

Status report

The Canadian Hospitals Injury Reporting and Prevention Program: a dynamic and innovative injury surveillance system

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Abstract

This status report on the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP), an emergency department-based injury and poisoning surveillance system, describes the result of migrating from a centralized data entry and coding process to a decentralized process, the web-based eCHIRPP system, in 2011. This secure system is improving the CHIRPP's overall flexibility and timeliness, which are key attributes of an effective surveillance system. The integrated eCHIRPP platform enables near real-time data entry and access, has user-friendly data management and analysis tools, and allows for easier communication and connectivity across the CHIRPP network through an online collaboration centre. Current pilot testing of automated data monitoring and trend analysis tools—designed to monitor and flag incoming data according to predefined criteria (for example, a new consumer product)—is revealing eCHIRPP's potential for providing early warnings of new hazards, issues and trends.

Keywords: *injury surveillance, injury prevention, informatics, syndromics, epidemiology, public health*

Introduction

Unintentional injuries are the leading cause of death among Canadians aged 1 to 44 years and the fourth leading cause of death among all ages combined.¹ Most injury events are not unavoidable accidents but are predictable and preventable.²

Health surveillance is the systematic, ongoing collection of health information and its analysis, interpretation and dissemination to make it meaningful and accessible.^{3,4} Injury surveillance is vital to understanding the circumstances leading to the injuries; knowing these circumstances leads to their prevention via early warnings of new hazards and trends, public awareness campaigns and product safety legislation. Surveillance systems must therefore be

dynamic³ and evolve with changing behaviours, hazards, environments, technology and other factors. Flexibility and timeliness are key attributes of a good surveillance system.³ Flexibility means that “[t]he system should be easy to change, especially when ongoing evaluation shows that change is necessary or desirable,” and timeliness signifies that “[t]he system should be able to generate up-to-date information whenever that information is needed.”^{3,p.16-17}

Before 1990, national injury surveillance relied mainly on mortality and hospital administrative data. Despite their importance for measuring the incidence of the most serious injuries, these data are limited in their capture of less serious cases and the details of some injury contexts. The Canadian Hospitals Injury Reporting and

Highlights

- The Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) has remained a flexible injury surveillance system that has adapted over time.
- Most recently, the dynamic, online eCHIRPP injury surveillance platform is improving the flexibility and timeliness of the CHIRPP.
- eCHIRPP's integrated, user-friendly data management and communication tools allow for easier information access, communication, and connectivity across the CHIRPP network.
- Pilot testing of automated data monitoring and trend analysis tools is showing eCHIRPP's potential for providing early warnings of new injury issues and trends among Canadians.

Prevention Program (CHIRPP) is an emergency department (ED)-based injury and poisoning surveillance system established in 1990 in response to the need for enhanced and timelier injury surveillance information in Canada.

The CHIRPP operates in 11 pediatric and 6 general hospitals across Canada (see Table 1) and is funded and administered by the Public Health Agency of Canada (PHAC). It collects patients' accounts of pre-event injury circumstances (narratives of “what went wrong”) using the Injury/Poisoning Reporting form, a questionnaire completed during their visits

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to the ED. The attending physician or other staff add clinical data to the form, and data coders extract other information found in patients' narratives. The CHIRPP captures a more complete picture of the injury event, one that includes risk and protective factors, than hospital administrative or mortality data alone, and also identifies less serious injury cases that do not require hospitalization.

Since 1990, the CHIRPP database has accumulated nearly three million records, of which approximately 80% are pediatric.

Throughout the program's 25 years, in collaboration with Health Canada's Consumer Product Safety Directorate and other organizations, CHIRPP data have been used to develop product safety standards and legislation.⁵⁻⁹ Over 100 scientific papers on a wide variety of topics cite these data.¹⁰⁻¹⁶ The CHIRPP on-site directors and coordinators are also routinely consulted on shaping injury surveillance and prevention.

Examples of other hospital-based, sentinel injury surveillance systems include the United States' National Electronic Injury Surveillance System (NEISS), which produces near real-time data via a network of nearly 100 hospitals,¹⁷ and the European Union's Injury Database (EU-IDB), which provides standardized cross-national information on the external causes of injuries treated in 100 EDs in the European Union.¹⁸ Both of these systems can be publicly queried online and have been shown to be flexible.¹⁹

In this paper, we describe the CHIRPP's recent modernization to meet demands for timelier information, continued flexibility, and dynamic and integrated informatics technology that is flexible to changing business needs. (The history of the CHIRPP is described elsewhere.²⁰⁻²²) The evolution of the CHIRPP is also in keeping with the Government of Canada's agenda to strive to use "new technologies to improve networking and access to data" via "efficient, interconnected and nimble processes, structures and systems."²³

Following a brief description of recent changes to the CHIRPP codebook (a reference

manual describing the variables and codes), we discuss the innovative, web-based eCHIRPP platform and its key successes and future directions. Beyond published evaluations of some systems, including the CHIRPP, the information on modernizing injury surveillance systems is scarce.^{18,19,21,24} The scarcity of knowledge on new technological tools for injury surveillance has also only recently been acknowledged,²⁵ so this is a timely contribution to the discussion.

The CHIRPP codebook

The CHIRPP codebook has remained flexible with changing program needs and information demands. Specifically, the CHIRPP has evolved to reduce redundancies, increase comparability to national and international injury classification and provide more detailed and timely data on essential variables and targeted topics including emerging hazards or issues and changing trends. One example, created in 2010, is an aggregated version of the external cause of injury variable based on the *International Classification of Diseases and Related Health Problems 10th Revision*,²⁶ which has been useful for producing summary statistics on environmental events and circumstances on the cause of injury. A validation study is planned to assess the comparability of the proportions of CHIRPP's external cause of injury data to other Canadian and international ICD-10 coded health data. Around the same time, the sports and recreation (SPAR) variable was also created for a more detailed and timely capture and analysis of any SPAR-related activity related to the injury, especially for tracking more severe injuries among youth, especially head injuries. Many new factor codes were also created to identify additional consumer products, including emerging hazards. These are just some of the examples of how the CHIRPP codebook has been modified to remain flexible over time.

CHIRPP gets connected: eCHIRPP

The most significant enhancement to the CHIRPP's flexibility and timeliness has been an electronic application. Established in 2011, eCHIRPP is one of many integrated,

web-based health surveillance applications developed by PHAC's Canadian Network for Public Health Intelligence (CNPHI). CNPHI is "a comprehensive framework of applications and resources designed to fill critical gaps in Canada's national public health infrastructure."^{27,p.353} The ultimate goal of the CNPHI is to enhance day-to-day public health delivery by empowering public health stakeholders with innovative scientific public health informatics resources;²⁷ additional objectives of the CNPHI and initiatives to enhance public health surveillance are described elsewhere.^{28,29}

eCHIRPP was designed for much more than data entry alone: it was developed as a single integrated platform to produce timely injury data, user-friendly data management and analysis tools, and easier communication and connectivity across the CHIRPP network and to optimize local injury surveillance at each CHIRPP site. True to CNPHI values, eCHIRPP was developed using a collaborative, program-centric, iterative approach with its end users contributing ideas to increase the application's functionality.²⁷

The timeliness of data entry has vastly improved because of eCHIRPP. Its online,* dynamic nature enables data entry in near real-time at the CHIRPP hospitals; historically, this was centralized at national headquarters. PHAC coders then verify the data, code patients' narratives, complete data quality inspections and error handling, all online. This online, collaborative process allows considerably more data to be simultaneously entered into the system and is gradually decreasing lag time between data entry and information dissemination, resulting in injury information being available for analysis locally and nationally within a few days of patients presenting to the emergency room. (With the previous system of centralizing data entry at national headquarters, the lag time between data collection and data entry was up to two years because of the accumulated data entry backlog.)

eCHIRPP also has integrated data management tools that have greatly enhanced its flexibility and timeliness. For instance, authorized CHIRPP staff can directly manipulate eCHIRPP's linked codebook to periodically

*Access to the eCHIRPP platform is restricted to users whose registration is vetted and approved by the Public Health Agency of Canada and participating hospitals, and the sign-on process is secure and password-protected.

add new data elements (for example, a code for a new consumer product), and the rationale and history of changes are also automatically logged directly in eCHIRPP. These features greatly simplify and enhance autonomy over change management, ensure that historical documentation of the CHIRPP codebook is consistent and up-to-date and enable more timely capture and analysis of new issues and trends as the injury landscape evolves. Before the CHIRPP became electronic, these tasks required separate and time-consuming manual change procedures and documentation and relied on technical services personnel to manipulate data elements in the CHIRPP database. Now CHIRPP staff can make these changes and update their documentation instantaneously in eCHIRPP.

The CHIRPP sites (see Table 1) now have greater autonomy over their information: they can extract eCHIRPP data and produce statistical reports using integrated eCHIRPP data analysis and query tools, making them less reliant on national headquarters to provide data extracts and conduct analyses. In a recent poll, 82% (9 out of 11; two “undecided”) of the CHIRPP sites that responded agreed/strongly agreed that they are now better equipped to efficiently

respond to local information requests from media, researchers and others with an interest in injury statistics, as well as advance their own injury prevention, surveillance and research initiatives such as scientific studies and public awareness campaigns about injury prevention.

An integrated collaboration centre provides survey tools, documents management, and discussion and news forums that are simplifying access to and sharing of injury surveillance knowledge across the CHIRPP network. The system also includes an integrated print management tool that allows each eCHIRPP site to print blank Injury/Poisoning Reporting forms, eliminating the need to ship forms, and the eCHIRPP dashboard displays dynamic data entry and coding productivity statistics.

Figure 1 illustrates the CHIRPP process flow now and in the past, as well as how it is envisaged for the future.

Future directions

Timely information is critical for syndromic surveillance, the early identification of

emerging hazards and changes in trends. Syndromic surveillance is “... the process of collecting, analysing and interpreting health-related data to provide an early warning of human or veterinary public health threats, which require public health action.”^{30,p.1} Pilot testing of CNPHI’s automated data monitoring and trend analysis tools—designed to monitor and flag incoming data according to predefined criteria and thresholds (for example, a new consumer product, or a rare but serious hazard)—is showing eCHIRPP’s potential for injury syndromics surveillance. In the case of rare events, a single case will generate a verifiable alert. An example of this are eye injuries caused by hockey sticks in organized minor hockey. No cases are expected because of the requirement to wear a full face shield and any generated alerts are likely to be false positives; so far, three false positives have been detected by eCHIRPP.

Syndromics surveillance was also applied to eCHIRPP data in a proof-of-concept study to analyze the effectiveness of monitoring and predicting laundry detergent packet-related injuries in Canada.³¹

Current and historical CHIRPP statistics are also provided to government and non-governmental organizations, media, academia and other stakeholders for injury prevention initiatives, and eCHIRPP has improved the timeliness of this information. Examples of injury topics that have recently been analyzed in response to such information requests include team sports, window and balcony falls, concussions, and hoverboard use statistics from the years 2015 and 2016, rather than pre-eCHIRPP statistics that were up to two years old. It was also possible to efficiently update CHIRPP sports injury statistics from 2004 to 2014³² with estimates for 2015, in response to stakeholders’ requests for the most current information.

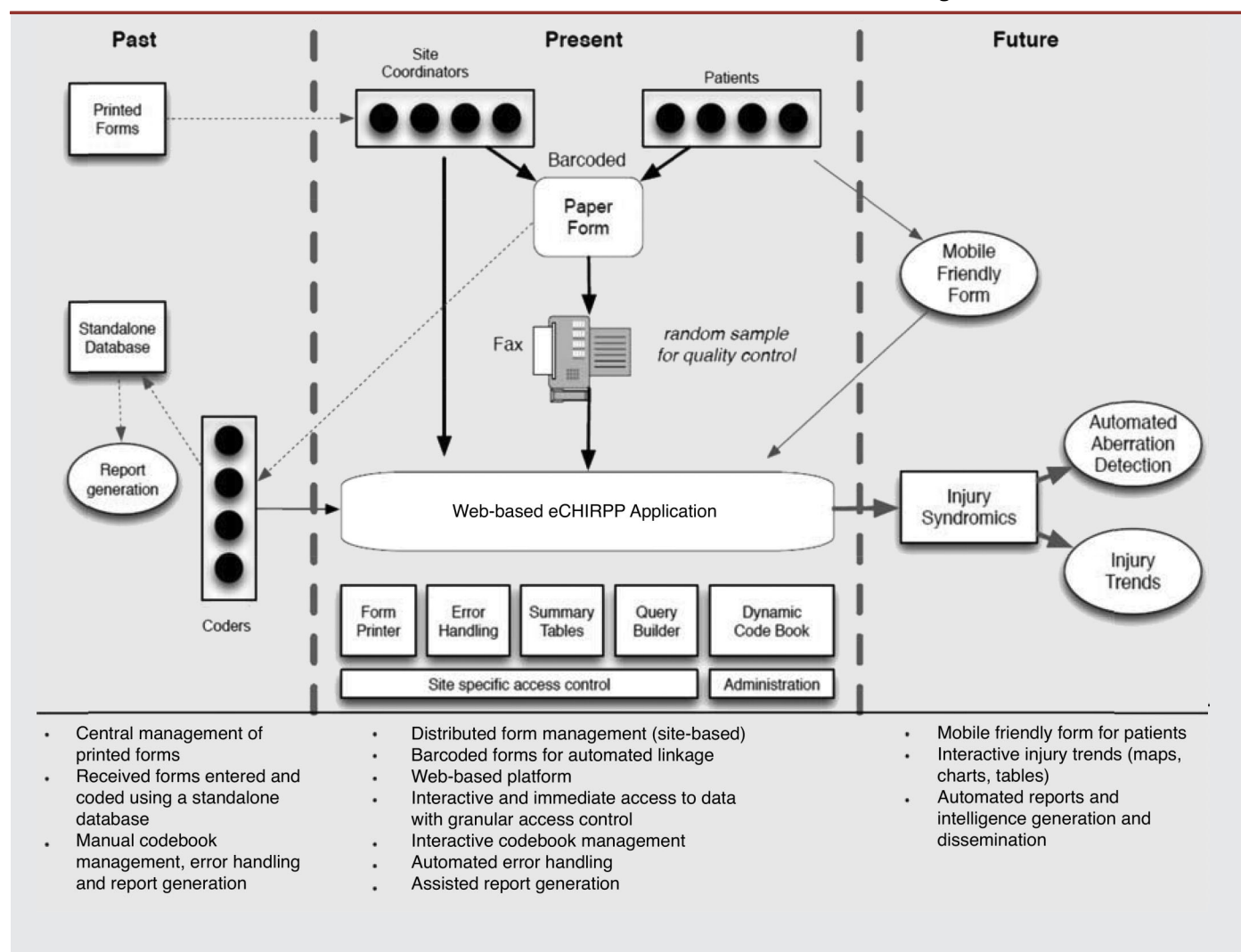
Future directions also include piloting a mobile-friendly version of eCHIRPP to collect data using hand-held devices, exploring the feasibility of integrated knowledge sharing across other CNPHI surveillance platforms, continuing assessment of applying injury syndromics for early detection of changes in trends and emerging

TABLE 1
Current CHIRPP sites

Site	Location	Joined the CHIRPP
BC Children's Hospital	Vancouver, B.C.	April 1990
Kelowna General Hospital	Kelowna, B.C.	April 2011
Alberta Children's Hospital	Calgary, Alta.	April 1990
Stollery Children's Hospital	Edmonton, Alta.	June 2009
Health Sciences Centre Winnipeg Children's Hospital	Winnipeg, Man.	April 1990
Arctic Bay Health Centre	Arctic Bay, Nun.	January 1991
Children's Hospital at London Health Sciences Centre	London, Ont.	April 1990
The Hospital for Sick Children	Toronto, Ont.	April 1990
Kingston General Hospital	Kingston, Ont.	June 1993
Hotel Dieu Hospital	Kingston, Ont.	June 1993
Children's Outpatient Centre, Hotel Dieu Hospital	Kingston, Ont.	September 2011
Children's Hospital of Eastern Ontario	Ottawa, Ont.	April 1990
Montreal Children's Hospital	Montréal, Que.	April 1990
CHU Sainte-Justine	Montréal, Que.	April 1990
Hôpital de l'Enfant-Jésus, CHU de Québec	Québec, Que.	July 1991
IWK Health Centre	Halifax, N.S.	April 1990
Janeway Children's Health and Rehabilitation Centre	St. John's, N.L.	April 1990
Carbonear General Hospital	Carbonear, N.L.	April 2011

Abbreviations: CHIRPP, Canadian Hospitals Injury Reporting and Prevention Program; CHU, centre hospitalier universitaire.

FIGURE 1
The evolution of CHIRPP: from manual data collection to innovative insights



issues, estimating denominators to calculate population rates, enhancing capture of intentional injuries, and increasing adult data collection by expanding to more general hospitals. Moreover, the interest in using eCHIRPP to enhance injury surveillance in the North is strong, which would provide a valuable opportunity to assess the unique circumstances and injury patterns of northern injuries.³³

Limitations

Like all injury surveillance systems, the CHIRPP is not without limitations. As the program comprises a sample of Canada's hospital EDs, the data should not be used to draw conclusions about injury patterns across the entire Canadian population.

However, some studies, have shown CHIRPP data to be representative of the profile of injuries in sports and recreation in Calgary, compared to regional health administrative data;^{34,35} injury cases at Montreal Children's Hospital that did not require admission, did not present to the ED overnight, or were not poisonings;²¹ and children with severe injuries and younger children presenting at the Children's Hospital of Ontario.³⁶

Because most of the CHIRPP hospitals are pediatric (usually located in major cities), certain groups are under-represented in the data, including rural inhabitants (including some Aboriginal peoples), older teens and adults. Also, while CHIRPP captures people who are dead on arrival at the hospital, those who died at the scene

or later in hospital are not included. Patients who bypass the ED registration desk for immediate treatment may not be captured as well as those who do not complete an Injury/Poisoning Reporting form. On average, the CHIRPP capture rate (percentage of eligible patients who complete a CHIRPP form) is 68%, and it is even as high as 90% to 100% at some hospitals.

The process of establishing the new eCHIRPP system itself also had various limitations. Additional time and effort was invested by CHIRPP personnel at national headquarters and the hospital sites to develop eCHIRPP training materials and protocols and undergo training and hospitals' ethics review, and the sites also had

to adapt to the increased workload when performing data entry. Network delays at the sites have also occurred periodically, and as with any system, brief, periodic service interruptions are required when system updates are performed.

Conclusion

This paper contributes to the knowledge on modernizing injury surveillance systems.

It demonstrates the CHIRPP's flexibility, showcasing recent years. Changes to the codebook reflect evolving information demands, and eCHIRPP's implementation has enabled the program to make great strides in enhancing its dynamic and flexible nature, while improving the timeliness of its information. The eCHIRPP system is also in keeping with the Government of Canada's modernization agenda, and new knowledge about injuries and their protective and risk factors will also continue to influence the CHIRPP's evolution as health surveillance must continue to adapt to changes in the populations being monitored, new knowledge and technology, and changing information demands.

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Que.; Hôpital de l'Enfant-Jésus du CHU de Québec, Québec, Que.; IWK Health Centre, Halifax, N.S.; Janeway Children's Health and Rehabilitation Centre, St. John's, N.L.; Carbonear General Hospital, Carbonear, N.L.; and the Newfoundland Centre for Health Information, St. John's, N.L.

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