Building a Knowledge Base for Health Information Exchange Between Emergency Departments and Poison Control Centers

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Abstract
Electronic information exchange between emergency departments and poison control centers could reduce medical error, reduce time to treatment, and improve continuity of care for poisonings. This paper describes our ongoing work developing a knowledge base for health information exchange between emergency departments and poison control centers. We determined expert consensus on salient legal, operational, and clinical aspects of exchange, and we are conducting a detailed analysis of the current process as the basis for improvement. The products provide concrete guidance for further research and development, and policy initiatives to promote adoption.

1. Introduction

Poison control centers (PCCs) are twenty-four hour resources for poison information, clinical toxicology consultation and poison prevention education. These centers provide information and recommendations to both patients and emergency care providers, based on individual patient information and a detailed history of the exposure. Specialists in poison information (SPIs) and emergency care providers communicate with each other, exchanging patient information, treatment recommendations, and information about clinical effects and lab results. Despite the centrality of information exchange to poison control, the exchange of information between PCCs and emergency departments (EDs) is almost entirely conducted via telephone. Verbal communication is a known and frequent source of medical error, especially in EDs, where providers are known to experience heavy communication loads with frequent interruption. [1, 2] PCCs’ reliance on verbal communication creates substantial potential for data loss, delays in time to treatment, and medical error.

Because of the unique need for rapid access to information and the acuity of the clinical environment, few areas of the health care delivery system stand to change and benefit more from health information exchange than our nation’s EDs. [3] Potential exists to reduce medical error, reduce time to treatment, and improve continuity of care for poisonings with electronic exchange of data and information between PCCs and EDs. Additionally, electronic information exchange could improve and support communication, improve the availability of data and information to clinicians at the point of care, and ensure timely follow-up. It would also enable definitive linkage of ED patient records with PCC patient records, replacing current probabilistic linkage approaches used in retrospective analyses of poisoning morbidity and mortality. ED-PCC information exchange is also an exemplar of provider to provider health information exchange. Provider to provider health information exchange and its implications for communication and workflow are understudied. This paper describes our ongoing work developing a knowledge base for health information exchange between EDs and PCCs.

2. Background

2.1 Poisoning

Unintentional poisoning has exceeded motor vehicle crashes as the leading cause of injury death in the United States. [4] The death rate from unintentional poisonings, particularly prescription pain relievers, has been increasing dramatically in recent years. [5] [6] The number of deaths due to unintentional poisoning reported in 2006 was more than double that of 2000. In 2009, at least 597,787 patients were treated for poison exposures in U.S. health care facilities. [7] The annual cost of medical expenses related to poisoning in the U.S. has been estimated at over $26 billion dollars. [8]

2.2 Poison Control Centers
Poison centers collaborate daily with EDs to provide care for patients. Of the more than 2.4 million poison exposures reported to US PCCs in 2009, 24 percent were managed in a health care facility. [7] PCC specialists provide clinical toxicology consultation to ED health care professionals. Consultation includes information about the toxin, expected clinical effects, monitoring parameters and specific treatments (e.g., antidotes, reversal agents). As situations evolve, the poison center specialists and ED care providers are in regular communication. Both parties assess and reassess the situation as new information becomes available. The ED care providers share clinical information with the PCC, including patient symptoms, general condition, and the results of certain laboratory tests. Poison centers frequently update treatment recommendations as additional information becomes available.

### 2.3 Current information exchange

Current information exchange is almost entirely conducted via telephone using verbal communication. Like all patients, poisoned patients are often the subject of “hand-offs” with multiple providers caring for them throughout their treatment course. The poison center specialist involved in the case may stay the same through the course of the patient stay in the ED or may change if the patient stay crosses a shift change. Likewise, information may be communicated to one or multiple ED care providers depending on the workload in the ED and the status of the poisoned patient or other patients in the ED.

Emergency care providers are particularly prone to verbal communication related errors because they carry a very high communication load characterized by frequent interruption. [1, 2] [9, 10] This vulnerability is magnified by high patient volume, and EDs are increasingly subject to a crisis of overcrowding. [11, 12] Both ED care providers and PCC specialists in poison information experience multi-tasking, shift changes, patient hand-offs, and interruptions. These circumstances complicate workflow and create opportunities for error. [13]

While EDs and PCCs currently share data to support population health (e.g., identifying trends that suggest emerging ingestions like bath salt abuse), data and information collected by PCCs is not electronically exchanged with other health care providers in order to facilitate care of an individual patient. The electronic data that supports PCC patient care for toxic exposures remains isolated in the PCC’s clinical information system, as does the data of the ED in its own system. SPIs and ED care providers communicate select data and information to each other via phone calls and facsimile. This approach leaves ample opportunity for miscommunication, inadequate communication, and error. [14] [15] Additionally, any information moved among patient care settings via phone may or may not be stored in electronic form for continued use by the recipient ED. This situation creates substantial potential for data loss.

### 2.4 Toward electronic exchange

Interoperable systems and health information exchange (HIE) can be used to effectively support data and information sharing to support continuity of care. However, there are some readily apparent barriers to electronic exchange of PCC data. First, United States PCC information systems are not believed to be interoperable and do not typically implement data standards that facilitate interoperability. Second, there is little funding to support standardization of poison center data and the development of tools for purposes of interoperability and HIE. PCCs are also likely subject to widely recognized challenges in HIE adoption: the need to demonstrate the value of HIE to stakeholders, effective integration with clinical work and information flow, and the need to address privacy/security concerns.

The purpose of our ongoing research is to develop a knowledge base for effective electronic information exchange between EDs and PCCs. We began by identifying consensus opinion on clinical, operational, and legal considerations important for electronic information exchange between EDs and PCCs. We are conducting an analysis of the current process, including detailed analysis of the information that PCCs and EDs exchange by telephone. Concurrently, we are working with our regional health information exchange organization toward PCC connection to a statewide clinical health information exchange.

### 3. Work in Progress

Our work is supported through a grant by the U.S. Agency for Healthcare Research and Quality (1R21HS018773-01). We are describing the information requirements for electronic information exchange between PCCs and EDs in support of
individual patient care, describing current information exchange scenarios, and gathering consensus opinion on the clinical, operational, and legal considerations relevant to electronic information exchange. We are using multiple approaches, including interviews with clinicians and stakeholders, review of documents, analysis of recorded PCC calls, storyboarding, and domain analysis modeling. We determined consensus among national experts on salient issues with a four-round Delphi study. See figure 1 for an overview of the study.

3.1 Specific Aims of the Study

Our study is defined by three specific aims, which we seek to accomplish via two distinct arms, or approaches (see figure 1):

1. Describe information requirements for electronic information exchange between PCCs and EDs.
2. Describe current data/information exchange scenarios between a regional PCC and an ED.
3. Identify salient clinical, operational, and legal considerations related to electronic exchange of data and information between PCCs and EDs.

Figure 1. Operational model for study

3.2 Arm One: Analysis of Current Process

The first arm of the study, currently in progress, addresses the first two aims of the study with a review of documents, interviews with ED and PCC staff, and a detailed analysis of call recordings (see figure 1). We are using this information to describe current information exchange processes as the basis for process improvement. The products will include process diagrams, storyboards, and a domain analysis model.

The analysis of call recordings is a unique aspect of this analysis. Because all calls to/from PCCs are routinely recorded and archived, we are able to analyze actual communication between EDs and PCCs with a non-intrusive approach. We have sampled cases that involve communication between EDs and PCCs. In 20-case increments, we linked those records to call recordings, extracting and transcribing the associated call recordings, and analyzing the information content in incremental batches using a saturation sampling approach. We reached saturation with 80 cases, or four batches.

Analysis in currently in progress. Preliminary data reveal that multiple data/information types, not currently represented in the NPDS coding system, are exchanged between EDs and PCCs to support patient care. Additionally, the analysis of call recordings has revealed multiple inefficiencies and examples of poor data quality in the current verbal information exchange process. PCC specialists call to exchange information but cannot reach the care provider or obtain the result of a laboratory test. Information is communicated in an ambiguous fashion, where observations and findings are characterized rather than described. For example, the result of a laboratory test is described as “normal” or “fine”, but the actual result is never communicated.

3.3 Arm Two: Delphi Study

The second arm of the study used the Delphi method to address aim three (see figure 1). We convened a panel of N=71 national experts in emergency medicine and poison control for a modified Delphi study that we conducted September-December 2010. We presented a small group of eight panelists with a series of open-ended questions related to potential electronic information exchange between PCCs and EDs. We analyzed the responses using Colaizzi’s seven-stage thematic analysis and converted them to a series of statements. The full panel (N=71) rated the importance of each statement on a 7-point Likert scale. We also invited panelists to submit comments.

The results, reported elsewhere, indicated a high level of engagement by panelists. The response rate was notably high for web-based survey research (0.73-0.77), and the panel reached consensus on most (114/121) statements. Panelists agreed upon importance of most outcomes including potential
effects on communication, the importance of exchange related to information availability for decision making, and potential to reduce medical error. They also agreed upon key aspects of adoption and implementation, such as the importance of funding for initial and ongoing costs. Panelists demonstrated a high level of interest and enthusiasm for exchange, but expressed concerns related to funding, support, training, usability, and workflow integration.

Examples of high importance, high consensus statements describing potential outcomes of ED-PCC electronic information exchange (rating = 6, % agreement > 90%):
- Error reduction
- More complete clinical picture
- Improved availability of information to multiple team members in emergency department

Examples of high importance, high consensus statements describing issues related to implementation (rating = 6, % agreement > 90%):
- Avoid the introduction of additional, time-consuming processes
- Avoid presenting so much information that it cannot be integrated into patient care
- Involvement of specialists in poison information in design of systems

Examples of high importance, high consensus statements describing issues related to adoption (rating = 6, % agreement > 90%):
- Technology safeguards to prevent adverse consequences
- Advocacy by ED nurses
- Availability of adequate staff training

3. Limitations

The analysis of current process is based on interactions of a single poison control center and two emergency departments. Consequently, the products may partially reflect local practices. However, essential features of the PCC–ED collaboration process, like processes for registering a patient or drawing a laboratory specimen, should remain consistent across settings. The results of Delphi studies are often weakened by poor response rate. However, as previously indicated, the response rate was high and stable across rounds. Because we purposefully selected panelists for their expertise and did not select them to represent any particular population, the results should be interpreted as the consensus of an expert panel, not the consensus of all emergency medicine and poison control experts.

4. Conclusions and Future Directions

The Delphi study focused the thought and attention of national emergency medicine and poison control experts on electronic information exchange. This intellectual engagement with relevant issues set the stage for important non-technical initiatives related to PCC–ED electronic information exchange, including policy changes and standards development/adoption. The consensus description itself can be used to guide and focus these non-technical initiatives to facilitate PCC–ED electronic information exchange adoption and use. The knowledge gleaned in this process about issues and priorities for PCC–ED is informative for other provider-to-provider information exchange scenarios in health care. Smaller, resource-limited settings like private physician practices and independent clinics face IT barriers similar to those of PCCs.

This research provides concrete guidance for efficient research and development by identifying critical stakeholder priorities and needs. It allows us to tailor future work to those needs, producing the knowledge and tools most likely to positively impact information management. We are generating the necessary preliminary data for a demonstration project and establishing the collaborative relationships necessary for local proof-of-concept of PCC–ED electronic information exchange. Such a project would be an essential step toward widespread PCC–ED electronic information exchange and enable more detailed study of the myriad issues relevant to design and implementation. Currently, we are engaged in planning PCC connection to Utah’s clinical health information exchange, in collaboration with the University of Utah and the Utah Health Information Network.

5. References


