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Implementation of an Injury Surveillance System at a Local Community Health Center Emergency Room

By

Kien Hue Quan

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of **Master of Science**

in

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Louis Hugo Francescutti (Supervisor)

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Garnet Cummings (Committee member)

Date June 9, 2001

Abstract

This project describes the implementation of an emergency department (ED) injury surveillance system at a local community health center. The improvisational model of technological change by Orlikowski and Hofman is used as a conceptual foundation to explain the innovation process in this complex, turbulent and flexible setting. Key dimensions' interdependent relationship and its influence on workflow and data collection are explored.

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I would like to express my sincere thanks to Louis Hugo Francescutti, my academic supervisor, who endured my two years plus within the department, provided guidance to the project, and opened up a new opportunity for my career. My heartfelt thanks to Francis Lau, member of my advisory committee, for his professionalism and consistent instruction. Francis Lau 's advice and expertise in the field of health informatics have been invaluable since my undergraduate years. Many thanks to Garnet Cummings, member of my advisory committee, for offering instrumental suggestions and support.

Thanks are also due to Gian Jhangri who made sure the project's descriptive statistics was on track and Bob Mckim, NECHC project evaluator, who provided

NECHC historical information and ,particularly, gave myself privilege to use his computer from time to time..

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Abbreviation

ACICR	Alberta Center for Injury Control and Research
ANISU	Australian National Injury Surveillance Unit
CHA	Capital Health Authority
CPR	Computer-based Patient Records
ED	Emergency Department
ER	Emergency Room
HASS	Health Administration Solution System
ICD	International Classification of Diseases
IS	Information System
ISC	Injury Surveillance System Component
NDS	National Data Standard
NE	North East
NECHC	Northeast Community Health Center
PHC	Primary Health Care
PRF	Patient Registration Form
RAH	Royal Alexandria Hospital
UAH	University of Alberta Hospital

Chapter One Introduction

1.1 Injuries study and the need for data

Injuries are the leading cause of death and disability among children and young adults[1]. Up to the age of 44, injury-related deaths continue to exceed deaths from any other cause. Fortunately, injuries can be prevented. Reliable injury surveillance data on injury frequency, cause, and outcome is a prerequisite to the formulation and implementation of control and preventive policies [2]. Surveillance is defined as the systematic collection, analysis, interpretation, dissemination, and application of health data to a public health problem.[3] An injury surveillance system can assist injury professionals to:

- Detect trends and patterns in injury
- Identify risk factors
- Develop control measures and evaluate their impact
- Facilitate policy makers to set priorities, allocate resources, and deal with pressing injury issues with policy makers

1.2 Existing injury data collection practices

Injury data is currently obtained from various sources, including hospital records, trauma services and mortality statistics.[4] However, up to 90% of all injuries end up in the emergency department (ED).[5] These medically-attended injury data are not part of any comprehensive data collection practices.

1.3 Scope of Thesis

This project examines the process of implementing the Injury Surveillance System Component (ISC) at a local community health center ED. First, existing injury surveillance initiatives are identified. Second, major streams of technological innovation are described. A model is used to provide a conceptual framework for information system implementation of ED ISC. Third, the research design encompassing location,

system information, subjects, data sources, and method is detailed. Finally, results are discussed and recommendations presented.

1.4 Organization of Thesis

This thesis is arranged in five chapters and six appendixes. The second chapter presents a literature review of the following:

- Current emergency room injury surveillance systems
- Major streams of technological innovation
- The improvisational model
- Improvisational model and the ISC implementation

The dynamics within the Capital Health Authority (CHA) are also examined. Specifically, the impact of different perspectives on information needs during the initial phase of the ISC is detailed. Chapter three describes the study design and method. Chapter four includes the study results, discussion of the project's findings, and recommendations. Chapter five summarizes the project and is reserved for publication. Appendix A introduces the Northeast Community Health Center (NECHC) where the ISC was implemented. Appendix B describes HASS (Hospital Administration Software Solutions) and injury data elements. Appendix C describes data collection results from the CHA database. Appendix D presents some software mentioned in the discussions. Appendix E covers patient and NECHC staff interview scripts. Appendix F reviews ethics on patient information requests.

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Chapter Two Literature Review

Injury surveillance systems are often based on data that have been collected for other purposes. For example, severe injury-related data may be available from trauma services or hospital records. Police reports may provide information on injuries resulting from vehicle crashes. Hospital emergency department (ED) data represent an important but underused source of information for injury-surveillance practice. A review of current injury data collection practices helps demonstrate the essential role of an emergency department (ED) injury surveillance system. The review also brings forth people and organizational issues that are critical to both the implementations of health information systems and dealing with changed organizations that these systems often. The final section of the chapter explores a conceptual framework and the improvisational model that associates system implementation and change management..

2.1 Emergency Room electronic surveillance systems

2.1.1 Sources of injury surveillance data

a. Hospital discharge records

   Hospital discharge records have often been used as a source of injury surveillance data. Discharge summaries which are abstracted and transcribed to computer files are often used as a source of injury surveillance data. Unfortunately, there are limitations to these data. For example, only a certain percentage of injured persons who receive medical treatment are admitted to a hospital resulting in hospital records that under-represent injury incidence. In addition, these data are generally not available in a timely manner as data abstraction and transcription is a time consuming process.Furthermore, major injury data elements such as the external cause (E codes) are not consistently captured [1,2,3].

b. Trauma registry

Trauma registry is a comprehensive source of surveillance data for severe injuries. Trauma data are used primarily for quality assurance of care and assessment of treatment effectiveness. Drawbacks for these data are related to representativeness, flexibility, and timeliness [4,5,6].

c. Mortality data

Injury deaths are usually coded by using International Classification of Disease Codes (ICD), according to the nature of injury (N codes) and the external cause (E codes). The medical examiner and coroner's office may provide additional injury information at the time of autopsy. However, fatal databases do not provide morbidity information therefore the data is incomplete and non-representative. It also limits full assessment of preventative and control intervention, especially at a community level [7,8,9].

d. Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP)

is an emergency room-based injury surveillance system administered by the Bureau of Chronic Disease Epidemiology within the federal government. All 10 children's hospitals across Canada participated in this program when it was initially instituted in 1990. Parents and ER physicians fill out a standardized form that gathers demographic, injury, and clinical data. Completed forms are then coded and transcribed to a national database in Ottawa. The primary goal of CHIRPP is to alleviate the incidence and severity of children injury and severity in Canada. Studies have shown CHIRPP data are of relatively high quality and may be used with caution for research and public health policy. However, CHIRPP data underestimates admission rates and demonstrates some systematic errors in capture. Furthermore, CHIRPP contributes to a national database therefore it is not specific in identifying local or community injury problems [10,11,12].

e. Population-based emergency room injury surveillance system

Since most injuries are treated in ED, ED surveillance is essential for determining the impact of injuries. Injury is the most frequent reason for ED visits for all age groups, accounting for over 76,000 visits to CHA ED in 1997-1998. According to Alberta Injury Prevention Center 1994 data, there were 1,358 deaths and 31,471

hospitalizations as the result of injury in the province of Alberta. According to some estimates, for every childhood injury death there are 45 hospitalizations and 1300 ED visits. Public health professionals want to collect and analyze this ED visits population data to develop and evaluate strategies for injury control and prevention [8,13,14].

2.1.2 Community ED electronic injury data collection

ED or groups of ED that allow the assemblage of population-based surveillance data serve communities or "defined populations". Population-based surveillance is defined as pertaining to a general population within a geopolitical boundary; this population is the denominator and/or sampling frame [15]. Community injury surveillance data depict local trends and patterns of injury, which vary greatly between communities. This in turn facilitates the practice of community-responsive measures [16, 17,18]. Information technology has evolved and transformed the healthcare landscape. It revolutionizes the way healthcare organizations approach information applications and management [19]. Computer-based patient record (CPR) systems offer access (availability, timeliness, reliability, and ease of use), quality, security, flexibility, and efficiency.[20, 21] Public health information standards are changing. The International Classification of Diseases has become shared standard. The Centers for Disease Control and Prevention is spearheading the initiative for standardized ED reporting. They are collaborating with the major clinical information standards developer groups such as HL7, in an attempt to unify systems and standards surrounding public health information and surveillance[22, 23]. Harmonizing data standards such as data definitions, component structures, code values, and data use allows for more effective collaboration among public health agencies and healthcare providers. It also increases acceptability, simplicity, and flexibility to those using the computer-based patient record (CPR) systems[24, 25]. These potential benefits along with population-based characteristics have positioned the community ED electronic injury data collection at the forefront of injury surveillance data. It

meets public health surveillance system guidelines and explicit criteria such as simplicity, flexibility, acceptability, timeliness, representativeness, sensitivity, and positive predictive value [26,27].

2.2 Major streams on technological innovation

2.2.1 Organizational issues that influence information technology diffusion

Informatic implementations often involve large systems with wide-ranging effects. Staff can easily be overwhelmed by changes especially when they perceive that they will not be involved in the decision-making process. If not carefully planned, technological innovations may foster adversarial relationships between staff and management.. In addition, staff my resist the changes and refuse to co-operate. Every implementation is conceived with the intention in response to perceived changes in an organization. Acceptance of an information system such as the ED electronic injury surveillance system by its intended users is a critical final stage in a successful systems implementation.. The people and organizational issues area is a blend of many disciplines. These include psychology, sociology, social psychology, social anthropology, organizational behavior and development, management, and cognitive sciences [28,29]. There has been much research into organizational issues that often arise during the evaluation of health information systems. The following listing illustrates a few of the issues:

- User involvement and participation: users need to be actively involved in changes. Seeking inputs at the early stages of the overall process is an important consideration.[54]

- The benefits of change: a successful implementation needs to emphasize its benefits. Caregivers need to understand that the information system is supportive of their work pattern and is ultimately beneficial to patient care.[55]

- Strategies for managing complex change: the process of change management involves diverse perspectives such as sets of behavior, the way people in an organization think and act, development of skills and commitment, etc.[28]
- Organizational structures: study has shown that a successful implementation needs to includes a fit between strategy and the organizational structurewhether it is centralized or decentralized [45].
- Organizational cultures: cultures vary from one organization or profession to the next and it can influence the acceptance of an innovation [56].

2.2.2 Major theories and research streams

Information technology (IT) implementation is defined as an organizational effort directed toward diffusing appropriate information technology within a user community. Zmud and Apple's stage model founded on Lewin's change model (unfreezing, change, refreezing) incorporates some of the post-adoption behaviors. [30] The model includes:

- Initiation. Pressure to change originates from organizational push or pull. A compatible IT solution is found.
- Adoption. Support for the IT solution is pursued.
- Adaptation. The IT application is developed, introduced, and sustained. Organizational procedures are altered to accommodate the change.
- Acceptance. Staff or employees are encouraged to utilize the application.
- Routinization. The application usage is optimized and becomes part of daily activities.
- Infusion. The IT application is profusely used throughout the organization's different levels.

Zmud and Kwon identify five major contextual factors that affect each stage.[31] They are the characteristics of the user community, organization, technology, the task to which technology is being applied, and organizational environment.

a. Factors research has identified issues that have an impact on IT implementation outcomes. Certain individual, organization, and technology factors are important considerations in the effectiveness of IT solutions. Results from factors-based studies have been relatively consistent in highlighting a small set of factors that regularly impact be related to IT implementations.[32] They include top management support, a relevant and well-planned design, satisfactory user-designer coordination, and well-corporated users. [33,34]

b. Mutual understanding research studies focus on designer quality. Such research stresses issues such as user-designer interaction, purpose, objectives, design, use, impacts and evaluation.[35] The studies indicate that user-designer interaction and cognitive functioning are highly desirable. Moreover, a sense of empathy or "mutual understanding" between user and designer can be influential. [36]

c. Process research, which focuses on social change activities, views implementation efforts as a sequence of generic stages, each of which are dependent on the success of the previous stage[37, 38] . These stages are both distinct and associated with information system life cycle. The finding that commitment to change, implementation, extensive project definition and planning encourage implementation success, is significant. It suggests that a unified understanding and commitment to implementation among management, designer, trainer and user helps to nurture and sustain the motivation for appropriate implementation behavior. [39]

d. Political research examines diverse interests by stakeholders. These interests motivate the participation or defiance of individual stakeholders to IT implementation efforts. participation or defiance of IT implementation efforts. Stakeholders who believe the proposed changes will impact their interests act to influence the course of the process. [40]

Prescriptive research highlights generic implementation risk factors.[41] These risk factorscan involve participant attributes, organization contexts and the project itself. Prescriptive strategies, based on experience and observation, to surmount specific risks are put forth.

2.2.3 Improvisational model and ISC implementation

Orlikowski presents the improvisational model that takes advantage of evolving capabilities, emerging practices, and unanticipated outcomes associated with the use of new technologies. According to Orlikowski, conventional theories on technological change originate in Lewin's three-stage change model of unfreezing, change, and refreezing. This model considers change as an event to be managed. It may be appropriate for organizations that are relatively stable and bounded. However, given today's more turbulent, flexible, and uncertain organizational settings, such a model is becoming less appropriate. Orlikowski's improvisational model defines three categories of changes in the implementation process: anticipated, emergent and opportunity-based. Anticipated changes are planned ahead of time and occur as intended. Emergent changes arise spontaneously and are not originally anticipated. Opportunity-based changes are not anticipated ahead of time but are introduced purposefully and intentionally during the change process. The model is particularly suitable under the following circumstances:

- The technology being implemented is open-ended and customizable.
- An organization uses information technology to enable changes that are unprecedented, flexible, complex, and uncertain in nature

It further notes that planning should be considered only as a guide. The organization's management creates an environment that facilitates improvisation instead of predefining each step and then controlling events to fit the plan. To effectively execute the model, it is necessary to make ongoing assessment and adjustment of the technology and the organization. [42] (Figure 2.1)

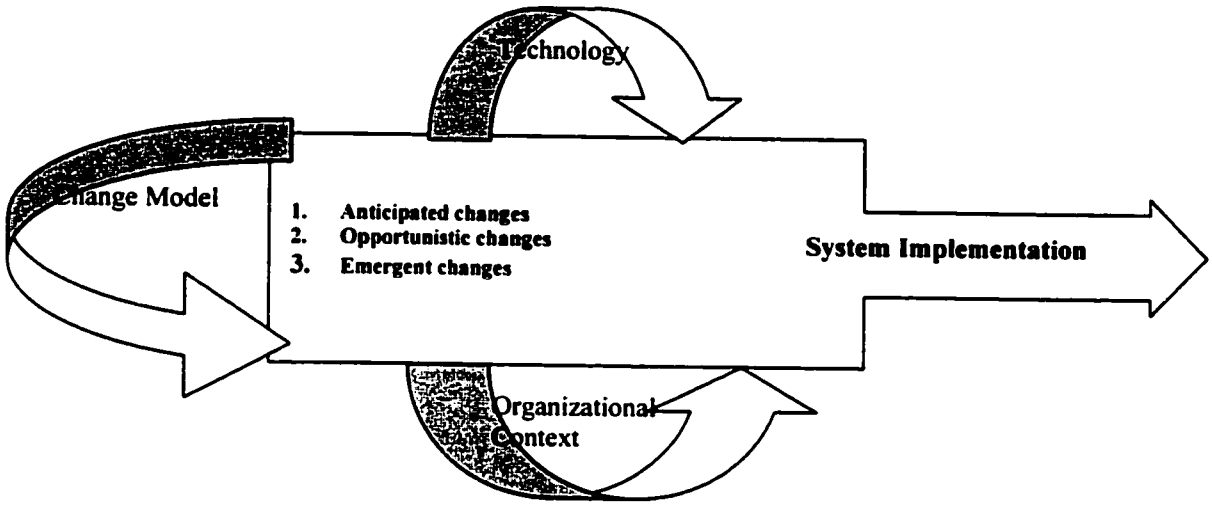

Figure 2.1 Improvisational Model for Technological Innovation

2.3 Conditions justifying the model's application

The improvisational model requires a tolerance for flexibility, uncertainty, and complexity. It is appropriate for open-ended and customizable technologies. Certain ED and surveillance computer system characteristics have been identified as befitting the application of such a model:

1. ED is an intensive area in the hospital with rapid pace and emphasis on immediate treatment of patients in need of emergency care [43]. As NECHC ED staff gained experience and understood the ISC better, they shifted their focus from sole care giving to both care giving and injury data documentation. This impact on workload may prompt structural changes. [44,45]
2. In setting its vision-"healthier people in healthier communities"- the Edmonton Capital Health Authority (CHA) board had identified three health issues that had considerable influence on the health of people in the region and commanded a significant proportion of resources [46]. The board had considered these three issues, one of which was injury control and prevention,

as priorities for action. Managerial support from NECHC and the presence of champions had a major role in ensuring and achieving a successful injury surveillance system implementation. Carla Policicchio, ED team leader at the NECHC, has over 19 years of wide ED experience. She held several senior managerial positions with CHA, and had a good understanding of the dynamic setting of the ED. As a result, Ms. Policicchio was instrumental in providing guidance to the proactive management of the clinical information system implementation.

Dr. Louis Francescutti, chair of the advisory body of Alberta Center for Injury Control and Research (ACICR) initiated the process leading to the ISC implementation. He first noticed the ISC application in supporting injury surveillance in ED settings within the CHA. Dr. L. Francescutti is known for his experience in successful strategies involving a combination of engineering, enforcement, economic incentives and education. Dr. G. Cummings, Royal Alexandra Hospital emergency department chief, has been an advocate for a comprehensive injury surveillance system. Dr.F. Lau, Faculty of Business, University of Alberta, has conducted research in information system planning, design, implementation, use and effects of knowledge and learning systems in organizations. Their experience, credibility and commitment to organizational learning and employee empowerment would establish a core competency factor to overcome both expected and unexpected challenges. These characteristics were particularly compatible with the improvisational model.

3. There has been a tremendous dynamism in injury control and prevention in Alberta. It has involved multi-disciplines. ACICR has a provincial mandate to provide coordination and support for organizations and professionals in injury control. A trauma registry enables the monitoring of serious injuries in trauma centers[6]. The CHA Public Health section addresses determinants of health and takes action to improve health at the community level e.g. child injury prevention. ED physicians require injury surveillance data to practice preventive medicine in CHA ED. Injury control in Alberta is a shared responsibility [47] and a successful injury surveillance system implementation

needs to include these multi-disciplines and their specific information needs [48,49]. It was necessary to develop and present to all parties involved a clear vision of this project; namely, implementation of a community-based pilot project aimed at local specific injury problems.

4. There are circumstances which are sufficiently sensitive for ED care providers to document injuries e.g. child abuse, sexual assault [50, 51]. It was recognized that data capturing under these ED situations could be a challenge [52,53].
5. As it is noted in Appendix B, the computer system to be implemented represented an open-ended and customizable version of information technology.

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Chapter 3 Research Study

3.1 Project Objective and Research Question

The project objective is to implement and assess an ED injury surveillance system at a local community health center. The research question is to determine if the theory of improvisation can be used to explain the implementation in terms of workflow and capture of surveillance data.

Hospital emergency department data represent an important but underused source of information for the injury-surveillance effort. As discussed in chapter 2, information technology and evolving data standards have promoted the use of an ED injury surveillance system to address the information needs of successful injury control and prevention strategies, particularly at a local level. According to Berger and Mohan [1] and Strome [2,3], injury data that are reliable, timely and readily accessible are necessary for policy decision-making in planning injury control and prevention [4]. It is well known that the success of an innovation, such as a new information system depends on the acceptance of its potential users.[5] Caregivers adopt and use the system in terms of their beliefs, values, practices, and norms. The new system challenges the way people in an organization think and act; it disturbs traditional patterns of conduct and forces people to modify established practice routines.[7] Information systems implementation has received much attention in the last two decades. Conventional theories on technological change as suggested in Lewin's change model were discussed in chapter 2. This model may be appropriate for organizations that are relatively stable and bounded. However, given today's more turbulent, flexible, and uncertain organizational settings, such a model is becoming less appropriate.[6] The improvisational model differentiates itself from other models of change by two major assumptions. First, it considers change as an ongoing process rather than an event with an end point. Second, the incorporated changes cannot be anticipated ahead of time.[8,14] This alternative model for managing technological change in an ED setting may allow an organization to leverage the evolving capabilities, emerging practices, and unanticipated outcomes associated with the use of new technology. Organizational contexts have

considerable influence on the outcome of innovation process. This is particularly true for health service organizations such as the NECHC where there is diversity of practice [19, 20]. NECHC is built on a primary health care (PHC) model that promotes integration of services focusing on the needs of clients. PHC is focused on health in a broad sense and includes collaboration with different health sectors. Its mission emphasizes the promotion of health and well-being, prevention and response to injury, illness, and discomfort (Appendix A). A study, assessing the health needs of the Northeast community indicated high level of injuries on a per capita basis in this part of the city [12]. The NECHC needs to understand injury patterns and disseminate injury data to enhance decision-making in injury control and prevention. As a result, the NECHC is an appropriate choice of institution to pilot the implementation of an electronic injury surveillance system.

3.2 Research Design

3.2.1 Study approach

The objective of this study is to implement an electronic injury surveillance system with the intent to explore ways by which surveillance data can be captured as part of the routine workflow. The most effective method of capturing quality data by nurses, physicians, and registration clerks will be examined. People and organizational issues are crucial aspects as organizations attempt to introduce innovation and subsequent changes. By applying the improvisational model for change management in an ED setting, the study will determine whether the model adequately explains the implementation both in terms of work flow and injury surveillance data capture. The improvisational model requires a process to recognize the different types of change or occurrence of major events and an effective response [8]. The research approach was qualitative in nature, using data collected primarily through semi-structured interviews supplemented by descriptive statistics on patient cases.

3.2.2 Research location

North East (NE) Edmonton has a population of 66,941 comprised of 33,918 females and 33,023 males. There are 24,170 females and 24,154 males under 45 years old, for a total of 48,324 (72.2%)[9]. There are 22,441 private households with an average income of $44,196 and a median income of $39,935 compared to an average of $51,118 and a median of $42,701 for the province of Alberta[10]. The NECHC provides emergency services in addition to Laboratory, Family Health, Mental Health and other services. Emergency service is available on a 24-hour, 7 days per week basis (Appendix A). Emergency Medical Services (EMS) arranges patient transfers to other facilities for hospital admission since NECHC does not have in-patients beds[11].

A study, assessing the health needs of the NE community, indicated a relatively high level of injuries [12]. During the first three months of operation, the center had over 6,500 ER visits [13].

3.2.3 Study phases

The study was conducted over a period of eleven months and consisted of three phases: planning, deployment, and assessment (Tables 3.1, 3.2)

a. Planning phase

The formation of the core project group , development of a comprehensive injury data set, data management with data dissemination consideration, and the workflow study began in mid-November 1999.

- Project group formation and ISC implementation work-plan. The core members were Dr. L.H. Francescutti (Principal Investigator), CHA Information System ED project team, Ms. Carla Policcichio (NECHC ED team leader), and graduate student Hue Quan. The group convened and addressed basic questions such as the data collection objectives, who would capture data, and what would be done with the data.
- Data set development. The project group adopted the Australian National Injury Surveillance Unit (ANISU) National Data Standards (NDS) for

public health injury surveillance as a foundation for the ISC data set (Appendix B). Group members acknowledged that the data set was needed to not only give a comprehensive description of the scope of the injury problem but also to ensure data collection compliance. Incompliance is often an issue due to the extra resources required in terms of staff and time for in-depth data gathering.

- Data management and dissemination. Even though the focus of the study was workflow and data capture, the group also discussed the issues of data storage, quality, and dissemination.
- Workflow study. Observations, interviews, and meetings with NECHC staff were held to explore how ED information flowed, how the data collection system was used, and its perceived consequences for performance, staff, and work relationships.

b. Deployment phase

The deployment phase consisted of ISC installation, a data collection trial to determine the most effective way for NECHC staff to capture quality data, and a workflow study.

- ISC installation. The ED project team activated the ISC, checked its functionality, and made sure the injury surveillance application was integrated with HASS (Hospital Administration Software Solutions).
- Data collection trial. The 3 groups included in the data collection trial were physicians, nurses, and registration clerks. Each group collected a week of injury-related data (estimated to be about 100 patients). The trial was done in three consecutive weeks for three groups. The injured population was defined as patients for whom the triage nurse had indicated "Y" in the mandatory field "Injury (Y/N)" of the ISC Triage Form . If staff were able to capture ISC data after patients had signed consent, ISC . data entry fields were filled in. These included activity when injured, type of place, injury mechanism, injury factor, human intent and external cause of injury (Table 3.3). Data were validated for correctness by phoning patients the next day and repeating the ISC data entry questions. The

findings helped to create a template for uniform data collection in ED within the CHA region.

- Workflow study. Observation, interviews, and meetings were organized to assess the impact of the ISC introduction on work pattern, staff interaction with the system, and the consequences of the deployment process.

c. Assessment phase

The assessment phase involved qualitative analysis and descriptive statistics based on data collected during the planning and deployment phases.

Table 3.1 Timelines of the implementation study phases

Phases	**Nov 99**	**Dec 99**	**Jan 00**	**Feb 00**	**Mar 00**	**Apr 00**	**May 00**	**June 00**	**July 00**	**Aug 00**	**Sep 00**
Planning	X	X	X	X	X	X	X	X	X		
Deployment										X	
Assessment										X	X

Table 3.2 Summary of the tasks during implementation study phases

Phases	**Tasks**
Planning	• Project group formation with ISC implementation work-plan • Data set development • Data management consideration that included data dissemination • Work flow study
Deployment	• ISC installation • Data collection trial with staff training • Work flow study
Assessment	• Data analysis

3.2.4 Technology

a. Hospital Administration Software Solutions (HASS)

The CHA implemented a new emergency department computer system at NECHC in September 1999. The system, called Hospital Administration Software

Solutions (HASS), was developed in Australia (Appendix B). HASS also had an injury surveillance component (ISC)which was deployed during the study. HASS has the following features:

- Full security system enabling multi-level user access control for windows, menus and reports
- Full multi-user capabilities including record locking and window refreshing
- Site nominated mandatory coded data entry fields
- Minimal keyboard usage as clinical information can be entered using touch screen
- Ability to customize report destination and printer for each report printed.

b. Injury surveillance system component (ISC) (Figure 3.1) [21]

The ISC was a component residing within HASS. When the ISC window opened during triage or following the update of a patient record, the patient's last/first name, date of birth, age, sex, date of injury, and presenting problem would be transferred from the triage window. If staff were busy and unable to complete the data immediately, data could be entered at a more convenient time. The ISC user could re-enter the injury surveillance window from other screens by performing a patient search or double clicking on the record from a patient list.

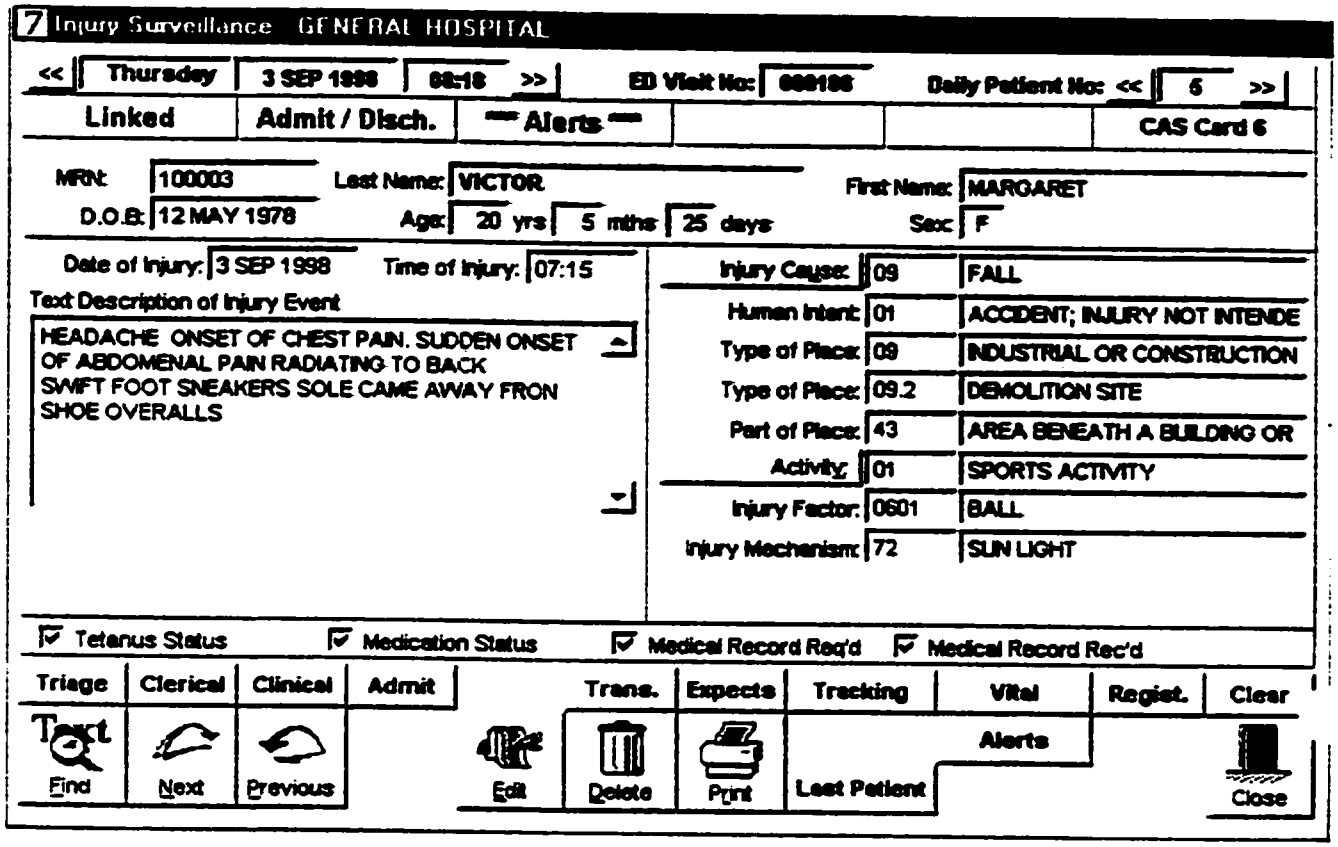

Figure 3.1 ISC window

3.2.5 Subjects

The project involved RAH trauma service, Kim Borden (ACICR staff), Carla Policcichio* (NECHC ED team leader), Dr. L.H.Francescutti * (Principal Investigator), Public Health research coordinator, CHA Information System ED project team, HASS developer, Dr. F. Lau * (Faculty of Business, thesis committee), Dr. G. Cummings * (RAH senior ED physician), NECHC physicians, nurses, registration clerks, patients, and graduate student Hue Quan. During the data collection trial, NECHC staff (physicians, nurses and registration clerks) who were scheduled to be on duty received 45 to 60 minutes of ISC computer training. Training sessions covered ISC data entry, editing, saving and

* project champions

navigation between forms. Training took place either before or after shift rotations. The ISC implementation, its interaction with clinical, nursing and support staff and improvisational changes were the focus of the study. Injured patients were enrolled in the study after they signed the consent form.

3.2.6 Method

a. Data sources (Table 3.4)

Data sources for this study were staff, patients, and the ISC data repository.

1. Staff

Data collection was primarily from observations, meeting notes, interviews, training sessions, and documents. Due to confidentiality concerns raised by staff graduate student Hue Quan used field notes instead of tape recording interviews .

- Throughout the planning phase and the early part of deployment phase, meetings and interviews consisted of the HASS developer, ED project team members, public health staff and champions. The interviews were semi-structured and included specific issues related to (Appendix E):
  - ISC implementation work-plan
  - Organizational context
  - User acceptance
  - Staff's strength and belief
  - Expectations on technological capabilities
- During the deployment phase, interviews were conducted with nurses, physicians, and registration clerks who had participated in the three-week data collection trial. Interviews were held at the time of ISC user training sessions. The interviews were semi-structured and included specific issues related to (Appendix E):
  - Overall impression of training sessions
  - Technological assessment of the ISC components

- Current NECHC data collection practice and staff preference
- Workflow and the impact of ISC introduction
- Relevance between injury surveillance and direct patient care in ED setting
- NECHC staff experience with HASS

A senior NECHC staff member who was actively involved in the project was asked to review and revise the interview questions to ensure they fit the NECHC ED setting.

- Direct observations of staff using the system before and during ISC deployment were done.
- A comment book collected staff feedback during the data collection trial.
- Email correspondence, references documenting how NECHC came into being, HASS user training manuals, ACICR's Alberta Injury Data Report (Table 3.4)

2. Patients

To validate ISC data collected during the trial, NECHC staff obtained consent from patients for follow-up telephone interviews. Graduate student Hue Quan telephoned patients the day after their ED visit. If patients were not home or there was no answer, a second attempt was made an hour later. The case was marked "patient not available" after 3 redial attempts. The interview was based on a script that included the following (Appendix E):

- Patient's identity, their awareness of the study, and whether they had signed the consent form
- External injury cause: Event, circumstance or condition associated with the occurrence of injury, poisoning or violence
- Bodily location of main injury: the anatomical location of the main injury
- Date and time of injury
- Activity related to injury: the specific type of activity being undertaken by the person when injured
- Type of place where injury event occurred: the nature of the location of the person when injured.

- Specific products or substances that were involved
- Safety precautions or devices that were in use

The interview was used to quantify the level of agreement between the ISC recorded information and that obtained from the patient. The study involved human participants so Health Research Ethics Board (HREB) [15] approval was required [*]. The HREB protocol stated non-invasive interventions and measures including interviews, surveys and questionnaires need to be reviewed by the board (Appendix F). During training sessions, the necessity of explicit effort in seeking a patient's consent to participate in the study and permission to call them at home the following day was emphasized. NECHC management also reinforced the practice of seeking a patient's consent and permission through both written communication in the forms of ED logs, reminders and verbal communication during shift reports.

3. Patient case data (HASS repository)

Patient demographic and ISC electronic data were retrieved from the centrally stored Oracle database. A NECHC research staff and an ED system analyst assisted in downloading data from Oracle to a Microsoft Access database, using Open Data Base Connectivity setup (ODBC). First, the NECHC patient data were separated from the data pool by using a NECHC medical record number that had a unique identifier starting with "0000". Next, patient cases were limited by the data collection trial dates. Lastly, injured patients identified by Injury (Y/N) = "Yes" data field were retrieved. The ISC data entries were summarized in Table 3.3:

Table 3.3 Patient demographic and ISC data elements

Data Elements	Description	Data Types
Last Name	Patient last name	Text of size 30
Middle Name	Patient middle name	Text of size 30
Medical Record Number	NECHC Patient medical record number started with "0000"	Text of size 12
Gender	Patient gender	Male or Female

[*] The HREB is a joint committee of the University of Alberta Health Sciences Faculties, the CHA, and the Caritas Health Group.

Date of Birth	Patient date of birth	Date (DD-MMM-YYYY)
Date of injury	Date injury event occurred	Date (DD-MMM-YYYY)
Time of injury	Time injury event occurred	Time (HH:MM)
Brief description	Free-text entry of what went wrong. It may provide additional information..	Memo
Brand name/product fault	Product related to injury event e.g. child walker	Memo
Safety equipment or device	Equipment or device used during the injury event e.g. seat belt	Memo
External injury cause	Event, circumstance or condition associated with the occurrence of injury, poisoning or violence	Text of size 30
Human intent	The role of human intent in the occurrence of injury as assessed by caregivers	Text of size 30
Type of place	The type of place at which the person was situated when injured.	Text of size 30
Activity	The specific type of activity being undertaken by the person when injured	Text of size 30
Injury factor	Types of objects and substances involved in the occurrence of the injury	Text of size 30
Injury mechanism	The way in which the injury was sustained	Text of size 30
Nature of main injury	The nature of the injury chiefly responsible	Text of size 30
Bodily location	The anatomical location of the injury chiefly responsible.	Text of size 30

Table 3.4. Summary of data sources

Data Source	**Volume**	**Type**
Email	68	qualitative
NECHC references documenting how NECHC was established	5	qualitative
HASS user training manuals	2	qualitative
ACICR's Alberta Injury Data Report	1	quantitative
Meeting notes, notes as a result of direct observations, interview, field notes, and comment book	32 pages	qualitative

Patient case data (HASS repository)	3 weeks trial data	quantitative

b. Analysis

1. Content analysis.

Email, field notes and documents were analyzed for content with NUDIST (Non-numerical Unstructured Data Indexing Searching and Theorizing) software. NUDIST is a computer package designed to aid users handling Non-numerical and Unstructured Data. NUDIST -supports qualitative analyses, enabling the processing of coded data through an index system, searching text or patterns of coding and theorizing about the data (Appendix D). Data were organized according to the following steps:

- Making a document system. Field notes were imported into NUDIST. While browsing the document, text units were inserted as an annotation for ideas. Ideas included descriptions of the goals of each phase, primary activities, major events or issues, or what participants liked or disliked. For example, physicians commented on ISC data entry:

> *" I do not think it will work for physicians. We have HASS in place for several months. It takes 10 seconds to sign on and only 1/3 of the physicians do it. To do consult entry, it takes about 30 second and none of the physicians use the function. We have skill but it is rather for something else like patient care, not clerical work."*
>
> *" I make rounds and see the patients, five or more consecutively. By the time I could make it to the computer, I might not be able to remember what injury questions or whom I have asked. I could write it down during visits but time is a factor. I just do not have time to write notes and re-write it on the computer. I have heard about using hand held devices but still one has to click or key it in while contacting patients."*
>
> *"My working schedule here at the NECHC is almost once in every three or four weeks. I might be able to learn how to use the computer but three or four weeks after I rotate back to here, I might not be able to remember how to use the computer."*

The annotations related to the above comments would be "physicians perceived that they had other priority and ISC data entry was not on their

list"; "physicians believed there seemed to be a lack of fit between physician work pattern and data entry".

Other non-physician professionals commented:

> *" Physician prefers to write notes in physician section, nurses also fill up the blank area designated for nurse. There are certain duplication in what caregivers are writing. "*

In this example, the annotation would be " physicians did devote themselves to data entry but in paper format".

- Using nodes. NUDIST provides nodes for Document Annotations that allow annotations such as those from the above example to be coded. A text unit of any length could be inserted and coded at Document Annotations, as ideas occurred. For example, after reviewing the above annotations, the commentary would be "physicians were familiar with and ingrained in manual data entry. Any change in the documentation system would require a concurrent change in human knowledge, skills, and behavior". Thus, an emergent event during ISC deployment phase would be " from physicians' perspective, there was a sense of reluctance to do ISC data entry".

2. ISC data quality assessment

The study used the following criteria for data quality assessment: data completeness, data correctness, additional information, missing data, and timeliness.

- Data completeness: ISC injury (yes/no) field in the Triage Form was a mandatory data entry field. Hence it could be used as a standard reference for determining the number of injury-related ED visits i.e. true injury. Completeness was defined as the proportion of all injury events of interest that were captured by ISC and was calculated as a/(a + c). (Table 3.5)

Table 3.5 Data completeness and correctness

	True injury	False injury	Total
Injury events captured by ISC	a	b	a + b
Injury events missed by ISC	c	d	c + d
Total	a + c	b + d	a+ b + c + d

- Data Correctness: Correctness was defined as the proportion of observations that truly had the injury events of interest and was calculated as a/(a + b) [16,17,18]. The injury-surveillance population of interest was (a + c) which was presumably eligible for capture by ISC. The total ED patient visits that included injury-related and non-injury related sets of patients was (a + b+ c + d). Patients would be phoned the next day to obtain relevant injury data. Measuring the agreement between respondent information and that provided by the ISC would determine data correctness (Table 3.5).
- Additional information: The ISC injury brief description window was a free text entry field. It gave staff the opportunity to supplement the ISC coded data. It would appear logical to search this data item for confirmation and expansion of coded data items.
- Missing data: Charting practice that left data entry fields blank introduced ambiguity because it could be interpreted either as a non-responsive patient or ED staff forgetting to collect information. Missing data was calculated as a proportion of total injury data items (c/a + c).
- Timeliness: There were circumstances in which a patient's condition was considered urgent. ED staff was encouraged to do real-time data entry, but they also had the option to enter a comment indicating that data collection would be deferred in an emergency situation.

3. Patient case statistics

Total injury cases were provided during each of the three weeks of the data collection trial (Appendix C) along with percentage distributions of each of the following injury surveillance data items:

- External cause
- Human intent
- Type of place
- Type of activity
- Injury factors
- Injury mechanisms

3.3 References

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Chapter 4 Findings

4.1 Planning phase

4.1.1 Current workflow at the NECHC

A patient presenting to the NECHC ED was triaged by a nurse and the chief complaint was recorded directly into the HASS system. The chief complaint is a mandatory field. Unless the patient needed immediate care, he or she proceeded to the registration clerk where additional information such as demographics, worker's compensation (if injury was occupation-related), and senior pharmaceutical profile (for patients over 65) was collected and keyed into a separate system called Enovation. The HASS and Enovation systems did not communicate to each other. A clerk had to transfer HASS data to Enovation in a timely manner so as not tie up the flow of patient records. The registration desk then printed out a patient registration form (PRF). When the patient was inside a treatment room, the physician or nurse charted their physical examination and detailed assessment results either into HASS or PRF. The HASS system was complemented with hand-written notes, progress notes, discharge planning, and forms that resided in the patient binder. Once the patient was discharged or transferred to a tertiary hospital the encounter was considered closed. Diagnosis and intervention, if any, data were abstracted into the Ambulatory Care Classification System (ACCS) 's 3M database. The data collected for ACCS is used to classify ambulatory service recipients into clinical groups with similar resource needs and clinical profiles [1] (Figure 4.1).

4.1.2 NECHC staff perception

NECHC staff mentioned during meetings and discussions that they were mostly familiar with HASS. At the inception of the system, the staff used almost all of the application's functionality: chief complaints, clinical parameter entries

like vital signs, primary and/or secondary diagnosis. A NECHC research staff completed a chart review along with a HASS data summary for the first three months of year 2000 and found that physicians were not using HASS consistently. For example, about 30% primary diagnoses were entered by physicians. Despite extensive training and system revisions, NECHC staff explained that time-constraint was the major issue. There was no decision to mandate additional use of the system other than to ensure entry of the chief complaint.

4.2. Deployment phase

4.2.1 Test trial

Before deployment, a test trial with ten typical injury scenarios using ISC was observed. Two staff members played the roles of caregiver and patient. This simulation was warranted as a quality check of the system.

4.2.2 Training

During the data collection trial, there were 8 training sessions with interviews for nurses: 4 one-to-one sessions, 2 sessions with groups of 2 and 2 sessions with groups of 3 nurses. There were five registration clerk training sessions with interviews: 3 one-to-one sessions, 1 session with groups of 2 and 1 session with groups of 3 clerks. Physician training sessions with interviews were comprised of 4 one-to-one sessions. Training sessions ranged from 45 to 60 minutes except for physician sessions, which lasted only 15 minutes (Table 4.1). The in-service covered ISC data entry, editing, saving and navigation between forms. Staff training and interviews were planned and scheduled in advance. Initial planning was to have both pre and post deployment staff interviews. As a result of discussions with the NECHC team leader, interviews were held once during training due to staff coverage and patient load issues during the deployment phase. In addition, pre-scheduled training sessions were often modified to accommodate schedule changes. For example, a cardiac patient's

hemodynamic symptoms became exacerbated and extra personnel were required. Scheduled sessions were usually re-arranged and, sometimes carried out inside treatment rooms or at the front desk so nurses could participate and simultaneously monitor patients.

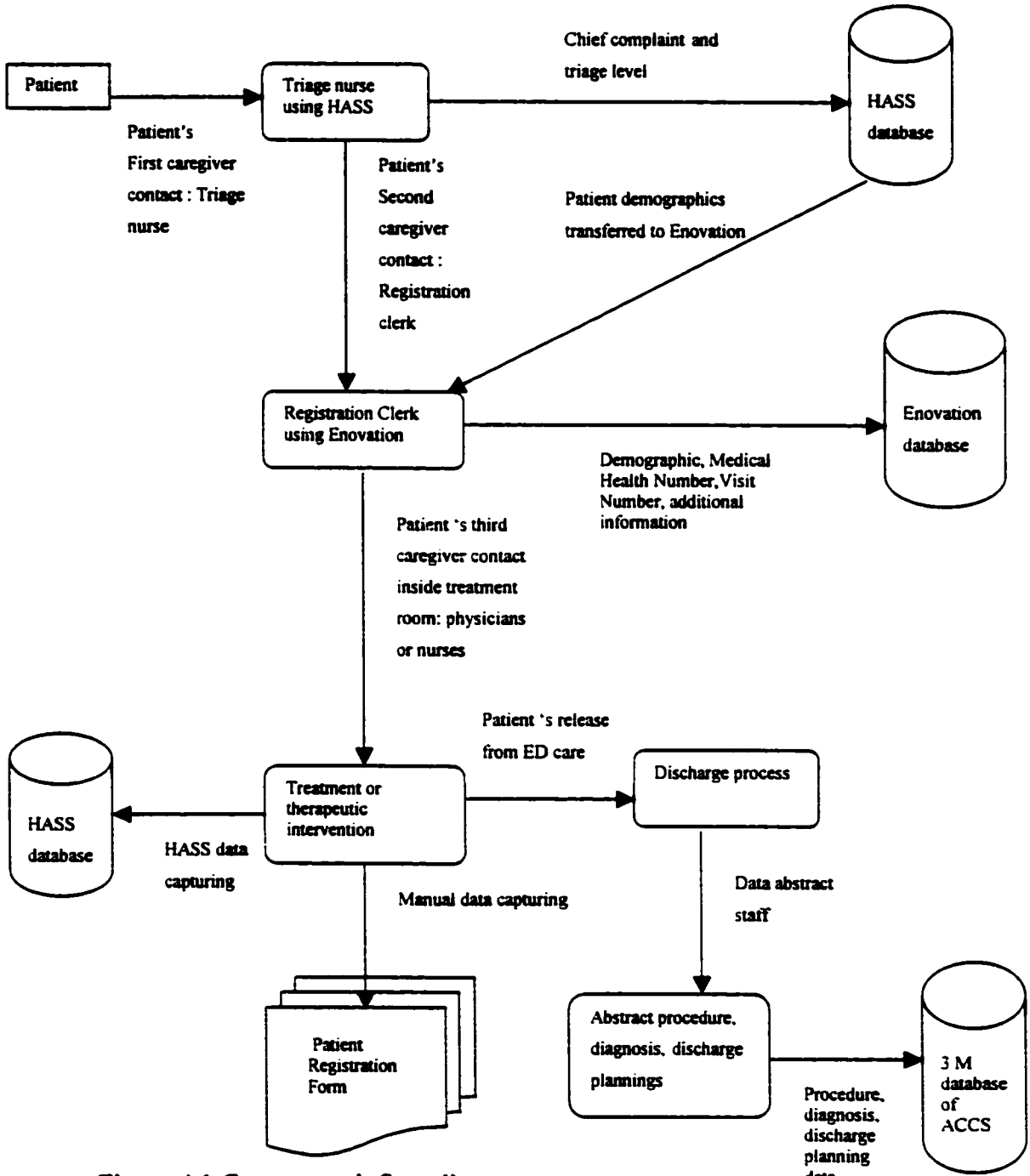

Figure 4.1 Current work flow diagram

Table 4.1 Summary of ISC training

Staff	Session with 1 trainee	Session with 2 trainees	Session with 3 trainees	Total staff trained	Training duration
Nurse	4	2	2	14	45 to 60 minutes per session except 1 for 15 minutes
Registration clerk	3	1	1	8	
Physician	4	0	0	4	
Total	11	3	3	26	

4.2.3 Workflow

During the ISC deployment phase, there were three groups of staff involved in the data collection trial: physicians, nurses, and registration clerks. Each group collected a week's injury-related data (estimated to be about 100 patients). The trial was done in three consecutive weeks for the three groups. NECHC staff explained the study to patients, sought their consent, obtained permission for phone interviews, and entered injury-related data directly into HASS. This injury surveillance project and its accompanied data collection were additional to staff 's concurrent workflow and documentation routine. Most were already familiar with HASS's existing functionality and evaluated the relatively short ISC training session as satisfactory. Peer learning was considered a convenient resource, on par with support from ED project team and graduate student Hue Quan. For example, staff found the summarized version of the study in bullets format (prepared by Hue Quan) helpful while recruiting patients to participate

a. Nurse group
   - Triaged injured patient via "injury (Y/N)" mandatory field of the ISC Triage Form. This data item would be used as standard reference for data completeness.
   - Asked for patient consent as study participants.
   - Performed eleven ISC data entries

b. Registration clerk group

- Nurse triaged injured patient via "injury (Y/N)" mandatory field of the ISC Triage Form. This data item would be used as standard reference for data completeness.
- Asked for patient consent as study participants
- Performed eleven ISC data entries

c. Physician group

- Nurse triaged injured patient via "injury (Y/N)" mandatory field of the ISC Triage Form. This data item would be used as standard reference for data completeness
- Asked for patient consent as study participants
- Performed eleven ISC data entries plus injury diagnosis and bodily location data entries in the HASS Clinical Form.

A senior NECHC physician expressed concern about doctors' compliance in data collection. He suggested if the ISC collection took less than 2 minutes, there would be chance to improve compliance. After discussion with Dr. F. Lau, Hue Quan modified the data capturing process for physicians to include only two fields: injury diagnosis and bodily location. The eleven ISC data entries were removed and the nurse would capture the "injury (Y/N)" mandatory field.

4.3 Assessment phase

There were a total of 197 "Y" injured cases recorded during the nurse group week. Triage nurses were able to capture ISC data from 98 cases. ISC data were validated through phone calls for 32 cases. Data completeness was 49.7%. According to the nurses, missed opportunities to collect data were due to high patient load. Nurses were did not have sufficient time to explain the study to patients, seek their consent, and do ISC data entries. Data correctness and presence of additional information were confirmed to be 100% for the 32 recorded cases. Also, there were neither missing data nor delayed entries for these 32 confirmed cases. During the registration clerk group week, there were a total of 172 injured cases recorded. The Triage Form Injury (Y/N) mandatory field entered by the triage nurse was used as a reference to determine the number of

injured cases. Registration clerks were able to capture ISC data from 38 cases. Data completeness was 22.1%. According to the clerks, missed opportunities to collect data were again due to overwhelming patient load. ISC data were validated through phone calls for 15 cases. Data correctness and the presence of additional information were confirmed to be 100% for all 15 cases. There were neither missing data nor delayed entries for these 15 confirmed cases.
There were 154 "Y" injured cases during the physician week and no ISC data were collected (Table 4.2). The ISC injury-related data results were retrieved from HASS repository (Appendix C).

Table 4.2. Summary of the three data collection groups

Staff	Injured population	Data Complete-ness	Confirmed cases	Data Correctness	Additional information	Missing data	Data entry delay
Nurse	197	49.7%	32	100%	100%	none	none
Registrat-ion clerk	172	22.1%	15	100%	100%	none	none
Physician	154	0%	0	-----	-----	-----	-----

4.4 Discussion

4.4.1 Conceptual framework

Employing the improvisational model required a process that recognized the different types of change or major events as they occurred and to respond effectively to them. Two sets of enabling conditions were essential: aligning key dimensions of the change process and dedicating resources to provide ongoing support for the change process. The key dimensions were the technology, the organizational context, and the change model. Ongoing support involved adapting both the organization and the technology to changing organizational conditions, use practices, and technological capability [2].

4.4.2 Major events and their interpretations (Table 4.3)

a. Anticipated changes

- Project group formation with ISC implementation work-plan

The implementation was an incremental change instead of a transformational change. After the relatively successful adoption of HASS in September 1999, the ISC may be interpreted as an expansion of the system. The project group convened and addressed basic questions such as objectives of data collection, who would capture data, and what to do with the data. ISC implementation was perceived as a change in the structure of the center to further leverage the HASS capabilities. Almost all NECHC staff were familiar with the system log on procedure using username and password. They were able to navigate through different user interface screens. Some nurses mentioned they were able to learn and use the HASS system from their peers. One nurse commented that for her age, using a computer was a challenge but in the end she was fine. She had no problem with asking other nurses or reading the user manual.

- Data set development

How comprehensive would the ED injury surveillance data set be? The data set is an essential component of the project. The data set should be comprehensive, easy to apply, have good reliability, and enable analysis for injury control and prevention. A trauma service staff felt that computerized ED format should have the potential to collect real time data with details such as sport injury categories when cause of injury was related to sports. An ACICR injury specialist added:

> *" The most important thing is good quality data, maybe this is selfish but we need data with in-depth details. "*

Another notion argued that the data required for injury surveillance really depended on the objectives of surveillance, the setting and practicality in which data were collected, the resources available, and especially user compliance. As one data specialist from ACICR noted:

> *"An ER injury data set has to be better than what we currently have. CHA hospitals already have the ACCS system that abstracts hospital charts. However, the data collected by this system are of limited value due to insufficient data items. It is important to manifest type of location,*

dynamics of an injury-causing event, context in which injury happens. We need relatively great depth of information. The challenge we face is how extensive we need and what about user compliance. Free-text entry describing what went wrong might be useful. "

As a NECHC senior member commented:

" We should start with something at a smaller scale and do assessment to see how well the ISC acceptance is. After that we make decision to expand the amount of data to be collected, depending on the purpose of surveillance. Otherwise we get choke with a big piece."

HASS 's ISC data set was based on the Australian National Data Standards for Injury Surveillance (NDS-IS). The data items and coding specifications were divided into two levels. Level one was built primarily for basic, routine public health surveillance. Level two was designed to support most ED settings with addition of extended data items (Appendix B). The consensus was to introduce a modified level two for NECHC with data items representing most commonly occurred scenarios and make use of the free-text entry window. This unique window allowed users to describe what went wrong or to add any information they felt was useful and complement the structured data entry. A pre-test with ten typical injuries using the ISC was observed. The proportion of finding the appropriate codes was 60%, the remaining data were either captured in the free-text format or listed under miscellaneous. It was necessary to have Information System ED team's support in keeping data items updated.

- workflow

Who would collect the data? An equally important component of the ISC implementation was to decide who was (were) the best candidate(s) for quality data collection. The practice needed to fit the work pattern, workflow, and its environment. A senior physician from RAH who had just finished an ED physician survey made this suggestion:

" If it takes doctors 2 minutes to do data entry per patient they have to spend 2 hours every shift after seeing 60 patients. Try to time the ISC data collection process. Anything more than 2 minutes will discourage the doctors."

Some nurses were curious about the injury surveillance feature within the HASS but a fewcould not hide the feeling that ISC might affect workload:

"When the center opened last year, we made use of the system's many features but now we are not entering items like diagnosis. Maybe we are too busy."

Registration clerks work on two separate systems. They read through HASS and transcribe patient demographics into the Enovation system. They need to complete the transcription in a timely manner, as patient records have to be released without tying up the data flow. The clerks also type in pharmacological information for seniors and Worker compensation related data for such cases. They believed ISC would affect their workload. To ease the ISC implementation and understand the workload situation better, a data collection trial was held with each staff category doing a complete week of ISC data collection. Data quality assessment based on electronic data and patient telephone interviews would be useful to determine who would be the most efficient ISC data collector.

What would an effective data collection pattern look like? ED patients always went to the triage nurse first and some information related to the ED visits was recorded. The patient's next stop was the registration clerk where demographics were entered. A clinical form was printed and inserted into a patient chart. Once inside the treatment area, the caregiver would either hand-write information onto the printout form or type in some information directly into the computer. After the patient was discharged, a summary was written and the patient was "released" from the computer. A NECHC staff specialized in ICD coding, abstracted patient chart diagnosis data the following day. One nurse said:

" Quite often, patient was questioned repeatedly for the same information. There are also duplication in data recording as the hand-written data might overlap that of the computer."

One nurse raised the issue further:

"Not only there were duplication. When we paper chart information, we do not really follow a consistent pattern. I might ask what happened without asking when, how, and where."

Another nurse suggested:

"It does not have to be nursing staff. Other professionals like respiratory, licensed practitioner nurse, orthopedic technician etc also contact patients. They could fill in and do the data as well."

The ISC addition was a challenge to the staff as it affected practice patterns and professional relations of individuals and groups within the center. The data collection pattern that included injury surveillance elements had to be clearly defined and well coordinated. The next caregiver should be able to follow the data the previous caregiver has captured and continue to conduct data collection in a seamless manner. Maybe the ISC could be the only official injury surveillance trial discarding the need for secondary hand-written notes. The data collection trial would shed some light on the issue.

- ISC data management

What happened to the collected data? Obviously, data were not collected for the sheer purpose of collecting. As mentioned in the literature review section, surveillance is defined as the systematic collection, analysis, interpretation, dissemination, and application of health data to a public health problem. A senior RAH ED physician explained: " *We should close the loop: collect the data and feedback to the community.* "

An ACICR injury specialist pointed out: *"Once we have the data to identify injury problem, the community will get something in return.* "

One Public Health member asked: " *How do we send the data out, to whom, and who look after the data.* " According to this member, there would be a need to establish procedures for data management, quality assurance, report generating and dissemination according to local standards. All these functions would surface once the ISC was implemented. A NECHC nursing staff wondered:

> " *We are always collecting data. It would be nice to know what happens to the data, have they been used for some purposes?* "

During the deployment phase, the NECHC project evaluator temporarily managed and made ISC data accessible for the study.

b. Opportunistic changes

- CHA set mandate for injury control and prevention

Edmonton Capital Health board had set a mandate for injury control and prevention as part of its health issues priorities. It recommended improved

data collection and surveillance as part of a combination of strategy. This strengthened the ISC implementation at the NECHC. A senior NECHC staff was delighted:

> *" We have done ED services for a long time, this is an opportunity to move injury surveillance forward not to mention we have such a fantastic computer system at the center. "*

An ACICR staff noted:

> *" Now you have the chance to do real time injury data collection. No doubt it is a challenge from my experience with data collection and compliance. It is exciting to see how you are doing. "*

- NECHC staff's improved participation

  Finding out about staff attitudes during the deployment phase helped to identify areas where support could be provided to ease the process. Staff suggestions were considered and actions were taken to improve the conditions. For instance, a printed list of data items posted by the computers helped to query ISC listing. To streamline the study explanation part, a laminated sheet with a brief summary in pointed format was prepared. A communication book at the front desk gave staff the chance to input comments, ideas, and questions. It also included frequent briefings on how things were proceeding. Staff also believed that even though injury surveillance might not directly impact patient care in the ED setting , it did have an impact on injury control and prevention. The growing participation and involvement were evidence of a change from a relatively passive attitude to an active response.

- Project champions

  Dr. G. Cummings assumed the role of a champion for the project. Kim Borden, ACICR data manager, had valuable input for injury data set development. Ms. Nonie Fraser Lee was assigned as project adviser by Public Health Research. These people were on board before the deployment phase. The implementation process reflected a multidisciplinary involvement.

- HASS implementation at the university hospital was on schedule

  HASS at the University of Alberta Hospital (UAH) was implemented on schedule. Thus, the ED project team was able to allocate extra resources to

support the pilot ISC project in terms of computer application support, system enhancement and data items update. This accelerated the user preparation phase at the NECHC.

- NECHC HASS initial data reports

  NECHC HASS data results from the first three months of operation indicated many unspecified causes of ED visits. This improved the acceptance of a comprehensive data set for injury control and prevention even though there were some concerns about the data required and resources available. An ACICR injury specialist addressed this issue:

  " Do you notice the unusual number of unspecified causes? I do not think it serves any purposes when you have poor data quality. "

c. Emergent changes

- Workflow

  During the deployment phase some believed that ISC data entry took too much time, changed work patterns or even professional values. Staff already busy with patient care, paper charting and other HASS data entry required extra effort to explain the ISC study to the patient. The purpose was to obtain permission to collect the individual patient's injury data, and to do a phone interview the next day. It became another time constraint factor on staff. For example, a triage nurse while attempting to calm a crying injured child had to also try to explain the ISC study to the parents.

- Updating ISC data set was a challenge

  Precise purposes of surveillance, the settings in which data were collected, and the resources available were important determinants of the data collected. The data set developed for the project (that is, predefined lists of injury-related questions or observations) could not meet all the terms of how, when, where, and what. The lists kept growing as unspecified or miscellaneous items increased . During the ISC deployment phase, there were two types of questions related to the use of data items. First, staff were not sure of the semantics of some of the data items. For example, patient slipped, fell and hit concrete. To register mechanism of injury, some users would key "fall by

slipping" and some would pick "contact with static object". Second, and it happened quite often, the user could not find the appropriate data items to describe the situation. For instance, a child was run over by a garbage wagon inside a shopping mall. User would end up selecting "other or unspecified circumstance" as external cause. In some circumstances, staff found it confusing having to scroll the data item lists several times before they could click a button and sometimes were not even sure what was selected. Over time, staff began to pick data items closest to the described scenario and to make use of the free-text entry. Also, the Information System ED team updated the lists to address any changes.

- Data entry duplication

While the triage nurse collected ISC electronic data, subsequent caregivers in the treatment room area were handwriting some patient injury information that overlapped with what had already been captured by the ISC. According to a NECHC research assistant:

> *" Physician prefers to write notes in physician section, nurses also fill up the blank area designated for nurse. There are certain duplication in what caregivers are writing."*

- Physician training was modified

Physicians were less enthusiastic in using computers to collect data given the workload and fee-for-service arrangement. A week before the physician's data collection trial, a senior NECHC physician mentioned:

> *" I do not think it will work for physicians. We have HASS in place for several months. It takes 10 seconds to sign on and only 1/3 of the physicians do it. To do consult entry, it takes about 30 second and none of the physicians use the function. We have skill but it is rather for something else like patient care, not clerical work."*

One NECHC physician commented:

> *" I make rounds and see the patients, five or more consecutively. By the time I could make it to the computer, I might not be able to remember what injury questions or whom I have asked. I could write it down during visits but time is a factor. I just do not have time to write notes and re-write it on the computer. I have heard about using hand held devices but still one has to click or key it in while contacting patients."*

Another physician mentioned this:

"My working schedule here at the NECHC is almost once in every three or four weeks. I might be able to learn how to use the computer but three or four weeks after I rotate back to here, I might not be able to remember how to use the computer."

With these changes, a decision was made to modify ISC training and data collection during physician week. Physicians were requested just to key in the two injury-related data elements during the trial: diagnosis and bodily locations. Other ISC data entries were left out.

- Adjusted interview schedule

  Due to staff coverage and patient load issues during the deployment phase, the interview was carried out during training sessions instead of being held pre and post deployment as initially planned. Also, pre-scheduled training sessions were quite often modified to accommodate changes. Staff's overall impression of the relatively short training sessions was satisfactory and useful. For instance, they were able to navigate the ISC window from other screens with little difficulty.

- Data completeness was not optimal

  Overall data completeness was less than 50%. Injury diagnosis and bodily location, two important pieces of information for injury surveillance, were missed almost totally. This would pose a challenge to data management and dissemination.

- Limited resource to upgrade ISC or HASS

  Considerations of user convenience and system functionality had impact on the implementation process. For instance, it would be helpful if the current version could let users capture primary and secondary injuries, tailor data entry screen, and print out reports. The ED team did not have the resources to revise user needs in a timely manner. As a senior ED team member mentioned:

  " There are limitations to what HASS developers could do for the program as it works on contract basis. We have certain budget allocated to ISC..."

Table 4.3. Summary of the major events and interpretations. P = Planning phase, D = Deployment phase, P-D = shortly before deployment phase, A = Assessment phase

Type of	Event	Interpretation

change		
Anticipated	• Project group formation with ISC implementation work-plan (P)	• An incremental change instead of a transformational change such as occurred after HASS implementation a year ago.
	• Development of a well balance data set (P)	• Data set comprehensiveness depended on surveillance objectives, settings, and practicality
	• Workflow (P)	• Data collection trial helped to determine who would be the most efficient data collector • Data collection trial also helped to determine how injury surveillance would fit into the ED work practice
	• ISC data management (P)	• ISC pilot at the NECHC helped to head start planning for data management
Opportunistic	• CHA set mandate for injury control and prevention (D)	• Organizational context: external environmental influence
	• NECHC staff participation (D)	• Round the clock support and feedback helped to improve staff participation in staff collection. Staff awareness of the importance of injury surveillance also played a role.
	• Project champions (P-D)	• Multidisciplinary involvement
	• HASS implementation at the university hospital was on schedule	• ED project team was able to accelerate the ISC process at NECHC
	• NECHC HASS initial data reports (P-D)	• Reinforced the belief to develop a comprehensive data set
Emergent	• Workflow (D)	• The research nature and ethics requirement of the project needed extra effort from staff to collect ISC data and acquire permission from patients.
	• Updating ISC data set was a challenge (D)	• Data items update was on-going
	• Data entry duplication (D)	• Manual data entry was ingrained in work practice
	• Physicians ISC training and data collection plan was modified (D)	• Further work on physician's role in direct electronic data entry
	• Adjusted interview and training sessions (D)	• Flexibility is needed to handle changes
	• Overall data completeness was less than 50% (A)	• ISC data management and data dissemination would be a challenge as a result of lack of data completeness
	• Limited resource to upgrade ISC or	• Resource allocation to problem-solving

	• Overall data completeness was less than 50% (A)	• ISC data management and data dissemination would be a challenge as a result of lack of data completeness
	• Limited resource to upgrade ISC or HASS (D)	• Resource allocation to problem-solving was a challenge

4.4.3 Major events and their relations with organization and technology (Table 4.4)

It is important to depict the interaction among the three dimensions of change process: technology (information technology infrastructure, system features), organizational context (structure, culture, business process), and the change model. This allows the alignment of key change dimensions with results.

a Change model and the technology

- SC data set update

  The technology was open-ended and customizable so the improvisational model provided the flexibility for NECHC to adapt and learn through use. For example when a user could not find a suitable external cause of injury item to fill data entry field,the ED team was able to respond immediately to address the issue. One evident result of the ever-growing data items was that at certain point, the list overwhelmed the user. The consequences of this unexpected effect could be poorer data quality, discouraged users, and a constrained future flexibility.

- Workflow and system upgrade

  The ISC introduction during deployment phase affected workflow and work practice. NECHC staff experienced time constraints in ISC data collection., For instance, finding a suitable data item to fill data entry field took time. A system upgrade would facilitate and expedite data gathering under this circumstance. There were situations where more than one injury cause or diagnosis was identified; an update to current the ISC version would help caregivers to accurately capture these data. Due to limited resources, the

ED project team was not able to provide immediate support to revise the system functionality.

b. Change model and organizational context.

- Data entry duplication

CHA and NECHC management's commitment to focus on organizational learning and employee empowerment was compatible with the model. For example, a data collection trial evaluating data collection patterns and discussion input from staff were evidences of a flexible management. One emergent change was the existence of overlapping electronic and paper passed data recording.. An organization employs innovation with the objective of improving performance and productivity. It assumes business processes defined as sets of activities often cutting across the major functional boundaries within organizations [3,4] can benefit through information technology interpreted as "automation". The paper-based record is familiar to a large number of users and it is relatively ingrained [5]. Experts in management and information technology have begun to recognize the limitation of automation when business processes are automated without first streamlining and improving them [6]. The paper-based charting system and HASS coexisted during the ISC deployment phase. Caregivers could capture the same information without knowing what data was collected before and patients were questioned repeatedly. The lesson learned from this was that redefining the boundaries of the ISC data capturing process and identifying its critical performance measures can help avoid the pitfalls of automating an unfavorable and inappropriate process. For example, NECHC could adopt ISC as the sole and official injury data collection tool and discard the paper-based charting of injury events.

- Physicians reluctant to do ISC data entry

Another emergent change was physician unwillingness to do data entry. There has long been ambivalence on the part of physicians concerning the use of computer-based patient records (CPR) and especially concerning data entry. Some physicians perceive CPR entry as taking away from patient care

time by having them do extra clerical work. Others, not the physicians themselves, experience the advantage that CPR can provide [7]. The physician's lack of understanding of the long-term value of CPR has led to widespread organizational stress[6] . Data entry, in particular, has been shown to be a major issue for CPR. This disincentive is also compounded by the fee-for-service arrangement [8]. The concept of "fit" is central to understanding the interaction of CPR with its organizational context [6]. If an organization wants to change the user's behavior or belief in innovation adoption, it must emphasize the need to change either prior to or concurrently with the introduction of the system. If the implementation is not carefully planned and it does not take organizational context into account, the new system may be put in place but the organization is likely to stay status quo. The desired outcomes would not likely then occur.

c. Organizational context and technology. [9,10]

The NECHC 's health delivery model, team-oriented work practice, its tolerance to changes, and the ISC 's technical versatility allow the improvisational model to be applied into the center's ED setting. Indeed, NECHC could take advantage and leverage HASS technicality to improve ISC data collection. For example, to streamline injury data collection and avoid duplication, one challenge would be to install the ISC report option into HASS. Injury data printed along with the ED triage data would let subsequent caregivers follow the data previous caregivers had captured The ED team was not budgeted at the time to upgrade the system functionality. The plan to advance this system add-on functionality was to be delayed until next budget season.

Table 4.4. Summary of major changes and their relationships with organization and technology. O = organization, T = technology

Type of change	Event	O	T	Lessons Learned

Anticipated	Project group formation with ISC implementation work-plan	√	√	Organizational commitment crucial
	Development of a well balanced data set	√	√	Injury surveillance data set should be comprehensive, aligned with surveillance objectives, and practical.
	Workflow	√		Redefining the data collection process as a whole e.g. adopting electronic data as an official source of data capturing
	ISC data management	√		Organization should clearly define process for data management and dissemination during planning phase
Opportunistic	CHA set mandate for injury control and prevention	√		Organization should leverage external environmental influence
	NECHC staff participation	√	√	Round the clock support would greatly motivate user participation
	Project champions	√		Champions are necessary to move the project forward
	HASS implementation at the university hospital was on schedule	√	√	Resource allocation is important to expedite the project
	NECHC HASS initial data reports	√	√	Evidence and facts from past experience such as HASS initial data reports would help to promote the project
Emergent	Workflow		√	Resources are needed to ease the change process
	Updating ISC data set was a challenge		√	Technical support is necessary
	Data entry duplication	√		Organization should redefine the data collection process as a whole and adopt ISC as the official data capturing tool
	Physicians ISC training and data collection plan was modified	√		Champions are needed to facilitate changes
	Adjusted interview and training sessions	√		Flexibility is necessary to accommodate changes.
	Overall data completeness was less than 50%	√	√	Technical support and organization's reinforcement of its injury surveillance commitment are crucial
	Limited resource to upgrade ISC or HASS	√		Organization should prioritize resource allocation and respond to immediate needs

d. Dedicating resources for ongoing support.

According to the improvisational change model, ongoing change process requires dedicated support over time to adapt both the organization and the technology to changing organizational conditions, work practices, and

technological capabilities. [11] During the planning phase, the leadership of the champions and direct involvement of senior management established guidelines for ISC initiation process. In addition, the project took advantage of opportunistic changes, in particular injury prevention defined by the Edmonton Health Board as a public health priority. This required attention on the external environment of the project. The external environment, namely the mandate set by the health authority, influenced the course of ISC implementation. Thus, the planning phase with ISC data set developmentwas greatly accelerated. Over the deployment phase, constant contact with ISC users, timely response to their needs, round the clock support, and technological intervention by the ER team to update data lists proved to ease the transition to ISC use. Visible evidence was the change of attitude from passive to activeparticipation. Staff came up with an increasing number of comments and feedback as to how to make the system work better. The continuous monitoring of the implementation process and the ability to discern major events was perceived to be productive. One of the emergent changes that needed to be focused on was the response from the physicians. According to these physicians, time was a major hurdle for data entry. Further studies related to organizational issues and system implementations are necessary to assess the overall role of physicians in injury data gathering.

4.5 Recommendation

1. Champion in injury control and prevention.

   Injury surveillance is an aspect of public health that could be dramatically transformed by the application of information technology. Injury control intervention reflects legislatively mandated policies in government context. The impact and usefulness of ED injury surveillance system on injury prevention practice only becomes apparent if it contributes to control and prevention of adverse injury events in a community. Injury prevention champion characterizes injury trends and patterns and operates through government agencies to implement regulatory measures and policy directives.

2. Workflow and ISC data collection

Computer has considerable limitations when the system is implemented without first streamlining and addressing the perception of data collection process. The study has demonstrated the existence of duplication and physicians' uneasiness in electronic data capturing. To improve the effectiveness and success of ISC implementation, the process could be revised. Nursing staff will be the primary ISC data collector. During the triage stage, nurse keys in chief complaint description and the ISC details that will be printed out on the Assessment form. ISC details describe the context of the injury such as where, when, how, etc. The form is attached to the patient chart and used by other ED caregivers in subsequent stages. This will help to minimize the chances of patients being questioned repeatedly for the same injury information. Physician completes the ISC data documentation by hand-writing injury diagnosis and anatomical locations onto the Assessment form. These two data elements will be abstracted and transcribed to computers.

3. Technical support and system upgrade

As part of the effort to improve data quality and compliance, the computer user interface needs to address the time constraint factor in the ED setting. Users should be able to capture comprehensive ISC data in a timely manner. Two interface design options are suggested.

- Free text entry and data abstract. The ISC will allow free text entry into each of its data fields such as external cause, place of injury, injury mechanism, etc. Coding free text data into a relational database form (abstract) would be applied afterwards. There are software applications available that perform data abstracts with high sensitivity and specificity (Appendix D).
- Selective pick-list. Current ISC versions require user to scroll through long list of data items before a reasonable choice can be found. For example, to locate subtype place of injury-(kitchen inside a residential unit) the user has to go through all kinds of facility structures that include agriculture complexes, fitness compartments, etc. Having a

'smart' selective pick-list by limiting subtype of place to domestic units once user selects residential, would reduce the time spent in screening data.

4. Data management and dissemination
    - HASS should be able to generate ISC data reports in a case-based or aggregate manner to meet public health surveillance, clinical research and administrative needs.
    - HASS user involvement and participation in system development have been practiced early on as an important factor of system success. The perceived usefulness of ISC data should be encouraged, as usefulness is believed to be a very significant factor in system use intentions. IS aggregate data reports, dissemination and their impact in community injury control and prevention facilitates user's system ownership and commitment to the system.
    - ISC data subject to standard practices of management and quality control. Data are released in accordance with rules and regulations established by direction of data ownership. A data manager will establish procedures for quantity and quality control, coordinate with data users on generating reports, data retrieval and analysis etc.

4.6 Conclusions

This study examines the contribution of the improvisational model to technological innovation in an emergency room setting. Informatics implementation is a complex change process that often involves wide-ranging effects. Traditional models usually manage change as a sequential series of predefined steps. This improvisational model recognizes and capitalizes on the fact that change is ongoing and uncertain. The model is particularly befitting to a turbulent organizational environment in which the technology being implemented is open-ended and customizable. It is also helpful when the organization tolerates change as a norm. The NECHC is built on a primary health care model

emphasizing innovative practice and promoting integration of service while focusing on the needs of clients. Its commitment in delivering this health concept constitutes a framework in justifying the application of the improvisational model. The course of ISC implementation experiences the anticipated, opportunistic, and emergent changes that reflect the unprecedented, complex, open-ended, and flexible nature of technology, people, and organization involvement. Recognizing major events or changes as they occur and responding to them effectively by aligning the three key dimensions, namely technology, change model, and organizational context, have proven to have a significant impact on ISC implementation. There are still unsolved issues surrounding ISC adoption and adaptation. The balance between information needs for injury prevention and existing data collection resources, the difficult aspects of physician data entry, data management and system capabilities pose critical challenges to the very objectives of introducing an electronic injury surveillance system in an emergency room setting. An effective execution of the model requires constant review, assessment, and adjustment of the technology, people, and organization. As a result of these activities, it is equally important to allocate resources to support the ongoing changes.

4.7 References

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Chapter 5 Summary

5.1 Abstract

This project describes the implementation of an emergency department (ED) injury surveillance system at a local community health center. The improvisational model of technological change by Orlikowski and Hofman is used as a conceptual foundation to explain the innovation process in this complex, turbulent and flexible setting. Key dimensions' interdependent relationship and its influence on workflow and data collection are explored.

5.2 Introduction

Surveillance is defined as the systematic collection, analysis, interpretation, dissemination, and application of health data to a public health problem.[1] Hospital ED data represent an important but underused source of information for injury-surveillance effort. . Public health professionals want to collect and analyze this ED visits population data to develop and evaluate strategies for injury control and prevention.[2, 3,4] A local community health center NECHC (NorthEast Community Health Center) in Edmonton opened its ED service in September1999. The ED implemented a computer system called Hospital Administration Software Solutions (HASS) with an Injury Surveillance System component (ISC) which has not been utilized.

This project examines the process of implementing the ISC at NECHC in terms of workflow and capture of surveillance data. First, existing surveillance initiatives are identified. Second, major streams of technological innovation are described. A model is used to provide a conceptual framework for information system implementation. Third, the research design encompassing study approach, location, study phases, system information, subjects, data sources, and method is discussed. Last, key changes, their relationships with the organization and technology, and the significance of these findings are discussed.

5.3 ED injury surveillance system as a technological innovation

5.3.1 Existing injury surveillance initiatives

Routine data on injuries derived from mortality statistics do not provide morbidity information.[7] Trauma registries focus primarily on injuries on a severity scale.[13] This incomplete and non-representative injury data do not describe accurately the scope of injury. Canada has a national database CHIRPP (Canadian Hospitals Injury Reporting and Prevention Program) but it is at a national level and is not specific in identifying local injury problems.[8] Alberta 's ACCS (ambulatory care classification system) is used throughout the province's emergency departments. Its main purpose is to predict resource needs and cost management.[9]

5.3.2 ED electronic injury data collection

Injury problems and trends vary between communities, and specific information is needed to prioritize control programs and assess the effectiveness of control measures.[5,6,7,10,12] Computer-based patient record (CPR) systems offer access (availability, timeliness, reliability, and ease of use), quality, security, flexibility, and efficiency.[35, 36] Public health information standards are changing throughout the world. Harmonizing data standards such as data definitions, component structures, code values, and data use allow for more effective collaborations among public health agencies and healthcare providers. It also increases acceptability, simplicity, and flexibility to the persons actually using the CPR systems [37, 38]. These potential benefits along with population-based characteristics have positioned the community ED electronic injury data collection at the forefront of injury surveillance data. It meets public health surveillance system guidelines and explicit criteria such as simplicity, flexibility, acceptability, timeliness, representativeness, sensitivity, and positive predictive value.[39,40]

5.3.3 Major Streams on Technological Innovation

a. Major themes and streams

Most initial studies on innovation have examined two perspectives – adoption and diffusion.[11] Adoption perspective evaluates the characteristics of an organization that make it responsive to innovation and change. Diffusion perspective attempts to understand why and how innovation spreads and what leads to widespread acceptance. Later studies have described the stage model of diffusion integrating theories from organizational change, innovation, and technology diffusion literature. The stage model includes initiation, adoption, adaptation, acceptance, routinization, and infusion. This six-phase implementation process can be related to Lewin's change model of unfreezing, changing and refreezing.[14] By contrast, some authors present an episodic and discontinuous pattern of adaptation. They suggest that the learning curve be characterized between short, intensive periods of adaptation around new technologies and longer periods of relatively routine use.[15]

b. Improvisational model (Figure 5.1)

This project uses change management model with the conceptual framework based on the improvisational model by Orlikowski. The model defines three categories of changes in the implementation process: anticipated; emergent; and opportunity-based. Anticipated changes are planned ahead of time and occurred as intended. Emergent changes arise spontaneously and are not originally anticipated. Opportunity-based changes are not anticipated ahead of time but are introduced purposefully and intentionally during the change process. It further notes that planning should be considered only as a guide, and management creates an environment that facilitates improvisation instead of predefining each step and then controlling events to fit the plan. To effectively execute the model, it is necessary to make ongoing assessment and adjustment of the technology and the organization.[15]

5.3.4 Conditions justifying the model's application

The improvisational model requires a tolerance for flexibility, uncertainty, and complexity. It is appropriate for open-ended and customizable technologies. Certain ED and the mentioned surveillance computer system characteristics have been identified as befitting the application of such a model:

1. ED is an intensive area in the hospital with rapid pace and emphasis on immediate treatment of patients in need of emergency care.[16] As NECHC ED staff gained experience and understood the ISC better, they shifted their focus from sole care giving to both care giving and injury data documentation. This impact on workload may prompt structural changes.[27,28,33]
2. In setting its vision-"healthier people in healthier communities"- the Edmonton Capital Health Authority (CHA) board had identified three health issues that had considerable influence on the health of people in the region and commanded a significant proportion of resources.[30] The board had considered these three issues, one of which was injury control and prevention as priorities for action. Managerial support from NECHC and the presence of champions e.g. Dr. L.Francescutti, chair of the advisory body of Alberta Center for Injury Control and Research (ACICR), Dr. G. Cummings, Royal Alexandra Hospital emergency department chief had major role in ensuring and achieving a successful injury surveillance system implementation. Their experience, credibility and commitment to organizational learning and employee empowerment would establish a core competency factor to overcome challenges whether expected or unexpected. These characteristics were particularly compatible with the improvisational model.
3. There has been a tremendous dynamism in injury control and prevention in Alberta. ACICR has a provincial mandate to provide coordination and support for organizations and professionals in injury control. Trauma registry monitors serious injuries in trauma centers.[13] CHA Public Health section addresses determinants of health and takes action to improve health at community level e.g. child injury prevention. ED physicians require injury surveillance data to practice preventive medicine in CHA EDs. Injury control in Alberta is a shared

responsibility.[34] and a successful injury surveillance system implementation needs to include these multi-disciplines and their information needs.[29,32] It was also necessary to develop and present to all parties involved a clear vision of this project; namely, implementation of a community-based pilot project aimed at local specific injury problems.

4. There are circumstances which are sufficiently sensitive for ED care providers to document injuries e.g. child abuse, sexual assault.[17, 18] It was recognized that data capturing under these ED situations could be a challenge.[19, 20,25,26]
5. As it is noted in Appendix B, the computer system to be implemented represented an open-ended and customizable version of information technology

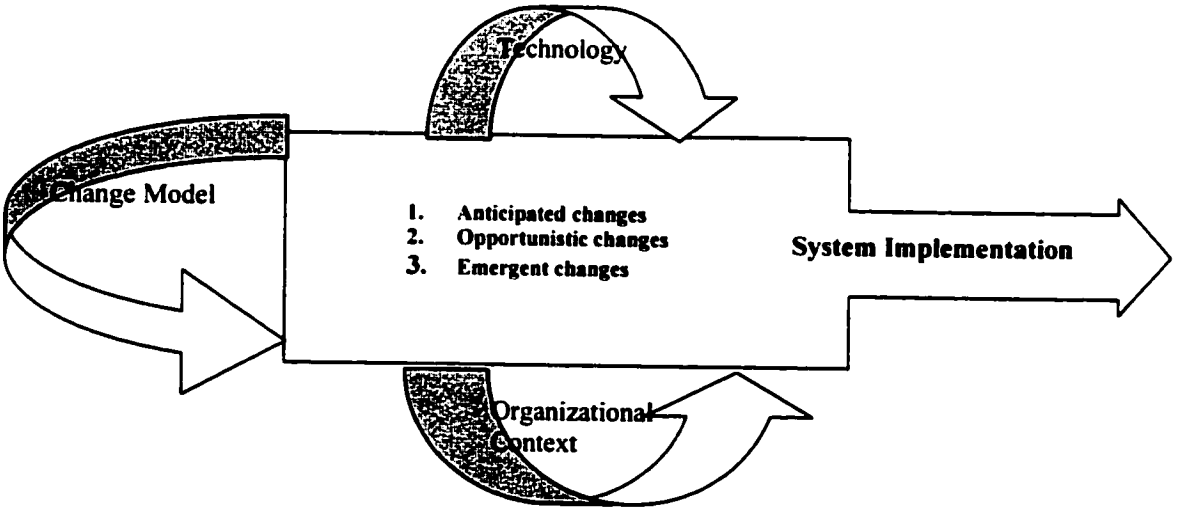


Figure 5.1:Improvisational Model for Technological Innovation

5.4 Project Objective and Research Question

Project objective is to implement and assess an ED injury surveillance system at a local community health center. The research question is to determine

if the theory of improvisation can be used to explain the implementation in terms of workflow and capture of surveillance data.

5.5 Research design

5.5.1 Research location

NorthEast (NE) Edmonton has a population of 66,941 with 33,918 female and 33,023 male. There are 24,170 female and 24,154 male under 45 years old for a total of 48,324 (72.2%) [44]. Private household is 22,441 with an average income $44,196 and a median of $39,935 ($51,118 average and $42,701 median for all Alberta) [45]. The NECHC provides emergency services in addition to Laboratory, Family Health, Mental Health and other services. Emergency service is available on a 24-hours, 7 days per week basis (Appendix A). Emergency Medical Services (EMS) arranges patient transfers to other facilities for hospital admission since NECHC does not have in-patients beds.[21]

Royal Alexandra Hospital (RAH), a nearby tertiary care hospital showed that 75% ED visits of its 1994 emergency service came from NE with 45% adolescence. A study, assessing the health needs of the NE community, indicated a relatively high level of injuries on a per capita [22]. During the first three months of its opening, the center had over 6,500 ED visits.[31]

5.5.2 Study phases

The study was conducted over a period of eleven months and consisted of three phases: planning, deployment, and assessment (Table 5.1, 5.2)

a. Planning phase

It began mid November 1999 that included the project group formation with its core members, development of a comprehensive injury data set, data management with data dissemination consideration, and workflow study.

b. Deployment phase

The deployment phase consisted of ISC installation, a data collection trial to determine the most effective way to capture quality data by NECHC staff, and work flow study.

c. Assessment phase

The assessment phase would involve qualitative analysis and descriptive statistics based on data collected during the planning and deployment phases.

Table 5.1. Timelines of the implementation study phases

Phases	**Nov 99**	**Dec 99**	**Jan 00**	**Feb 00**	**Mar 00**	**Apr 00**	**May 00**	**June 00**	**July 00**	**Aug 00**	**Sep 00**
Planning	X	X	X	X	X	X	X	X	X		
Deployment										X	
Assessment										X	X

Table 5.2. Summary of the tasks during implementation study phases

Phases	**Tasks**
Planning	• Project group formation with ISC implementation workplan • Data set development • Data management consideration that included data dissemination • Work flow study
Deployment	• ISC installation • Data collection trial with staff training • Work flow study
Assessment	• Data analysis

5.5.3 Technology (Appendix B)

ISC was a component resided within HASS [23,24]. When the ISC window opened during triage or following the update of patient record, patient's last/first name, date of birth, age, sex, date of injury, and presenting problem would be transferred from the triage window. If staff were busy and unable to complete the

data immediately, data could be entered at a more convenient time. ISC user could re-enter the injury surveillance window from other screens by performing a patient search or double clicking on the record from a patient list (Figure 5.2)

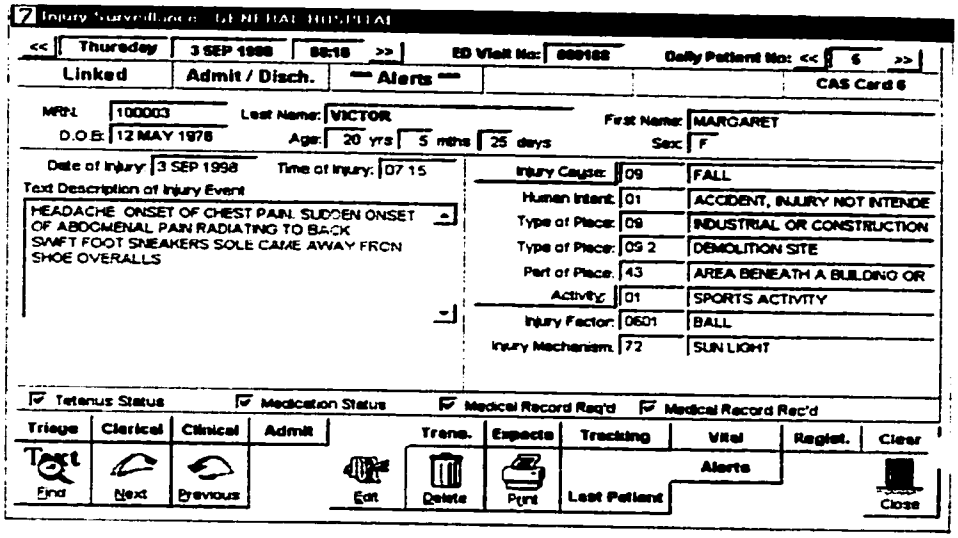


Figure 5.2 ISC window

5.5.4 Subjects

The project involved RAH trauma service, Kim Borden * (ACICR staff), Carla Policcichio*(NECHC ER team leader), Dr. L.H.Francescutti *(Principal Investigator), Public Health research coordinator, CHA Information System ER project team, HASS developer, Dr. F. Lau*(Faculty of Business, thesis committee), *Dr. G. Cummings (RAH senior ER physician), NECHC physicians, nurses, registration clerks, patients, and thesis student Hue Quan. During the data collection trial, NECHC staff (physicians, nurses, registration clerks) who were scheduled on duties received 45 to 60 minutes of ISC computer training.

5.5.5 Method

a. Data sources (Table 5.4)

Data sources collected in this study were staff, patients, and ISC data repository.

1. Staff

Data collection was primarily from observations, meeting notes, interviews, training sessions, and documents. Due to confidentiality concerns raised by staff graduate student Hue Quan used field notes instead of tape recording interviews. Interview script was in Appendix E.

2. Patients

To validate ISC data collected during the trial, NECHC staff obtained consent from patients for follow-up telephone interviews Graduate student Hue Quan telephoned patients the day after patients' ED visits. If patients were not home or there was no answer, a second attempt was made an hour later. The case would be marked "patient not available" after 3 redial attempts. The interview was based on a script (Appendix E):

3. Patient case data (HASS repository)

Patient demographic and ISC electronic data were retrieved from the centrally stored Oracle database. A NECHC research staff and an ED system analyst assisted in downloading data from Oracle to Microsoft Access database, using Open Data Base Connectivity setup (ODBC). First, the NECHC patient data were separated from the data pool by using NECHC medical record number that had unique identifier starting with "0000". Next, patient cases were limited by the data collection trial dates. Lastly, injured patients identified by Injury (Y/N) = "Yes" data field were retrieved. The ISC data entries were summarized in Table 5.3:

Table 5.3. Patient demographic and ISC data elements

Data Elements	Description	Data Types
Last Name	Patient last name	Text of size 30
Middle Name	Patient Middle Name	Text of size 30
Medical Record Number	NECHC Patient medical record number started with "0000"	Text of size 12
Gender	Patient gender	Male or Female
Date of Birth	Patient date of birth	Date (DD-MMM-YYYY)
Date of injury	Date injury event occurred	Date (DD-MMM-YYYY)

* project champion

Time of injury	Time injury event occurred	Time (HH:MM)
Brief description	Free-text entry of what went wrong. It could provide additional information.	Memo
Brand name/product fault	Product related to injury event e.g. child walker	Memo
Safety equipment or device	Equipment or device used during the injury event e.g. seat belt	Memo
External injury cause	Event, circumstance or condition associated with the occurrence of injury, poisoning or violence	Text of size 30
Human intent	The role of human intent in the occurrence of injury as assessed by caregivers	Text of size 30
Type of place	The type of place at which the person was situated when injured.	Text of size 30
Activity	The specific type of activity being undertaken by the person when injured	Text of size 30
Injury factor	Types of objects and substances involved in the occurrence of the injury	Text of size 30
Injury mechanism	The way in which the injury was sustained	Text of size 30
Nature of main injury	The nature of the injury chiefly responsible	Text of size 30
Bodily location	The anatomical location of the injury chiefly responsible.	Text of size 30

Table 5.4. Summary of data sources

Data Source	Volume	Type
Email	68	qualitative
NECHC references documenting how NECHC was established	5	qualitative
HASS user training manuals	2	qualitative
ACICR's Alberta Injury Data Report	1	quantitative
Meeting notes, notes as a result of direct observations , interview, field notes , and comment book	32 pages	qualitative
Patient case data (HASS repository)	3 weeks trial data	quantitative

b. Analysis

1. Content analysis.

Email, field notes, documents were analyzed for content with NUDIST (Non-numerical Unstructured Data Indexing Searching and Theorizing) software. NUDIST is a computer package designed to aid users in handling Non-numerical and Unstructured Data. NUDIST supports qualitative analysis, enabling the processing of coded data through an Index System, searching text or patterns of coding and theorizing about the data (Appendix D). Data were organized according to the following steps:

- Making a document system.
- Inserting text annotations
- Using nodes. NUDIST provided node for Document Annotations at which annotations could be coded. Text unit of any length could be inserted and coded at Document Annotations as ideas occurred.

2. ISC data quality assessment

The study used the following criteria for data quality assessment: data completeness, data correctness, additional information, missing data, timeliness

- Data completeness: ISC injury (yes/no) field in the Triage Form was a mandatory data entry field. Hence it could be used as standard reference for determining the number of injury-related ED visits i.e. true injury. Completeness was the proportion of all injury events of interest that were captured by ISC and was calculated as a/(a + c). (Table 5.5)

Table 5.5. Data completeness and correctness

	True injury	False injury	Total
Injury events captured by ISC	a	b	a + b
Injury events missed by ISC	c	d	c + d
Total	a + c	b + d	a+ b + c + d

- Data Correctness: Correctness was the proportion of observations that truly had the injury events of interest and was calculated as a/(a + b) [41,42,,43] . The injury-surveillance population of interest was (a + c)

which was presumably eligible for capture by ISC. The total ED patient visits which included injury-related and non-injury related sets of patients was (a + b+ c + d). Patients would be phoned next day to obtain relevant injury data. Measuring the agreement between respondent information and that provided by the ISC would determine data correctness (Table 5.5).

- Additional information: The ISC injury brief description window was a free text entry field. It gave staff the opportunity to supplement the ISC coded data. It would appear logical to search this data item for confirmation and expansion of coded data items.
- Missing data: Charting practice that left data entry fields blank introduced ambiguity because it might be interpreted either as non-responsive patient or ED staff forgetting to collect information. Missing data was calculated as a proportion of total injury data items (c/a + c).
- Timeliness: There were circumstances in which patient condition was considered urgent. ED staffs were encouraged to do real-time data entry but also had the option to put comment suggesting data collection would be deferred in an emergency situation.

3. Patient case statistics

Total injury cases would be provided during each of the three weeks data collection trial (Appendix C) along with percentage distributions of each of the following injury surveillance data items:

- External cause
- Human intent
- Type of place
- Type of activity
- Injury factors
- Injury mechanisms

5.6 Findings

5.6.1 Planning phase and current workflow

A patient presenting to the NECHC ED was triaged by a nurse and chief complaint was recorded directly into HASS system. Chief complaint is a mandatory field. Unless the patient needed immediate care, he or she proceeded to the registration clerk where demographics were obtained and keyed into a separate system called Enovation. These 2 systems did not communicate to each other. Clerk had to transfer HASS data to Enovation in a timely manner so as not tie up the flow of patient records. The registration desk, then, printed out a patient registration form (PRF). When the patient was inside a treatment room, physician or nurse charted physical examination and detailed assessment either into HASS or PRF. HASS system was complemented with hand-written notes, progress notes, discharge planning, and forms that resided in the patient binder. Once patient was discharged or transferred to a tertiary hospital, the encounter was considered closed. Diagnosis and intervention, if any, data were abstracted into the Ambulatory Care Classification System (ACCS) 's 3M database. The data collected for ACCS is used to classify ambulatory service recipients into clinical groups with similar resource needs and clinical profiles [9] (Figure 5.3).

5.6.2 Deployment phase

ISC was installed and activated during this phase.

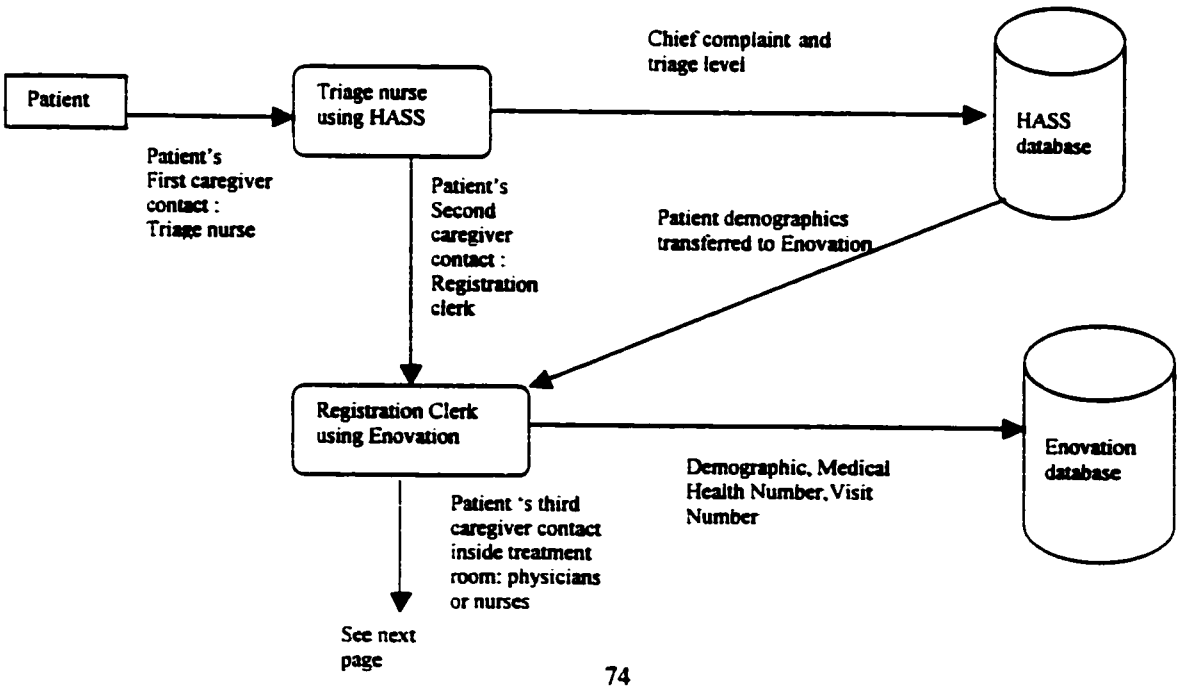
a. Training

There were 8 training sessions with interviews for nurses: 4 one-to-one sessions, 2 sessions with groups of 2 and 2 sessions with groups of 3 nurses. For registration clerks, there were 5 training sessions with interviews: 3 one-to-one sessions, 1 session with group of 2 and 1 session with group of 3 clerks. Physician training sessions with interviews were comprised of 4 one-to-one sessions. (Table 5.6). Initial planning was to have pre and post deployment interviews. As a result of discussions with the NECHC team leader, interviews were held once during training due to staff coverage and patient load issues during the deployment phase. In addition, pre-scheduled training sessions were often modified to

accommodate schedule changes. For example, a cardiac patient's hemodynamic symptoms became exacerbated and extra personnel were required. Scheduled session was usually re-arranged and, 2 groups of 3. For registration clerks, there were 5 training sessions with interviews: 3 one-to-one, 1 group of 2 and 1 group of 3. Physician training sessions with interviews were 4 one-to-one. (Table 5.6). Due to staff coverage and patient load issues during deployment phase, interviews were held once during training after discussion with NECHC team leader. Initial planning was to have pre and post deployment interviews. Also, pre-scheduled training sessions were quite often modified to accommodate the changes. For example, a cardiac patient's hemodynamic symptoms became exacerbated and extra personnel were required. Scheduled session was usually re-arranged and, sometimes, it was carried out inside treatment room or at the front desk so nurses could participate and simultaneously monitor patients.

Table 5.6. Summary of ISC training

Staff	Group of 1	Group of 2	Group of 3	Total staff trained	Training duration
Nurse	4	2	2	14	45 to 60 minutes per session except 1 for 15 minutes
Registration clerk	3	1	1	8	
Physician	4	0	0	4	
Total	11	3	3	26	



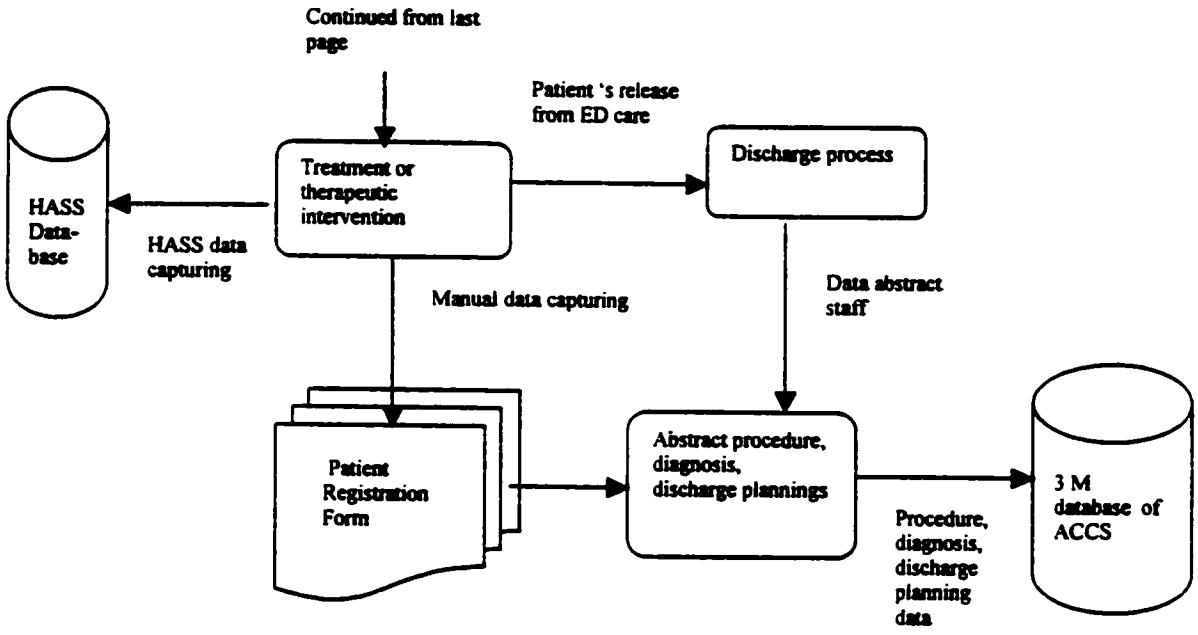


Figure 5.3 Current work flow diagram

b. Workflow

During the ISC deployment phase, there were three groups of staff involved in the data collection trial: physicians, nurses, and registration clerks. Each group collected a week's injury-related data (estimated to be about 100 patients). The trial was done in three consecutive weeks for the three groups. NECHC staff explained the study to patients, sought their consent, obtained permission for phone interviews, and entered injury-related data directly into HASS. This injury surveillance project and its accompanied data collection were additional to staff 's concurrent workflow and documentation routine. Most were already familiar with HASS's existing functionality and evaluated the relatively short ISC training session as satisfactory. Peer learning was considered a convenient resource, on par with support from ED project team and graduate student Hue Quan. For example, staff found the summarized version of the study in bullets format (prepared by Hue Quan) helpful while recruiting patients to participate.

5.6.3 Assessment phase

There were a total of 197 "Y" injured cases recorded during the nurse group week. Triage nurses were able to capture ISC data from 98 cases. ISC data were validated through phone calls for 32 cases. Data completeness was 49.7%. According to the nurses, missed opportunities to collect data were due to high patient load. Nurses were did not have sufficient time to explain the study to patients, seek their consent, and do ISC data entries. Data correctness and presence of additional information were confirmed to be 100% for the 32 recorded cases. Also, there were neither missing data nor delayed entries for these 32 confirmed cases. During the registration clerk group week, there were a total of 172 injured cases recorded. The Triage Form Injury (Y/N) mandatory field entered by the triage nurse was used as a reference to determine the number of injured cases. Registration clerks were able to capture ISC data from 38 cases. Data completeness was 22.1%. According to the clerks, missed opportunities to collect data were again due to overwhelming patient load. ISC data were validated through phone calls for 15 cases. Data correctness and the presence of additional information were confirmed to be 100% for all 15 cases. There were neither missing data nor delayed entries for these 15 confirmed cases.

There were 154 "Y" injured cases during the physician week and no ISC data were collected (Table 5.7). The ISC injury-related data results were retrieved from HASS repository (Appendix C).

Table 5.7. Summary of the three data collection groups

Staff	Injured population	Data Complete-ness	Confirmed cases	Data Correctness	Additional information	Missing data	Data entry delay
Nurse	197	49.7%	32	100%	100%	none	none
Registrat-ion clerk	172	22.1%	15	100%	100%	none	none
Physician	154	0%	0	-----	-----	-----	-----

5.7 Discussion

5.7.1 Conceptual framework

Employing the improvisational model required a process to recognize the different types of change or major events as they occurred and to respond effectively to them. Two sets of enabling conditions were essential: aligning key dimensions of the change process and dedicating resources to provide ongoing support for the change process. The key dimensions were the technology, the organizational context, and the change model. Ongoing support involved adapting both the organization and the technology to changing organizational conditions, use practices, and technological capability.[16]

5.7.2 Major events and their interpretations

a. Anticipated changes

- Project group formation with ISC implementation work-plan

  The ISC implementation may be interpreted as an expansion of the HASS system. The project group convened and addressed basic questions such as objectives of data collection, who would capture data, and what to do with the data.

- Data set development

  How comprehensive would the ED injury surveillance data set be? The data set is an essential component of the project. The data set should be comprehensive, easy to apply, have good reliability, and enable analysis for injury control and prevention.

- workflow

  Who would collect the data? An equally important component of the ISC implementation was to decide who was (were) the best candidate(s) for quality data collection. The practice needed to fit the work pattern, workflow, and its environment. To ease the ISC implementation and understand the workload situation better, a data collection trial was held with

each staff category (nurse, registration clerk, and physician) doing a complete week of ISC data collection. Data quality assessment based on electronic data and patient telephone interviews would be useful to determine who would be the most efficient ISC data collector.

- ISC data management

What happened to the collected data? Obviously, data were not collected for the sheer purpose of collecting. There would be a need to establish procedures for data management, quality assurance, report generating and dissemination according to local standards. All these functions would surface once the ISC was implemented.

b. Opportunistic changes

- CHA set mandate for injury control and prevention

Edmonton Capital Health board had set a mandate for injury control and prevention as part of its health issues priorities. It recommended improved data collection and surveillance as part of a combination of strategy. This strengthened the ISC implementation at the NECHC.

- NECHC staff's improved participation

Finding out about staff attitudes during the deployment phase helped to identify areas where support could be provided to ease the process. Staff suggestions were considered and actions were taken to improve the conditions. Staff also believed that even though injury surveillance might not directly impact patient care in the ED setting, it did have an impact on injury control and prevention. The growing participation and involvement were evidence of a change from a relatively passive attitude to an active response.

- Project champions

Dr. G. Cummings assumed the role of a champion for the project. Kim Borden, ACICR data manager, had valuable input for injury data set development. Ms. Nonie Fraser Lee was assigned as project adviser by Public Health Research. All these happened shortly before the deployment phase. Given these changes, the implementation process reflected a multidisciplinary involvement.

- HASS implementation at the university hospital was on schedule

  HASS at the University of Alberta Hospital (UAH) was implemented on schedule. Thus, the ED project team was able to allocate extra resources to support the pilot ISC project in terms of computer application support, system enhancement and data items update. This accelerated the user preparation phase at the NECHC.

- NECHC HASS initial data reports

  NECHC HASS data results from the first three months of operation indicated many unspecified causes of ED visits. This improved the acceptance of a comprehensive data set for injury control and prevention even though there were some concerns about the data required and resources available.

c. Emergent changes

- Workflow

  There were some beliefs during the deployment phase that ISC data entry took too much time, changed work patterns or even professional values. Due to research nature of the project and subsequent ethics, extra effort was needed to explain the ISC study to the patient in addition to staff's routines that included patient care, paper charting, and other HASS data entry. The purpose was to obtain permission to collect the individual patient's injury data, and to do a phone interview the next day. It became another time constraint factor on staff. For example, a triage nurse while attempting to calm a crying injured child had to also try to explain the ISC study to the parents.

- Updating ISC data set was a challenge

  Precise purposes of surveillance, the settings in which data were collected, and the resources available were important determinants of the data collected. The data set developed for the project (that is, predefined lists of injury-related questions or observations) could not meet all the terms of how, when, where, and what. The lists kept growing as unspecified or miscellaneous items increased. In some circumstances, staff found it confusing having to scroll the data item lists several times before they could click a button and sometimes were not even sure what was selected. Over time, staff began to pick data items

closest to the described scenario and to make use of the free-text entry. Also, the Information System ED team updated the lists to address any changes.

- Data entry duplication

  While the triage nurse collected ISC electronic data, subsequent caregivers in the treatment room area were handwriting some patient injury information that overlapped with what had already been captured by the ISC.

- Physician training was modified

  Physicians were less enthusiastic in using computers to collect data given the workload and fee-for-service arrangement. A decision was made to modify ISC training and data collection during physician week. Physicians were requested just to key in the two injury-related data elements during the trial: diagnosis and bodily locations. Other ISC data entries were left out.

- Adjusted interview schedule

  Due to staff coverage and patient load issues during the deployment phase, the interview was carried out during training sessions instead of being held pre and post deployment as initially planned. Also, pre-scheduled training sessions were quite often modified to accommodate changes. Staff's overall impression of the relatively short training sessions was satisfactory and useful. For instance, they were able to navigate the ISC window from other screens with little difficulty.

- Data completeness was not optimal

  Overall data completeness was less than 50%. Injury diagnosis and bodily location, two important pieces of information for injury surveillance, were missed almost totally. This could pose a challenge to data management and dissemination.

- Limited resource to upgrade ISC or HASS

  Considerations of user convenience and system functionality had certain impact on the implementation process. For instance, it would be helpful if the current version could let users capture primary and secondary injuries, tailor data entry screen, and print out reports. The ED team did not have the resources to revise user needs in a timely manner.

Table 5.8. Summary of the major events and interpretations. P = Planning phase, D = Deployment phase, P-D = shortly before deployment phase, A = Assessment phase

Type of change	Event	Interpretation
Anticipated	• Project group formation with ISC implementation work-plan (P)	• An incremental change instead of a transformational change after HASS implementation a year ago.
	• Development of a well balance data set (P)	• Data set comprehensiveness was depended on surveillance objectives, settings, and practicality
	• Workflow (P)	• Data collection trial helped to determine who would be the most efficient data collector • Data collection trial also helped to determine how injury surveillance would fit into the ED work practice
	• ISC data management (P)	• ISC pilot at the NECHC helped to head start planning for data management
Opportunistic	• CHA set mandate for injury control and prevention (D)	• Organizational context: external environmental influence
	• NECHC staff participation (D)	• Round the clock support and feedback helped to improve staff participation in staff collection. Staff awareness of the importance of injury surveillance also played a role.
	• Project champions (P-D)	• Multidisciplinary involvement
	• HASS implementation at the university hospital was on schedule	• ED project team was able to accelerate the ISC process at NECHC
	• NECHC HASS initial data reports (P-D)	• Reinforced the belief to develop a comprehensive data set
Emergent	• Workflow (D)	• The research nature of the project and subsequent ethics requirement needed extra effort from staff in addition to ISC data collection and other routine duties.
	• Updating ISC data set was a challenge (D)	• Data items update was ever on-going
	• Data entry duplication (D)	• Manual data entry was ingrained in work practice
	• Physicians ISC training and data collection plan was modified (D)	• Further work on physician's role in direct electronic data entry
	• Adjusted interview and	• Flexibility is needed to handle changes

	training sessions (D)	
	• Overall data completeness was less than 50% (A)	• ISC data management including data dissemination would be a challenge
	• Limited resource to upgrade ISC or HASS (D)	• Resource allocation to problem-solving was a challenge

5.7.3 Major events and their relations with organization and technology (Table 5.9)

It is important to depict the interaction among the three dimensions of change process: technology (information technology infrastructure, system features), organizational context (structure, culture, business process), and the change model. This allows the alignment of key change dimensions with results.

a Change model and the technology

- SC data set update

The technology was open-ended and customizable so the improvisational model provided the flexibility for NECHC to adapt and learn through use. For example when a user could not find a suitable external cause of injury item to fill data entry field, the ED team was able to respond immediately to address the issue. One evident result of the ever-growing data items was that at certain point, the list overwhelmed the user. The consequences of this unexpected effect could be poorer data quality, discouraged users, and a constrained future flexibility.

- Workflow and system upgrade

The ISC introduction during deployment phase affected workflow and work practice. NECHC staff experienced time constraints in ISC data collection. For instance, finding a suitable data item to fill data entry field took time. A system upgrade would facilitate and expedite data gathering under this circumstance. There were situations where more than one injury cause or diagnosis was identified; an update to current the ISC version would help caregivers to accurately capture these data. Due to limited resources, the

ED project team was not able to provide immediate support to revise the system functionality.

b. Change model and organizational context.

- Data entry duplication

CHA and NECHC management's commitment to focus on organizational learning and employee empowerment was compatible with the model. For example, a data collection trial evaluating data collection patterns and discussion input from staff were evidences of a flexible management. One emergent change was the existence of overlapping electronic and paper-based data recording. An organization employs innovation with the objective of improving performance and productivity. It assumes business processes defined as sets of activities often cutting across the major functional boundaries within organizations [47,48] can benefit through information technology interpreted as "automation". The paper-based record is familiar to a large number of users and it is relatively ingrained [36]. Experts in management and information technology have begun to recognize the limitation of automation when business processes are automated without first streamlining and improving them [49]. The paper-based charting system and HASS coexisted during the ISC deployment phase. Caregivers could capture the same information without knowing what data was collected before and patients were questioned repeatedly. Lesson learned from this was that redefining the boundaries of the ISC data capturing process and identifying its critical performance measures can help avoid the pitfalls of automating an unfavorable and inappropriate process. For example, NECHC could adopt ISC as the sole and official injury data collection tool and discard the paper-based charting of injury events.

- Physicians reluctant to do ISC data entry

Another emergent change was physician unwillingness to do data entry. There has long been ambivalence on the part of physicians concerning the use of computer-based patient records (CPR) and especially concerning data entry. Some physicians perceive CPR entry as taking away from patient care

time by having them do extra clerical work. Others experience the advantage that CPR can provide for their patient care.[50] Physician's lack of understanding of the long-term value of CPR has led to widespread organizational stress. [49] Data entry, in particular, has been shown to be a major issue for CPR. This disincentive is also compounded by the fee-for-service arrangement [51]. The concept of "fit" is central to understanding the interaction of CPR with its organizational context [49]. If an organization wants to change the user's behavior or belief in innovation adoption, it must emphasize the need to change either prior to or concurrently with the introduction of the system. If the implementation is not carefully planned and it does not take organizational context into account, the new system may be put in place but the organization is likely to stay status quo. The desired outcomes would not likely then occur.

c. Organizational context and technology. [52,53]

The NECHC 's health delivery model, team-oriented work practice, its tolerance to changes, and the ISC 's technical versatility allow the improvisational model to be applied into the center's ED setting. Indeed, NECHC could take advantage and leverage HASS technicality to improve ISC data collection. For example, to streamline injury data collection and avoid duplication, one challenge would be to install the ISC report option into HASS. Injury data printed along with the ED triage data would let subsequent caregivers follow the data previous caregivers had captured The ED team was not budgeted at the time to upgrade the system functionality. The plan to advance this system add-on functionality was to be delayed until next budget season.

Table 5.9. Summary of major changes and their relationships with organization and the technology. O = organization, T = technology

Type of change	Event	O	T	Lessons Learned
Anticipated	Project group formation with ISC implementation work-plan	√	√	Organizational commitment is crucial

	Development of a well balance data set	√	√	Injury surveillance data set should be comprehensive, aligned with surveillance objectives, and practical.
	Workflow	√		Redefining the data collection process as a whole e.g. adopted electronic data as an official source of data capturing
	ISC data management	√		Organization should clearly define process for data management and dissemination during planning phase
Opportunistic	CHA set mandate for injury control and prevention	√		Organization should leverage external environmental influence
	NECHC staff participation	√	√	Round the clock support would greatly motivate user participation
	Project champions	√		Champions are necessary to move forward the project
	HASS implementation at the university hospital was on schedule	√	√	Resource allocation is important to expedite the project
	NECHC HASS initial data reports	√	√	Evidence and facts from past experience such as HASS initial data reports would help to promote the project
Emergent	Workflow		√	Resources are needed to ease the change process
	Updating ISC data set was a challenge		√	Technical support is necessary
	Data entry duplication	√		Organization should redefine the data collection process as a whole and adopt ISC as the official data capturing tool
	Physicians ISC training and data collection plan was modified	√		Champions are needed to facilitate changes
	Adjusted interview and training sessions	√		Flexibility is necessary to accommodate changes.
	Overall data completeness was less than 50%	√	√	Technical support and organization's reinforcement of its injury surveillance commitment are crucial
	Limited resource to upgrade ISC or HASS	√		Organization should prioritize resource allocation and respond to immediate needs

d. Dedicating resources for ongoing support

According to the improvisational change model, ongoing change process requires dedicated support over time to adapt both the organization and the technology to changing organizational conditions, work practices, and technological capabilities.[54] During the planning phase, the leadership of the champions and direct involvement of senior management established guidelines for ISC initiation process. In addition, the project took advantage of opportunistic

changes, in particular injury prevention defined by the Edmonton Health Board as a public health priority. This required attention on the external environment of the project. The external environment, namely the mandate set by the health authority, influenced the course of ISC implementation. Thus, the planning phase with ISC data set development was greatly accelerated. Over the deployment phase, constant contact with ISC users, timely response to their needs, round the clock support, and technological intervention by the ER team to update data lists proved to ease the transition to ISC use. Visible evidence was the change of attitude from passive to active participation. Staff came up with an increasing number of comments and feedback as to how to make the system work better. The continuous monitoring of the implementation process and the ability to discern major events was perceived to be productive. One of the emergent changes that needed to be focused on was the response from the physicians. According to these physicians, time was a major hurdle for data entry. Further studies related to organizational issues and system implementations are necessary to assess the overall role of physicians in injury data gathering.

5.8 Conclusions

This study examines the contribution of the improvisational model to technological innovation in an emergency room setting. Informatics implementation is a complex change process that often involves wide-ranging effects. Traditional models usually manage change as a sequential series of predefined steps. This improvisational model recognizes and capitalizes on the fact that change is ongoing and uncertain. The model is particularly befitting to a turbulent organizational environment in which the technology being implemented is open-ended and customizable. It is also helpful when the organization tolerates change as a norm. The NECHC is built on a primary health care model emphasizing innovative practice and promoting integration of service while focusing on the needs of clients. Its commitment in delivering this health concept constitutes a framework in justifying the application of the improvisational model. The course of ISC implementation experiences the anticipated, opportunistic, and

emergent changes that reflect the unprecedented, complex, open-ended, and flexible nature of technology, people, and organization involvement. Recognizing major events or changes as they occur and responding to them effectively by aligning the three key dimensions, namely technology, change model, and organizational context, have proven to have a significant impact on ISC implementation. There are still unsolved issues surrounding ISC adoption and adaptation. The balance between information needs for injury prevention and existing data collection resources, the difficult aspects of physician data entry, data management and system capabilities pose critical challenges to the very objectives of introducing an electronic injury surveillance system in an emergency room setting. An effective execution of the model requires constant review, assessment, and adjustment of the technology, people, and organization. As a result of these activities, it is equally important to allocate resources to support the ongoing changes.

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Appendix A NorthEast Community Health Center (NECHC)

The NECHC is an innovative practice setting that is guided by Primary Health Care as defined by the World Health Organization in 1978. Health professionals at the center base their practice on this primary health care approach and use strategies that promote integration of service focusing on the needs of clients.[1]

A. Conceptual model

1. Primary Health Care (PHC)[2,3]

   PHC is focused on health in a broad sense and includes collaboration with different health sectors and use of appropriate technology among other objectives. Its mission emphasizes promoting health and well being, preventing and responding to injury, illness, and discomfort.

2. Integration of service

   The center offers services that are available based on identified health needs. All center services function as a team to ensure the complement of professionals is working together. It also encourages use of an integrated clinical record that shares assessment and treatment information among health providers.

3. "Wholistic" approach

   There is strong support for a prevention focus in health care. Three key areas for such an approach are: individual health, family health, and community health

B. Background – A community-driven process

The process to develop the center was started about 15 years ago by community residents. The provincial government considered the proposal in early 1980s but the plan was deferred until 1993. A survey conducted that year identified the need for 24-hour ER services. A closer study at the needs was done by an independent consultant and funded by CHA. After an intense community consultation process, summary of the findings was submitted. The NECHC started its service in September 1999.

C. General principles underlying the role of the center

1. A one-stop emergency location.
2. Gateway to other supports people need. Staff should be able to refer patients to where additional supports are required.

3. While waiting for emergency services, staff can make an appointment with specialists, educate people about health problem and follow up on their progress.
4. Outreach to where the needs are. For example schools, community locations, centers for newcomers etc

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Appendix B. Health Administration Software Solutions (HASS)

HASS is a computerized management tool designed to increase the operational efficiency within the emergency department. The system tracks patient attendance and location, and enables easy access to patient demographic, clinical and project data.[1]

A. Introduction

I. Features

1. Full security system enabling multi-level user access control for windows, menu and reports.
2. Application designed to mimic the ER workflow patterns and hard copy registration format.
3. Site nominated mandatory coded data entry fields.
4. Rapid touch screen entry using touch screens.
5. Audit trail maintenance

II. Windows

1. Triage window captures the following information: presenting complaint, triage category, nurse assessment, vital signs. It also asks the question Injury (Y/N)?
2. Clerical window collects information such as patient demographics, mode of arrival, health insurance, language spoken etc. It asks the question Injury (Y/N)?as well.
3. Clinical window is designed for real time entry of patient clinical data, primary and secondary diagnosis. It has a section for injury bodily location and diagnosis.
4. Admission window data collection involves patient name, date of birth, insurance and compensation status, admission date and time.
5. Transfer window enables the collection of patient transfer detail such as departure status, referral to location, departure date and time.
6. Injury surveillance window allows data collection as a result of injury or poisoning. If the Go To Injury Surveillance setting has been set by the System Administrator as a mandatory function via the triage and clerical windows, Injury surveillance window opens automatically when the record is updated.

B. Injury surveillance Window (Figure B.1)

Data entry fields:

1. Date and time of injury
2. Text description of injury event allows free text entry.
3. Injury cause refers to the event, circumstance or condition associated with the occurrence of injury, poisoning or violence.
4. Human intent designates any human intervention that may have a direct influence on the injury.
5. Type of place (first part) refers to the type of place where the patient is injured.
6. Type of place (second part) is for the specific type of place relates to the area within the Type of place (first part).
7. Part of place is associated with part of the Type of place (second part).
8. Activity lists the type of activity patient is involved in when the injury occurs.
9. Injury factor codes the types of objects and substances involved.
10. Mechanism of injury refers to the type of injury sustained, say, chemical effect.

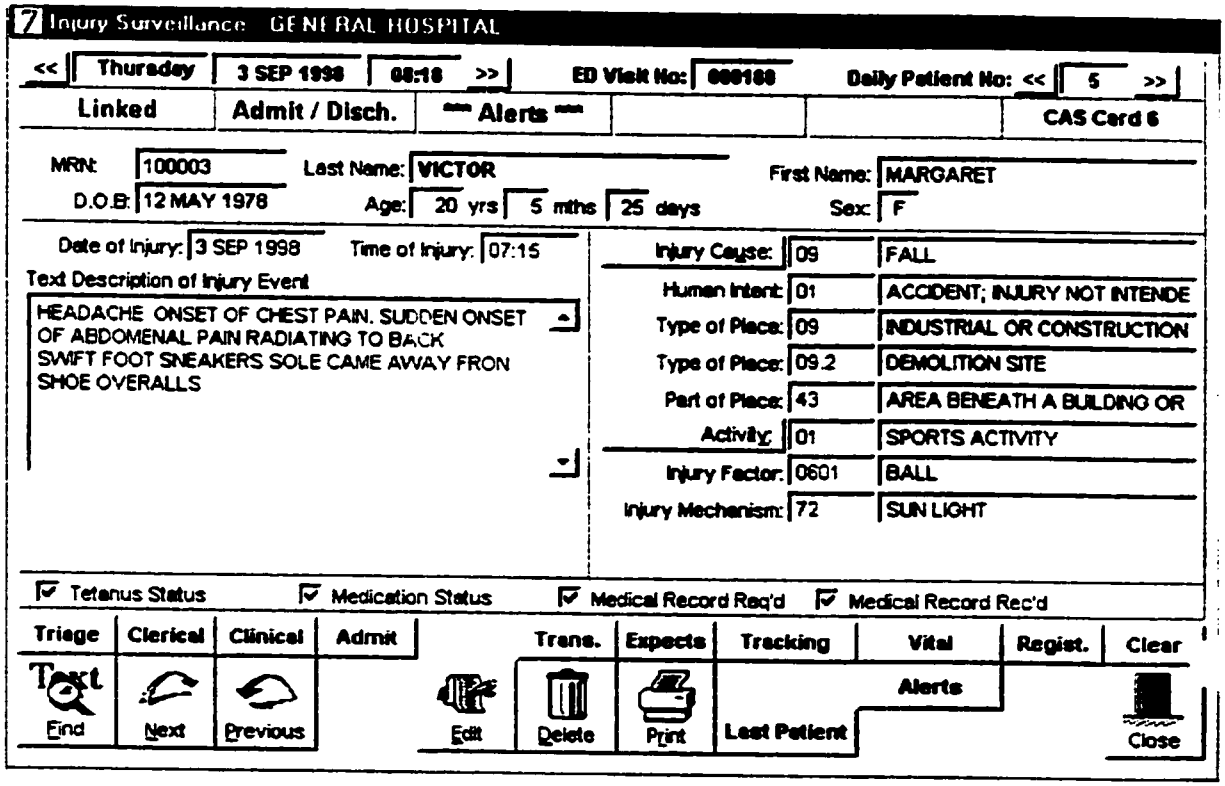


Figure B.1 ISC window

11. Brand name/product fault window is optional (Figure B.2) It can be set to open for instances related to child injury. There are two sections. Upper section lists the product by brand name that produces the injury. Lower section describes the product fault and how it causes the injury

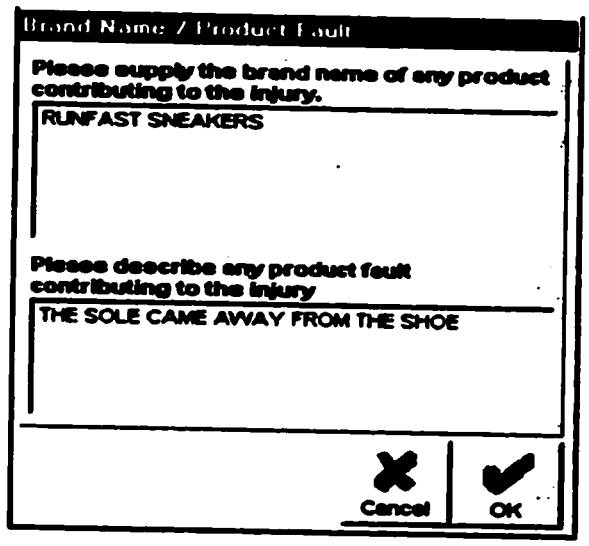


Figure B.2
Brand name/product window

12. Safety equipment window is also optional (Figure B.3). It is programmed to activate according to injury condition e.g. motor vehicle. The upper section shows a range of safety equipment, the lower section enables the entry of additional equipment.

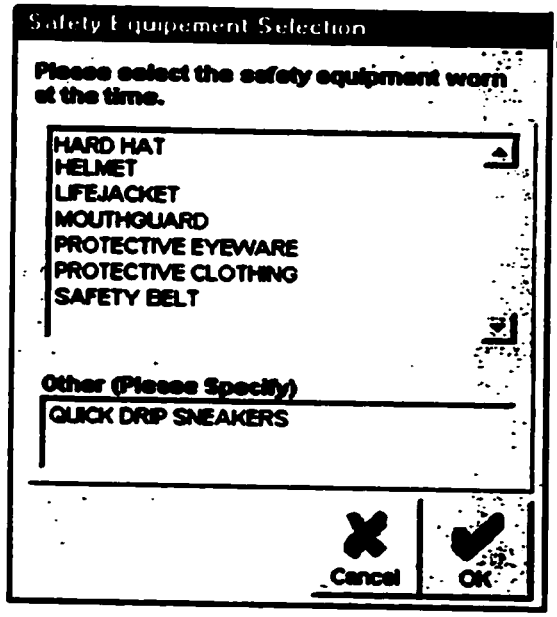


Figure B.3
Safety equipment window

13. The injury palette inside the Clinical window enables the recording of the nature of main injury (Figure B.4).

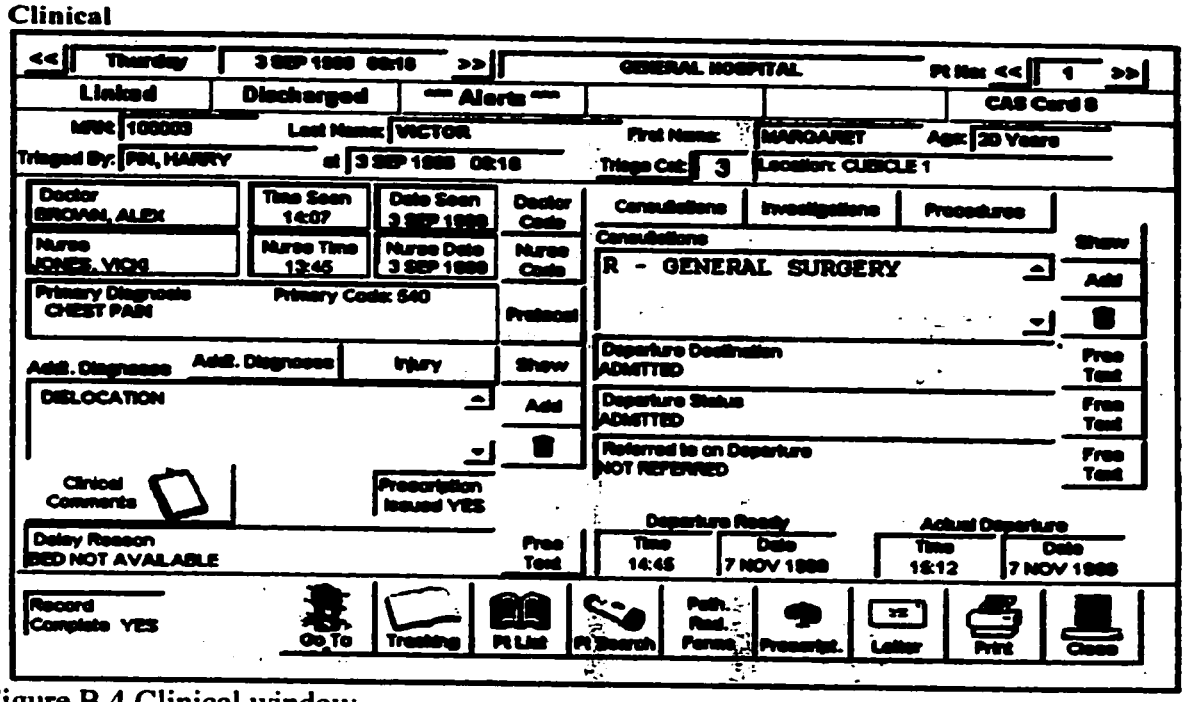


Figure B.4 Clinical window

Upon clicking on the nature of the main injury, a second palette displays bodily location of injury (Figure B.5).

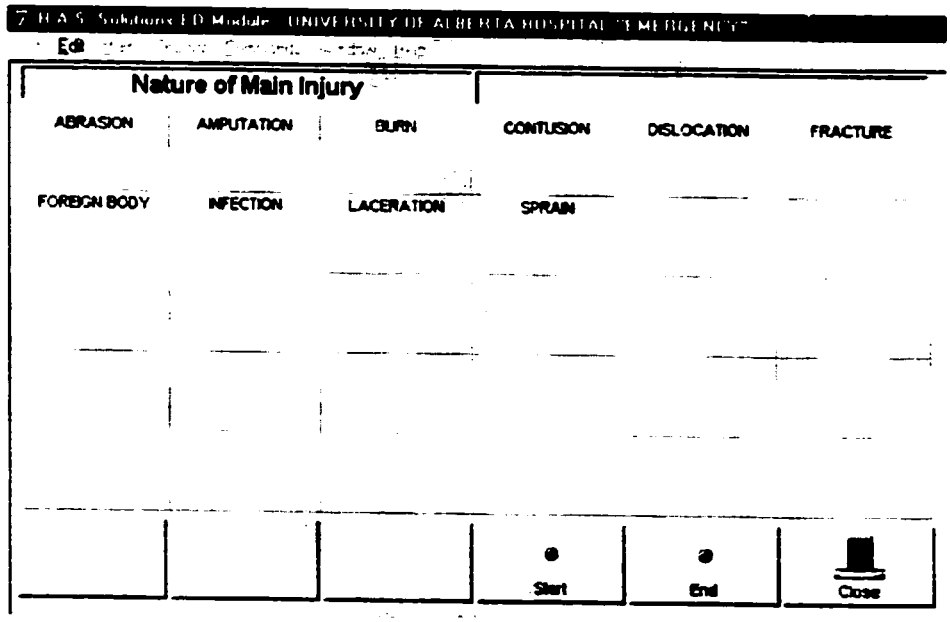


Figure B.5 Nature of main injury window

C. Injury surveillance codes[2]

The data set is based on the National Data Standards (NDS-IS) for public health injury surveillance by the Australian National Injury Surveillance Unit (ANISU). The NDS-IS is designed for a wide range of injury settings. It is also intended to set a standard for comparisons between data captured in different places. The underlying principles in developing the data set include:

- Usefulness for public health injury surveillance at different levels, depending on the purposes of surveillance
- Ease of data collection
- Compatibility with ICD codes

The NDS-IS is developed to provide three levels of injury data collection:

1. Level 1 is intended for basic, routine public health surveillance. It consists of five core injury items:
    - Description of injury event
    - External cause which is further divided into External Cause-major groups (30 items)and External Cause-intent groups (11 items)
    - Place of injury occurrence (13 items)
    - Activity when injured (9 items)
    - Principle diagnosis, injury or poisoning which is further divided into Nature of main injury (32 items) and Bodily location of main injury (22 items)

2. Level 2 is built on the first level with extended and additional data items. It is used primarily in ER setting within a hospital, and generally requires special resources. It consists of :
   - Description of injury event
   - External cause with full ICD 9 –CM or ICD-10 'External Cause' code
   - Place of injury sub type
   - Place of injury part
   - Principle diagnosis
   - Major injury factor
   - Mechanism of injury
   - Date of injury
   - Time of injury

3. Level 3 is planned for specialized surveillance or research (under development)

The ISC implementation at the NECHC adopted a modified level 2 classification.

D. Concordance with ICD codes[3]

The data items applied in NDS-IS are mapped to ICD. Folllowing is an example of main external cause (Table b.1).

Table B.1 Main external cause and ICD mappings

NDS-IS	Type of 'external cause'	ICD-9-CM	ICD-10
1	Motor vehicle - driver	E810-E825/0	V40-V48/0,5 V49/0,4 V50-V58/0,5 V59/0,4 V60-V68/0,5 V69/0,4 V70-V78/0,5 V79/0,4
2	Motor vehicle - passenger or unspecified occupant	E810-E825/1	V40-V48/1-4,6,7,9 V49/1-3,5-9 V50-V58/1-4,6,7,9 V59/1-3,5-9 V60-V68/1-4,6,7,9 V69/1-3,5-9 V70-V78/1-4,6,7,9 V79/1-3,5-9
3	Motorcycle - driver	E810-E825/2	V20-V28/0,4 V29/0,4

			V30-V38/0,5 V39/0,4
4	Motorcycle - passenger or unspecified whether driver or passenger	E810-E825/3	V20-V28/1-3,5,9 V29/1-3,5-9 V30-V38/1-4,6-9 V39/1-3,5-9
5	Pedal cyclist or cycle passenger	E800-E807/3 E826-E829/1 E810-E825/6	V10-V19
6	Pedestrian	E800-E807/2 E810-E825/7 E826-E829/0	V01-V09
7	Other or unspecified transport related circumstances • Includes railways, water transport, air transport • Includes drowning associated with watercraft • Excludes machinery accident in watercraft	E800-E807/0,1,8,9 E810-E829/4,8,9 E958/5,6 E968.5 E988/5,6 E830-E835 E837-E848	V81-V92 V94-V99 X82 Y03 Y32
8	Horse related • Includes fall from; trampled, kicked, or bitten by; etc. • Excludes injuries to pedestrians or vehicle occupants resulting from collision with a horse [1-6]	See Note 1.	See Note 1.
9	Fall - low • Includes falls on same level, or <1m, or if no information on height. • Excludes falls in/on/from transport [5,6,8] and falls resulting in drowning [11,12]	See Note 2.	See Note 2.
10	Fall - high (1m or more) • Includes fall, jump, being pushed from high place • Excludes fall in/on/from transport [5,6,8] and falls resulting in drowning [11,12]	See Note 2.	See Note 2.
11	Drowning, submersion - in swimming pool	E910/5,6	W67-W68
12	Drowning, submersion - other than swimming pool • Includes drowning in unspecified place • Excludes drowning associated with watercraft [7]	E910/0-4,7-9 E954 E964 E984	W65-W66 W69-W74 X71 X92 Y21
13	Other threat to breathing • Includes inhalation of food, suffocation in	E911-E913 E953 E963 E983	W75-W84 X70 X91 Y20

	enclosed space, strangulation, etc		
14	Fire, flames, smoke • Includes asphyxiation or poisoning related to fires, explosion related to conflagration • Excludes transport related	E890-E899 E958.1 E968.0 E988.1 E990	X00-X09 X76 X97 Y26
15	Exposure to hot drink, food, water, other fluid, steam, gas, or vapour • Includes scalds	E924/0,2 E958.2 E968.3 E988.2	X10-X14
16	Exposure to hot object or solid substance • Includes contact burns, etc • Includes burn if unspecified whether due to solid, liquid or gas	E924.8	X15-X19 X77 X98 Y27
17	Poisoning - drugs and medicinal substances • Includes adverse effects of medication in normal use	E850-E858 E930.0-E950.5 E962.0 E980/0-5	X40-X44 X60-X64 X85 Y10-Y14 Y40-Y59
18	Poisoning - other substances • Includes poisoning if unspecified whether medication or other subst. • Excludes invenomation by animal [22] or plant [28].	E860-E869 E950.6-E952.9 E962/1-9 E980/6-9 E972 E981 E982 E997.2	X45-X49 X65-X69 X86-X90 Y15-Y19 Y35.2
19	Firearms • Excludes explosives [28]	E922 E955/0-4 E965/0-4 E970 E985/0-4 E991/0-2	W32-W34 X72-X74 X93-X95 Y22-Y24 Y35.0
20	Cutting, piercing object • Excludes machinery, power tools or appliances [24]	E920/3,4,8,9 E956 E966 E974 E986	W25-W27 W45 X78 X99 Y28 Y35.4
21	Dog-related	See Note 1.	See Note 1.
22	Other animal-related • Excludes horse[7], dog[21]	See Note 1.	See Note 1.
24	Machinery in operation • Includes power tools, appliances • Includes machinery in context of watercraft • Excludes machinery in the context of other transport [1-7]	E836 E919 E920/0-2	W24 W28-W31

25	Electricity	E925 E958.4 E988.4	W85-W87
26	Hot conditions (natural origin), sunlight	E900.0	X30 X32
27	Cold conditions (natural origin)	E901.0 E958.3	X31
28	Other specified external cause (including late effects)	E870-E879 E900/1,9 E901/1,8,9 E902-E904 E905.7 E907-E909 E914-E915 E921 E923 E924/1,9 E926 E927 E928/0-8 E929 E955/5,9 E958/7,8 E959 E960.1 E961 E965/5-9 E967 E968/4,6-8 E969 E971 E975-E978 E985.5 E988/3,7,8 E989 E991/3,9 E992-E999	V93 W23 W35-W44 W49 W60 W64 W88-W99 X28 X33-X39 X50-X58 X75 X83 X96 Y05-Y08 Y25 Y33 Y35.1 Y35/.5-.7 Y89.9
29	Unspecified external cause	E928.9 E958.9 E968.9 E988.9	X59 X84 Y09 Y34
30	Struck by or collision with person	E917 E960.0	W50-W52 Y04
31	Struck by or collision with object • Excludes: pinching or jamming between objects [28]; machinery in operation [24]; firearm projectile [19]; cutting object [20]	E916 E918 E958.0 E968.2 E973 E988.0	W20-W22 X79 X81 Y00 Y02 Y29 Y31 Y35.3

Key:

E810-E829/4,8,9 means: 'all E-codes in the range E810-E829 where the 4th digit is 4, 8 or 9.'
E910/0-7,9 means: 'E-codes E910.0 to E910.7 and E910.9.'
E911-E913 means 'all valid 3 or 4 digit E-codes from E911.0 to E913.9.'

Note 1: ICD-9-CM and (to a lesser degree) ICD-10 do not enable good identification of 'horse related injuries' or 'dog related injuries'. When data collected according to Level 1, Item 2A are compared with aggregated ICD data, the three Item 2A 'Animal' categories [8], [21] & [22], should be combined. The resulting single 'Animal related' category is nearly equivalent to the following ICD codes, which should be used to define a comparison group:
ICD-9-CM: E810-E825/.5; E826-E829/.2,.3; E905/all but .7; E906.
ICD-10: V80, W53-W59, X20-X27, X29

Note 2: ICD-9-CM and ICD-10 do not generally allow the height of a fall to be specified. When data collected according to Level 1, Item 2A are compared with aggregated ICD data, the two Item 2A 'Falls' categories [9] & [10] should be combined. The resulting single 'Falls' category is nearly equivalent to the following ICD codes, which should be used to define a comparison group:

ICD-9-CM:	E880-E888; E957, E968.1, and E987
ICD-10:	W00-W19, X80, Y01, Y30

Note 3: ICD-9-CM and ICD-10 provide many more categories for coding 'accidental' external causes than for other intent groups, and specific codes for non-accidental instances of the types of event covered by some Item 2A categories are not provided. The ICD codes shown in the Table A2.2A, include only 'accidental' instances of the type of event covered by some Item 2A categories (groups 1 to 7, 11, 16, 21, 22, 24, and 26). Provision of codes for non-accidental instances is also incomplete for some other groups. Accordingly, it is advisable to take account of both Item 2A and Item 2B when comparing data collected according to the NDS-IS Level 1 categories with aggregated ICD data.

Reference

1. HASS Emergency Department Module User Guide January, 1999 Version 8.1
2. http://www.nisu,flinders.edu.au
3. NDS-IS Level 1, Item 2A: external cause – major groups
   ICD-9-CM (1996, second edition, vol 1: 331-370)
   ICD-10 (1992, vol 1: 1026-1123)

Appendix C ISC Data Results[1]

A. Nurse week (Table C.1)

There were a total of 197 "Y" injured cases recorded during nurse week. Triage nurses were able to capture ISC data from 98 cases. ISC data were validated through phone calls for 32 cases. Data completeness was 49.7%. Data correctness and presence of additional information were confirmed to be 100% for these 32 cases. Also, there were no missing data or delay entries for these 32 confirmed cases.

- % Breakdown of 98 cases throughout week showed:

Table C.1 Patient case distribution during nursing week

Time	MON	TUE	WED	THURS	FRI	SAT	SUN	MON	TOTAL	%
1-7 AM	0	1	0	1	4	3	0	1	10	10.2
8-12 AM	1	6	5	2	4	4	0	4	26	26.5
13-17PM	3	10	4	9	2	6	4	1	39	39.8
18-24PM	6	5	2	5	3	0	0	2	23	23.5
TOTAL	10	22	11	17	13	13	4	8	98	
%	10.2	22.4	11.2	17.3	13.3	13.3	4.1	8.2		

- Human intent was characterized as the following with almost 94% accident.

Table C.2 Human intent percentage during nursing week

Accident; injury was not intended	93.9
Intentional self-harm	1
Maltreatment by spouse or partner	2
Other or unspecified assault	2
Other or unspecified intent	1
Total	100

➢ Other specified and unspecified activity accounted for about 30% of type of activity:

Table C.3 Type of activity percentage during nursing week

Sports activity	11.2
Leisure activity	19.4
Working for income(includes travel to/from work)	14.3
Other type of work(includes unpaid housework)	20.4
Resting, sleeping, eating, other personal activity)	4.1
Being nursed or cared for	1
Other specified activity	17.3
Unspecified activity	12.2
Total	**100**

➢ (*) Could be grouped as "Other external causes" and it was 22% of external causes:

Table C.4 External cause percentage during nursing week

Motor vehicle - driver	3.1
Fall - high (drop of 1 metre or more)	10.2
Exposure to hot fluid or gas	1
Exposure to hot object or solid substance(include contact burns)	1
Cutting, piercing	17.3
Dog related (incl. bitten, struck by)	1
Animal-related(excludes horse or dog)	1
Machinery	1
Unspecified external cause *	11.2
Struck by or collision with object or person *	6.1
Struck by or collision with person	6.1
Struck by or collision with object	14.3
Other or unspecified transported-related circumstances *	3.1
Other specified external cause *	2
Pedal cyclist or pedal cycle passenger	2
Fall - low (on same level, or <1 metre drop or no information on height)	19.4
Total	**100**

➢ There were 60% "others" of the 98 injury factors:

Table C.5 Injury factor percentage during nursing week

Waste container, rubbish basket, refuse bin	2
Other or unspecified appliance	2
Nail, screw, carpet tack, drawing pin, etc	2
Ladder, movable steps (incl. step stool)	2
Hand tool	6.1
Powertool	2
Welding equipment	1
other or unspecified tool	6.1
Other or unspecified chemical substance	2
Hot water	1
Water (excludes hot water [1321])	1
Other or unspecified factor	60.2
Knife	3.1
Drinking glass	2
Clothesline, clothes drying rack, clothes horse	1
Other or unspecified utensil or container	6.1
Total	**100**

➢ Fall was almost 36% of injury mechanism:

Table C.6 Injury mechanism percentage during nursing week

Fall by stumbling on same level	8.2
Fall by slipping, tripping on same level	13.3
Fall on or from stairs	8.2
Other or unspecified fall	6.1
Contact with moving object includes vehicle, grinding metal	9.2
Contact with static object includes sidewalk, wall, window	9.2
Contact with animal	1
Other or unspecified contact	9.2
Pinching, crushing	3.1

Bite/sting by animal/human/insect	1
Cutting, tearing	11.2
Puncture	7.1
Other specified crushing/piercing	2
Other specified mechanism of injury	5.1
Unspecified mechanism of injury	6.1
Total	**100**

➢ Almost half the cases happened at home:

Table C.7 Type of Place percentage during nursing week

Facility other than health settings (e.g. school, child care)	3.1
Home (including farm house)	46.9
Industrial or construction area	7.1
Recreational area (Place for informal recreational activity)	11.2
Residential institution (excluding hospital)	1
Sport or athletics area(place mainly for formal sports)	5.1
Street or highway(public road)	16.3
Trade or service area	8.2
Unspecified place	1
Total	**100**

➢ Parts of place were as follow:

Table C.8 Parts of Place percentage during nursing week

Bathroom	4.1
Bedroom	4.1
Hall/foyer	1
Kitchen	10.2
Laundry	1
Living/dining area	5.1
Family room/rumpus room	3.1
Auditorium/spectator area	1

Garage	3.1
Workshop	5.1
Specialized structure(e.g.: silo, tank, pylon)	1
Stairs	11.2
Area beneath a building or structure	1
Verandah or balcony	2
Roof	1
Roadway	18.4
Car park	5.1
Bicycle path/bike way	5.1
Playground	12.2
Garden	5.1
Total	**100**

B. Registration clerk (RC) week

There were a total of 172 injured cases recorded during RC week. HASS chief complaints entered by triage nurse were used as reference to determine the number of injured cases. Registration clerks were able to capture ISC data from 38 cases. Data completeness was 22.1%. According to RC, missing opportunities to collect data were due to overwhelming patient load. ISC data were validated through phone calls for 15 cases. Data correctness and presence of additional information were confirmed to be 100% for all 15 cases. There was no missing data and delay entry for these 15 confirmed cases.

- Breakdown of 38 cases throughout week showed:

Table C.9 Patient case distribution during clerks week

Time	TUE	WED	THURS	FRI	SAT	SUN	MON	TUE	TOTAL
1-7AM	0	0	0	1	0	0	0	0	1
8-12AM	2	1	2	0	2	2	0	2	11
13-17PM	0	3	4	0	4	4	0	0	15
18-24PM	0	1	2	1	4	3	0	0	11
TOTAL	**2**	**5**	**8**	**2**	**10**	**9**	**0**	**2**	**38**

- Human intents for all 38 cases were accidents

- 29% of type of activity were either categorized as "Other specified" or "Unspecified activity":

Table C.10 Type of activity percentage during clerks week

Sports activity	8
Leisure activity	6
Working for income(includes travel to/from work)	5
other type of work (includes unpaid housework)	5
Resting, sleeping, eating, other personal activity	2
Being nursed or cared for	1
Other specified activity	4
Unspecified activity	7
Total	38

- (*) Could be grouped as "Other external causes" and it accounted for almost 32%:

Table C.11 External cause percentage during clerks week

Fall - high (drop of 1 metre or more)	2
Firearm	1
Cutting, piercing	5
Dog related (incl. bitten, struck by)	1
Machinery	2
Unspecified external cause*	3
Struck by or collision with object or person*	5
Struck by or collision with person	1
Struck by or collision with object	4
Other or unspecified transported-related circumstances*	2
Pedal cyclist or pedal cycle passenger	1
Fall - low (on same level, or <1 metre drop or no information on height)	9
Unspecified external cause*	2
Total	38

➢ 65% of Injury factors were "Other or unspecified factor":

Table C.12 Injury factor percentage during clerks week

High chair	1
Other or unspecified appliance	2
Nail, screw, carpet tack, drawing pin, etc	1
Ladder, movable steps (incl. step stool)	1
Powertool	1
other or unspecified tool	4
Other or unspecified factor	25
Knife	1
Clothesline, clothes drying rack, clothes horse	1
Other or unspecified utensil or container	1
Total	38

➢ 34% of Injury mechanism were due different types of "Fall":

Table C.13 Injury Mechanism percentage during clerks week

Fall by stumbling on same level	7
Fall by slipping, tripping on same level	4
Fall on or from stairs	1
Other or unspecified fall	1
Contact with moving object includes vehicle, grinding metal	2
Contact with static object includes sidewalk, wall, window	3
Contact with animal	1
Other or unspecified contact	4
Pinching, crushing	2
Cutting, tearing	4
Puncture	2
Unspecified acute over-exertion of body/part of body	1
Other specified mechanism of injury	6
Total	38

➢ Almost half the cases happened at home:

Table C.14 Type of Place percentage during clerks week

Home (including farm house)	18
Residential institution (excl. hospital)	1
Facility other than health settings (e.g. school, child care)	1
Recreational area (Place for informal recreational activity)	5
Sport or athletics area(place mainly for formal sports)	3
Street or highway(public road)	6
Industrial or construction area	1
Unspecified place	3
Total	38

➢ Parts of place were as follow:

Table C.15 Part of Place percentage during clerks week

Bedroom	3
Kitchen	3
Living/dining area	1
Family room/rumpus room	3
Office	1
Specialized structure (e.g. silo, tank, pylon)	1
Court (tennis, squash etc)	2
Stairs	1
Roadway	7
Car park	1
Bicycle path/bike way	3
Playground	5
Garden	7
Total	38

c. Physician week

There were 154 "Y" injured cases during the physician week and no ISC data were collected

REFERNCES

1. Capital Health Authority (CHA) Information System

Appendix D Softwares: DtSearch and NuDist

A. Dtsearch[1]

I Introduction

dtSearch Corp. started text retrieval research and development in1988. It began marketing the dtSearch line of text retrieval products in 1991. The product line has the ability to instantly search gigabytes of text. Organizations with intense document search needs such as Fortune 500 companies and intelligence, space and law enforcement government agencies have deployed the dtSearch. Numerous commercial applications embedded with dtSearch products include SAP AG, ScanSoft, Seagate Software, Computer Sciences Corp., General Dynamics Information Services, Physician's Desk Reference etc

II. Technical description (Figure D.1)

Central to DtSearch 's powerful search capability is its indexing and searching algorithms that allow for fast indexing and searching performance even over extremely large databases and other diverse collections of documents. The algorithms are engineered to maintain consistent indexing speeds regardless of the size of the document set. The dtSearch product line was developed to make efficient use of system resources under the Windows platform.

Armed with over two dozen text search options, the product offers unparalleled intelligent searching. In addition to basic search options such as boolean (and/or/not), proximity, phonic etc, the dtSearch product line has the following special search capabilities:

- fuzzy searching. This enables the finding of terms even if they are misspelled. Search fuzziness level goes from 0 to 10 corresponding to the level of typographical or OCR errors in files. For example, a fuzziness level of 1with a search for "alphabet" would find "alphaqet." With a fuzziness level of 3, a search for "alphabet" would find not only "alphaqet" but also "alpkaqet."

- concept/synonym/thesaurus searching. dtSearch can perform automatic query with variable levels of expansion (user-defined synonyms, built-in synonyms, or built-in synonyms + related words).

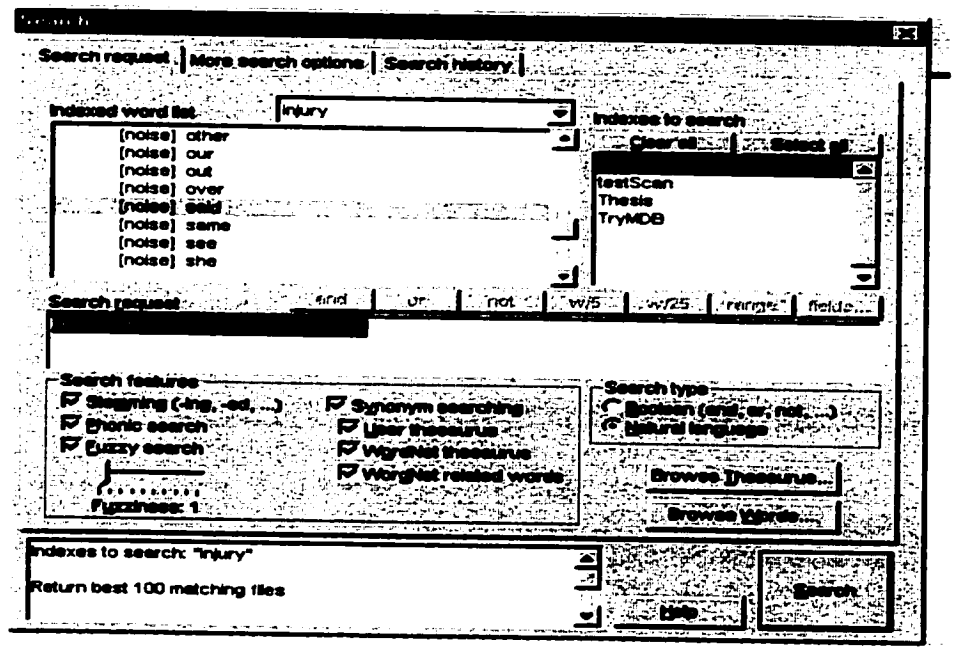
- natural language searching. Natural language searches, also known as query-by-example, look for all words in a search request and return results based on automatic term weighting. Using the "Vector Space" method, dtSearch's relevancy ranking takes into account the frequency of hits, relative frequency of the search terms in the index, and hit density in retrieved documents.

- field searching. dtSearch automatically recognizes and indexes fielded data in such file formats as MS Word, Excel etc, making these fields

separately searchable by field name (as well as accessible for full-text searching). Using 32-bit ODBC (Open Data Base Connectivity), dtSearch can also index and display records in Access, Paradox, FoxPro, and dBase databases. Each record is treated as a separate document.

- variable term weighting. dtSearch provides also the ability to specify relative weights. These weights can be positive or negative. For example, a user might assign a positive weight of 3 to the word "green" and a negative weight of five to the word "orange."

Figure D.1 dtSearch search window



B. NUDIST (Non-numerical Unstructured Data Indexing Searching and Theorizing) [2]

I Introduction

NUDIST is developed by QSR (Qualitative Solutions and Research), a software company in Melbourne, Australia. It is a computer package designed in handling Non-numbericl and unstructured Data in qualitative analysis, by supporting processes of coding data in an Index System, Searching text or searching patterns of coding and Theorizing about the data.

II. Technical description (Figure D.2)

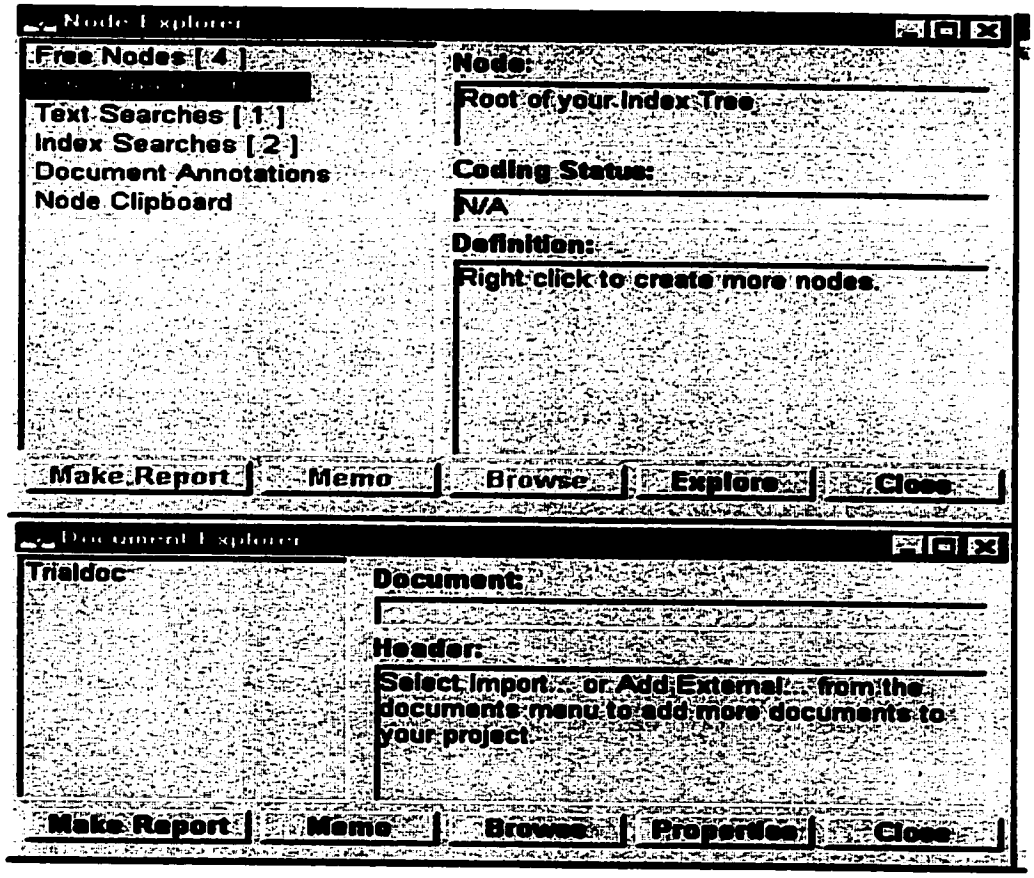
- NUDIST manages data documents such as text (reports, minutes, interviews etc) and non-textual records (musical scores, photos etc)

- The product creates an environment in which user can create, manage and explore ideas and categories to minimize clerical routine and maximize flexibility, and to discover new ideas and build on them.

- QSR NUDIST is designed for asking questions, building, and testing theories. It allows user to:
  - search for patterns in coding and building new codes
  - clarify ideas, discover themes
  - construct and test theories
  - display matrices and build models

- A NUDIST project is organized in 2 interlocking subsystems, linked by search procedures:
  - Document system that contains information about every document, either imported or external.
  - Index system is made up of nodes which are containers for user's thinking about the project. Nodes store the index categories constructed by the user.

Figure D.2 Document system and Index system



References

1. http://www.dtsearch.com
2. QSR NUDIST User Guide

Appendix E Interview Scripts for Patients and NECHC Staff

A. Interview scripts for staff

I. Planning phase and early part of deployment phase

Interviews involved HASS developers, ED project team members, public health staff, and project champions. The script covered specific issues related to:

a. ISC implementation workplan

Conversation expanded and pursued information on injury surveillance objectives, data collection and dissemination. Participants gave their thoughts on whom they considered as ideal candidate(s) to collect data and reason(s) behind their thinking.

b. Organizational context

The intention was to capture the perspectives on what features of the community health center were salient to the project, what did staff know about injury surveillance.

c. User acceptance

The purpose was to find out what participants had in mind on data collection /charting, compliance, and data quality.

d. Staff's strength and belief

Questions were posed to elicit responses on relevance between injury surveillance and direct patient care in ED setting, whether caregiver would perceive ISC as a measure more on prevention or health promotion than immediate patient care.

e. Expectation on technological capabilities

The conversation was to solicit viewpoints on how comprehensive an injury data set would be, understanding of ISC features and its capabilities to handle ever-growing information needs, role of technical support and system revisions.

II. Deployment phase

NECHC staff were interviewed during ISC training sessions. The script included topics such as training session, technological understanding, current work practice and cognitive frames when facing new technology, impact of ISC, and HASS experience:

a. Overall impression of training session.

NECHC weighted the relatively short ISC training session in terms of usefulness and practicality.

b. Technological assessment of the ISC components.

The center's staff got the opportunities to assess ISC user interface, navigation to and from ISC window, data items pick-list ease of use etc

c. Current NECHC data collection practice and staff's preference.

The center was using two parallel systems in data collection: HASS and paper forms. The discussion explored how staff practiced data collection, what were their preferred data capturing format, and what impact they perceived in terms of computer technology.

d. Workflow and the impact of ISC introduction

The ISC deployment was an addition to NECHC staff's existing routine. Subjects discussed included what impact would it cause in terms of work practice, and how caregiver would fit ISC into their work flow.

e. Relevance between injury surveillance and direct patient care in ED setting

Was injury surveillance relevant to direct patient care or was it more on prevention and how would that affect community injury control and prevention?

f. NECHC staff's HASS experience.

The center implemented HASS earlier during its grand opening and the system had gone through some update and revision. The discussion geared toward staff's familiarity with the system, how they learned to use HASS. For example what resource(s) they found to be useful: computer manual, supervisor, or peers.

B. Interview script for patients

The script was a printed form with ISC-related questions. Patient consent form with NECHC patient identifier sticker was attached with the script. When Hue Quan called the patient at home, he or she was asked to confirm his or her identity, understanding of the study, and the consent to the interview. The interview included the following questions that were based on ISC data entry:

- What went wrong?. This was similar to the ISC free-text description that allowed the patient to briefly describe what happened.
- Where and when did the injury happen? The question helped to provide the date and time of injury and the type of place at which the patient was situated.
- What was the cause of injury? Answer from patient identified event associated with the occurrence of injury e.g. fall.

- Where did it hurt? This question located the anatomical part of the injury e.g. left wrist.
- What were you doing when it happened? The question intended to ask patient the type of activity being undertaken when injured and whether the injury was related to work, sport etc.
- Was it related to some sort of consumer product? Any safety device? The purpose was to identify types of objects and substances involved in the occurrence of injury and whether patient was using certain safety devices e.g. helmet

Appendix F HEALTH RESEARCH ETHICS BOARD REQUEST FOR ETHICS REVIEW

A. Introduction

The Health Research Ethics Board (HREB) is a joint committee of the University of Alberta Health Sciences Faculties (UAHSF), the Capital Health Authority (CHA), and the Caritas Health group (CHG). The board is

- charged with the administration of the collaborative ethics review process on behalf of the UAHSF, the CHA, and the CHG
- designed to expedite and improve the ethics review process for all students and faculty of the UAHSF, and all CHA and CHG staff.

There are two Health Research Ethics Boards (HREB A and HREB B). Both boards have representation from the Health Sciences Faculties, the CHA, and the CHG. Both boards use guidelines formulated by the Medical Research Council and other agencies for making decisions. The two HREBs focus on different types of research [1].

The ISC project falls within HREB B which addresses non-invasive intervention and measures including:

- interviews, surveys, questionnaires
- educational strategies
- psychological, social or behavioural interventions
- observation or descriptive research
- non-invasive physiological measures e.g. heart rate
- audio and/or video recording or other monitoring.

B. Changes made during deployment phase

The ethics request was presented to the HREB B during ISC planning phase. At the time of ISC deployment, there were some changes:

- The project objective was to implement and assess an ED injury surveillance system at a local community health center. The research approach was qualitative in nature, using data collected primarily through semi-structured interviews supplemented by descriptive statistics on patient cases instead of inferential statistics to generalize data collected from representative sample. As a result, the sample size planning was not executed and the data collection trial was conducted with 3 groups of NECHC staff in 3 consecutive weeks.
- Due to resource limitation, NECHC management recruited grad student Hue Quan to perform patient phone interviews and validate ISC patient case data. Also, ISC in-service and staff interview took place at the same time during training sessions instead of having pre and post deployment interviews separated from in-service.

C. Ethics request

HREB A ___

HREB B _X

HEALTH RESEARCH ETHICS BOARD
REQUEST FOR ETHICS REVIEW

**NOTE: This form has been designed to be used by researchers in a wide variety of fields. Some questions may not be pertinent for this particular project. It is extremely important to read the information and follow the instructions found in the Guidelines for Researchers. Please refer to the guidelines for all the submission information.

Section A:
General information.

A1. Title of Project:
Implementation of an Injury Surveillance System at a Local Community Health Center Emergency Room

A2. Name of Principal Investigator:

Name: Dr. Louis H. Francescutti
Title(s): B.Sc.(Hnrs), MD, PhD, MPH
Department / Program: Medicine/ Epidemiology & Emergency Medicine
Mailing address for ethics information: Department of Public Health Sciences
Faculty of Medicine and Dentistry
13-103 Clinical Sciences Building
Edmonton, Alberta, Canada T6G-2G3

Telephone: (780) 492-6546 Fax: (780) 492-0364 E-mail:Louis.francescutti@ualberta.ca

Signature: _____ Date: _____

A3. Name of Co-Investigator: (Required for Students, Residents, Visiting Scholars, etc.)

Name: Kien Hue Quan
Title(s):BCom
Department/Program: Public Health Sciences/M.Sc. Epidemiology
Mailing address for ethics information: Department of Public Health Sciences
Faculty of Medicine and Dentistry
13-109 Clinical Sciences Building
Edmonton, Alberta, Canada T6G-2G3

Telephone: (780) 450-7798 Fax: (780) 450-7640 E-Mail: hquan@cha.ab.ca

Signature: _____ Date: _____

A4. Authorizing Signatures: (For U of A staff, must be signed by Department Chair or Associate Dean, Research. For CHA or Caritas staff, must be signed by administrative supervisor of Principal Investigator.)

I support the implementation of this project.

_____ _____
(Signature) (Date)

_____ _____
(Name: Please print) (Title)

A5. Co-Investigator(s) / Thesis Committee:

Name	Department / Program	Telephone
1.		
2.		
3.		
4.		
5.		

A6. Expedited review:

If the study procedures are **limited** to any of the following, please check the appropriate box. (See guidelines page 7)

___examination of patient or medical or institutional records
___ secondary analysis of data
___ use of biological specimens normally discarded
___ collection of blood and urine specimens
___ modification of previously approved protocol
*specify title and approval date:

A7. Which one of the following best describes the type of investigation proposed? Check more than one if appropriate.

___ clinical trial
___ multi-centre trial
_X_ pilot study
___ drug study
_X_ technology assessment / development
___ qualitative study
___ epidemiological study
___ sequel to previously approved project
___ first application in humans
___ other (specify):

A8. Where will the research be conducted? (Note that administrative approval is required to carry out research in any Capital Health or Caritas facility):

_X_ Capital Health Site (specify): NorthEast Community Health Center

___ Caritas Site (specify):

___ U of A Site (specify):

___ Other (specify):

Funding/Budget

A9. How is the proposal funded?

___ funding approved (specify source):

___ funding request pending (specify source):

_X_ no external funding required

A10. Are any of the investigators involved in this study receiving any direct personal remuneration or other personal or family financial benefits (either direct or indirect) for taking part in this investigations? (See guidelines, page 7)

___ yes If yes, append a letter detailing these activities to the Chair of the appropriate review committee.

_X_ no

Attach a budget summary. Note that the summary must include details of investigator payments and recruitment incentives (if present).

Additional Documentation

A11. If any of the following applies to this study, attach the appropriate letters of approval/support. (See Guidelines page 8)

Health Protection Branch or other Canadian federal agency approval:

_X_Not applicable
___ Attached
___ Pending

Radiation Safety Committee Approval (required for all studies involving radioisotopes and non-routine X-rays):

_X_Not applicable
___ Attached
___ Pending

Electromechanical or Biohazardous Materials Safety Approval:

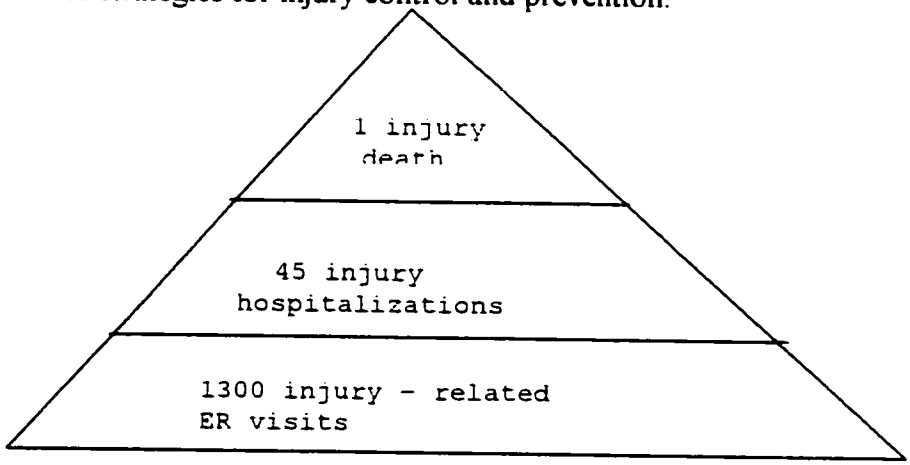
_X_Not applicable
___ Attached
___ Pending

Section B:
Details of Project
{Note that spaces have been minimized in this electronic version of the form. Use "cut and paste" to add information. Do **NOT** indicate that the board should "see attached".}
Description of the Project

B1. Provide a clear statement of purpose and objectives of the project.
This is a descriptive study on the design, implementation and effects of an emergency room injury surveillance system at a local community health center.

B2. State hypotheses and / or research questions.
The research question is to determine if the theory of improvisation can be used to explain the design, implementation and effects of this system.

B3. Briefly summarize past human and/or animal research which has led to this project.
(1 page maximum, 12 point font)
Surveillance is defined as the systematic collection, analysis, interpretation, dissemination, and application of health data to a public health problem. It is considered as an important step in injury prevention and control. Injury data can be used to quantify the magnitude of problem, identify populations at risk, prioritize and evaluate injury control programs. Public health surveillance should have the capacity to address these tasks: ongoing data collection; timely data dissemination; and data linkage to prevention and control activities.
Although the number of surveillance and health information systems has increased in recent years, public health surveillance is fragmented. Hospital emergency room data represent an important but underused source of information for injury-surveillance effort. According to some estimates, for every childhood injury death there are 45 hospitalizations and 1300 emergency room (ER) visits. Public health professionals expect to collect and analyze this ER visits population data to develop and evaluate strategies for injury control and prevention.



Routine data on injuries derived from mortality statistics do not provide morbidity information. Trauma registries focus primarily on injuries on a severity scale. This incomplete and non-representative injury data do not describe accurately the scope of injury. Canada has a national database CHIRPP (Canadian Hospitals Injury Reporting and Prevention Program) but it is at a national level and does not identify specific local injury problems. Alberta 's ACCS (ambulatory

care classification system) is used throughout the province's emergency room. Its main purpose is to predict resource needs and cost management. Injury problems and trends vary between communities, and specific information is needed to prioritize control programs and assess the effectiveness of control measures. ER injury surveillance system (ISS) is widely advocated as a prerequisite for injury prevention strategy. ISS is more than enumeration of events. It ensures dissemination and communication of surveillance results to others and facilitates its consequent use for public health actions. The target audience for the NorthEast Community Health Center (NECHC) ISS encompasses public health practitioners, Capital Health Authority ER management, professional organizations e.g. Alberta Center for Injury Control and Research (ACICR). The collected data will be fed back to the local community and help to develop and evaluate strategies for local injury control and prevention. The ISS implementation of this project, thus, is the initial step in the development of an effective public policy for injury control and prevention.

Description of Sample/Population.

B4. Describe the numbers and type(s) of subjects to be included. If appropriate, specify number of subjects in each study group. Provide a rationale for the sample size and include sample size calculations where appropriate.

The research approach is to recognize the different types of change or major events as they occur in the system implementation process and to respond effectively to them. Subjects are physicians, nurses, research personnel, registration clerks and management at NECHC. It involves utilization of qualitative data collected from observations, meetings, interviews, training sessions and documents. The project includes a trial that will help to identify an effective pattern of injury-related data collection. The process specifies the sample size of patients that visit the emergency room. Sample size calculation is based on estimates drawn from chart auditing. Patient charts from January 2000 to March 2000 are reviewed to determine relevancy of injury-related recordings by caregivers. The results show that nurses enter injury-related items with a mean of 24.16, standard deviation of 10.62 and confidence interval of 2.80. For the physicians, the results are mean 35.38, standard deviation 12.75, and confidence interval 3.37. Using confidence level of 95%, the trial needs at least 90 patients for descriptive study. Staffs who are involved in the data collection trial are divided into 3 groups: physician group (5 physicians), nursing group (8 nurses), and clerical group (3 registration clerks). Each group collects a week's injury-related data (estimated to be about 100 patients). The trial is done in three consecutive weeks for three groups. Descriptive statistical procedures include measures of central tendency, variability, frequency distribution table and graph to assess data quality that covers data completeness, correctness, timeliness, and comprehensiveness.

B5. List any subject inclusion/exclusion criteria.

The computer data collection trial includes patients who present at the NECHC with injuries as chief complaints.

B6. Will subjects be recruited who are -

Under 18 years of age	[ ] yes	[X] no
Cognitively impaired	[ ] yes	[X] no
Residing in institutions (e.g. prison,	[ ] yes	[X] no

extended care facility)		
Students	[ ] yes	[X] no
Employees of researcher(s)' organization	[ ] yes	[X] no
In emergency or life-threatening situations	[ ] yes	[X] no
Have language barriers (eg. illiterate, not English-speaking, dysphasic)	[ ] yes	[X] no
In another country	[ ] yes	[X] no

Description of Research Procedures

B7. Provide a summary of the design and procedures of the research. Include details of any specific manipulations/interventions and measures: quantity, type and route of administration of drugs or radiation; operations; tests; use of devices that are prototypic or altered from those in clinical use; time commitment for subjects; method of data analysis. (Maximum 2 pages using 12 point font. Append questionnaires, interview protocols, if applicable.)

A. Project Objective and Research Question

This is a descriptive study on the design, implementation and effects of an ER injury surveillance system at a local community health center. The question is to determine if the theory of improvisation can be used to explain the design, implementation and effects of this system.

B. Design

I. Research location: The NECHC provides emergency services among other services such as Laboratory, Family Health, Mental Health etc. Emergency service is available on a 24-hours, 7 days per week basis.

II. Current Data Processing Pattern in the Emergency Room at NECHC

A patient presenting to the ER is triaged by a nurse and chief complaint is recorded directly into HASS system. Chief complaint is a mandatory field. Unless the patient needs immediate care, he or she proceeds to the registration clerk where demographics and additional information are obtained. The registration desk, then, prints out a patient registration form (PRF). Once the patient is inside a treatment room, physician or nurse charts physical examination and detailed assessment either into HASS or PRF. HASS system is complemented with hand-written notes, progress notes, and forms that reside in the patient binder.

III. Length of Time: The study is conducted over a period of nine months. It begins mid November 1999 with the development of an injury data set. The ISS is implemented after a series of bench testing of its functionalities. Hue Quan, thesis student, provides NECHC staff with ISS in-service and hands-on training. A data collection trial is employed to determine an effective data collection pattern.

IV. Technology: Capital Health Authority (CHA) has implemented a new emergency room computer system at NECHC. The system called Hospital Administration Software Solutions (HASS) is developed in Australia. It is a comprehensive patient tracking system with the capacity to capture wide range of data such as triage, clinical, patient information etc. ISS is a component within HASS that has not been used.

V. Subjects: The data set development comprises RAH trauma service coordinator, ACICR data manager, NECHC ER team leader, Dr. L.Francescutti, Public health researcher, ER project team and thesis student Hue Quan. The improvisation section of the study involves NECHC physicians, nurses, research personnel, registration clerks and management. During the data collection trial, 5 physicians, 8 nurses, and 3 registration clerks receive ISS computer training and participate in the study groups. The ISS implementation, its interaction with clinical, nursing and support staff and improvisational changes are the focus of the study.

VI. Method:

1. Theory of improvisation

Employing the improvisational model requires a process to recognize the different types of change or major events as they occur and to respond effectively to them. Two sets of enabling conditions are essential: aligning key dimensions of the change process and dedicating resources to provide

ongoing support for the change process. The key dimensions are the technology, the organizational context, and the change model. Ongoing support involves adapting both the organization and the technology to changing organizational conditions, use practices, and technological capability. The research approach is utilization of qualitative data collected from observations, meetings, interviews, training sessions and documents.

- Meetings and interviews are conducted with HASS developer, ER project team members, champions, and NECHC staff on organizational context, user expectation, and technological capabilities. Interviews will be performed in two stages: pre-implementation (see attached interview form A) and post-implementation (see attached interview form B).
- Observations on user practices are done at NECHC ER
- During training sessions, issues related to technology understanding, individuals' cognitive frames when facing new technology are raised.
- Documents include meeting notes, correspondence, NECHC initial ER data, RAH ER data, and training materials.

2. Data collection trial

Staffs who are involved in the data collection trial are divided into 3 groups: 5 physicians (PG), 8 nurses (NG), and 3 admission clerks (AG). Each group collects a week's injury-related data (estimated to be about 100 patients). The trial is done in three consecutive weeks for three groups. Descriptive statistical procedures include measures of central tendency, variability, frequency distribution table and graph. The project includes all patients who present to the ER with injuries as chief complaints

a. Standard Reference

HASS chief complaint is a mandatory data entry. Hence it can be used as standard reference for determining the number of injury-related ER visits i.e. data completeness.

b. Data Completeness (Table F.1)

Table F.1 Data completeness and correctness

	Standard positive	Standard negative	Total
ISS positive	a	b	a + b
ISS negative	c	d	c + d
Total	a + c	b + d	a+ b + c + d

Completeness is the proportion of all injury events of interest that are recorded by ISS and is calculated as a/(a + c).

c. Data Correctness (Table F.1)

Correctness is the proportion of observations that truly have the injury events of interest and is calculated as a/(a + b). The injury-surveillance population of interest is (a + c) which is presumably eligible for capture by ISS. The total ER patient visits which include injury-related and non-injury related sets of patients is (a + b+ c + d). Patients will be phoned next day to obtain relevant injury data. Correctness is determined by measuring the agreement between respondent information and that provided by the ISS.

d. Comprehensiveness

The ISS brief description is a free text entry field. It gives staff the opportunity to supplement the ISS coded data. It would appear logical to search this data item for confirmation and expansion of coded data items. One point is awarded for confirmation and two points for expansion

e. Missing Data

Charting practice that leaves data entry fields blank introduces ambiguity because it may be interpreted either as patient not responding or ER staff forgetting to collect information. Missing data is calculated as a proportion of total injury data items (c/a + c) (fig. 1).

f. Timeliness

There are circumstances in which patient condition is considered urgent. ER staffs are encouraged to do real-time data entry but also have the option to put comment suggesting data collection deferral in this situation. One point is awarded if there is no deferral of data entry comment.

The study uses the following criteria to compare the three mentioned ISS data collection patterns:

- Data completeness
- Data correctness
- Comprehensiveness
- Missing data
- Timeliness

B8. Which treatments or procedures are additional to those required for standard patient care?

Investigators of this study will not interfere with any medical treatment or intervention at the emergency room of the NECHC.

The investigators of this study will not intervene in standard patient care during the patient's emergency room visit.

B9. If the procedures include a blind, under what conditions will the code be broken and what provisions have been made for this? Who will have the code?

Not applicable

Obtaining Consent

B10. Clearly detail who will be recruiting subjects and obtaining consent, and the procedures for doing this. If appropriate, specify whether subjects will be randomly assigned to groups before or after consent has been attained.

The purpose of this research project is to examine computer system implementation, use and consequences of an injury surveillance system (ISS) on work pattern in an emergency room (ER) setting. It also studies how well a computer system can collect injury data. Study subjects include NECHC staff, HASS developers and patients. NECHC staffs consist of physicians, nurses, registration clerks, ER project team members, and project champions. The project collects both quantitative and qualitative data. Qualitative data are primarily collected from meetings, observations, training sessions, data entry and face-to-face interviews with NECHC staff. During the first meeting, NECHC staffs are informed of the research study, their right and ability to withdraw from the study at any time without consequence. They are provided with information sheets and consent forms. When staffs decide to participate in the project, meetings and face-to-face interviews will be scheduled for them.

Once the injury surveillance system (ISS) is implemented, NECHC staff input injury data directly into the ISS. To ensure data validity during the study, NECHC physicians, nurses or registration clerk will obtain consent from patients for follow-up telephone interview the next day. A NECHC registration clerk will be interviewing the patient. During the interview, each ISS data entry item is repeated in sequence:

- What went wrong?
- What caused the injury?
- Where and when did it happen?
- Where did it hurt?
- What was the context of injury?
- If a specific product or article was involved, please give details.
- What safety precautions/devices were in use?

The interview is used to quantify the level of agreement between the ISS recorded information and that obtained from the respondent. Combined efforts are practised to ensure NECHC staffs seek permission of patients to call them the following day. During training sessions, patient's willingness or refusal to participate is highlighted. This will also be reinforced by NECHC management through communication in forms of shift reports, ER log, reminders, and to-do-lists.

B11. Attach a copy of consent form(s), information sheets and all recruitment notices, letters or advertisements. (See Appendix A of Guidelines. Use of standard Consent is highly recommended.)

The documents are attached.

B12. Specify methods for dealing with groups identified in #B6. If the subjects are not able/competent to give fully informed consent, who will consent on their behalf?

The study involves assessing the validity of information collected by the injury surveillance system. The assessment is done through telephone interview with patients the next day after their emergency room visits. Patients may belong to the following subjects:

- Under 18 years of age
- Cognitively impaired
- In emergency or life-threatening situation
- Have language barriers

The study only recruits these patients if they are accompanied by parents, guardians or relatives and the latter will be given the opportunity to read the information sheet and complete the consent form. Proxy respondent information provided by parents, guardians or relatives are considered for telephone interview in these situations.

B13. What is the reading level of the Information Letter?
What is the reading level of the Consent Form?
(For most populations, the target level is Grade 8. See Appendix A of Guidelines for information on calculating reading level. The Standard Consent Template is Grade 7.)
What steps have been taken to make the consent form and subject information documents comprehensible to the person giving consent? (Please include a statement on how the reading level was determined, i.e.: level was determined using Word Perfect 6.0)

The reading level of the Information Letter is Grade 7
The reading level of the Consent Form is Grade 8.
Microsoft Word Spelling and Grammar was used to determine the reading levels

B14. If subjects will be offered compensation for participating in the research, provide details.

Specify the amount, what the compensation is for, and how payment will be determined for subjects who do not complete the study.

No compensation will be provided for participants in this study.

B15. Do any of the procedures include the use of deception or partial disclosure of information to subjects?

[ ] yes — Provide rationale for deception or partial disclosure. Describe the procedures for (a) debriefing the subjects and (b) giving them a second opportunity to consent to participate after debriefing.

[X] no

Risks and Benefits

B16. What are the benefits of the proposed research for the subject and / or for scientific knowledge in general?

Injury is the leading cause of death for people under the age of 44 and causes more potential years of life lost than any other disease process. In Alberta, there were 1,358 deaths, 31,471 hospitalisations and 42,774 potential years of life lost due to injury. Injury surveillance data is used to

- estimate the magnitude of injury problem
- determine the etiology of injury
- evaluate injury control strategies.
- Facilitate planning and co-ordination of injury control efforts.

Among its health issues priorities Edmonton Capital Health board has set a mandate for injury control and prevention. It recommends improved data collection and surveillance as part of a combination of strategies. Several population-based studies indicate that 78% to 87% of all medically attended injuries are treated in the emergency rooms (ER). However, few reports of ER injury surveillance systems have been published. The implementation of computerized injury surveillance system at the NECHC emergency room is the first of its kind in Canada. The ISS will provide data that is accurate, timely, and readily accessible to plan, implement, evaluate, and sustain injury control processes. Injury problems and trends vary between communities, and specific information is needed to prioritize control programs and assess the effectiveness of control measures. The NECHC ISS will have tremendous impact on the local community's injury control and prevention programs.

B17. What adverse effects may result from the research? (Include risks, discomfort, incapacity, psychological risks, and any reported side effects of procedure or drug.) How will adverse effects be dealt with?

Patient may have physical, mental, or emotional concerns during the follow-up phone call the next day. This will be addressed during training sessions. ER nurses will tend to these delicate circumstances, converse with the patient and handle the situation in a professional way. Physician

will be consulted, if necessary, as part of a team approach. The NECHC management will emphasise this guideline through communication during the data collection trial.

Privacy and Confidentiality

B18. What steps will be taken to respect privacy of subjects and protect confidential data?
The standard health guidelines of privacy and confidentiality will be observed in this study. All information provided by the patients will be handled in a confidential and secure manner aligned with CHA patient information policies. NECHC computer accesses use password security. Staffs are only authorised to access relevant information within their legitimate responsibility.
Data collected during survey and interview will be kept in a secure place (on disc and in paper form) accessible only by the research team and no identity will be revealed.

B19. Identify any agencies or individuals who will have access to confidential data now or in the future.
Capital Health Authority (CHA), Alberta Center for Injury Control and Research, Public Health Research, and CHA Trauma Services will be using the data in the future. The data are disseminated in an aggregate format such as no patient name will be identified.

B20. Do you anticipate secondary analysis of these data? (Note that secondary analysis requires further research ethics approval.)

___ Yes
_X_ No

University of Alberta

Appendix B (For patients)

Title of Project: Implementation of an Injury Surveillance System at a Local Community Health Center Emergency Room

Principal Investigator(s):
Dr. Louis H. Francescutti, MD, PhD, MPH
Assistant Professor, Department of Public Health Sciences & Division of Emergency Medicine, University of Alberta Phone (780)-492-6546
Chair to the Advisory Board of the Alberta Center for Injury Control and Research

Co-Investigator(s):
Kien Hue Quan, Bcom
Graduate student, Department of Public Health Sciences
13-109, Clinical Sciences Building
University of Alberta
(780)-492-7349

Purpose:
The purpose of this research project is to study how well a computer system can collect injury data. The NorthEast Community Health Center is chosen as a location to see whether the system will work for the Edmonton health region. Once the computer system is set up and works well, other hospitals will use the system. Injury information can thus be put to use in injury prevention program.

Background:
Injury is the leading cause of death for people under the age of 44. Although the usage of computers has increased in health care, injury-related computer system is still not complete. Hospital emergency room injury data is able to help local community to do injury control and prevention program. The benefit of this project is to find a way to collect good injury data. This will help policy-makers to make decisions.

Department of Public Health Sciences

Procedures:

1. You visit the NorthEast Community Health Center's emergency room. Nurse at the front desk checks how serious you are hurt
2. Registration clerk at the desk asks few information about yourself: your name, age, where you live etc.
3. If your emergency room visit is injury-related, staff will ask you the following questions:
    - What went wrong?
    - What was the cause of injury?
    - Where and when did it happen
    - Where did it hurt?
    - What were you doing when it happened?
    - Was it related to some sort of consumer product?

All these information are entered directly into the computer.

4. To make sure the information is correct, a staff from the centre phones you the next day and checks your answers to the above questions. A consent form will be provided to ask for your permission to do the phone call.
5. Before you make decision whether or not you want to be part of the study, you are shown this information sheet which explains the purpose of the study. If you decide to take part in the study, please sign the consent form. You could refuse to answer any question listed above. The care you receive in the emergency room is not affected by your decision.
6. All information in the consent form is kept in secure place for at least five years. Only the research team will have access to this information. Your name or any other identifying information will not be used in any report format of the study results.

Note: The telephone interview should not take more than 10 minutes of your time.

Risks:

There are no risks to you by taking part in this study.

Confidentiality:

Only the research team has access to the information you provide. Health information guidelines of confidentiality are followed throughout this study. All information will be held confidential except when professional codes of ethics and/or legislation require reporting.

University of Alberta

Freedom to withdraw:
You have the choice to withdraw from this project at anytime and do not have to give a reason. There is no effect to the care you receive at the emergency room.

Contacts:
You will be able to make comments about this project. The project investigators can be reached at the above phone numbers. Concerns can also be forwarded to the "Patient Relations Department of the capital Health Authority" at 407-1040. This office has no affiliation with the project investigators

Department of Public Health Sciences

University of Alberta

Appendix B (For NorthEast Community Health Centre staff including physicians, nurses, and registration clerks)

Title of Project: Implementation of an Injury Surveillance System at a Local Community Health Center Emergency Room

Principal Investigator(s):
Dr. Louis H. Francescutti, MD, PhD, MPH
Assistant Professor, Department of Public Health Sciences & Division of Emergency Medicine, University of Alberta Phone (780)-492-6546
Chair to the Advisory Board of the Alberta Center for Injury Control and Research

Co-Investigator(s):
Kien Hue Quan, Bcom
Graduate student, Department of Public Health Sciences
13-109, Clinical Sciences Building
University of Alberta
(780)-492-7349

Purpose:
The purpose of this research project is to examine computer system implementation, use and consequences of an injury surveillance system (ISS) on work pattern in an emergency room (ER) setting. It also studies how well a computer system can collect injury data. The NorthEast Community Health Centre is chosen as a pilot location for the Edmonton health region. Once the computer system is set up and data collection efficiency is proven, the system implementation pattern will be used as a template for other capital health hospital ER. Injury information can thus be put to use in injury prevention program.

Methods:
The project collects both quantitative and qualitative data. Qualitative data are primarily collected from meetings, observations, training sessions, data entry and face-to-face interviews. Study subjects are key users who participated in the implementation of the ISS i.e. physicians, nurses, and registration clerks. Quantitative data are related to injury data quality assessment. Interview guides are developed in a structured format with questions and multiple choice check boxes.

Department of Public Health Sciences

University of Alberta

Background:
Injury is the leading cause of death for people under the age of 44. In Alberta, there were 1,358 deaths and 31,471 hospitalisations in 1996. Although the number of health information systems has increased in recent years, injury-related information system is fragmented. Hospital emergency room injury data represent an important but underused source of information. Injury data is able to help local community to develop and injury control and prevention program.
The benefit of this project is to determine an efficient way of collecting good quality injury data. Once data are gathered, it can be distributed to policy-makers to put these data into action.

Procedures:

7. Meetings are conducted with key users on user expectations and technological capabilities.
8. Observations on key user practices are done during data collections.
9. During training sessions, issues related to technology understanding, individuals' cognitive frames when facing new technology are raised.
10. There are two phases of interviews: before and after system implementation. The first is conducted shortly after user training. The second is scheduled after the data collection trial
11. Interviewees include physicians, nurses and registration clerks.
12. The interview guides contain specific issues to be discussed with the respondent e.g. reasons for introducing the system, diversity of tactics adopted to ensure a successful implementation, injury data collection impacts on work pattern etc
    All these information are entered directly into the computer.
13. You are asked to sign a consent form to see if you are willing to participate in the study
14. You should read this information sheet first. You can choose whether or not you want to sign the consent form.
15. Once you agree to take part in the study, you will be given this information sheet and the consent form. Only the researchers will have access to this information

Note: The interview should not take more than 10 minutes of your time.

Department of Public Health Sciences

University of Alberta

Risks:
There are no risks to you by taking part in this study.

Confidentiality:
Only the investigators of this study have access to the information you provide. Health information guidelines of confidentiality are followed throughout this study.

Freedom to withdraw:
You have the choice to withdraw from this project at anytime and do not have to give a reason. There is no effect to you by withdrawing your participation in the study.

Contacts:
You will be able to make comments about this project. The project investigators can be reached at the above phone numbers.

Department of Public Health Sciences

University of Alberta

Appendix B (For HASS developer, ED project team members, and other NECHC staff)

Title of Project: Implementation of an Injury Surveillance System at a Local Community Health Center Emergency Room

Principal Investigator(s):
Dr. Louis H. Francescutti, MD, PhD, MPH
Assistant Professor, Department of Public Health Sciences & Division of Emergency Medicine, University of Alberta Phone (780)-492-6546
Chair to the Advisory Board of the Alberta Center for Injury Control and Research

Co-Investigator(s):
Kien Hue Quan, Bcom
Graduate student, Department of Public Health Sciences
13-109, Clinical Sciences Building
University of Alberta
(780)-492-7349

Purpose:
The purpose of this research project is to examine computer system implementation, use and consequences of an injury surveillance system (ISS) on work pattern in an emergency room (ER) setting. It also studies how well a computer system can collect injury data. The NorthEast Community Health Centre is chosen as a pilot location for the Edmonton health region. Once the computer system is set up and data collection efficiency is proven, the system implementation pattern will be used as a template for other capital health hospital ER. Injury information can thus be put to use in injury prevention program.

Methods:
The project collects both quantitative and qualitative data. Qualitative data are primarily collected from meetings and face-to-face interviews. Study subjects are NECHC champions, ER project team members, and HASS developer who participate in the implementation of the ISS. Quantitative data are related to injury data quality assessment. Interview guides are developed in a structured format.

Department of Public Health Sciences

University of Alberta

Background:
Injury is the leading cause of death for people under the age of 44. In Alberta, there were 1,358 deaths and 31,471 hospitalisations in 1996. Although the number of health information systems has increased in recent years, injury-related information system is fragmented. Hospital emergency room injury data represent an important but underused source of information. Injury data is able to help local community to develop and injury control and prevention program.
The benefit of this project is to determine an efficient way of collecting good quality injury data. Once data are gathered, it can be distributed to policy-makers to put these data into action.

Procedures:

16. Meetings are conducted with key project members on system implementation process, in-service arrangement and scheduling, and data element development.
17. The interview guides contain specific issues to be discussed with the respondent: their perceptions of promoting the surveillance system, user acceptance, staff's strength and belief, expectations on technological capabilities.
    All these information are entered directly into the computer.
18. You are asked to sign a consent form to see if you are willing to participate in the study
19. You should read this information sheet first. You can choose whether or not you want to sign the consent form.
20. Once you agree to take part in the study, you will be given this information sheet and the consent form. Only the researchers will have access to this information

Note: The interview should not take more than 10 minutes of your time.

Risks:
There are no risks to you by taking part in this study.

Department of Public Health Sciences

University of Alberta

Confidentiality:
Only the investigators of this study have access to the information you provide. Health information guidelines of confidentiality are followed throughout this study.

Freedom to withdraw:
You have the choice to withdraw from this project at anytime and do not have to give a reason. There is no effect to you by withdrawing your participation in the study.

Contacts:
You will be able to make comments about this project. The project investigators can be reached at the above phone numbers.

Department of Public Health Sciences

University of Alberta

Part 1 (to be completed by the Principal Investigator):
Title of Project: Implementation of an Injury Surveillance System at a Local Community Health Center Emergency Room

Principal Investigator(s): Dr. Louis H. Francescutti, MD, PhD, MPH
Assistant Professor, Department of Public Health Sciences & Division of Emergency Medicine, University of Alberta
Phone (780)-492-6546
Chair to the Advisory Board of the Alberta Center for Injury Control and Research

Co-Investigator(s): Kien Hue Quan, BCom
Graduate student, Department of Public Health Sciences
13-109, Clinical Sciences Building
University of Alberta Phone (780)-492-7349

Part 2 (to be completed by patients):

Do you understand that you have been asked to be in a research study?	Yes	No
Have you read and received a copy of the attached Information Sheet?	Yes	No
Do you understand the benefits and risks involved in taking part in this research study?	Yes	No
Have you had an opportunity to ask questions and discuss this study?	Yes	No
Do you understand that you are free to refuse to participate or withdraw from the study at any time? You do not have to give a reason and it will not affect your care.	Yes	No
Has the issue of confidentiality been explained to you? Do you understand who will have access to your records?	Yes	No
Do you want the investigator(s) to inform your family doctor that you are participating in this research study? If so, please provide your doctor's name:	Yes	No

_____ *(N.B. This question is optional).*

This study was explained to me by: _____

I agree to take part in this study.

_____

Signature of Research Participant Date Witness

_____ _____

Printed Name Printed Name

I believe that the person signing this form understands what is involved in the study and voluntarily agrees to participate.

_____ _____

Signature of Investigator or Designee Date

Department of Public Health Sciences

University of Alberta

Part 1 (to be completed by the Principal Investigator):
Title of Project: Implementation of an Injury Surveillance System at a Local Community Health Center Emergency Room

Principal Investigator(s): Dr. Louis H. Francescutti, MD, PhD, MPH
Assistant Professor, Department of Public Health Sciences & Division of Emergency Medicine, University of Alberta
Phone (780)-492-6546
Chair to the Advisory Board of the Alberta Center for Injury Control and Research

Co-Investigator(s): Kien Hue Quan, BCom
Graduate student, Department of Public Health Sciences
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University of Alberta Phone (780)-492-7349

Part 2 (to be completed by the NECHC physicians, nurses, and registration clerks):

Do you understand that you have been asked to be in a research study?	Yes	No
Have you read and received a copy of the attached Information Sheet?	Yes	No
Do you understand the benefits and risks involved in taking part in this research study?	Yes	No
Have you had an opportunity to ask questions and discuss this study?	Yes	No
Do you understand that you are free to refuse to participate or withdraw from the study at any time? You do not have to give a reason .	Yes	No
Has the issue of confidentiality been explained to you? Do you understand who will have access to your records?	Yes	No

This study was explained to me by: _____

I agree to take part in this study.

Signature of Research Participant Date Witness

Printed Name Printed Name

I believe that the person signing this form understands what is involved in the study and voluntarily agrees to participate.

Signature of Investigator or Designee Date

Department of Public Health Sciences

University of Alberta

Part 1 (to be completed by the Principal Investigator):
Title of Project: Implementation of an Injury Surveillance System at a Local Community Health Center Emergency Room

Principal Investigator(s): Dr. Louis H. Francescutti, MD, PhD, MPH
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Part 2 (to be completed by the HASS developer, ER project team members, and other NECHC staff):

Do you understand that you have been asked to be in a research study?	Yes	No
Have you read and received a copy of the attached Information Sheet?	Yes	No
Do you understand the benefits and risks involved in taking part in this research study?	Yes	No
Have you had an opportunity to ask questions and discuss this study?	Yes	No
Do you understand that you are free to refuse to participate or withdraw from the study at any time? You do not have to give a reason .	Yes	No
Has the issue of confidentiality been explained to you? Do you understand who will have access to your records?	Yes	No

This study was explained to me by: _____

I agree to take part in this study.

_____

Signature of Research Participant Date Witness

_____ _____

Printed Name Printed Name

I believe that the person signing this form understands what is involved in the study and voluntarily agrees to participate.

_____ _____

Signature of Investigator or Designee Date

Department of Public Health Sciences