



ITS and Transportation Safety: EMS System Data Integration to Improve Traffic Crash Emergency Response and Treatment

Final Report

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Executive Summary

Purpose

The SAFETEA-LU legislation mandates Strategic Highway Safety Plans (SHSPs) that are collaborative, comprehensive and based on accurate and timely safety data. A significant challenge exists for transportation planners to identify and use a range of new information sources beyond traditional crash data systems and to identify strategies for sharing a wide range of data across multiple agencies to support evidence-based safety planning. Correspondingly, while intelligent transportation systems (ITS) have long promised safety benefits, there has not been a strong emphasis on examining the extent to which ITS is capable of providing safety related data for clinical health assessment and planning purposes. This research project examines the linkages between ITS systems and the SHSP, focusing on the role of ITS, 911, Emergency Medical Services (EMS), and Trauma systems to provide timely and clinically oriented safety data for system performance improvement and informed decision making.

This study uses multiple methods to consider, devise and examine the use of advanced information systems to improve emergency response services and outcomes. First, a literature review was performed on the use of ITS and IT systems to integrate data across crash, EMS, and trauma organizations and information systems. Next, several state strategic highway safety plans (SHSP) were analyzed to understand how EMS and trauma data and information systems are addressed within safety planning processes. A “best practices” review was then conducted to scan various innovative IT systems that have been implemented and/or tested for the purpose of providing decision tools to cross-organizational decision makers. Findings from these analyses were grounded in a case study investigation in Minnesota at the State and local (Rochester, MN) level. This led to conceptual model development and information framework development. Analysis across these various methods provided a multi-layered understanding of statewide safety performance features.

Main Findings

Proposed in this study is an Integrated Crash Trauma Information Network (ICTN) in response to the multiple levels of analysis conducted. The proposed ICTN system forms a network of emergency responders, health care professionals, and IT/ITS systems to collect and share “real time” data to be communicated and immediately utilized to aid in the treatment of trauma victims. Such a system could also be used for retrospective analysis for performance and clinical analysis and research. Supporting the need for the ICTN system, researchers collected data from prior studies conducted in Minnesota, conducted a literature review, case studies in Minnesota, and an in-depth analysis of the benefits of linking IT systems, the SHSP, Emergency Medical Services (EMS), 911, trauma systems, and health information systems. The literature and best practices review illustrated many parallel and important technologies and initiatives for enabling an ICTN. Data standards, sensors, integration technologies, performance analysis tools, and functionality across these examples demonstrate that an ICTN could be accomplished over time. However, analysis of several state SHSP’s indicates little emphasis on integrating a wide range of EMS and crash data. Likewise, the case study conducted at local and state levels in Minnesota

demonstrated current challenges and potential benefits of utilizing and sharing cross organizational information for the delivery of integrated emergency medical services to crash victims. The case study findings indicated a need to understand the range of technological, organizational, and governance (policy) challenges to sharing information to gain insight into appropriate solutions. The general approach of this research, to look from one end of service delivery (i.e., crash notification) to the other end of service delivery (i.e., definitive patient care and recovery) and to capture data across each service step, allows for holistic analysis of an incident and patient care. Through this research, we found that “real-time” crash and patient data utilized to the degree envisioned (from end-to-end) does not exist. As such, an initial ICTN concept was developed and a normative architecture designed at a high level to present what the system could be. We posit that the ICTN would not only provide a mechanism to analyze and improve patient care, but would also help improve traffic safety planning. Noting and communicating details about a car crash, such as the type of crash, injury to victim, road conditions, police officer notes, etc. develops a holistic picture of how factors play direct roles in accident prevention. Furthermore, connecting patient data with crash data allows for in-depth analysis of the “combination” of data from a variety of health care professionals, continuing with a “proof of concept” approach to improving safety on the road. On a policy-level, this approach to crash data analysis is in line with SAFETEA-LU’s legislative requirement for SHSPs to perform evidence-based safety planning.

Conclusion

In conclusion, a phased approach to further investigate the development and viability of an ICTN system was proven to be valuable to fully understand its many dimensions. Further comparative case study investigations would aid in the development of a prototype for the system. The use of a prototype would illustrate a real time, end-to-end crash trauma system, demonstrating the expected benefits for safety decision support and planning, with the aim to reduce car crashes, and improve the quality of emergency care.

Chapter 1

Introduction

The SAFETEA-LU legislation mandates Strategic Highway Safety Plans (SHSPs) that are collaborative, comprehensive and based on accurate and timely safety data. A significant challenge exists for transportation planners to identify and use a range of new information sources beyond traditional crash data systems and to identify strategies for sharing a wide range of data across multiple agencies to support evidence-based safety planning. Correspondingly, while intelligent transportation systems (ITS) have long promised safety benefits, there has not been a strong emphasis on examining the extent to which ITS is capable of providing safety related data for clinical health assessment and planning purposes. This research project examines the linkages between ITS systems and the SHSP, focusing on the role of ITS, 911, Emergency Medical Services (EMS), and Trauma systems to provide timely and clinically oriented safety data for system performance improvement and informed decision making.

This report presents findings from the first phase of project research (Tasks 1 and 2) including the analysis of existing information from safety reports (SHSP) and ITS, EMS, and health information systems, and a literature review and case study analysis in Minnesota. The analysis was used for conceptual model development of an integrated information system for better understanding, evaluating, and planning for multi-organizational emergency responses to automobile crashes. This research directly relates to the ITS Institute mission to “enhance the safety and mobility of road- and transit-based transportation through our focus on human-centered technology”, as well as to the TechPlan theme of research aimed at the interface of transportation planning and ITS, and specifically focuses on new elements in transportation planning forwarded through the SAFETEA-LU legislation.

Background and Prior Work

The combination of (ITS) and safety information systems can have a positive effect on the emergency preparedness, response effectiveness and overall safety of state highways (Shepherd, Baird, Abkowitz, & Wegmann, 2006). For example, information technology has been used to assist in decreasing the amount of crashes and therefore injuries experienced throughout communities (e.g., automated speed enforcement, traffic management systems). ITS has also been used to reduce the amount of time it takes for Emergency Medical Services (EMS) to respond to a crash and consequently increase the chances of patient survival (e.g., automatic crash notification, next generation 911). While these systems exist in many areas, there are still many questions about whether “crash avoidance” or “crash readiness and response” is more productive in the impacts they make. In order to better understand, answer these questions, and take advantage of these systems and the opportunities they offer, requires provision, sharing and analysis of the data they generate (T. A. Horan & Schooley, 2007).

In order to act upon highway and traffic safety problems, decision and policy makers need access to accurate, timely and comprehensible information. Transportation and safety data should be accessible to the degree that it can be easily mapped throughout the lifetime of transactions that may occur between automatic crash notification systems, 911 calls, EMS response, admittance

into trauma wards and the eventual status of health outcomes (B. Schooley & Horan, 2007). Safety and traffic fatalities have long been viewed as a policy and public health issue, yet there are few systematic methods to present the full range of possible crash and emergency response information to allow for a comprehensive approach to improving crash response and health outcomes. Furthermore, there are still questions about whether “crash avoidance” or “crash readiness and response” is more productive in the impacts they make.

This research extends previous work on time-critical information services conducted by our research team (T. A. Horan & Schooley, 2007). In our prior work, we developed a conceptual model for analyzing organizational, operational, and governance dimensions of performance information sharing across multiple cooperating EMS organizations (T. A. Horan & Schooley, 2007). The framework was applied within a comparative case study in San Mateo County, CA and with the Mayo Clinic in Southeast MN (B. Schooley & Horan, 2007). A key finding of the case study work was an identified need for more focused attention on the clinical requirements of emergency care practitioners for a wide range of crash and incident information to enhance their real-time capabilities to assess patient needs, assign appropriate resources for providing care, and determine the effectiveness and efficiency of emergency care practices across the end-to-end emergency care process. This research is positioned to address this identified need in more depth and in a manner that connects to safety planning and ITS directions and possibilities.

This research project is taking place in multiple phases. This paper reports on Phase 1, which has ensued from January through May, 2008. More specifically, this report provides:

- A review of recent research on information integration for emergency response to crashes
- A review of current ITS systems and practices that address components as well as challenges and opportunities for integrated information sharing for automobile crash emergency responses
- A case study analysis of “on the ground” efforts at the State and local level to integrate and utilize cross-organizational information for EMS responses
- Identification of the underlying components that would describe the architecture for a crash trauma information network (CTIN)
- Recommendations based on the above analysis for moving forward with additional research and development of an integrated crash trauma information network (CTIN).

Methodology

This study uses multiple methods to consider, devise and examine the use of advanced information systems to improve emergency response services and outcomes. First, a literature review was performed on the use of ITS and IT systems to integrate data across crash, EMS, and trauma organizations and information systems. Next, several state strategic highway safety plans (SHSP) were analyzed to understand how EMS and trauma data and information systems are addressed within safety planning processes. A “best practices” review was then conducted to scan various innovative IT systems that have been implemented and/or tested for the purpose of

providing decision tools to cross-organizational decision makers. Findings from these analyses were grounded in a case study investigation in Minnesota at the State and local (Rochester, MN) level. This led to conceptual model development and information framework development. Analysis across these various methods provided a multi-layered understanding of statewide safety performance features.

Chapter 2

Review of Research and Best Practices: Integrated Crash, EMS, and Trauma Information Systems

Key to the development and implementation of EMS level technologies and services is understanding how pre and post EMS activities affect opportunities for EMS process improvements and related health outcomes. Our previous research identified that there are a multitude of Inter-organizational gaps in regards to data access and integration across crash notification, pre-hospital services, hospital and post-hospital health services, and post-crash assessment. It is necessary to analyze these gaps in order to provide effective patient tracking across the incident timeline and consequently assist in providing grounded recommendations for EMS strategies and increased value to organizations down the emergency response service chain (Benjamin Schooley, Marich, & Horan, 2007). In order to better understand where these opportunities reside it is important to have a firm understanding of current research and practices within each domain. Perhaps the best way to frame the review is to consider the end-to-end EMS process, from a vehicle crash through until hospital discharge (T. A. Horan & Schooley, 2007) see Figure 2.1).

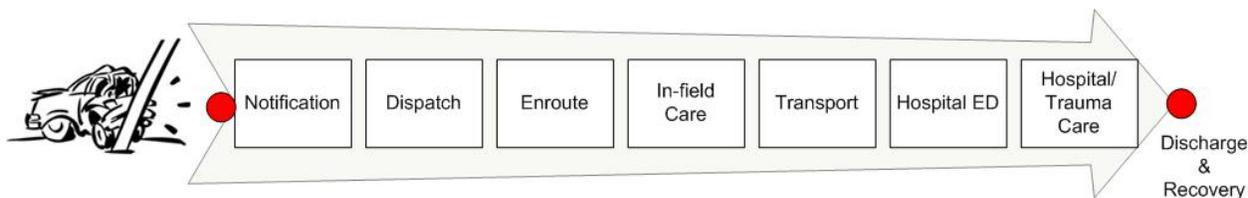


Figure 2.1 Emergency Response Process (Adapted from Horan and Schooley, 2007)

Across these processes, we have identified several ITS and hardware and software communication technologies commonly used in the collection, transfer, and analysis of crash incident and EMS response information from one organization to another. For the purposes of this research, it is important to understand what these technologies and processes are in order to gain an “information integration” architectural perspective. Table 2.1 describes these crash emergency response intervals and the technologies commonly used within and across them.

Looking at the overall emergency response process (Figure 2.1), our review has focused on technological advancements and current research within the fields of automatic crash notification (ACN), next generation 911 (NG911), EMS to trauma communications, electronic health record systems (EHR), and integration across each. From this effort opportunities are sought toward identifying key touch points between these systems through which a comprehensive and more integrated trauma information network can be described.

Table 2.1 Emergency Response Process Intervals and Sample Technologies Used

Process Intervals	Example Information Technologies Used
Pre-Incident Preparation	Electronic Personal Health Record (PHR) for emergencies (the AAA card for personal health emergencies)
From “crash” to “notification”	911, E-911, ACN technology and integration (e.g., Mayday system)
From “notification” to “dispatch”	Computer Aided Dispatch (CAD), traffic management systems, GPS+GIS, mobile data terminals (MDT's), decision support tools, 2-way radios, pagers, cell phones
From “dispatch” to “arrival on scene” (in-field care)	Computer Aided Dispatch (CAD), patient care record (PCR) systems, traffic management systems, GPS+GIS, mobile data terminals (MDT's), decision support tools, 2-way radios, pagers, cell phones, navigation systems
From “arrival on scene” to “departure to hospital/trauma center” (in-field care and transport)	Patient care record (PCR) systems, decision support systems, telemedicine applications (remote care), wireless data communications, hospital availability/diversion systems
From “departure to hospital/trauma center” to “arrival to hospital/trauma center” (transport and handoff to hospital emergency department (ED))	Patient care record (PCR) systems, traffic management systems, GPS+GIS, navigation systems, hospital availability/diversion systems
From hospital “admission” to “discharge”	Hospital emergency department admissions/registry, trauma registry, electronic medical records, clinical information systems, electronic lab/radiology systems, clinical decision support
Post-incident evaluation	CODES, data warehouses, business intelligence, crash analysis reporting systems (e.g., FARS), other reporting and analytics

Automatic Crash Notification (ACN)

Advancements in Automatic Crash Notification (ACN) systems has allowed for decreasing the amount of time that occurs between the onset of a crash and the time that it is reported to 911 dispatch or other emergency services. The need for these systems are illustrated in light of data that shows average emergency response times in urban areas are significantly shorter than in rural areas, largely due to the additional time needed to respond to distant and often remote locations (T. Horan, McCabe, D., Burkhard, R., Schooley, B. , 2005). Additionally, while urban areas are impacted by more crashes on average, due to the increased length of response time, rural areas make-up 58% of fatalities (NHTSA, 2008).Further supporting the critical need for effective response are findings suggesting that survivability is increased for those cases were EMS is promptly notified and dispatched (Clark & Cushing, 2002).

While the potential for ACN systems to help save lives may be high, we have observed that in order to be of benefit ACN systems will need to be effectively integrated into the overall emergency services system, including tailoring ACN information output to the needs of physicians (B. Schooley, Horan, & Marich, 2008). On a related note, the impact of ACN on

patient health outcomes will be limited so long as penetration of the technology in vehicles, and throughout the larger marketplace, remains small (IIHS, 2002). Outside of the effort to report the time of crash and send EMS teams to the incident scene as quickly as possible, it has also been identified that there are critical elements to the crash information itself that needs to be reported so that EMS can respond effectively once on scene and then take the patient to a medical center that can properly treat their wounds. For example, Augenstein, et.al (2005) make several recommendations for priorities in transmitting crash data including aspects such as general crash severity, direction of impact, multiple impacts, age of passengers, use of seat belts and other indicators. While issues to implementation remain, there is significant evidence that ACN systems should be a critical component of a larger crash trauma information network system.

Next Generation 911 (NG-911)

To date, emergency 911 phone calls, whether communicated through traditional “wired” or more recent “wireless” networks, are an essential part of the public safety network. As such, 911 has been targeted as an essential component of an integrated “voice and data” emergency communications system. Toward this end the Hatfield Report (2002) provided recommendations toward upgrading 911 infrastructures while at the same time acknowledging the organizational difficulties in doing so. Due to these observations a 911 Bureau has been established and is charged with considering how to effectively develop a 911 network that can sufficiently address improvements and opportunities made available by Internet Protocol (IP) networking standards, voice over IP (VOIP) communications, location identification techniques and public safety answering point (PSAP) processes and resources (Moore, 2008).

This next generation of 911 services (NG911) will be charged with providing faster and more accurate information delivery, a broader range of information data forms (i.e. location data, multimedia), and increased elasticity and security of PSAP methods (Dodge, 2007). Importantly, the technologies that would allow us to describe such a scenario are already available to us within isolation; it is when we seek to integrate them that difficulties both technologically and organizationally are encountered. For example, advancements in VOIP technologies are providing alternative means for acquiring the physical location of emergency callers (Kim, Song, & Schulzrinne, 2006). Unless the VOIP user registers their phone number and address with their particular VOIP service provider, then their location will not be registered and sent to the appropriate PSAP that would map their location and dispatch emergency resources (Moore, 2008). NG911 is charged with developing methods to overcome such challenges.

ACN and NG911 systems must be tightly integrated into the overall emergency system in order to effectively initiate the chain of events that will increase a crash victim’s chance of survival. Proof of concept demonstrations like those provided by GM’s OnStar technologies, in which crash notification messages previously routed manually were routed straight to the appropriate PSAP (Battelle Company, 2006), show how data integration practices can assist in cutting crucial minutes off of EMS response times. It is these types of efforts of transportation system integration that now need to be further enacted at the next link within the EMS response chain involving communication between NG911 systems, the EMS teams that respond, and efficient routing of patients to trauma centers that can best provide therapies for patient injuries. Our discussions with GM OnStar representatives have confirmed the value of the next step in ACN integration (B. Schooley et al., 2008). On a related note, GM OnStar is currently sponsoring

work at the Center for Disease Control (CDC) to analyze how “real time crash data from OnStar’s Advanced Automatic Crash Notification (AACN) vehicle telemetric system and similar systems from other companies can be used to determine whether occupants need care at a trauma center” (CDC, 2008). As such, and as illustrated here, an important element of an integrated system would be to integrate NG911 systems with ACN, EMS, and trauma systems for improved response and care delivery to crash patients.

National Emergency Medical Services Information System (NEMSIS)

Computer-aided 911 dispatch systems and electronic patient care record (PCR) systems used by paramedics in the field have been used and improved over the past few decades. It wasn’t until very recently that data inter-operability and standards initiatives enveloped the software industry that develops these particular products. The National EMS Information System (NEMSIS) is a data standard that allows for transfer of EMS data in the “pre-hospital” setting. As of October 18th, 2007, 52 states had signed on to adopt the NEMSIS data standard, the benefit being that standardized protocols have been created for local, state, and national level information transfer to allow for “pre-hospital” research and analysis (Mears, Ornato, & Dawson, 2001; NEMSIS, 2008).

Systems prior to NEMSIS, such as the Automated Incident System (AIS) used by Utah, lacked reporting and analysis abilities. The Utah AIS has been replaced by a system that is compliant with NEMSIS called the Pre-hospital Online Active Reporting Information System (POLARIS). This system allows data analysis from many different emergency medical services organizations, as displayed in Figure 2.2 below (POLARIS, 2008). While implementations such as these are still novel, it is important to note that these are focused on integrating “pre-hospital” information and do not currently include crash, crash analysis, trauma, or other hospital information needed for more holistic evaluation of a patient. In terms of an integrated crash trauma information network, connecting NEMSIS-enabled software systems with hospital ED and trauma systems would be a next important step.

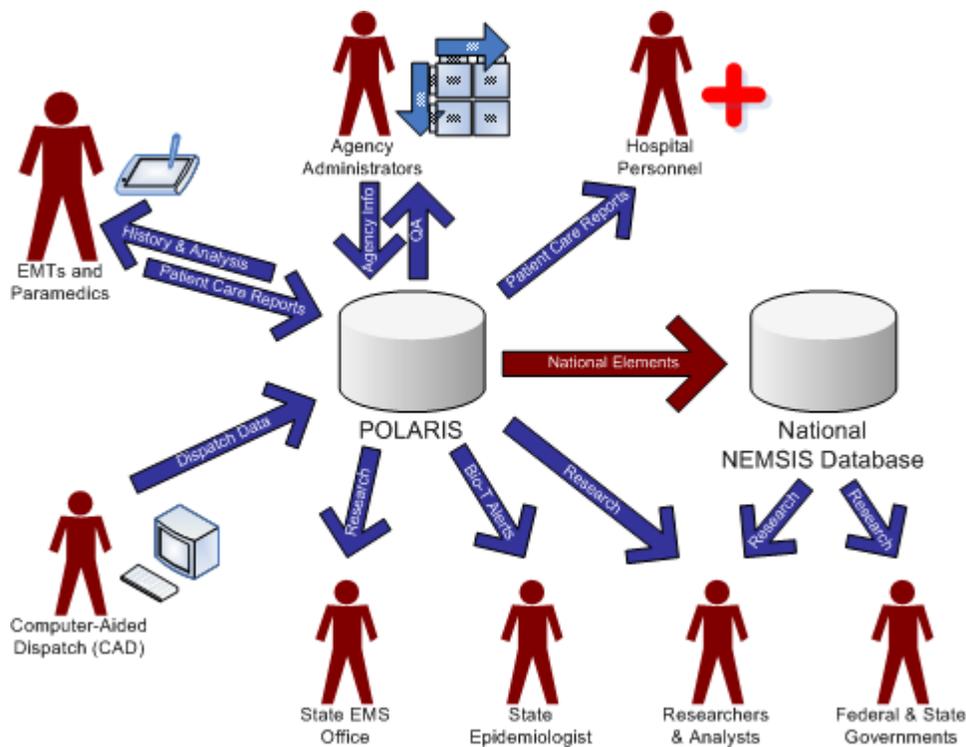


Figure 2.2 Data Lifecycle of Pre-hospital Patient Care

Diagram extracted from: <http://health.utah.gov/ems/data/polaris/overview.html>

EMS and Trauma Communications

While NEMSIS is important and essential, little is known how that information will be used in a clinical environment such as an emergency department or trauma center setting due to the few implementations that have taken place to date. It is also unclear how NEMSIS-enabled systems will integrate with hospital and trauma center data systems – a critical issue to be understood and determined. Trauma centers themselves have long had issues with information sharing. For example, Mann, et.al (2006) note that although statewide trauma registries have been implemented since the 1970s, that data comparability across hospital registries is still of limited status and moreover that this component of trauma information integration has not been evaluated to an appropriate extent. Found within their own study was that currently, maintenance of a centralized trauma registry is happening statewide across 32 different states through which between 70-80% of them require hospitals to report data. While encouraging, it is noted that for many of the states that have implemented a statewide trauma registry there is still wide variability as to the types of hospitals that are responsible for reporting injury data and a high degree of variability as to the way in which specific trauma elements are coded and characterized within trauma registries.

To address this issue, the National Trauma Data Standard (NTDS) initiative, formerly known as the National Trauma Registry, has been formed to define standardized data elements collected by the American College of Surgeons within the National Trauma Data Bank (NTDB). Its goal is to

homogenize the data in the NTDB, which contains patient information from across the nation. It has been planned for the NTDB and NTDS to be implemented in 2009. This development represents a significant component of an integrated crash trauma information network.

It will be important to understand how these efforts, will enable improved information sharing capabilities across EMS and hospital/trauma center domains. For example, one problem that needs resolution is the current general lack of coordinated systems to ensure that EMS know which facility would be most appropriate for transporting a trauma patient (Institute of Medicine (IOM), 2006). Paramedics need to know which medical centers have the equipment and staff with skills necessary to effectively treat the victim. *It has been reported recently that patients who suffer traumatic injuries have a 25% better chance of survival if taken to the appropriate trauma center according to the severity of their injuries* (Landro, 2007). As can be seen from these examples, one does not have to travel far into the trauma information systems network to identify the compound effect that a lack of standards, inconsistent reporting practices and incompatibilities between information systems will have on the health outcome of a patient. Existing projects such as the Crash Outcome Data Evaluation System (CODES) project to be described later are leading efforts toward tying information across all of the related crash data points from crash time to hospital exit in hopes of identifying opportunities for improvement and prevention (NHTSA, 2008).

Electronic Health Record Systems

Once the patient is transferred from the hands of the EMS staff they will be held within the care of trauma, inpatient, and outpatient and specialty care providers and consequently the patient's health information will be held within the different and various electronic health record systems used by those care provider organizations. Much of the current focus of clinical IT within the provider setting includes nursing and physician documentation systems, electronic medication administration records and computerized physician order entry (CPOE) systems. When well-implemented as part of a new healthcare infrastructure, these applications provide the foundation for more reliable, safe, and error-free care (Metzger, 2007). Conversely, while this provides the necessary information services for recording data as it relates to the in-hospital services provided, it does not describe efficiencies that could be gained through incorporation and visualization of pre-hospital data as it comes in for viewing by the physicians charged with providing immediate care to the patient. Furthermore, it is likely that there is considerable benefit and value to be found through the re-funneling of patient health outcome data back to the EMS organizations that began the original treatment of the patient. Preliminary efforts have noted that organizations are at times limited in their ability to access vital data related to end-to-end EMS services (Institute of Medicine (IOM), 2006). Although these studies have identified a need for integrating data across the spectrum of EMS and trauma services, there have been no empirically established efforts related to data integration across these domains (Benjamin Schooley et al., 2007).

Tracking Patients across the Emergency Care Process

An essential component of an integrated crash trauma information network is the ability of the "system" to track a patient from crash, through EMS response, hospital emergency department registration, trauma care, and rehabilitation. "Patient tracking", while originally conceptualized

as a way to locate disaster victims and reunify them with family members in the aftermath of a disaster, also provides an underlying capability to connect information and thus provide real-time and retrospective performance analysis and feedback (Joint Advisory Committee on Communications Capabilities of Emergency Medical and Public Health Care Facilities (JAC), 2008). Recently, the Virginia Hospital & Healthcare Association (VHHA), together with COMCARE, launched an Integrated Patient Tracking Initiative (IPTI). The initiative was conceptualized as a way to capture and distribute patient location information gathered by a range of EMS stakeholders in several counties in Virginia. The overall goal is to develop a national framework that can be used by communities and regions when obtaining and organizing patient tracking systems (COMCARE & Emergency Response Alliance, 2006). While the framework will describe how to track patients and the technical systems needed to do so, it does not describe the requirements or methods needed for reporting and analytics.

Data Integration and Analysis across Domains: The Crash Outcome Data Evaluation System (CODES)

As discussed previously, patient and crash incident data typically resides in many separate and disparate databases that are not easily integrated. CODES was funded and developed by NHTSA for the purpose of taking disparate data sets from crash, EMS, trauma, and related databases to perform a “probabilistic” linkage of data across systems. The system essentially links a crash with patient information in order to assess health and economic outcomes of crashes. Several states have utilized CODES (e.g., Utah, Minnesota, and Massachusetts). One notable example of the value of using CODES, and integrated crash trauma information more generally, was the passing of a Utah Senate Bill. In Utah, CODES has been implemented and well utilized as an important tool to analyze and interpret data collected from a variety of databases to recognize major causes for crashes. This data is then used to create State programs to improve conditions and create awareness about traffic safety. In 2001, data collected by CODES helped pass Senate Bill 48, *Passenger Limitations for Young Drivers*. This bill allows teenage drivers to have passengers in their vehicle only if they are accompanied by a licensed driver over the age of 21 years of age. To help pass this bill, CODES personnel used their database to formulate a fact sheet on the frequency, health outcomes, and costs associated with crashes involving teenage drivers. The fact sheet was distributed to legislators, CODES personnel answered questions at legislative hearings, and the data was cited in newspapers and on television. The governor signed Senate Bill 48 into law on March 15th, 2001 and the bill went in to effect on July 1, 2001 (NHTSA, 2008; Utah Codes, 2008).

While the implementation of CODES represents a significant advancement in terms of crash trauma information integration, the limitation of CODES is that it relies on “archival”, or past data. The implication is that data collection into the “integrated” database still requires a significant amount of manual human processes. Second, data analysis is primarily retrospective looking at incidents from one or several years in the past. In addition, not all crashes can be linked with EMS and trauma data due to unresolved redundancies in the information and a lack of a unique data identifier across all systems. Anecdotal evidence from practitioners described a 70-80% probability of reliable data linkage. This is a significant limitation for conducting analysis if the desire is to conduct analyses on the most recent day, week, month, or six months of data. This current research project seeks to understand how to build and enable an

information infrastructure that facilitates more “real-time” analysis, particularly from a clinical performance perspective.

Implication of These Systems for Our Research

This (Task 1) review provided an opportunity to review a variety of system developments that are underway for each stage of the emergency response (e.g. ACN) as well as preliminary efforts to link data elements for research and public health purposes (e.g. CODES). However, this review also confirmed a major premise of our research: the need exists to consider the value of an integrated crash trauma information network (ICTIN) for aiding in the detection, notification, response and treatment of crash victims. Moreover, while these various silo systems are in place, achieving linkages between them is not only a technological challenge, but a challenge that requires organizational and policy level attention as well. The policy-level attention begins with a review of State Highway Strategic Plans (SHSPs), as these plans represent the newly required planning vehicle for implementing new safety approaches.

Chapter 3

EMS Priorities within the Strategic Highway Safety Plan

Development of Strategic Highway Safety Plans (SHSP) is now a Federal requirement based on SAFETEA-LU, 23 U.S.C. § 148. Within the recommendations for creation of SHSPs is a four level framework for priority of services including Engineering, Education, Enforcement, and Emergency Medical Services (EMS) which are referred to as “the four E’s. It is recognized that of the four E’s, EMS is a fairly new focus and is based on the identification that improvement of EMS and surrounding services can provide opportunities for a more integrated safety effort. Furthermore it is generally understood and documented that no matter what efforts are taken to ensure strong engineering, enforcement and education programs, that effective EMS services are essential for positive patient health outcomes from traffic crashes that invariably occur (US Department of Transportation, 2006).

General guidance for SHSP includes several recommendations directed specifically as EMS related priorities. Recommendations from AASHTO (2006) for EMS related strategies included:

- Development and implementation of comprehensive models that would assist in ensuring effective response to crashes
- Increase education and involvement of EMS professionals in general traffic safety principles
- Provide for an emergency preparedness model for urban, rural and wilderness high-incident interstate highway settings
- Improve and integrate trauma systems
- Encourage and disseminate EMS/public health/public safety information and program activities

SHSP Comparison and Current Projects

Table 3.1 below provides a matrix briefly describing a survey of six current state SHSPs. Highlighted within are descriptions specific to safety and EMS related efforts and the demonstration or proposed project as described by the different states. These descriptions are provided by state and program-wide SHSP reports (More & Munnich, 2008) through which several (but not all) states have outlined specific plans toward addressing EMS related improvements within their state specific SHSPs. The purpose in evaluating SHSPs across different states was to identify where the majority of states focused their EMS improvement efforts and to assess the value obtained from specific project demonstrations.

Table 3.1 Comparison of SHSPs

SHSP EMS Related Descriptions	SHSP Described Efforts & Demonstrations
<p>Minnesota Focus: Creation of a statewide system to reduce crash response times by improving patient to trauma ward routing practices.</p>	<ul style="list-style-type: none"> - Improvement on ACN and 911 routing communications and development of rural intersection decision support technologies
<p>Alabama Focus: Reducing the time from crash to care by ensuring that trauma patients are transported to an appropriate facility with resources to care for patient injuries.</p>	<ul style="list-style-type: none"> - Provide advanced crash victim location through GPS technologies, make efforts toward statewide EMS quality and services coordination and increase consumer education on traffic safety
<p>Maryland Focus: Improving EMS services across a range of technology, process, and program improvement.</p>	<ul style="list-style-type: none"> - Improve electronic data and voice communications for emergency response and improve resource deployment for EMS response.
<p>California Focus: Reduce crash-related fatalities by at least 5 percent from 2004 levels through improvements in EMS system communications, response and safety education.</p>	<ul style="list-style-type: none"> - Advance technologies for locating crash sites, improving EMS access routes, dispatching, decreasing response times and increasing overall EMS system resources and effectiveness
<p>Utah Focus: Review of current systems in order to increase opportunities for crash data use.</p>	<ul style="list-style-type: none"> - Plans to advance development of technologies to analyze, and distribute crash data in a timely manner across multiple agencies with goals of increasing quality assurance standards
<p>Washington Focus: Continued efforts in developing Washington’s EMS and Trauma Care System (EMSTC).</p>	<ul style="list-style-type: none"> - Improve communications between response agencies, implementation of dispatch protocols, statewide implementation of GPS technology and continued efforts in partnerships to improve data

From a preliminary analysis of state SHSPs, a handful of states such as those described in Table 3.1 have made efforts toward improving EMS and trauma data systems to help drive safety planning efforts. Looking across these plans, we found that state efforts are divided between projects focusing on crash notification, crash identification and location (GPS), and improved data and systems collaboration between EMS and trauma agencies.

To take two examples, the Minnesota SHSP emphasizes comprehensive implementation of a statewide trauma registry as the key to improving EMS, whereas the Alabama SHSP utilizes a strategy targeting several specific problem areas related to EMS (i.e., crash notification and location, education of first responders, etc.). Minnesota's use of a broad strategy is supported within the SHSP by the following statement (MnDOT, 2005):

“This strategy is not intended to address a particular driving population, crash type or contributing factor, but instead is meant to improve patient care after a crash has happened. A statewide trauma system reduces both time-consuming secondary patient transfers and the time patients linger in emergency rooms and ambulances before receiving definitive care. This will be of particular benefit to patients in rural areas. Hospitals participating in the trauma system will ensure that health care practitioners have specific trauma education and treatment/transfer guidelines, which enhances the level of care and efficiency in treating the trauma patient. Further, a trauma registry supports a comprehensive process improvement program that ensures participating hospitals review actions and outcomes of each trauma case, from EMS arrival to patient discharge.”

The Minnesota SHSP describes their hope is that these improvements will result in achievement of their overall goal of having 500 or less traffic crash fatalities per year by 2008. Alabama on the other hand is managing their EMS strategy through several key projects that all have an impact on crash fatalities. The SHSP of Alabama (UTCA, 2006) outlines focus areas that will address 1) collection of trauma and care data in part through use of a Patient Care Report System, 2) improvement of the capability of first responders (often police) to offer better care to trauma victims, 3) improvement of the capability to locate victims through further use of GPS technologies, 4) strengthening the overall EMS profession so that practitioners are equally represented across the state, especially in places such as rural areas where having reasonable access to EMS responders is deemed low.

The examples provided above illustrate that SHSPs are a vehicle that need to address improvement of emergency responses to crashes through collaboration and ITS efforts. It should be noted however, that for many states less tangible descriptions of specific EMS and Trauma system improvement efforts are available. Through conversations with state and federal DOT leaders it is generally recognized that while EMS priorities are included within the plan, for many there are simply no specific tactics for addressing practice and improvements. However, there is consensus and agreement that these needs are important and that a path forward needs to be articulated.

The above review and analysis, taken together, led to the need for an “on the ground” investigation of how the discussed concepts are instantiated in practice. The next section of this report discusses findings from State and local case study investigations.

Chapter 4

Case Study Analysis-Minnesota Findings

The previous analysis of literature and best practices review provides a basis for devising a normative architecture for integrated crash trauma information systems. To “ground” this view, an in-depth case study was conducted at the State and local level. The state level analysis was conducted with decision makers at the various state level agencies involved in collecting and analyzing automobile crash incident and related emergency response and trauma care data. The local case study was conducted at the Mayo Clinic in Rochester, MN.

State Level Stakeholder Focus Group and Evaluation

Researchers sought to understand, from the State level practitioner perspective, how crash, EMS, and trauma information is being integrated and utilized in the State of Minnesota. A series of (one) focus group discussion and (2) follow-on interviews were conducted with state level Agency decision makers to better understand how to utilize information systems for improved access and integration of data. Moreover, the discussion focused on how to conceptualize the “next-generation” system that would not only facilitate the analysis of large archival data sets, but also allow for more real-time analysis and use of information from a clinical standpoint. Organizations involved in focus group discussions included the Emergency Medical Services Regulatory Board (EMSRB), the Health Department (State Trauma System), Department of Transportation (ITS Program and Office of Traffic Safety), and Department of Public Safety (Traffic Safety).¹ In these focus group discussions, an overview of the research approach was presented. Participants responded by discussing the importance of information sharing, the need for more integrated information systems at the State level, and the value of including such an initiative as part of the statewide “Toward Zero Deaths” initiative – a statewide cooperative of numerous traffic crash related organizations with the common goal of reducing annual traffic fatalities to zero. Focus group participants validated preliminary case study findings in terms of issues and challenges for constructing a statewide integrated crash trauma information system, as well as solutions that could greatly benefit the effort to reduce traffic crashes and improve public health.

In terms of operational challenges, participants described how information collection practices are typically not described or enforced at the state level. For example, real-time information sharing is difficult in part because ambulance providers are not required to input patient information into electronic systems at an emergency scene. Reporting typically takes place after a patient has been delivered to a trauma center, not providing the capability for physicians to access the information prior to even at patient arrival to a trauma center. In addition, the electronic patient information cannot be wirelessly transmitted because either the wireless infrastructure is immature, or there isn’t adequate funding to pay for wireless information

¹ The focus group discussion was held on March 14, 2008 at the Minnesota Department of Public Safety. A teleconference was held with MN State EMS Board Representative on February 12, 2008 and a teleconference was held with Minnesota Department of Transportation on April 9, 2008.

services from a major wireless telecommunications carrier. Yet participants also noted potential opportunities. For example, many vehicles are equipped with a “black box” that provides a record of information about an automobile crash. These boxes could prove a valuable data source for crash analysts, state patrol officers, EMS, traffic safety, and trauma practitioners if it were accessible and utilized.

Organizational challenges also exist related to the changes taking place across the State of Minnesota, especially in regards to the consolidation of 911 dispatch centers (also referred to as PSAPs). The State is currently in the process of consolidating the over 121 individual local level PSAPs to larger county level dispatch centers. While these shifts are in transition, there is a great deal of ambiguity in roles and responsibilities and reshifting of work priorities across the local and county systems. Trying to improve information sharing in such an environment creates additional challenges that must be recognized. At the State level, participants discussed the lack of people and resources to “crunch numbers” and conduct data analysis. While there is a push towards “evidence-based” decision making and more data analysis, there is a lack of people and skills necessary to conduct the analysis that has been demanded. One participant stated that they are focusing so much on getting and linking data that they have not been able to actually conduct analysis on that data. In terms of the various hospitals in the State, participants discussed the competitive nature of hospital service areas and this often causes barriers to sharing information. For example, the hospitals do not want to give away how much they are charging patients for services to competing hospitals.

At a policy level, participants discussed how State level agencies face many legal, policy, as well as “perceived” barriers to sharing crash, EMS, and trauma information related to a crash. For example, participants noted the progressive privacy laws enacted in Minnesota that have made it difficult for agencies to conduct crash and related public health analyses. Often the privacy laws are cited as barriers to sharing information across agencies and at times even across departments within a single agency, even in cases when written privacy policies and laws allow for information sharing. For example, the Office of Traffic Safety finds it difficult to access information from the Office of Driver and Vehicle Services, even though both departments reside within the Department of Public Safety.

While many obstacles were discussed, participants agreed that there exists substantial motivation to progress towards a more integrated, yet secure and private, information sharing environment to improve patient care, reduce crashes, improve emergency care, and reduce disability consequences, fatalities, and associated costs across the State. Participants discussed the need to move ahead with data sharing agreements for research purposes in order to provide a “proof of concept”. The State level participants recommended that this demonstration system be developed as a way to provide an overview and example of some of the benefits to an integrated data system. Furthermore, participants supported the notion that the process be a research oriented approach to finding a long-term solution. Participants also noted the need for a multi-phased approach and the need to define those phases through research due to the enormity of realizing such a long-term vision of integrated data sharing across the State. The research approach should include stakeholders from across the full spectrum of crash and emergency response organizations, integrate with “Toward Zero Deaths” programs, involve state trauma board of physicians to provide a “clinical” perspective on data sharing, and take a multi-phased approach

to development beginning with architecture development, prototype creation and testing, and demonstration of a “proof of concept” as a fraction of the larger system.

Local Case Study Analysis: Mayo Clinic Rochester, MN

Researchers conducted a case study of the local Rochester Minnesota Mayo Clinic trauma information system. Building on prior collaboration with the Mayo Clinic, the goal of the case study was to explore the use of intelligent transportation systems (ITS) and information technology more generally, to support emergency response efforts from the time of automobile crash notification, through dispatch, response, and patient care at the receiving trauma center. Researchers investigated information technologies used across this emergency continuum of care and then held a series of focus group discussions with Mayo Clinic practitioners to understand how information technology could be better utilized to exchange patient information across emergency care providers.

Methodology

Three focus group sessions were conducted at Saint Mary’s Hospital (part of the Mayo Clinic) in Rochester, Minnesota. Participants in the focus groups represented organizations across both pre-hospital and hospital domains. The personnel included members of the Mayo Clinic Emergency Communications Center, Mayo Medical Transport (ambulance provider), Corporate Communications, Information Technology, Emergency Medicine Physicians, and a Trauma Surgeon. Overall 14 Mayo Clinic personnel participated in the focus group sessions

An interpretive approach was used to analyze the transcribed focus group discussions in order to understand the cross-organizational information processes and procedures that influence performance across an inter-organizational emergency response and medical environment. Findings were organized along operational, organizational, and governance dimensions as prescribed in Horan and Schooley (2007), who developed a framework for analyzing inter-organizational emergency response systems. This analysis resulted in twelve themes, or characteristics, that the case study participants desired from the next-generation trauma information system.

Findings

These findings encompass three main dimensions – operational, organizational, and governance – resulted from the focus group sessions conducted at the Mayo Clinic. A summary of these findings is described below.

Operational Linkage Issues

Unified Patient Records – while integrated medical records and associated software to capture patient information are used by the Mayo Clinic hospitals, the pre-hospital sector (first responders, ambulance provider, 911 communications center) is not integrated into this information system. The implication is that the care providers that arrive to an automobile crash incident are not able to utilize pre-existing patient information. Nor is that information forwarded on to a receiving emergency department. Focus group participants noted how having such

information could significantly reduce data collection time on scene and also provide much needed information (e.g., medications, pre-existing medical conditions, allergies, blood type, emergency contact information, etc...) to help reduce medical errors and increase quality of care provision across the emergency response continuum of care. An integrated system should allow for identification and “pulling” of patient information from each authorized care provider.

Pre-hospital to hospital performance information sharing gap – the ability to easily share data between both pre-hospital and hospital domains inhibits a complete end-to-end perspective on performance. Focus group participants discussed the need to evaluate performance in a more holistic manner. Crash, EMS, and trauma information for the same crash incident exists in different databases in different organizations. The ability to integrate data across these “silos” would enable clinical and operational performance analysis across the entire emergency response from beginning to end. One example provided was that there currently exists no way for decision makers to know how ambulance response timeliness, for which data exists in the ambulance provider database, translates into better (or worse) patient outcomes, again for which data currently exists in the hospital database. Conducting such an analysis today would be very time consuming and error prone due to the complexities associated with data integration across disparate data systems. The “next generation” system should facilitate performance reporting across emergency response organizations.

Clinical Usability – personnel operating within a mostly bottom-up culture are eager to make requests for system improvement, including the software systems that they are required to use on a daily basis. They would like computer interfaces that are easier to use, enable automated data capture as opposed to manual data entry, and that “fit” with their emergency care processes as opposed to getting in the way of their time-critical work. However, there are many challenges associated with adopting new technology and difficulties arise in trying to determine the correct mix of technology to be used with existing data systems. Open, standardized, and interoperable software systems are key to allowing for continuous enhancements for more user friendly features.

Data Communications and Standards – personnel are acutely aware of the national movement towards data interoperability and standards development. Several participants noted their involvement in many national conferences and policy groups working to reconcile data communications and standards issues. Participants discussed the essential need to adopt standards to allow for enhanced levels of information integration across organizational boundaries.

Organizational Linkage Issues

End-to-end Awareness – participants discussed the existence of a great deal of performance and quality improvement activities within each organizational unit (hospital, ambulance, 911 communications, etc...). Yet, there is also a need for each unit to present a stronger business case for cross-organizational information sharing initiatives. While an advisory board exists that includes members across organizational units, participants noted that the entire multi-organizational system could benefit by devoting more attention on inter-organizational discussion and training on the importance of “end-to-end” performance, thus forwarding the system wide thinking and culture to allow for integrated information systems.

Individual and Organizational Performance Feedback – an important aspect to high quality performance at Mayo Clinic is that emergency teams receive formal feedback on their individual performance. Mayo Clinic personnel also provide informal feedback and training to outside ambulance transport service personnel in the surrounding communities. In addition, the Clinic operates a world-class simulation center to develop and enhance personnel skills with a goal toward improving patient care. As an important aspect of the Mayo culture, new and innovative ways to make feedback more far reaching and “real-time” would be a valuable system improvement. An example enhancement included the ability for a paramedic to check on the status of a patient that he or she provided care to at the scene of a crash. A data system that enabled such a “feedback loop” would allow for individuals to “self check” their individual work activities and performance.

Team Interaction – participants discussed how interaction among emergency response team members is excellent within the immediate vicinity of the Mayo Clinic (i.e., Rochester area); however, outreach activities are also necessary for outlying areas and non-Mayo organizations (e.g., State Patrol, other ambulance companies). Participants alluded to how interaction with practitioners across emergency response organizations would allow for a greater level of organizational trust and cooperation that could enhance information sharing and performance improvement.

Stakeholder Involvement – Mayo Clinic personnel discussed the benefits of working with legislative groups at all levels of government in order to find innovative ways to progress trauma care in their region. Stakeholder involvement at all levels of government, as well as with all participating emergency response organizations, is essential to improving services. Participants agreed that taking upon themselves the role of “facilitator” to involve a wide range of stakeholders had been important for Mayo’s cultural focus on continuous improvement.

Governance Linkage Issues

Use of Contracts – within the Rochester, MN area, the Mayo Clinic controls almost the entire end-to-end provision of service, from 911 medical phone calls, to air or ground ambulance response, to trauma care. Outside of the Rochester area there is mixed control including first responders as well as sub-contracted and volunteer ambulance providers. As such, the larger, regional emergency medical services (EMS) system is similar to many other EMS systems throughout the United States, constructed of many different, loosely coupled, and sometimes competing organizations. When outside the boundaries of control, the Mayo Clinic is faced with the financial and technical aspects related to inter-organizational information sharing and the need for contracts to enforce service performance levels.

Non-contract information sharing – networks of cooperating and collaborating organizations outside of the Mayo system have been established for the purpose of infusing the Mayo Clinic’s philosophy of high quality patient care. Information sharing and service cooperation often takes place without formal binding contracts in place. This is often at the expense of the Mayo Clinic. But the philosophy is that care provision at the Clinic will be enhanced if inter-connected care providers work like they do – with a focus on quality patient care.

Policy Opportunities – participants noted that opportunities to advance trauma care and information integration must be continually sought after at the state, national, and international level in order to leverage larger activities and continue to remain an innovation leader for improving trauma care to crash victims. Seeking after and leveraging related opportunities (e.g., grant funding) from a range of initiatives and programs (e.g., Homeland Security) provide added benefit and momentum to carry information integration forward.

Resources – many professional staff members are afforded the opportunity to spend a portion of their time doing research or supporting various process improvement initiatives. However, the Mayo Clinic is no different than other parts of the country in that resources will always be limited and priorities for spending must be determined. Costs for advanced inter-organizational information systems remain and individuals with highly technical skills to enable and manage such data systems remains prohibitive in many cases.

Outcomes

Taken together, these findings provided validation for the literature search conducted and grounded those findings through an investigation of actual service provision and related information systems to facilitate such. These findings also provide a high-level description of the characteristics of an integrated crash trauma information network system from operational, organizational, and policy perspectives of end users of the system. The pre-hospital to hospital information sharing gap was identified as a primary area that warranted further research for the likelihood of attaining performance improvement in the area of patient information hand-off. A significant approach moving forward would be to understand how to structure the implementation of these findings across the range of pre-hospital and hospital organizations in the Rochester, MN trauma service region.

Chapter 5

The Need for an Integrated Crash Trauma Information Network (ICTN)

Taking the literature review, best practices review, and Minnesota case study work together, findings indicated the need for a more integrated model for information system design and data sharing. Figures 5.1 and 5.2 illustrate an overview of the Integrated Crash Trauma Information Network (ICTIN) as conceptualized by researchers; taking into account the key features that should be included in the system design.

1. At the second level of Figure 5.1, there are a number of operational process considerations. These include the linear and dynamic work flows and processes of providing emergency medical care as seen through the eyes and experience of a patient. The top level of this diagram represents a linear work flow to represent the flow of a patient from emergency notification (e.g., ACN, 911 phone call), through dispatch, emergency medical care provision, and arrival and definitive care provision at an emergency department and/or trauma center. Emergency responder work processes may be dynamic or sequential, depending on how one views such work. But the sequential representation is meant to take into account the patient experience, an important system design characteristic as described by Schooley and Horan (2007).

2. As shown in the top level of Figure 5.1, a multi-organizational view of the system architecture is an essential consideration for the ICTIN concept. As described throughout this paper, and illustrated in Figure 5.2, many organizations are involved in emergency response activities, from emergency notification through care provision. Many other practitioners and organizations are involved in crash analysis, public health research, patient outcome research, and other analyses. The implication here is that the architecture needs to accommodate the information and data needs of a wide variety of organizations, including ubiquitous access to information, while maintaining the privacy and security of patient information. Fortunately, the technology exists to enable these software quality attributes. How to implement such attributes in a complex large-scale environment is a challenge yet to be resolved.

3. Dynamic information sharing considerations are represented on the third and fourth levels of Figure 5.1. From prior research, as well as through this analysis, a number of information types, or taxonomies, are captured, analyzed, and distributed across EMS organizational actors and hardware and software systems. The view represented here is one that would allow for information to be shared, distributed, and viewed by any and all authorized emergency responders (and information systems) at “downstream” points of an emergency response episode. For example, rather than waiting for a paramedic to click the “submit report” button of an electronic patient care record, patient information would be dynamically sent to physicians at a receiving emergency department or trauma center as it is entered. To enable such open communication systems web services and related information architecture standards would need to be implemented across organizations and information systems so that both “push” and “pull” functionality could exist for any and all authorized users.

4. Performance reporting capabilities are also enabled through such architecture, not only at the individual organizational level, but also across organizations and information systems. The

ability to pull any number of data elements not only benefits real-time clinical decision making, but would also allow for the creation of any number of customized reports for real-time monitoring (e.g., dashboards) or retrospective research and analysis. The idea here is that performance analysis becomes a system design consideration at the outset, as opposed to taking the traditional approach of constructing performance reports after the system has been built. As shown in Figure 5.2, reporting and analytics would be a key component of the ICTIN.

Crash Trauma Information Network

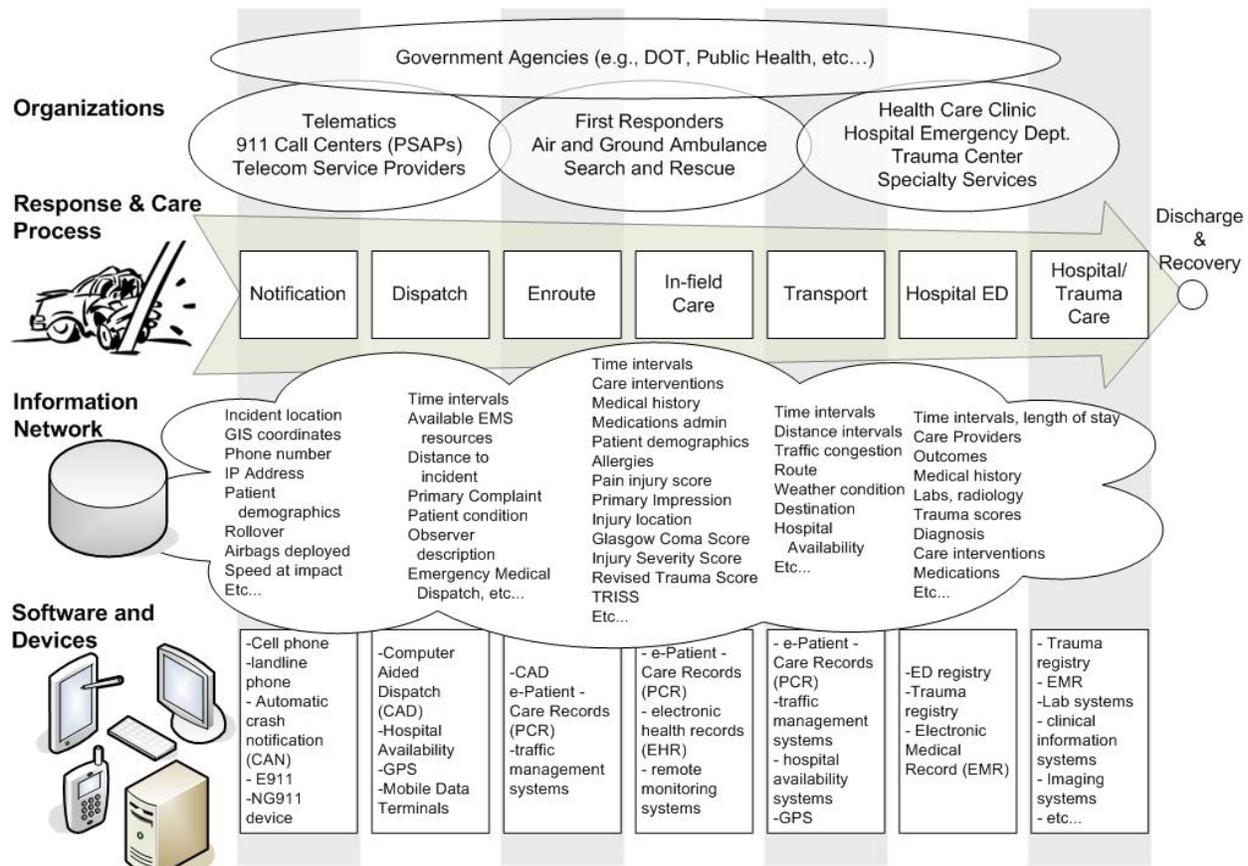


Figure 5.1 Information Coordination across the Emergency Response Process

5. Additional software architecture characteristics are illustrated in Figure 5.2. Though alluded to in the above discussion, these include:
 - a. Security/Privacy: A standard suite of network, software, and data security measures would be implemented to ensure safe transport of patient information in accordance with State and National privacy guidelines and laws.
 - b. Patient tracking system: In order to accurately identify data from one system to another, there must be a common data identifier. It has been argued that the highest level “key”, or data identifier should be a patient number, which could be assigned (or found) at the soonest possible point in the emergency response continuum (e.g., ACN notification, pre-loading of patient medical record information). In any case, the important attribute here is that data associated with a patient including vehicle,

incident, medical information, care provision, receiving hospital, medications administered, dispatched emergency resources, time of phone call, etc... would all be linked back to the patient for real-time and retrospective analysis. A patient tracking system would facilitate this core function of the ICTIN.

- c. **Directory and Access Services:** This would be one or several secure databases that include a listing of any and all authorized organizations and individuals allowed to access ICTIN information. Individuals would register and then be approved by the managing organization. Each organization and individual would be allowed access to certain information based on the information access policies prescribed by the managing body. The directory is controlled by a managing entity to be determined by the network stakeholders.

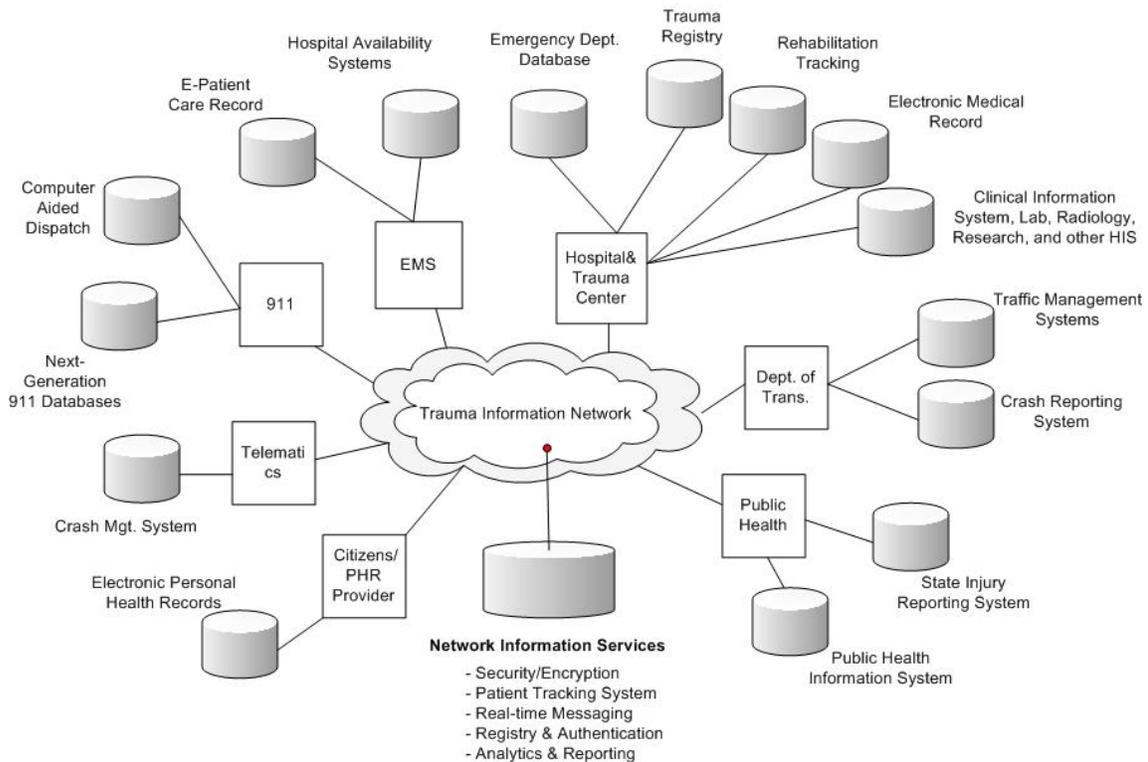


Figure 5.2 Organizational and Components of an Integrated Crash Trauma Information Network

Chapter 6

Subsequent Phases and Benefits

Directions for Subsequent Phases

While there exists a need for an integrated crash trauma information network (CTIN), there also exists a paucity of guidance, literature, and directions on how to achieve such a complex system implementation. As confirmed by the local and state focus group discussions in Minnesota, further exploration into the potential and feasibility of developing an integrated crash trauma information network would provide an innovative advancement from both a research and practice perspective. More specific recommendations for taking a phased and incremental research approach to move the concept forward are discussed below.

In our phased approach, several methods are being employed. A first task would be to validate the Minnesota case studies by conducting a comparative case study review in another state. Findings from a cross-case comparison would be used to outline the parameters for an initial prototype of the integrated crash information system. The prototype would be a simplified “sample” system to provide a “proof of concept” and illustrate how crash information could be shared from the moment of impact, through emergency dispatch and response, and then into the emergency room and health treatment services. This would include defining the “time” increments so as to understand at what point in an emergency response medical care has begun to be administered. Our straw man system (“CrashHelp”) will be defined through an iterative series of interviews and focus groups with significant stakeholders in the process, including departments of transportation, public safety, 911, emergency services, and healthcare. Small data sets from crash, EMS, health information systems would be collected and used to develop and populate the prototype to demonstrate its utility for safety decision support and planning purposes. Feedback analysis from policy-makers, planners, public health, EMS, safety engineers, emergency planners and citizens will focus on operational, organizational, and policy deployment challenges surrounding an enhanced EMS system, including possible benefits from its utilization. This would include examining what happens when the transportation and the healthcare system interacts under varying degrees of stress, or in an emergency/crisis response situation. Stress tests through software simulation tools may be used to better understand this phenomenon.

Expected Benefits

The primary beneficiaries of an eventual integrated crash information system will be those individuals in the traveling public that have had the unfortunate circumstance of being involved in an automobile crash. The system would extend current EMS systems to include a greater range of information, including information that has been requested by emergency room physicians but often not available (possibilities include digital picture of the crash, current medications being taken by the crash victims, and speed of vehicle at impact). This information is expected to improve not only the timeliness but also the quality of the emergency response.

Transportation safety and trauma system planners are also expected to be beneficiaries. The objective is to develop tools to guide EMS and trauma performance information integration efforts across a range of safety related agencies to allow for more holistic data analysis that can be both visualized and conducted in real-time. The benefits of this research would be to assist State DOTs in creating an SHSP that meets the data intensive requirements of SAFETEA-LU with the ultimate goal of reducing the number of highway fatalities and serious injuries on all public roads.

Finally, we have significant interest and participation in applying our findings from this work by key stakeholders including agency representatives from the MN Department of Transportation, MN Department of Public Safety, MN Emergency Medical Services Regulatory Board, MN Department of Health – State Trauma System, and the National Highway Transportation Safety Administration. A final step will be a deployment analysis that will examine the technical, organizational, and policy challenges and options for implementation in Minnesota as well as more broadly.

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