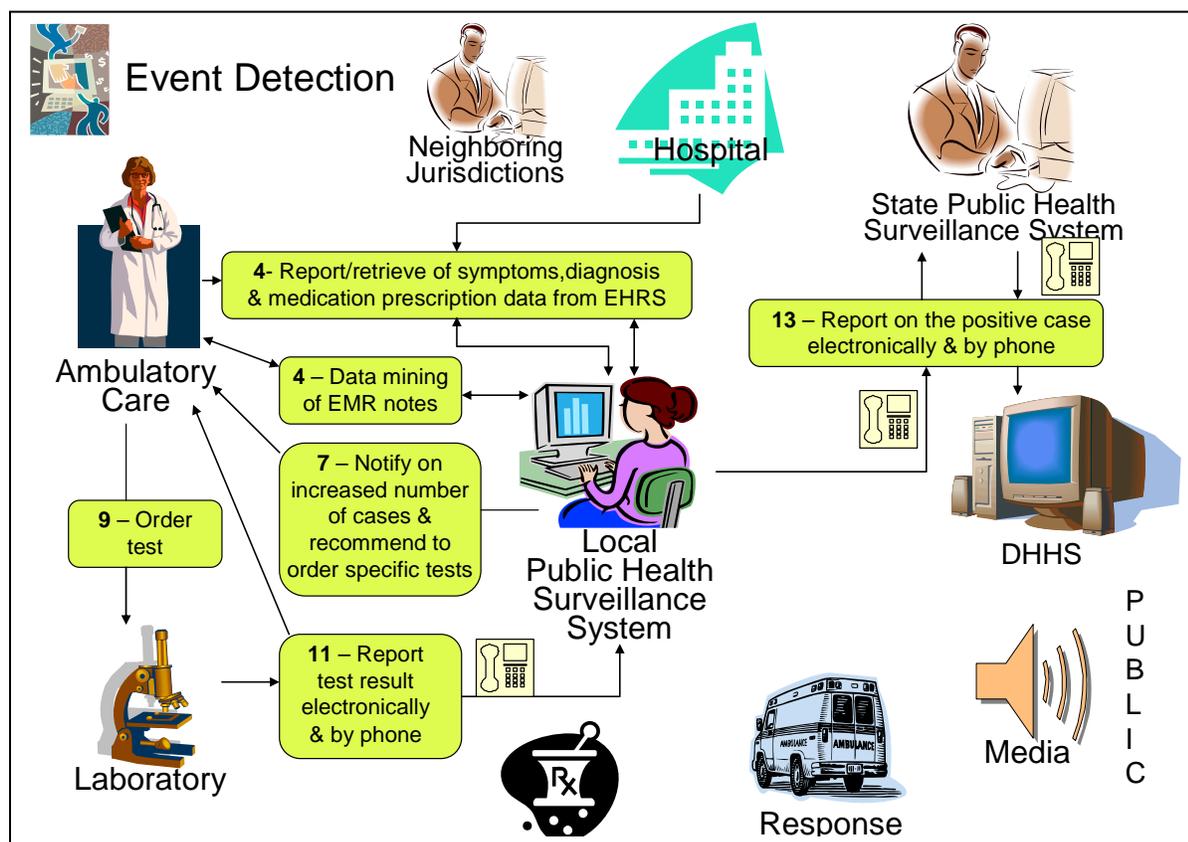


Fig. 7. Examples of EHR data exchange under the NYC SSS

j. Process issues encountered (e.g., privacy/security procedures, project steps, timeline and deliverables)

The individual patient data to be exchanged in electronic communications between providers (ambulatory care and hospital emergency departments), laboratory and NYC SSS will include patient identifiers or will be de-identified (pseudonymized) as determined by legal reporting requirements in the State of New York. Only patient ***de-identified*** data will be exchanged in electronic communications between NYC SSS and state health agency and DHHS and other governmental agencies. Privacy and security standards to be identified by the HITSP process should be considered for the system.

Data agreements for electronic data exchanges across participants will be developed.

System Development Steps, Deliverables and Timeline

In order to enable electronic data exchange between the CHC EHR and ASHR, the following phases in the system development processes are needed to be completed:

- System Design Phase (Months: 1-3)
- System Development Phase (Months: 4-12)
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- System Implementation Phase II (Months: 19-24)

Please see examples of system development steps, deliverables and project timeline in the Attachment 2.

The development of the EHR-PH data exchanges under this project should to be consistent with the national NHIN development activities including standards harmonization, EHRS certification, assessment of the state privacy and security regulation and business practices related to electronic health information exchanges, and NHIN prototypes development.

DISCUSSION

Enabling Electronic EHR-PH Data Exchanges – A Need for a Functional Requirement Standards

The benefits of electronic data exchanges across clinical and public health settings via EHRS had been described in various sources. Specifically, for the examples presented in this report they include the ability to:

- (a) reduce redundancy of completion of numerous data forms by providers and patients and therefore help save time for the patient/provider direct communication and increase the effectiveness of patient care and satisfaction with healthcare services,
- (b) improve data quality and comparability of data across systems due to elimination of multiple manual data entry points and therefore help reduce errors, improve patient safety and allow for longitudinal and cross-sectional data comparison,
- (c) exchange information by both providers and public health staff in a timely fashion to support clinical and public health decision support and therefore improve care coordination, public health response and safe lives,
- (d) conduct comprehensive population health assessments to detect trends in health status of the communities and guide the development of disease and public health threat prevention interventions,
- (e) assess resource utilization and guide the planning process for resources allocation for service delivery and coordination, and budgeting for programs and services,
- (f) serve as data warehouse for clinical and public health research to identify best practices and support knowledge transfer.

The functional specification is a necessary vehicle to assure that these benefits of the EHR-PH electronic data exchange are well understood and agreed upon across end users (clinicians and public health practitioners) and communicated clearly to the developers as functional requirements for the EHR-based interoperable clinical and public health systems.

The HITSP standard harmonization process entails the synchronization and further development of various standards and their implementation guides. The earlier focus of standards

development was on terminology, messaging and infrastructure standards. The critical need now is to begin the process of standardization of functional requirements (workflow/work processes) across EHRS-based exchange participants. Neglecting the standardization of functional requirements may result in inability to successfully utilize standards in EHRS and EHR-PH systems. Standard is not a product that exists by itself and somehow will be used. Standard is a process as well as. Successful implementation of the standard requires the standardization of the process of how the standard will be used in the context of end user functions.

The HL7 EHR functional model was the first attempt to begin this process. However, the removal of care settings (end users) from the model made it too generic to be viewed as a basis for the functional specification requirements which by definition requires **end users** to state the functions that the system will support as these functions relate to the user's work.

While we have invested in the development of data and terminology standards, guidelines for data collection, e.g., immunization schedule, screening guidelines etc., and standards for data analysis (laboratory and statistical), we are lacking data and information management guidelines that will allow for meaningful use of data we are collecting. The functional specification will serve as a basis for the standardization of data and information management activities as applicable to a specific domain of interest as it will describe how data are generated, used and exchanged in the context of user's daily activities (functions). Harmonization of functional requirements across application domains will lead to the development of functional standards.

Proposed Approach for Developing Functional Standard

We provided a description of examples of the electronic data exchange between clinical settings and public health agency's programs as functional requirements specifications for two public health application domains: school health and syndromic surveillance. These two examples of specifications were developed in the format of the Requirement Analysis Document - RAD - the key product of the requirement elicitation process for the information system design.

The goal of the requirement elicitation is to explain end user perspectives on the system to developers in order to guide the information system design and development. While the need for requirement elicitation process and RAD document is well understood by developers, end users are often lacking an understanding of the requirement elicitation process itself, the critical value of the RAD for the successful software product, the RAD's content, and more importantly their key role in RAD development.

RAD is the work statement that developer expects from user to begin designing an information system. Many information systems had failed because developers never received the RAD statement from users or developed it themselves. The RAD is the main step in the system design process as it states user needs for the system. And it is the user's (not developer's) responsibility to describe these needs in the language and format that developer can understand as the developer has usually minimal or no knowledge about the application domain for the system he will build. Without RAD written by user, the information system cannot be built.

We demonstrated that the RAD format can be successfully used to describe work processes and interactions between participants in the selected two public health domains. These domains serve

very distinct purposes such as routine healthcare management (school health) and response activities to a public's health threat event (syndromic surveillance system). However, both domains have a lot of commonalities with regard to using health information technology (HIT) for electronic data exchanges between participants. In both examples, patient's visit to a provider became a starting point (trigger) in data generation activities, data to be exchanged were recorded/stored in patient's medical record, communications/interactions between clinical and public health settings were needed to serve individual patient's and community needs, these communication channels were already in place even though they were based on data exchanges via paper forms, phone and fax. Built on commonalities between two domains, the RAD format provided an organized way to describe user's work processes that the system must support for the selected examples in a user's (lay) language but in the format that developers are familiar with.

We believe that the same approach can be used to describe electronic data exchanges between clinical settings and public health agency in other public health domains (e.g., communicable disease reporting, immunization, chronic disease care, etc.) as work process/workflow that support these exchange are similar, e.g., patient comes to see provider, provider records visit data in the patient's medical record, provider reports clinical data on a certain paper form to a certain public health program, public health practitioner communicates with clinician on care coordination, etc..

Public health domains/programs work processes for electronic data exchanges with clinical care described in the RAD format will help to see commonalities between these domains/programs. Clinical data reporting to multiple public health programs on multiple data forms could be replaced to enable simultaneous dataflow from a provider to multiple public health systems. Aggregated population health data can be accessible for providers through the EHR-PH system connectivity.

HITSP identified functional standard (workflow/process standard) as a separate category of standards for system interoperability. With functional standard, the EHR-PH data exchange developed at one clinical setting could be reproduced at other settings. *We propose to view these two examples of functional requirement specifications in a RAD format as prototypes of functional standards (workflow/process standards) for EHR-PH systems for the selected domains.*

While other standards are developed by standard development organizations, functional standards are needed to be developed by users with first hand understanding of the environment in which the system will operate. This poses a new task on users. Both clinicians and public health practitioners have to be able to describe their work processes that the system needs to support in a way that developer will understand. RAD provides a framework that developers are already familiar with. Users need to learn how to participate in the requirement elicitation process and RAD development. *We propose to include the RAD development training in the public health informatics curriculum to enable public health practitioners to participate in the system design process.*

Generalizability

The two RAD specifications were developed based on the example of one clinical site (NYC CHC) and one local health department (NYC DOHMH). We believe that they can be used to guide the development of electronic data exchanges between other CHCs in NYC and DOHMH, other NYC providers (e.g., ambulatory care and hospitals) and DOHMH, and providers and public health agencies in other jurisdictions. Validation of the developed specifications is needed by stakeholders, i.e., school health program staff, public health staff from other public health agencies, clinical community and vendors, to build a consensus on the functional requirements for the EHRS-based data exchanges within these two application domains.

The validation can be conducted via in-person working meeting of a Panel of stakeholder representatives. The developed specification will be reviewed by the Panel members during the meeting. The Panel recommendations can be presented in the report. The report can serve as a basis for a publication in a peer-reviewed journal to disseminate information about the EHR-PH functional standard to a broader audience.

CONCLUSION

To facilitate the development of a functional standard for the EHR-PH systems interoperability the following steps are proposed for the following year:

1. Conduct validation of the two examples of the functional requirements specifications developed under this project (school health and syndromic surveillance) by relevant public health agencies programs staff and clinicians to build a consensus on the format and content of the requirements specification for these two domains.
2. Invite EHR vendors to participate in the validation process to educate them about public health needs for the EHR-based data exchange.
3. Based on the validation process and vendor input develop a consensus-based, functional specification requirements in the format of the Requirement Analysis Document for the EHR-based data exchange in school health and syndromic surveillance.
4. Communicate to the healthcare community the need for inclusion of these two RADs (school health and syndromic surveillance) in the functional standards for the EHRS and the EHR certification process.
5. Review state policies for the electronic data exchanges applicable to the two selected domains. This work can be done through the ongoing contract on Privacy from the Agency for Healthcare Research and Quality's (AHRQ) to the Research Technology Institute (RTI).
6. Work with other interested public health agencies (local, state and federal), clinicians and vendors to develop functional specification standards for other public health programs (application domains).

REFERENCES:

1. Bruegge B. and Dutoit A.H. Object-Oriented Software Engineering. Pearson prentice Hall. Upper Saddle River, NJ. 2nd edition: 707-750.
2. Public Health Data Standards Consortium. Response to the Request for Information on the Development and Adoption of a National Health Information Network from the Office of National Coordinator for Health Information Technology, Department of Health and Human Services; Released on November 15, 2004. Baltimore, MD, January 18, 2005:31p. plus Attachment. URL: http://phdatastandards.info/././knowresources/papers/docsandpdfs/PHDSC_Response_RFI.pdf
3. Key capabilities of an Electronic Health Record System. Institute of Medicine. Letter Report. July 31, 2003. URL: <http://www.iom.edu/report.asp?id=14391>
4. Public Health Data Standards Consortium. 2004. Pediatric Electronic Health Record-Public Health Perspectives. Report to Health Resources and Services Administration, December: 38p. plus 4 Attachments.
5. Orlova AO, Dunnagan M, Finitzo T, Higgins M, Watkins T, Tien A, Beales S. An electronic health record-public health (EHR-PH) system prototype for interoperability in 21st century healthcare systems. Am Med Inform Assoc. (AMIA), Annual Symposium, Proc., 2005.
6. American National Standards Institute. Healthcare Information Technology Standards Panel. URL: <http://www.ansi.org/hitsp>
7. Thompson TG and Brailer DJ. The decade of health information technology: delivering consumer-centric and information-rich health care. Framework for Strategic Action. Department of Health and Human Services. July 21, 2004.
8. U.S. Department of Health and Human Services. HHS Awards Contracts to Advance Nationwide Interoperable Health Information Technology. URL: <http://www.hhs.gov/news/press/2005pres/20051006a.html>
9. A collaboration to develop laboratory information management (LIM) system requirements. Public Health Informatics Institute, 2003, 4p.
10. Rumbaugh J, Jacobson I, Booch G. The unified modeling language reference manual, Reading, Massachusetts: Addison-Wesley, 1999, 23-39.
11. Heffernan R, Mostashari F, Das D. et.al. Syndromic Surveillance in Public Health Practice, New York City. Emerging Infectious Diseases, 2004:10(5): 858-864. URL: <http://www.cdc.gov/eid>
12. Dr. Neil Calman, The Institute for Urban Family Health, Personal Communications. September 30, 2005. Personal Communications.

13. New York City Department of Health and Mental Hygiene. Take Care New York Program. URL: <http://www.nyc.gov/html/doh/html/tcny/index.shtml>
14. New York City Department of Health and Mental Hygiene. School Health. URL: <http://www.nyc.gov/html/doh/html/scah/scah.shtml>
15. New York City Department of Health and Mental Hygiene. School Health. Guidelines for the Provision of Health and Educational Services for Students in the New York City Public Schools. URL: <http://www.nyc.gov/html/doh/html/scah/scah-medication.shtml>
16. New York City Department of Health and Mental Hygiene. Childhood Asthma Initiative. URL: <http://www.nyc.gov/html/doh/html/asthma/asthma.shtml>
17. SNOMED International. URL: <http://www.snomed.org>
18. Regenstrief Institute. Logical Observation Identifiers Names and Codes (LOINC®). URL: <http://www.regenstrief.org/loinc/>
19. Health Level Seven. URL: <http://www.hl7.org/EHR>
20. Accredited Standards Committee (ASC) X12. URL: <http://www.x12.org>
21. The National Council for Prescription Drug Programs, Inc. (NCPDP). URL: http://www.ncpdp.org/main_frame.htm
22. Continuity of Care Record (CCR). The Concept Paper of the CCR - Version 3. Medical records Institute. URL: <http://www.medrecinst.com/pages/about.asp?id=54>
23. Personal Health Record. American Health Information Management Association. URL: <http://www.myphr.com/faqs/index.asp>
24. Electronic Health Record. Health Level Seven. URL: <http://www.hl7.org/EHR>
25. Family Educational Rights and Privacy Act (FERPA). URL: <http://www.ed.gov/policy/gen/guid/fpco/ferpa/index.html>

Attachment 1. **Form Inventory**

#	Form Code	Form Name	Form is Generated at		
			Child's Age	Visit Type	Setting Type
Forms Completed by Primary Care Provider					
1*	211S	New Admission Examination Form	5 years of age and older	Pre-school physical examination	Primary Care Provider's Office, Community Health Center (Outpatient)
2*	05-06	Request for Educational Services			
3*	n/#	Multi-Use Medication Form			
4	05-06	Request for Provision of Medically Prescribed Treatment (Non-Medication)			
5	n/#	Glucose Monitoring Form			
6	n/#	Insulin Pump Form			
Forms Completed by Parent/Guardian					
7*	05-06	Provision of Medically Prescribed Treatment: Parent/ Guardian's Consent, Authorization and Release	5 years of age and older	Pre-school physical examination	Primary Care Provider's Office, Community Health Center (Outpatient)
8	05-06	Monitoring Blood Sugar and Dietary Needs: Parent/ Guardian's Consent, Authorization and Release			

* Bold font indicates forms included in the data exchange
n/# - Form does not have an identification number

Attachment 2. System Development Steps, Timeline and Deliverables

The system development process to enable electronic data exchange includes the following phases: system design phase (3mos); system development phase including pilot testing (9mos); system implementation phase (12mos). The total period is up to 24 mos. The detailed description of each phases, required deliverables and timeline for the school health data electronic data exchange is presented below.

System Design Phase – Month: 1-3

1. Allocate sustainable funding for the project activities for the upcoming 3 years.
2. Identify vendor(s)
3. Develop system design requirements specification for electronic data exchange between CHC's EHRS and ASHR system.
 - a. Develop a Requirement Analysis Document (RAD)
 - b. Develop system development evaluation criteria
 - c. Develop requirements for security measures of the data/information exchange between CHC EHRS and ASHR exchange
 - d. Review privacy issues related to the exchange of patient information between CHC EHRS and ASHR and develop correspondent business policies as needed, e.g. which diagnoses are appropriate to transmit and which are not to assure privacy and confidentiality of patient's health information.
4. Develop agreements between ASHR and participating CHCs for the electronic data exchange.

System Development Phase – Month: 4-12

5. Develop system development requirements specification for electronic data exchange between CHC's EHRS and ASHR system.
 - a. Conduct mapping of current CHC EHR data fields to the ASHR data fields from 211S and other forms to be included in the data exchange.
 - b. Assure the implementation of the nationally harmonized standards to be used in the electronic data exchange
 - c. Develop system development evaluation plan
6. Conduct pilot testing of the system prototype at one participating CHC (during 9th month)
7. Develop system implementation requirements specification for electronic data exchange between CHC EHRS and ASHR system.

System Implementation Phase I – Month: 12-18

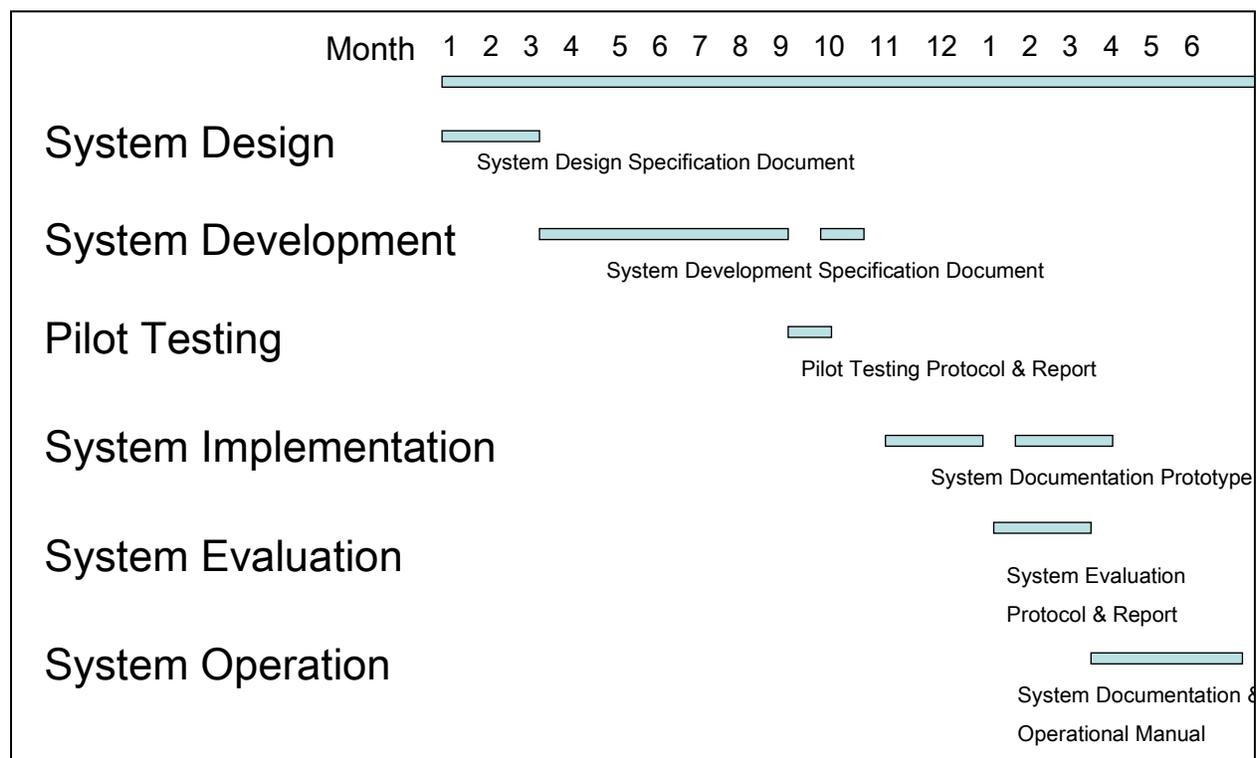
8. Built electronic data exchange between one participating CHC and ASHR system.
9. Evaluate system performance
10. Develop system operational and maintenance protocols, operational manual and training module
11. Develop a plan for system implementation at other participating CHCs.

System Implementation Phase II – Month: 19-24

12. Built electronic data exchange between participating CHCs and ASHR system.

13. Conduct pilot testing of the fully operational data exchanges between participating CHCs and ASHR
14. Activate fully operational system

Figure below presents an example of the timeline for the system design, development and implementation phases for the first 18 months of the project.



Example of the System Development Timeline