Risk-Informed Clinical Network for Safe Pediatric Emergency Transfers

Final Report

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2. ABSTRACT

PURPOSE
The study objectives were to develop and implement a risk-informed communication standard for pediatric emergency transfers that could be developed into a web-based tool to improve clinical communication and decision making during pediatric emergency transfers. This Clinical Information Network (CIN) is an intervention designed to support standardized, safe, and reliable clinical communication for pediatric transfers.

SCOPE
Transfer of pediatric patients from an ED to another hospital repeatedly has been shown to be a high-risk transition. Accurate patient assessment and communication of pertinent clinical information are key challenges to safe transfer of pediatric patients.

METHODS
Pertinent pediatric clinical information required for safe transfers was determined by an expert panel. Industrial engineering methods were applied to redesign the process and clinical workflow. Clinician surveys assessed the effectiveness of transfer communication and decision making.
Transfer charts were reviewed to assess the patient's condition and downstream events. An IT firm was engaged to build the CIN into a web-based electronic tool, accessible simultaneously by clinicians at both referring and receiving hospitals in real time, creating a channel for standardized, efficient transfer communication.

RESULTS
In 37% of transfers (n=106), there were substantive differences in the perceptions of the main medical problem between the clinicians at the sending and receiving hospitals. Additionally, adverse events were identified in 32% (n=34) of transfers. The CIN communications standard was implemented and tested by investigators and transport clinicians on both hypothetical and real retrospective cases, and workflow was assessed. They determined that the CIN appropriately captures all pertinent clinical information for the pediatric emergency transfers.

KEY WORDS: Clinical Information Network, pediatric emergency transfer, care transitions, interfacility transfers, health information technology, clinical communication support tool, web-based tool

3. PURPOSE

3.1 Objectives

Children are a high-priority population for patient safety study and improvement. Healthcare risks are common in pediatrics and have been demonstrated to lead to avoidable harm. Healthcare, as a life-critical industry, must assess existing risks and improve the reliability of the care delivered. Emergency medical care, particularly for children, is a known context of patient safety risk and a high-priority context for risk assessment and safety improvement. Findings from an Agency for Healthcare Research and Quality (AHRQ)-funded project, Leveraging Existing Assessments of Risk Now (LEARN) for Pediatric Patient Safety, described a set of underlying and interacting generic communication, coordination, and assessment risks across institutions related to the high-risk transition of pediatric emergency transfers. Many relatively high-frequency and high-harm risk processes and conditions were described in existing risk assessments submitted to the LEARN project for analysis. These underlying issues related to communication, coordination, and assessment were consistently found to be of relative high risk across institutions for pediatric patients. Using what has been learned from these risk findings, we propose to design a system to address underlying and interacting communication, coordination, and assessment risks.

Health information technologies (HIT) have been advanced as an effective method to address patient safety risks and to improve the safety and reliability of clinician communication across transitions in care. This study aimed to develop and implement the risk-informed, web-based Clinical Information Network for Safe Pediatric Emergency Transfers (Clinical Information Network) intervention to support standardized, safe, reliable clinical communication for pediatric transfers. Through development and implementation of this Clinical Information Network, the potential exists to develop a needed and effective standard for transfer communication, to improve the reliability and safety of clinical information exchange in the transfer process, and to improve the safety of pediatric emergency transfers. However, implementation of HIT solutions without attention to the potential for the introduction of new risks has been shown to increase morbidity and mortality.
Through the application of industrial engineering re-design principles and methods, the implementation of the Clinical Information Network will be informed by incorporating the findings from the LEARN project and assessments of potential new emerging risks in the process of implementation. The Clinical Information Network will be tested for its impact on the safety of pediatric emergency transfers and the potential for adoption by institutions in other geographic regions. The aims of this project are to:

Aim 1. Determine the pertinent pediatric clinical information required to ensure safe, reliable, and effective communication, coordination, and assessment in the process of pediatric patient transfers from referring emergency departments to receiving hospitals with pediatric services.

Aim 2. Create a Clinical Information Network to standardize the processes and tools for communication, coordination, assessment, and documentation during transfers informed by the risk assessments, industrial engineering observations, and expert input that includes:

- Age-group–specific, standardized tools based on findings from Aim 1;
- A web-based Clinical Information Network on a portal at the receiving hospital with secure access by the referring hospital's emergency departments; and
- Review of the "workflow" during transfers to identify and mitigate introduction of new risks.

Aim 3. Implement the Clinical Information Network at two referring hospital's emergency departments and at one receiving hospital by training of all clinicians and staff in (1) the use of the standardized processes for communication, coordination, assessment, and documentation and (2) the re-designed "workflow" to integrate these standardized processes and tools.

Aim 4. Evaluate the effectiveness of the implementation of the Clinical Information Network; and

Aim 5. Evaluate the impact of the Clinical Information Network by comparing transfers to the receiving hospital from two intervention referring hospitals with transfers from two control referring hospitals:

- Assess improvement in the reliability of the information exchanged during transfers; and
- Assess improvement in patient safety.

4. SCOPE

4.1 Background

In a 2004 report by Beckman, review of 191 reported inter-hospital transport incidents revealed that communication problems, inadequate protocols, inadequate training, and inadequate equipment were prominent. Errors of problem recognition and judgment, failure to follow protocols, inadequate patient preparation, haste, and inattention were common. Serious adverse outcomes occurred in 55 reports (31%), including major physiological derangement (15%), patient/relative dissatisfaction (7%), prolonged hospital stay (4%), physical/psychological injury (3%), and death (2%). Of the contributing factors identified, 46% were system based and 54% were human based. In addition, 52% of Emergency Departments (EDs) that accept pediatric patients have no inpatient pediatric ward. Only 10% of these EDs are in hospitals with a pediatric intensive care unit (PICU), thus often necessitating the transfers of critically ill children. Just half of these hospitals had written transfer agreements with facilities that offer the necessary inpatient pediatric services. The AAP encourages all EDs to establish transfer agreements with facilities with higher levels of pediatric care, and many have called for more studies to improve the safety and effectiveness of pediatric transfers.

The majority of pediatric ambulatory emergency visits are made to Emergency Departments (EDs) in hospitals that treat children and adults in the same department, are unlikely to have a pediatric emergency medicine physician on staff, and may lack basic pediatric equipment and skills. The aim of transferring a critically ill pediatric patient to a tertiary care hospital is to improve treatment and outcomes.

The transfer of pediatric patients from an emergency department to another hospital has been shown repeatedly to be a high-risk transition. Accurate patient assessment and communication of pertinent clinical information are key challenges to the safe transfer of pediatric patients. Lack of adequate pediatric medical knowledge and skills is also a contributing factor to patient safety risks during ED transfers for pediatric patients, particularly patients with complex chronic medical conditions. In addition, limited information about patients' medical histories and status is available to ED clinicians. Facilitating the exchange of real-time, clinical information provides the consulted pediatric clinicians with more accurate clinical information on which to base their recommendations.

Clinician communication and patient assessment are the two most frequent risk contributors identified from Root Cause Analyses (RCA) conducted on sentinel events reported to The Joint Commission in both adult and pediatric healthcare. Because of the significant harm associated with these events, the risk contributors to these serious events must be prioritized for intervention. Additionally, assessment and communication of patient acuity have been identified as a particular challenge in pediatrics due to the variability of physiological maturity of different age groups of children, which leads to wide ranges of normal and abnormal values. These challenges have led to pediatric sentinel events associated with clinicians' lack of ability to appropriately assess and interpret the available clinical information and communicate these findings, particularly for clinicians without pediatric training.

Clinical communications between clinicians (e.g., treatment order, critical result report, transfer instruction) are a major part of providing healthcare. Given that many of these communications are necessary and life critical, the reliability of such communications is essential to safe, high-quality healthcare. There only recently has been attention given to the reliability of clinical communications between clinicians in medicine. Most communication work in healthcare has focused on communications between the clinician and the patient. The effectiveness of communications between clinicians in medicine has, perhaps, been taken for granted because clinicians are assumed, as highly trained, skilled individuals, to communicate effectively. The establishment of designed communication systems (e.g., ways of communicating, standards for information communicated, processes for communicating) to ensure the effectiveness and reliability of clinician to clinician communication are only just beginning to be studied, developed, and implemented.

Patient transfers, such as those between an ED and an inpatient service at another hospital, involve two or more individuals working within several different systems. The Joint Commission has responded to the risk of error at patient handoffs by endorsing a requirement for healthcare organizations to "implement a standardized approach to handoff communications, including an opportunity to ask and respond to questions" in their 2006 guidelines. However, there is little research in healthcare that provides evidence of what constitutes an effective handoff, how to perform it, and how to teach it. Pediatric emergency transfers involve cross-facility communication, clinical information exchange, assessment decision making, preparation, coordination, documentation, and finally the transfer of patient care responsibilities. Each of the above failures has been shown to exist in each of these processes.

Safe, effective clinical care depends on reliable, flawless communication between caregivers, particularly in the context of the high-acuity, high-risk transition of pediatric emergency transfers. Standardized communications have been shown to improve the reliability and safety of handoff communications in many high-risk industries, such as nuclear energy and aviation as well as medicine. The Joint Commission recommends that all institutions incorporate the following strategies related to the transition of handoff communications: 1) use of a standardized communication format, 2) communication of key information to the next clinician about diagnosis, treatment plans, medications, test results, 3) inclusion of training on effective handoff communications, and 4) encouraged communication between organizations providing care to a patient in parallel. However, for pediatric emergency transfers, there currently is no universally accepted or available emergency transport clinical information communication standard. This type of standard is recommended both for the reliability of communication during transport as well as for study systemic study of pediatric transport nationally. This project's objectives were to develop and test in multiple institutions and in more than one region a standard set of pertinent information that could become a standard for handoff communications between organizations at the time of pediatric emergency transfers and then develop a network such that the information is reliably communicated through access to the same document in parallel at each participating institution.

4.2 Settings

This study focused on the transfer of pediatric emergency patients in the Chicago area from two referring intervention hospitals (Northwest Community Hospital and Lake Forest Hospital) and two referring control hospitals (Swedish Covenant Hospital and Silver Cross Hospital) to a receiving hospital (Children's Memorial Hospital).

5. METHODS

This study employed the methods of an expert work group panel, industrial engineering observations, assessment surveys, chart reviews, and simulation of the CIN web-based tool.

5.1 Expert Panel

To identify the critical content and necessary communication for safe pediatric emergency transfers that would be contained within the CIN, the team established a baseline of elements by gathering necessary clinical data elements from AHRQ-funded LEARN study findings. With this baseline, the team developed a prototype of standardized clinical data elements and the CIN. The prototype was then further developed through an informed process using an Expert Panel.

An Expert Panel consisting of distinguished experts in the field of Pediatric Transport Medicine, the Transport Team Director for the receiving hospital (CMH), and the Emergency Department Chairs for the referring intervention hospitals was engaged to review and comment on the age-group–specific prototypes of the CIN tool.

The Expert Panel was provided with the age-group–specific prototypes of the Clinical Information Network tool and a review and scoring tool in an electronic format with each of the clinical information elements listed. The members of the Expert Panel used a scoring tool to rate the age-group–based clinical information elements on the following criteria: 1) the importance and relevance of the element to the transfer process; 2) the clarity of definition of the element; 3) the criteria used for the clinical element; 4) the relationship of each element to the other elements; and 5) the threshold values for each element.

The Expert Panel also had the opportunity to comment more broadly on each element in a blank text field and was asked to suggest any additional clinical elements that are necessary for safe transfer. The Expert Panel members were also asked to provide the values above and below what they consider to be the critical threshold of stability for each of the clinical status elements. The results of the scoring sheets were aggregated, presented, and discussed at the Expert Panel Meeting. Based on the comments and suggestions of the Expert Panel, a standardized set of clinical information elements by age group was selected, and this set of elements formed the communication standard for pediatric emergency transfers.

5.2 Industrial Engineering Observations

The industrial engineering team reviewed the referring hospital's emergency department and receiving hospital workflow processes to integrate the standardized processes and tools. The review focused on recognizing what difficulties physicians face when communicating and interpreting patient information.

By studying multiple groups of clinicians and multiple clinicians within groups, an idiosyncratic depiction of the phenomena being studied was avoided. The team conducted approximately 10-12 observations in each hospital. Observation sessions lasted 3-4 hours throughout the day to capture diurnal variations in tasks and interactions. A significant proportion of the observations was audiotaped. Audiotapes enabled us to distinguish among speakers in the various group conversations and meetings that occur in medical environments. The audiotapes were transcribed by transcriptionists and integrated into the field notes by the researchers. Interviews of physicians, nurses, and administrative staff in each of the hospitals were conducted. The number of interviews conducted was approximately 43. The interviews were designed around issues and themes that emerged during observations. All interviews were audiotaped and transcribed by transcriptionists for analysis.

Determining the workflow was a careful process recording and categorizing steps (or actions). Results were aggregated into larger events and categorized after discussing emerging categories with the informants. Once this basic coding and sorting process was complete, the more advanced, theoretically grounded steps outlined by Strauss and Corbin for "axial" and "selective" coding could be applied to create process models, indicating the steps that the clinical and administrative staff take to collect, interpret, communicate, act on, and document to accomplish a patient transfer.

The revised CIN workflow that was developed (Figure 5.1) and the transfer process workflow that was constructed were then tested in simulation to have a maximum impact for rapid assessment and adoption.

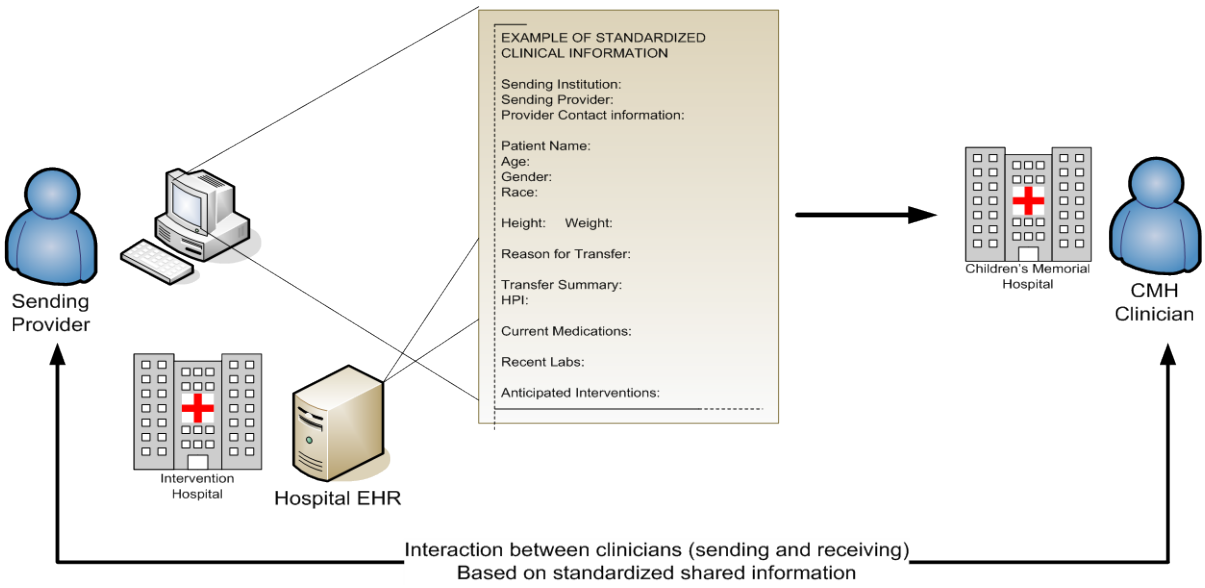

Figure 5.1

5.3 Assessment Surveys

Assessment of the congruence of patient acuity assessment was collected through the transfer assessment survey method. Two surveys were constructed: one for the referring hospital and one for the receiving hospital. Clinicians' perception of transfer patient acuity at the time of transfer was assessed. We evaluated the congruence of this assessment for both the referring clinicians compared to the assessment by pediatric-trained receiving clinicians at the receiving site before the implementation of the Clinical Information Network intervention. This assessment provided a measure of the quality of communication regarding the transfer patient's clinical status and an understanding at the referring site of the meaning of the presented clinical picture. To assess clinician's perception of the patient's acuity, we applied a visual analog scale developed by Brennan. The Acuity Assessment Tool is a 10-cm horizontal line. One end of the line is labeled *perfect health*, and the other end is labeled *impending death (death within 8 hours).* No other marks are on the line. Clinicians were asked to mark their assessment of the patient's acuity along the line. This assessment is then measured beginning at the point on the line (labeled *perfect health*) to the clinician's mark. We assessed congruence using Pearson's Correlation Coefficient.

5.4 Chart Reviews

Clinical information from transport logs and medical charts were abstracted to assess the processes and outcomes of the emergency transfer. Pediatric patients' medical records were accessed only from the receiving hospital (Children's Memorial Hospital) and not from any of the other sites. The research database was de-identified, though elements of dates and medical record numbers were collected to calculate durations (e.g., length of stay, etc.) and connect data about the same patients obtained from different sources. No identifying information pertaining to patients or clinicians was recorded, and such information is not intended to be included in any papers or reports resulting from the research. The data from the surveys and medical chart reviews provide us subjective and objective information that can be used in analyses to compare intervention and control sites, pre- and post-intervention of the CIN, to evaluate its effectiveness.

5.5 Simulation of the web-based CIN

Using the CIN web-based tool that was developed and finalized by Image Trend with the input of our CIN team, the Medical Director of the Children's Memorial Hospital Transport Team simulated the input of hypothetical and retrospective real cases. By following the workflow designed for this system, a simulation of data entry of a patient's clinical information enabled us to implement and practically test the CIN without introducing risk into a live system. This method allowed us to uncover holes that may have been otherwise overlooked.

6. RESULTS

6.1 Principal Findings

Quantitative analysis of the transfer assessment surveys and chart review data has revealed that the mean acuity scores for the intervention and control hospitals are nearly equal. Based on the answers to survey questions, survey respondents are generally satisfied with the current transfer process.

A comparison of problem lists obtained from the referring and receiving hospital institutions reveals that, for the majority of cases, the referring and receiving institutions do agree on the patient problems; however, in 37% of the transfers (n=106), there were significant differences in what the two hospitals perceived to be the main medical problem.

We also found that, of the 10 types of adverse events determined to be most prevalent, a total of 34 adverse events occurred during the 16-month data collection period (n=106), representing a 32% adverse event rate. Furthermore, the most frequently reported adverse event was “inaccurate Information,” which occurred in 14% of the transfers (44% of the adverse events). This is based on chart reviews of 106 pediatric patients and reflects a rate of 0.32 adverse events per person per month.

6.2 Outcomes

6.2.1 Communications Standard for Pediatric Emergency Transfers

It was determined that no standard for communication of the pertinent clinical information for effective pediatric emergency transfers existed. To have a standard for transfer communication is both a patient safety recommendation and a recommendation from the 2003 Guideline on Air and Ground Transport of Pediatric and Neonatal Patients. We engaged a subset of the authors of this Guideline and others from the Executive Committee of the American Academy of Pediatrics Section on Transport Medicine as an Expert Panel to review examples of transfer logs and documentation and to apply their knowledge and expertise through a modified Delphi process to assess each communication element—the format for the best method to communicate the element—and determine whether there were age-related communication elements across five pediatric age groupings. A set of recommended elements and formats emerged following three Delphi rounds. These then were compiled into a format to assess grouping of like elements and effective placement of elements based on eye tracking. Based on these recommendations, the elements were arrayed and tested by investigators on emblematic cases, and a series of sequences of iterative testing and refinement was conducted. The penultimate form was re-reviewed and finalized by the Expert Panel. The form was finalized on September 17, 2010.

6.2.2 Web-based Clinical Information Network

A critical outcome of this work has been the development of a standard set of clinical information elements, specifications for the design framework of the Healthcare Information Technology (HIT) infrastructure, and the establishment of the workflow process requirements. The partnership with Image Trend, an external IT company, enabled the transition of standardized elements to become a web-based format in which critical thresholds and alerts could be established as part of the data architecture. Partnering with this company also allowed continuous support, potential marketing capabilities, and technical expertise, which offered consistent and accurate reflection of the paper form on screen.

6.2.3 JTSEC Collaboration

Follow-on funding was received during the grant period to further evaluate the impact of the CIN.

This follow-on funding allowed the team to conduct in-situ simulations utilizing the CIN in partnership with the transfer network of OSF Healthcare System in Peoria, IL, in a different healthcare market and to test the impact of the CIN in the context of air transports. The OSF Healthcare System has many characteristics that differ from the Chicago-area network, including its rural setting, increased distance between hospitals, and the majority of transfers occurring by air versus ground. The aims were to assess the improvement in the effectiveness of communication, decision making, and placement in the context of both simulation and actual measures of care in pediatric emergency transfer cases. The benefits of the opportunity are far reaching, as it allowed us to explore the compatibility of the CIN in the various settings and enable any risks in existing systems to become evident and properly addressed. The simulations also allowed us to assess potential improvement in transfer process and outcomes as well as investigate the implementation of the CIN using newly developed mobile iPad platforms.

6.2.4 Future Opportunities

This research laid the ground for advancement in the field of real-time, web-based clinical information systems to aid pediatric emergency transfers. During the course of this study, many opportunities for future research activities arose as a result of our work, including conducting real-time simulations with the web-based tool in both rural and urban networks, testing the web-based tool in real pediatric emergency transfers and incorporating the tool into the clinical workflow, and post-implementation data gathering to compare the effectiveness of communication with and without the use of the CIN.

6.3 Discussion

6.3.1 Results

From March 2010 through October 2010, there were 43 transfers with paired surveys completed and assessed. Of these, four (9%) had identical problem lists, 28 (65%) had clinically similar problem lists, and 11 (26%) had clinically different problem lists. Thus, 32/43, or 74%, had the same or very similar diagnoses for the patients transferred. In 26% of the transfers, there were significant differences in what the two hospitals perceived to be the main medical problems. Of these 11 patients, five had the same primary problem listed, but they prioritized these differently. In 14% of the transfers, there were significant and meaningful differences. Accurate patient diagnosis is important for decision making about the mode of transport, the patient placement, and ensuring that appropriate subspecialty care is available. This study demonstrates a critical performance gap in the congruence of pediatric patient assessment and communication of this information in pediatric emergency transfers.

6.3.2 Challenges

During the course of this project, many challenges were encountered by the team that required creative and novel solutions. Many of these challenges and barriers were generated by the time-intensive task of transforming the paper CIN into a web-based tool.

The study investigators realized that the complexity of the programming required for the development of the critical features of the CIN, reinforced as necessary by the Industrial Engineering observations and other data collected related to the project, were beyond the capability of the initial IT team for de novo application development. The initial plan of the IT Team called for adapting a previously developed web-based survey instrument with back-end database development capability to collect information related to pediatric emergency transfers for this project. This instrument would enable robust back-end database development, but when tested, was inadequate for real-time clinical communication. The CIN Team then explored partnering with IT companies with some pieces of existing software capability and features that could provide a platform for overlaying the standardized data elements, functionality, and workflow requirements to better support both the database development and communication goals of this project.

Our next step was to partner with an IT company that had a platform with the necessary functionality on which to overlay the collection of the clinical communication elements determined to be essential through the expert panel review.

We worked with an IT company to customize their product to the needs of the CIN. We were in frequent communication with the company, ImageTrend, to perform the IT development for the project, and it took an unexpected amount of time to finalize the subcontract to work with them. Northwestern University's Office of General Counsel, Office of Sponsored Research, and Innovation and New Ventures Office all worked on the finalization of this agreement.

Once development was underway with Image Trend to specify the design of the framework of the HIT infrastructure, establish workflow process requirements, and build the CIN elements into an electronic format, the issue that continued to present itself was the rigid nature of the platform the CIN was being built upon. It was more difficult to customize to the needs we had desired that was initially presented. To achieve the outcomes that were required for our CIN tool, the situation required novel but bulky workaround solutions.

Creative solutions were proposed by our team and implemented to circumvent the barriers to accurately customize the tool for the pediatric population. For example, Image Trend maintains encompassing databases of selection options to populate various fields in the web form. The database of selection options are prepopulated with the options Image Trend uses in their other various applications; though additional options could be added to this master list, options that were not appropriate for pediatric patients had to be deselected. Once the drop-down menu displayed only the appropriate pediatric population selections, these procedures could not be segregated in a way that allowed the clinician to prompt only "Respiratory" procedures, for example. All procedures were interspersed without the ability to separate categorically. This presented a complexity in user interface as well as an increased potential for inaccuracy by the user (i.e., choosing a cardiac procedure when they were reporting on a respiratory incident). As such, our team proposed that each element of the procedure drop-down menu be titled by the type of procedure and then alphabetically arranged so that all types of procedures would now effectively be grouped together, achieving our goal. These added elements of customization were a key barrier to progress and resulted in an end product that was cumbersome and not completely responsive to the aims we set out to achieve.

Although additional user interface testing was done on the CIN web-based tool with hypothetical and retrospective real cases, no further simulations or real-time testing in the Chicago network of hospitals or other hospitals were completed due to the delayed timeline and the stage of the unrefined tool.

In addition, new technology advances have occurred across the life of the project and the development process, which could improve upon the currently developed system. We are seeking assistance to deploy this communications standard on mobile platforms, such as the iPad and smartphone technologies.

6.4 Conclusions

The development of the web-based Clinical Information Network (CIN) by the contracted software developers enabled a deeper understanding of the processes, workflow analysis and methods, website configuration, and security criteria and methods that are a part of the critical design to an effective communication tool. The transfer of the pertinent clinical data elements for pediatric emergency transfers from a paper format into a web-based form with user-friendly interface is an extremely rigorous, iterative, and decision-laden process. Incorporating a redesigned workflow, critical threshold values, and documentation nuances on top of an already intense process proved to be difficult to attain.

In addition, the Industrial Engineering team associated with the project not only helped to streamline the communication workflow process to better align with the clinical needs in the pediatric emergency transfer process but also added new knowledge about the nature and importance and contribution of trust in these communications.

The labor-intense work that was established as a part of this study, including the customization of elements to ensure correct pediatric response values and ranges, has been completed, and the extensive testing of these features conducted by investigators and research staff will not go unused.

The team intends to continue developing the work of the CIN by partnering with a new entrepreneurial, technologically advanced Information Technology start-up company that is just starting out and is looking to develop strong business relationships by showcasing their novel approach to clinical decision support tools and interfaces.

6.5 Significance

The standardized process and tool for the transfer of pediatric patients created by this project addresses a key recommendation for improved communication and coordination of pediatric ED and transport care. ED use by pediatric patients and subsequent transfers to another institution are increasing in number. Most pediatric patients are not cared for in children's hospitals with a wide range of pediatric expertise. Additionally, it is well known that EDs fill many existing gaps for patients in the US healthcare system (e.g., financial barriers to care, lack of access to other sources of care after hours, transportation barriers, lack of usual source of care), which accounts for the increase in the number of ED visits. However, there is also growing evidence that clinicians are using EDs as an adjunct source of care by referring patients to the ED for a variety of reasons (e.g., after-hours care, complicated cases, need for diagnostic tests). Particularly in urban settings, patients have been shown to receive care at multiple institutions. Unfortunately, many EDs are unprepared to take care of pediatric patients; they may not have pediatric-sized equipment or pediatric trained staff available necessitating transfer. Improving the reliability and effectiveness of clinical communication across sending and receiving hospitals can increase the safety of the management, placement, decision making, and overall care in the context of pediatric emergency transfers.

6.6 Implications

The Clinical Information Network could be applied to improve the accuracy, clarity, and reliability of interfacility communication and clinical information exchange regarding error-prone communication aspects of medical care across care transitions including transitions between primary care based practices, EDs, and inpatient settings.

As the CIN team learned through this grant, some of the challenges of programming a user interface involve facilitating clinical thinking, effective communication, and decision making. Additional layers of complexity exist, because medical transactions are complicated along with the complexity of the behavioral aspect of the culture of communication during a transfer. However, one of the most resourceful ways to capitalize on the findings of this research could be in the interaction with large-market vendors. The CIN is a web-based tool that is vendor independent and can be applied by receiving pediatric centers in the transfer networks. Likewise, the tool could potentially inform large-market vendors (like EPIC and Cerner) that are looking to create transport modules for their already developed, engineered, and mature systems. The adoption of the communications standard developed through experts in the field across the country and the web-based tool through which it is deployed by transport clinicians and pediatric EDs would be ideal and could improve the handoff of patients across this very challenging transfer of information. The CIN could be deployed as a widely used HIT platform, thus creating a seamless integration of critical elements for safe pediatric emergency transfers across institutions and pushing relevant clinical information into institutional EMRs that are already in use. The CIN is intended to guide clinicians in sending hospitals toward the type of information that will be needed, reducing delays and providing a system-level intervention to reinforce pediatric treatment regimens and guidelines. This would provide a reference resource and lessen the burden of education and training.

7. LIST OF PUBLICATIONS AND PRODUCTS

CIN Posters

Woods DM, Holl JL, Leonardi P, Rozenfeld RA, Reynolds S, Kelleher M Developing a Standardized Set of Elements for Communication in Pediatric Emergency Transfers. Poster presented at the 2010 American Academy of Pediatric Annual Meeting, Section on Transport Medicine. San Francisco, CA. October 2010.

Woods DM, Holl JL, Leonardi P, Rozenfeld RA, Reynolds S, Kelleher M. A Risk-Informed Clinical Information Network for Safe Pediatric Emergency Transfers. Poster presented at the 2011 Annual Research Meeting of Academy Health. Seattle, WA. June 2011.

Rozenfeld RA, Woods DM, Holl JL, Leonardi P, Reynolds S, Kelleher M. Are We Looking at the Same Child? Assessment and Communication Challenges in Pediatric Inter-facility Transfers. Poster presented at the 2011 Annual Research Meeting of Academy Health. Seattle, WA. June 2011.

Rozenfeld RA, Woods DM, Jovanovic B, Peng J, Gilmore C, Muller N. Assessment and Communication Challenges in Pediatric Inter-facility Transfers. Poster presented at the 2011 American Academy of Pediatric Annual Meeting. Boston, MA. October 2011.

CIN Presentations

Woods DM, Holl JL, Leonardi P, Rozenfeld RA, Reynolds S, Kelleher M. NACHRI Webinar Presentation Clinical Information Network for Safe Pediatric Emergency Transfers. September 2010.

Rozenfeld RA, Woods DM, Holl JL, Leonardi P, Reynolds S, Kelleher M. Are We Looking at the Same Child? Assessment and Communication Challenges in Pediatric Inter-facility Transfer. Podium presentation made at the 2011 Annual Child Health Meeting. Seattle, WA. June 2011.

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