Emergency Medical Services: The Frontier in Health Information Exchange

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ABSTRACT
Emergency medical service (EMS) providers routinely lack even basic access to pre-existing patient information when delivering patient care in the field. Improving access to pre-existing patient information could improve the quality, safety and efficiency of care that they can deliver. EMS providers in Indianapolis use an electronic record to document their care. In order to provide access to pre-existing patient information, we integrated the EMS electronic record into the Indiana Network for Patient Care (INPC) --an operational statewide health information exchange (HIE). Over a six month study period, there were 28,986 911 calls to EMS, with 4,332 (16%) requests for patient data. Of the 58 medics surveyed, a substantial majority felt the information delivered was an important tool for delivering quality patient care.

INTRODUCTION
In the nation's emergency and trauma care system, emergency medical services (EMS) play a critical role. Annually, hundreds of thousands of EMS personnel provide more than 16 million medical transports.

In addition, the Department of HHS has developed an Emergency Responder 'use case' which states "….timely electronic access to critical health information relating to the assessment, stabilization and treatment of the victims of emergency incidents. …range from individuals suffering from accidents or acute episodes of illness to large groups …as the result of widespread casualty incidents including natural disasters and terrorism."(1)

Today's emergency care system offers significantly more medical capability than was available in years past, however, of the thousands of EMS systems nationally; only a handful effectively coordinates care. EMS suffers from severe fragmentation, and absence of system-wide coordination. The lack of coordination between EMS and hospitals can result in delays that may compromise patient care.

Patient care could be improved by providing EMS personnel access to pre-existing medical information. A key component of any EMS system is to ensure that each patient is directed to the most appropriate facility. Medical direction is often protocol based, or requires information from the patient. Patients may not be able to recall pertinent medical facts due to new or preexisting conditions. Information on medications, allergies, prior visits and hospitalizations, and diagnoses is even more critical when "time is of the essence".

Our prior work(2, 3) shows a significant proportion of the healthcare information needed to provide emergency care is distributed across multiple healthcare systems. In addition, Hurricane Katrina taught the nation about the value of electronic accessible pre-existing patient information in disaster situations.(4) The Veterans Health Administration's (VHA) nationally shared data warehouse was a shining example of how such warehouses may work in crisis situations. Immediately following the disaster, information on past treatment was readily accessible in VA clinics and medical centers across the country that were treating displaced veterans and their families from Louisiana and Mississippi.

In order to improve access to pre-existing patient information in Indianapolis we integrated a sophisticated point of care EMS system with an operational regional health information exchange. We describe the underlying technology, the utilization statistics, and the survey results from the medics who use the system.

METHODS
Underlying Technology
Investigators at the Regenstrief Institute, Inc. created the INPC in 1994 with the goal of improving the medical care of patients. The INPC is an operational community wide electronic medical record and includes an active surveillance component built around real-time electronic laboratory reporting. The National Library of Medicine and the Agency for Healthcare Research and Quality have supported the initial development of the INPC. The system currently includes data from 30 hospitals in five health systems, the Marion County Health Department and various physician practices. These

hospitals account for over 95% of all beds and ED visits in Indianapolis, which has a population of 1.6 million. The core set of data currently received from all participants includes demographics, laboratory data, ED and inpatient encounter data including chief complaint, coded diagnoses and coded procedures. The system currently utilizes the real-time laboratory result data for active surveillance of reportable conditions.

Nearly all of the interface flows are carried by HL7 messages. All data are mapped to standardized terminologies.(5) We have developed mechanisms for linking patients registered independently in different institutions and for linking physicians' master files.(6) The INPC can also be used to enter clinical orders and visit notes from any device on the network and to store them in the appropriate medical record.

As of January 2010, the INPC system contains data for 10,197,853 unique individuals. This supports our assertion that the INPC is truly a population-based system.

Implementation

Marion and Hamilton County EMS providers use a commercial electronic patient care reporting and data management system (Siren ePCR™ Suite) that is designed specifically for EMS care. The EMS system relies on tablet computers linked through a wireless telephone network provider. The user interface relies on a large 'button' graphical interface and a finger touch-screen interface (Figure 1).

Figure 1

Data recorded by the EMS provider are transmitted to the system's central database in real time. Integration of the EMS system into the INPC was similar to adding any electronic resource through standards based messaging. (Figure 2)

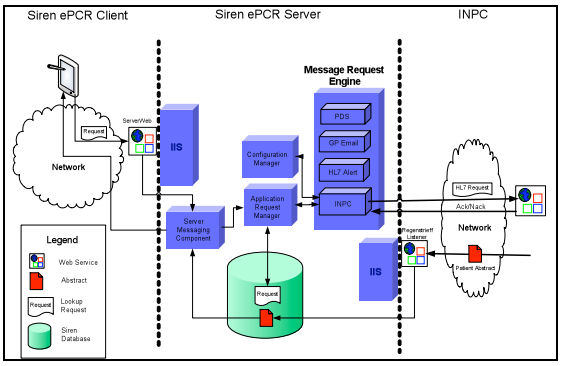

Figure 2

Providers were given additional training regarding the data after an INPC tab was added to the EMR system software lookup interface. The lookup request display is customized and configured for entry by the medic. The INPC patient lookup (Figure 3) request is sent from the EMR system client to the server through its messaging components. The EMR system messaging components supports a disconnected network environment as messages are queued until network connectivity is available to send the request to the EMR system server. Using the AES256 cryptographic cipher, EMR system encrypts all messages between clients and server, all patient identifiable data in the client side data-store and log files, and all database connection string password(s). Passwords stored in the remote client side data-store are hashed with the SHA256 cipher.

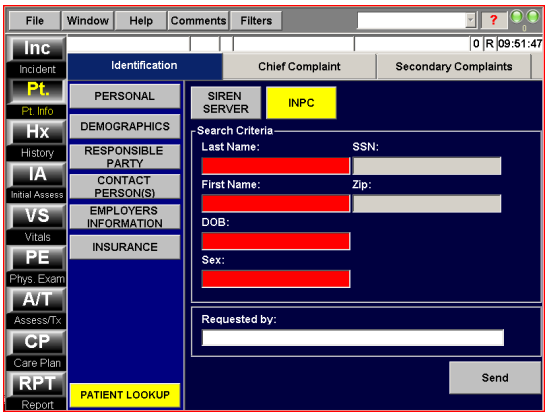

Figure 3

Messages are fragmented before they are transported to and from the server so that large messages can be sent efficiently. This technique facilitates efficient messaging in the presence of frequent network interruptions that may be experienced in the field because only small pieces (fragments) will need to be

resent in the case they are lost. This benefit is important when the relatively large sized patient abstract is returned back from the INPC system through the messaging components.

INPC patient lookup requests are sent to INPC system as HL7 version 2 messages that contain demographic information about the patient being looked up as well as information about the ambulance such as the primary crew member and unit ID (van number).

INPC patient lookup requests are sent to the INPC system synchronously via a web service call that contains one parameter used to pass the HL7 message containing the patient lookup. All the parameters for the web service call are configurable including the host, port, and timeout value that are used to invoke the web service. If the web service invocation times-out, the message can be resent using a configurable retry limit to prevent occasional network hiccups from causing the patient lookup request to fail. If the configurable retry limit is set to zero, the patient lookup request will fail and an error message will be sent back to the paramedic.

The INPC web service will immediately respond with a NACK or an ACK that indicates whether a patient match was made in the INPC system and that a clinical abstract is forthcoming. When an INPC patient lookup request results in a successful match in the INPC system, a patient abstract PDF document is returned asynchronously to the EMS system through a simple web service method that contains a single parameter, which will hold the INPC response message. The response message is an HL7 v2 message, which contains the patient abstract.

Once the package is fully received on the EMS system client, a dialog is displayed to the paramedic asking if they wish to accept the data, which is delivered as a PDF. If they accept the PDF, it is automatically opened and attached to the patient record on the client as a binary attachment. If the paramedic refuses, the PDF will be deleted on the client. In either case, a message is sent back to the server so that the final status is set and a complete record of the workflow is recorded.

Privacy

The INPC system contains and discloses highly confidential information that is protected by both federal and state law. As a result, the INPC agreement contains stringent confidentiality provisions. A committee made of representatives from our health information exchange (the Indiana Network for Patient Care Management Committee) provides an additional level of oversight and establishes policy for health information exchange.

We have a robust set of internal working policies within the INPC that have been crafted over the years to respond to a variety of governmental, stakeholder and consumer demands and concerns. We have developed comprehensive infrastructure, training, policies and procedures that help ensure the security and privacy of patient's protected health information. We have strict data-use agreements and Regenstrief champions the neutral "data Switzerland" role. We share all-data and have opt-out agreements for patients, providers and other stakeholders at the time of entry. We also have strict security and authentication policies and procedures and implement the broad extent of the HIPAA security requirements.

The INPC management committee has approved the use of data under the following conditions: 1) The EMS provider is licensed by the State; 2) The agency under which the provider is providing care is a member of the INPC; 3) The data (abstract) provided to the pre-hospital setting is a subset of the data provided to the Emergency Department.

Study Design

We analyzed data from two data sources for a six-month timeframe from July 1, 2009 through December 31, 2009. Indiana University's IRB approved the study. Additionally, we created a ten question questionnaire through Survey Monkey to obtain feedback from the medics regarding their experiences with the INPC EMS Abstracts.

The EMS 911 data resides securely as a web-based reporting service. This data set includes all the EMS run sheet data that is collected through the Siren ePCR tablet.

The INPC EMS REQUEST data resides securely within Regenstrief and contains information about the request packet sent from the tablet. We record 1) demographics about the requestor, e.g. medic name, unit number, and ambulance service; 2) patient look up demographics, e.g. name, date of birth, and zip code; and 3) outcome of the request: success or fail and if fail, reason for failure.

We used SQL statements to obtain subsets of the data for analysis.

Lastly, we wanted an anonymous mechanism to obtain feedback from the medics about their experiences using the system. A ten question survey was created on Survey Monkey regarding the medics'

experiences with the INPC EMS Abstract. Participation in the survey was strictly voluntary. Our study was approved by Indiana University IRB.

RESULTS

EMS 911 Data

Over the six month study period there were 28,986 911 calls for EMS services with 26,754 patient contacts. For each of these calls, there is a potential to contact zero (no patient found) to more one patient – as in a house fire, where more than one patient resides.

During the study period the number of EMS providers requesting INPC data increased from 64 to 88. In addition, the number of requests for INPC EMS data abstracts increased from 678 to 1,080, which as a percentage of patient contacts increased from 15% to 26% , respectively. (see Table 1)

Survey

Of the approximately 180 medics eligible to voluntarily complete the survey, there were 58 (32%) responses. The majority of responders were paramedics with over 3 years of experience.

8 (14%) of the 58 medics indicated they had never requested any data from the INPC. While 24 (41%) indicated they usually or always request an EMS INPC data abstract. Of the medics requesting the abstract, 38 (66%) indicated the data were important to very important in helping them provide care.

A majority felt there were specific types of patients where the information was felt to be more of value. Specifically in patients who are unable to communicate their heath history. Unconscious, uncooperative/intoxicated, and elderly patients with significant co-morbidities were frequently mentioned.

Regarding reasons why medics chose not to use the system, the majority cited computer and network difficulties. A moderate number commented on poor connectivity "chronic internet failure" resulting in delays to obtaining the INPC EMS abstract.

CONCLUSIONS

We are the first regional health information exchange in the country to connect pre-existing health information to EMS providers. Our research illustrates the quantitative and perceived benefits of access to medical records in the pre-hospital setting. The medical information provided in the INPC EMS abstract allows pre-hospital personnel to collect a more detailed medical history and allows for more informed treatment decisions.

Our research supports the need for further efforts to improve health information technology in the pre-hospital setting. Over the course of a year, in this one EMS system, there will be over 58,000 911 calls for EMS services with over 52,000 patient contacts, resulting in over 13,000 requests for patient data. This sizeable number is on par with a moderately-sized urban emergency department.

A majority of medics surveyed stated the value of the information received is important for them to deliver quality care. Many state the additional benefit of the medication list, allergies, and past medical history in patients with poor cognitive function, due to disease or intoxicants. Medics have found additional value in two groups of patients: 1) patients who heavily utilize access to emergency care; and 2) patients that are "found down" and are not able to be resuscitated.

Many medics described connectivity issues as a significant concern in order for them to receive data in real time. While charting in the electronic record does not require connectivity, data transfer does. In routine care, the electronic record will batch transmissions until connectivity has been re-established. It is likely there are "gaps" in coverage whereby connectivity is poor or absent. This will result in delays in the ability to transfer the INPC EMS Abstract to the tablet in a timely fashion.

Table 1

	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Total
911 Requests	4,981	5,308	4,995	4,908	4,451	4,343	28,986
Patient Contacts	4,581	4,801	4,590	4,527	4,172	4,083	26,754
Number of Requests for INPC Data	678	668	592	612	702	1,080	4,332
Number of Unique EMS Users	64	73	68	72	78	88	
Number of Requests / Patient Contacts	15%	14%	13%	14%	17%	26%	

Secondarily, efforts are also underway to establish connectivity from the Siren ePCR repository back to the INPC. Perhaps now more than ever, with the threat of bioterrorism and outbreaks of diseases such as H1N1, it is essential that EMS, hospitals, and state and local public health agencies partner to conduct surveillance for disease prevalence of outbreaks and other health risks.

Emergency responders can recognize the diagnostic clues that may indicate an unusual infectious disease outbreak so that the public health authorities can respond quickly. However, a partnership that allows for improved communication of information between emergency providers, public health officials, and HIE must first be in place.

EMS systems routinely do not have access to pre-existing health information. Their source of information is limited to the patient, family, or bystanders. In our case, we've provided the INPC EMS abstract which can "speak" for the patient, when they are unable. Access to this information can (1) potentially improve care through initiating more appropriate therapies based upon the patient's pre-existing medical history and (2) avoiding medications the patient is allergic to when the patient is unable to provide a medical history on their own . In the case of mass casualty events, access to HIE data will help inform EMS to make more appropriate triage and transportation decisions based upon the information contained within the electronic medical record.

EMS encompasses the initial stages of the emergency care continuum. It includes emergency calls to 911 with dispatch of emergency personnel to the scene. The speed and quality of EMS services are critical factors in a patient's ultimate outcome. For patients who cannot breathe, are in hemorrhagic shock, or are in cardiac arrest, the decisions made and actions taken by EMS personnel may determine the outcome as much as the subsequent hospital-based care-- and may mean the difference between life and death.

ACKNOWLEDGEMENTS

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