Improving the Capture of Poisonings in Children and Youth by the Canadian Hospital Injury Reporting and Prevention Program

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EXECUTIVE SUMMARY

Unintentional poisonings among children and youth is a public health concern in Canada. Every year, approximately 1,600 Canadian children and youth are hospitalized for an unintentional poisoning (PHAC, 2011a), and there were 464 recorded deaths between the years 2000-2007 (Statistics Canada, 2010). While unintentional poisonings among younger children are more prevalent, there is a higher risk for fatality amongst children and youth aged 15-19 years (CDC, 2008; BC DPIC, 2010).

This report was written for the Injury and Child Maltreatment Section of the Health Surveillance and Epidemiology Division, Centre for Health Promotion, to make recommendations on improving the representativeness, completeness, and timeliness of the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP). CHIRPP is an injury surveillance system based in the emergency departments of 11 paediatric and four general hospitals (Herbert & Pless, 2010). Recommendations in these areas will increase the usefulness of CHIRPP for analysis and policy decisions to reduce unintentional poisonings among children and youth ages 0-19 years.

The main advantage of this system is that it captures circumstantial and contextual information surrounding an injury or poisoning event (Herbert & Pless, 2010). Its limitations are timeliness, representativeness, and completeness. A quantitative validation study revealed that there is a significant difference between poisonings captured as a percentage of all injuries from CHIRPP and from the National Ambulatory Care Reporting System (NACRS), a population-based health database for Ontario. For fiscal year 2007, however, the CHIRPP and NACRS comparatives for the Kingston region – CHIRPP's most direct and accurate comparison with NACRS – indicates no significant difference between the percentages of poisoning captured between the two databases.

A jurisdictional scan of national injury and/or poison surveillance systems in Canada, the United States, Europe, the United Kingdom, Wales, the Netherlands, and Australia was used to inform recommendations on how to improve the representativeness, completeness, and timeliness of CHIRPP. The resulting recommendations include: 1) increased collaboration and integration between multiple databases and relevant stakeholders of poison prevention across different agencies, organizations, and jurisdictions; 2) standardize data collection, coding processes, and data reporting between databases; 3) select a population that is representative of national hospital emergency-departments for the CHIRPP system using statistical sampling methods; 4) increase the timeliness of the CHIRPP system to "real-time" or "near real-time" surveillance; 5) include new data elements useful for analysis and poison prevention; 6) establish uniform and regular training among CHIRPP hospital staff and administrators, analysts, and data entry personnel; and 7) implementation of regular evaluations and assessments of CHIRPP.

INTRODUCTION

The objective of this report is to make recommendations that will make the Canadian Hospitals Reporting and Prevention Program (CHIRPP) more complete, representative, and timely; hence more useful for analysis and policy recommendations to reduce unintentional poisonings among children and teenagers ages 19 and under. CHIRPP is unique in that it captures contextual and circumstantial information that compliment population-based hospital and mortality, and ambulatory databases in Canada. Recommendations on how to improve CHIRPP in these areas will optimize uses of CHIRPP for the purposes of preventing and mitigating poison-related injuries within Canada.

This report was written for the Injury and Child Maltreatment Section of the Health Surveillance and Epidemiology Division, Centre for Health Promotion. Ages 0-19 is the scope for this report due to CHIRPP's paediatric focus and higher occurrences of poisoning-related fatalities amongst 15-19 year olds. This scope also provides a technical advantage in terms of ease of comparability and analysis with several other primary health databases in Canada, as they have the same age group categories.

BACKGROUND

Poisoning

Poisoning is defined by the World Health Organization and UNICEF (2008, p. 123) as: "[A]n *injury* that results from being exposed to an exogenous substance that causes cellular injury or death. Poisons can be inhaled, ingested, injected or absorbed."

The World Health Organization's International Classification of Diseases 10th edition (ICD-10) (WHO, 2007) defines accidental (or "unintentional") poisonings as: 1) accidental overdose of a drug; 2) wrong drug given or taken in error; 3) drug taken inadvertently; 4) accidents in the use of drugs, medicaments and biological substances in medical and surgical procedures; and 5) poisoning, when not specified whether accidental or with intent to harm. Noxious substances administered with suicidal or homicidal intent, or with the intent to harm are excluded (WHO, 2007). Classifications of noxious substances include: 1) accidental poisoning by and exposure to prescription and non-prescription medication, and biological substances (X40, X4, X43, and X44); 2) accidental poisoning by and exposure to narcotics and psychodysleptics (hallucinogens) (X42) 3) accidental poisoning by and exposure to alcohol (X45); 4) accidental poisoning by and exposure to organic solvents, halogenated hydrocarbons, gases, and vapours (X45, X46, and X47); 5) accidental poisoning by and exposure to pesticides, and other unspecified chemicals and noxious substances (X49) (WHO, 2007).

Unintentional poisonings are a serious public health concern in Canada and the economic burden of unintentional poisonings in 2004 was reported at $771 million; this figure includes both direct and indirect costs for all Canadians (SmartRisk, 2009). Unintentional poisonings among children and youths are common. Every year, approximately 1,600

young Canadians – ages 19 and under – are hospitalized for unintentional poisonings in Canada (PHAC, 2011a). There are 73 recorded deaths in Canada from unintentional poisonings among this age group in 2006 (Statistics Canada, 2010). Using census data for 2006 as a reference, an average of 0.0009% of young Canadians, ages 19 and under, died during that year (Statistic Canada, 2007). Research indicates that although unintentional poisonings are most prevalent among young children, unintentional poisonings among youths ages 15-19 years of age are five times more likely to be fatal (Borse, Gilchrist, Dellinger, Rudd, Ballesteros & Sleet, 2008; British Columbia Drug and Poison Information Centre, 2010).

The collection and analysis of poisoning data for the purposes of poison prevention and intervention initiatives is present in jurisdictions, such as the United States, Australia, and countries within the European Union (Waring et al., 2007). In Canada, poisoning data is being collected and analyzed by multiple agencies and organizations, including CHIRPP.

The Canadian Hospitals Injury Reporting and Prevention Program

"Public health surveillance is defined as the ongoing and systematic collection, analysis, and interpretation of health data to describe and monitor a health event for the purpose of planning, implementation and evaluation of public health prevention and intervention programs" (cited in Ballard & Calvert, 2001, p. 175).

In Canada, the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) is an injury surveillance system based in the emergency departments of 11 paediatric and four general hospitals (Herbert & Pless, 2010). Mackenzie and Pless (1999) reports that there are over 750 hospitals that provide emergency rooms services within Canada and that participating CHIRPP hospitals are a small sample of that. CHIRPP has a paediatric focus and information from this database is an important source of injury data for policy makers and injury prevention researchers within Canada (Public Health Agency of Canada, 2009, CHIRPP section).

Originally adapted from the Victoria's Injury Surveillance System in Victoria, Australia, CHIRPP first operated within all ten of Canada's paediatric hospitals in 1990 under Health Canada's Child Injury Division of the Laboratory Centre for Disease Control (Pless, 2008; Herbert & Machenzie, 2004; Mackenzie & Pless, 1999). The program is currently operating under the Public Health Agency of Canada's Injury and Child Maltreatment Section of the Health Surveillance and Epidemiology Division (Public Health Agency of Canada, 2009, CHIRPP Section). There are five participating CHIRPP hospitals within the province of Ontario, three in Quebec, two in Alberta, and one participating hospital each in Manitoba, British Columbia, Northwest Territories, Nova Scotia and Newfoundland (Public Health Agency of Canada, 2009, CHIRPP Section).

CHIRPP Processes

Each participating CHIRPP hospital has an on-site paid CHIRPP Coordinator and an on-site unpaid CHIRPP Director (Herbert & Mackenzie, 2004). CHIRPP Directors are typically hospital emergency physicians responsible for the overall administration of the CHIRPP program within each hospital (Herbert & Mackenzie, 2004). The main responsibility of CHIRPP Coordinators is to facilitate data collection on injuries – including poisonings – presenting to the hospital emergency department (Herbert & Mackenzie, 2004). Injured patients or their accompanying caregivers are asked to complete the first side of a one-page, double-sided CHIRPP questionnaire form (Herbert & Mackenzie, 2004). The physician and/or the CHIRPP Coordinator completes the second side of the form, detailing the nature of injury, injured body part(s), intent, and patient disposition (PHAC, n.d.a).

Each CHIRPP form (see example in Appendix A) captures demographic information such as date of birth, sex and postal code (Mackenzie & Pless, 1999). Circumstantial information for injuries captured by CHIRPP include, but are not limited to, time and place of injury (PHAC, n.d.a). Patient/caregiver narratives capture information on activities engaged at the time of injury, injury cause, and contributing factors. One of CHIRPP's advantages is that it allows the identification of product, sports and safety equipment-related injuries (Herbert & Pless, 2010; PHAC, n.d.a). Any information that is not completed by the patient or their accompanying guardian is extracted (where available) from the patients' medical records (Herbert & Mackenzie, 2004; Herbert & Pless, 2010). Completed CHIRPP forms are sent to the Injury and Child Maltreatment Section at the Public Health Agency of Canada on a monthly basis by mail, for data entry into the CHIRPP database (Herbert & Pless, 2010).

Currently there are approximately 2 million records within the system – for the years 1990-2009 – (Herbert & Pless, 2010) available for analysis and reporting. Analysts of the Injury and Child Maltreatment Section disseminate their analysis by means of briefs, reviews, reports, and responses to queries from other government departments, researchers, injury prevention centres and the media (Herbert & Pless, 2010).

Poisonings within CHIRPP

At present, there are 25,329 records for unintentional poisoning within the CHIRPP database for Canadians aged 0-19 years, between the years 1990-2008, or approximately 1.5% of all CHIRPP records for this age range and time-frame (PHAC, 2011b). Unintentional poisoning is defined by CHIRPP as unintentional self-harm by a noxious agent(s). A recent analysis of poisonings within CHIRPP broke down incidences of poisoning into the following categories:

- Medications (Rx and over-the-counter)
- Alcohol
- Chemicals

- Household cleaners
- Personal use products
- Fumes
- Illegal substances
- Plants
- Combinations of alcohol and illegal substances
- Cigarettes
- Multiple agent types
- Infant formula
- Kitchen ingredients
- Anaphylactic agents
- Rocks/dirt
- Toys
- Lead
- Caffeine/energy drinks (PHAC, 2011b)

Further detail on these substances is provided in Appendix B.

The following figures and table were compiled using information from the CHIRPP database (PHAC, 2011b). Data for the figures is in Appendix C.

Figure 1
Poison-related injuries; by agent and age group; CHIRPP; 0-9 years, 1990 – 2008

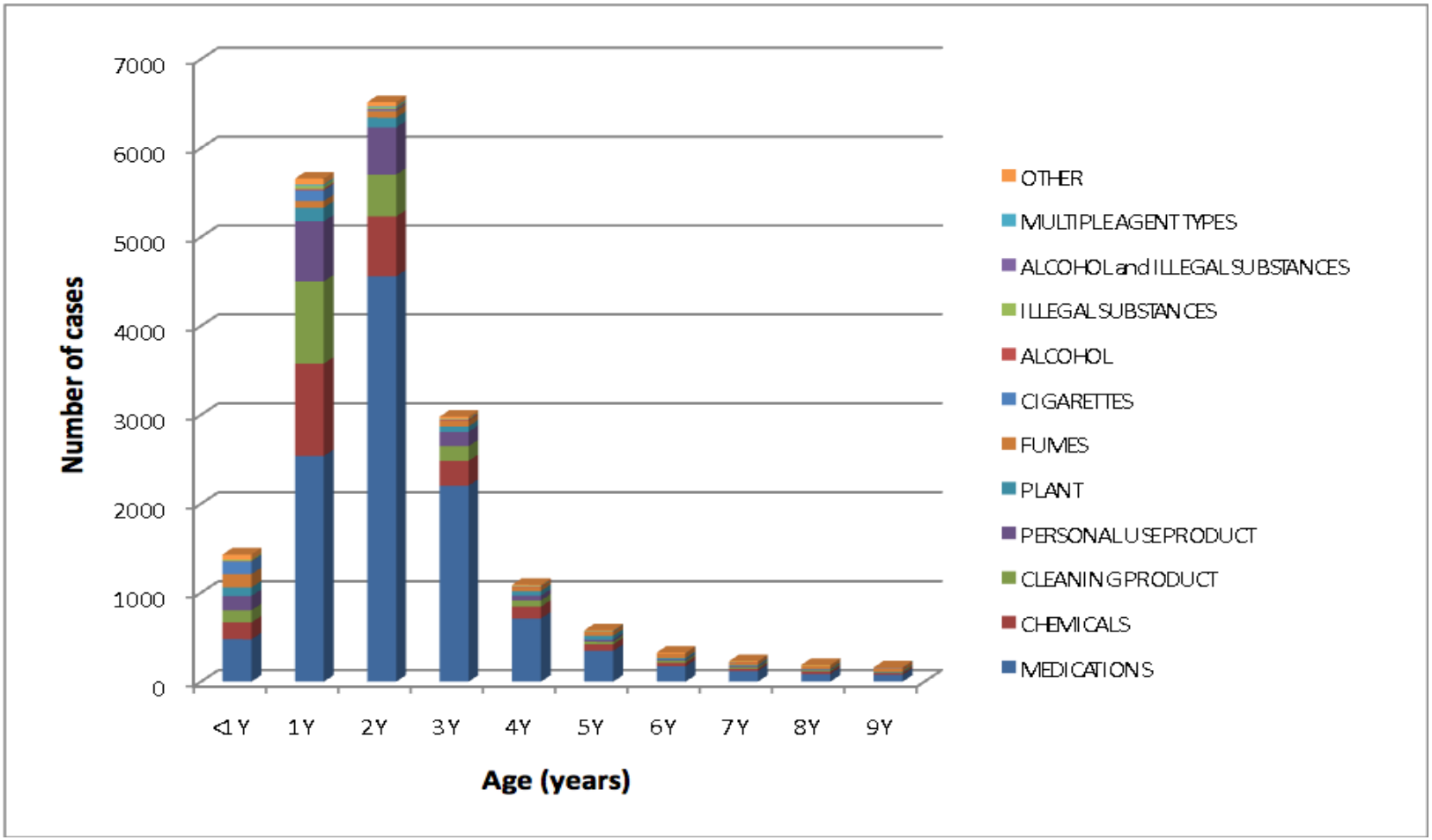

Figure 2
Poison-related injuries; by agent and age group; CHIRPP; 10-19 years, 1990 – 2008

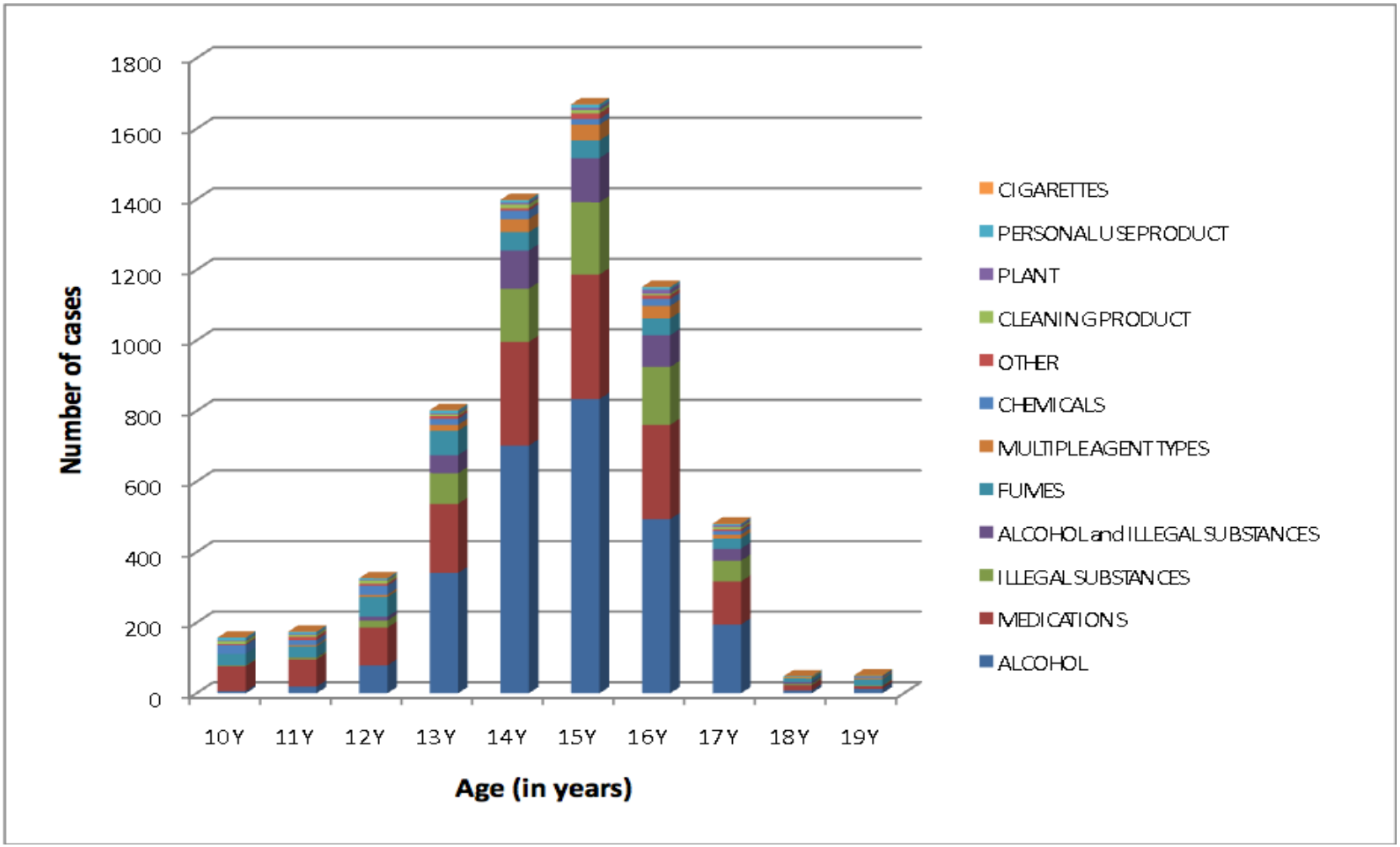

Figure 3
Poison-related injuries; by hospital disposition; CHIRPP; 0-19 years, 1990 – 2008

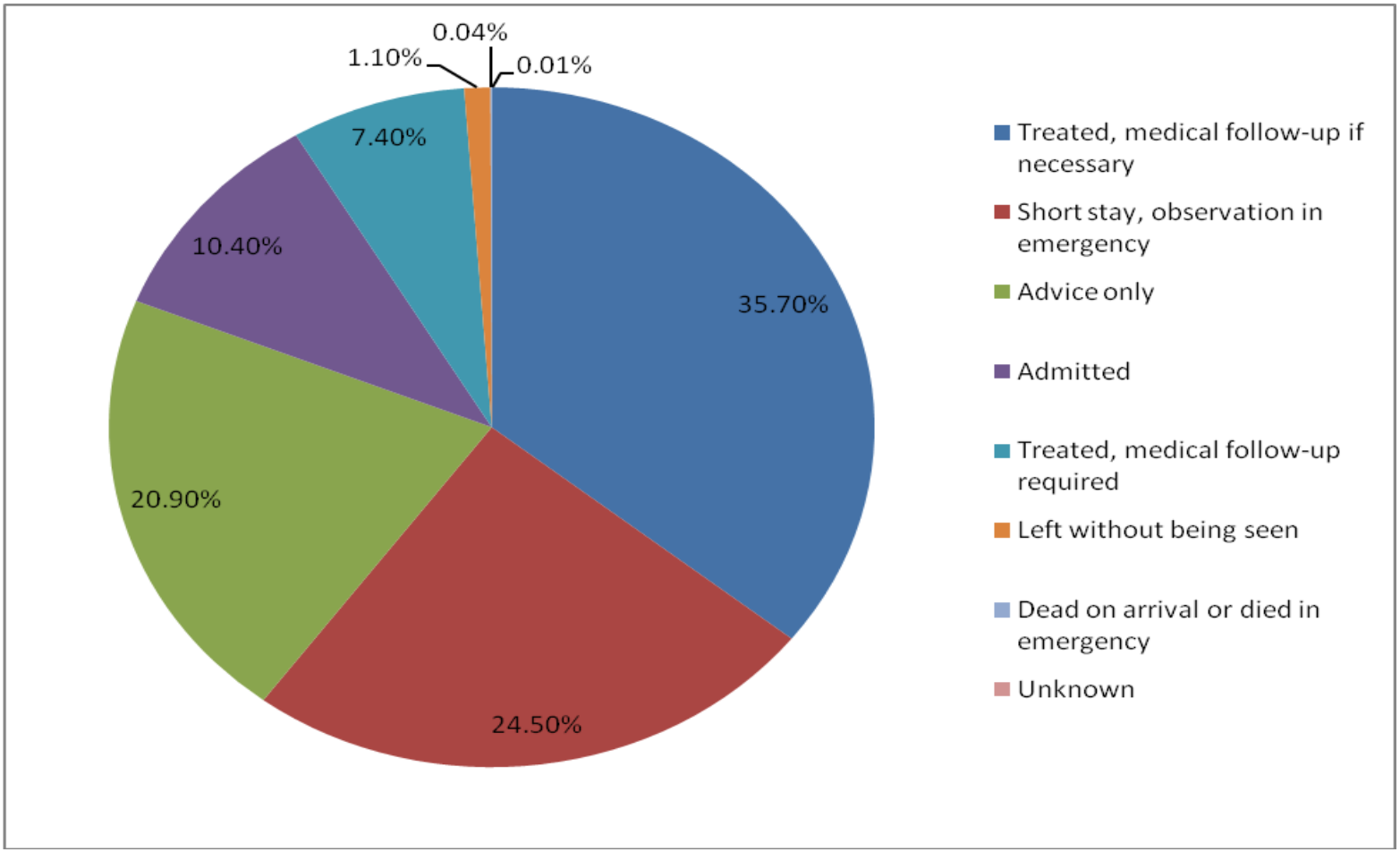

Table 1
Poison-related injuries; by poisoning agent and male-to-female ratio; CHIRPP; 0-19 years, 1990-2008

Poisoning agent	**M/F**
Medications	1.08
Alcohol	0.82
Chemicals	1.41
Household cleaners	1.44
Personal use products	1.15
Fumes	1.20
Illegal substances	1.04
Plants	1.08
Combinations of alcohol and illegal substances	0.91
Cigarettes	1.55
Multiple agent types	0.78
Unknown agent/missing data	1.40
Infant formula	0.79
Kitchen ingredients	1.73
Anaphylactic agents	3.00
Rocks/dirt	1.63
Toys	1.40
Lead objects	2.00
Coffee/energy drinks	1.00
Total	**1.11**

CHIRPP Features and Limitations

One of the advantages of CHIRPP is that the system complements population-based mortality and hospitalization data with circumstantial and contextual injury information (Herbert & Pless, 2010). Halperin and Horan (1998) explains that basic circumstantial information on injuries is necessary for injury prevention and evaluation.

An issue with CHIRPP is the need for increased timeliness and "real-time surveillance" so as to identify new injury trends as they appear. CHIRPP relies on retrospective analysis of poisoning data as a means for generating information to be used for intervention and preventative measures. At present, the timeliness of the CHIRPP surveillance system is of concern. The CHIRPP database indicates that data entries are backlogged by approximately 1.5 years (PHAC, n.d.b). This affects the government's ability to monitor, identify and respond to changes in injury trends. A redevelopment of CHIRPP is in process and is projected to increase the timeliness of data collection and entry through interactive phone systems, smart phone applications, web-based data upload processes, and data mining technologies.

One of CHIRPP's major drawbacks is that it is not population-based. There is no standard method for selecting CHIRPP hospitals and hospitals participate in the CHIRPP program on a voluntary basis.

Below is a table illustrating CHIRPP's representativeness:

Table 2
CHIRPP features and issues regarding representativeness

CHIRPP feature	**Issue regarding representativeness**
Large portion of paediatric hospitals	Under-representation of older children and teenagers, and patients receiving medical attention at their nearest hospital emergency department
Located in large urban cities	Under-represents rural and remote populations, as well as Aboriginal communities
Does not capture deaths that occur before arriving or after leaving the hospital	Under-represents fatal injuries
Five of 15 hospitals are located in Ontario	Over-represents the province of Ontario

It is also important to note that injuries seen at hospital emergency departments may not be similar to those seen at other health care facilities such as clinics and family physicians (Pickett, Brison & Mackenzie 2000). In the case of poisonings, many incidences of poisonings are not seen at hospital emergency departments, but rather, patients and/or their guardians acquire assistance from poison control centres. A study conducted by Macarthur and Pless (1999) reported that systematic data capture errors were present in poisonings, injuries admitted to the hospital, and injuries seen during evening or night shifts. Many injuries of this nature were missed by the CHIRPP system; for instance injuries admitted to the hospital were more likely to bypass the registration desk for direct admittance to the hospital (Macarthur & Pless, 1999), and evening and night injuries were more likely to be missed because CHIRPP coordinators are generally present during the day; also over-night clerks may be less aware of CHIRPP because training is routinely conducted during the day (Macarthur & Pless, 1999).

Poisonings had an increased likelihood – compared to other injuries – of being missed by the CHIRPP system because many hospital registration clerks failed to identify poisonings as an injury, even though poisonings is regarded as an injury type on the CHIRPP questionnaire form (Macarthur & Pless, 1999). CHIRPP's data capture errors for poisonings combined with under-representation due to reporting to poison control centres poses problems for national poisoning rate estimates. Although the CHIRPP program was

not intended to provide estimates for injury incidence rates among children and teenagers within the Canadian population (Pickett et al., 2000), it limits CHIRPP's ability to "determine priorities, identify populations at risk, and evaluate control programs for injuries…" (Macarthur & Pless, 1999, p. 216).

A final limitation that must be considered relates to an underestimation of injuries by the CHIRPP database. Residents seen at a hospital outside of their catchment area, for reasons such as travelling, will not be captured by the hospital in their catchment area.

METHODS

The research methodologies used for this report are jurisdictional scan and a quantitative validation study. A jurisdictional scan of national injury and/or poison surveillance systems in Canada, the United States, Europe, the United Kingdom, Wales, the Netherlands, and Australia was used to inform recommendations on how to improve the representativeness, completeness, and timeliness of CHIRPP.

A quantitative validation study was employed to compare poisonings as a percentage of all injuries captured by CHIRPP with the National Ambulatory Care Reporting System (NACRS), a population-based database for Ontario. The Z-test for two independent proportions is the statistical method used in this quantitative validation study.

JURISDICTIONAL SCAN

Canada

Health Canada piloted ProdTox, a web-based national surveillance system designed to integrate existing poisoning data from poison control centres in Canada (PHAC, 2005). ProdTox was scheduled to be implemented in 2002 but due to funding cuts, implementation efforts were ceased (PHAC, 2005). A national poison database has yet to materialize. National poison data is fragmented amongst poison control centres, CHIRPP, and various databases. Below is a high-level overview of organizations and databases that collect data for poison-related injuries.

The Canadian Association of Poison Control Centres

The Canadian Association of Poison Control Centres (CAPCC) was established in 1982 for the purposes of communicating and exchanging information among poison control centers in Canada (CAPCC, 2011). Some of the responsibilities of the CAPCC include, but are not limited to, reducing poisoning mortality and morbidity; representing Canadian poison control centres; promoting toxicology research; evaluating existing injury prevention programs; and establishing educational programs (CAPCC, 2011).

Below is a table of all poison control centres within Canada (CAPCC, 2011):

Table 3
Canadian poison control centres

CAPCC member	**Province**
BC Drug and Poison Information Centre	British Columbia
Centre anti-poison du Québec	Québec
Sykes Telehealth	New Brunswick
IWK Regional Poison Centre	Nova Scotia and Prince Edward Island
Manitoba Poison Control Centre	Manitoba
Ontario Poison Centre	Ontario
Poison and Drug Information Services	Alberta, Northwest Territories, and Saskatchewan
Non CAPCC member	
The Poison Information Centre - Janeway Child Health Centre	Newfoundland
Baffin Regional Hospital	Nunavut
Rankin Inlet (Kangiqliniq) Health Centre	Nunavut
Cambridge Bay (Ilaluktutiak) Health Centre	Nunavut
Emergency Department – Whitehorse General Hospital	Yukon Territory

Other CAPCC members include pharmacists, pharmaceutical companies, forensic toxicologists, public health staff, and emergency physicians (CAPCC website, 2011). Poison control centres serve all citizens of their respective provinces and territories, and they can be reached by a toll-free telephone number, with the exception of Newfoundland, Nunavut, and the Yukon Territory, where only local telephone numbers are provided (CAPCC, 2011). Poison control centres within Canada are funded by their respective provinces and territories, thus there is no standardized method of collecting and reporting information (CAPCC, 2011)

Discharge Abstract Database

The Canadian Institute for Health Information's (CIHI) Discharge Abstract Database (DAD) collects hospital discharge and day surgery information from all hospitals across Canada, except those in the province of Québec (CIHI, 2011a). The data collected includes demographical, clinical and administrative information, and this is used for analysis and reporting purposes (CIHI, 2011a). Regional, provincial and territorial hospitals across Canada use this data to inform their management decision-making processes; other uses of DAD support research purposes (CIHI, 2011a). The earliest data available to DAD is 1979. It is important to note that data from hospital emergency departments are not included in DAD.

Hospital Morbidity Database

The Hospital Morbidity Database (HMDB) is operated by CIHI and collects national demographic, clinical, and administrative information for hospital inpatient services (CIHI, 2011b). Data from psychiatric facilities, hospital emergency department visits, and day procedures are not included in HMDB (CIHI, 2011b). HMDB data is used for research, reporting, analysis, and to support management decision-making processes of hospitals (CIHI, 2011b). HMDB includes data from DAD, as well as data collected from non-DAD jurisdictions (CIHI, 2011b). The earliest available data from HMDB is 1994.

National Ambulatory Reporting Care System

The Canadian Institute for Health Information's National Ambulatory Care Reporting System (NACRS) collects data from hospital emergency departments, outpatient clinics, and day surgeries (CIHI, 2011c). Data from NACRS is used for analysis, reporting, and research purposes (CIHI, 2011c). Information from NACRS is also used to support management decision-making processes at health care facilities (CIHI, 2011c). In Ontario, data submission for hospital emergency department visits, day surgeries, dialysis, cardiac catheterization, and oncology are mandated (CIHI, 2011c). Data is also being submitted by some facilities in B.C., the Yukon Territories, P.E.I, Nova Scotia, Alberta, and Manitoba (CIHI, 2011c). The earliest available data from NACRS is 2001.

U.S.A

National Poison Data System

One of the primary functions poison control centers serve is to facilitate data collection and reporting (WHO & UNICEF, 2008; Zaloshnja, Miller, Jones, Litovitz, Steiner, C. & Sheppard, 2006; Wolkin, Patel, Watson, Belson, Rubin, Schier, J., . . . Litovitz, 2006). The National Poison Data System (NPDS), formally known as the Toxic Exposure Surveillance System (TESS) (Gussow, 2010), is a national poison surveillance database maintained by the American Association of Poison Control Centers (AAPCC) (Ballard & Calvert, 2001). NPDS was first piloted in 1983 and became fully operational in 1985 (Watson et al. 2005). NPDS has 60 poison control centers serving all 50 states United States and the District of Columbia, as well as American Samoa, Federated States of Micronesia, Guam, Puerto Rico, and the US Virgin Islands (Bronstein, Spyker, Cantilena, Green, Rumack, & Giffin, 2010). Of the 60 poison control centers, 57 have been accredited by the AAPCC as of July 1, 2009 (Bronstein et al., 2010).

Poison control centers are equipped with Certified Specialists in Poison Information (CSPIs) such as registered nurses and pharmacists, who provide telephone treatment and management advice to callers who have been exposed to poison(s) (Zaloshnja et al. 2006; Watson et al. 2005; Starr & Bronstein, 2008). Other staff members within each poison center include a Director of Operations, medical toxicologists, professional and public educators, and specialized consultants (Starr & Bronstein, 2008).

Toxicology specialists are required to pass a national clinical toxicology examination and are trained to collect data using the collection procedures and standards set by the AAPCC (Watson et al. 2005; Wolkin et al., 2006). This data includes information regarding the patient (i.e. gender, age, weight, and caller location); the substance or exposure; clinical effects (i.e. cardiovascular, dermal, gastrointestinal etc.); symptoms; recommended course of action; the reason for exposure; the time, date, and length of exposure; and the call type (Watson et al., 2005; Starr & Bronstein, 2008). Approximately 44% of all reported incidents are followed-up by a CSPI to collect information regarding the treatment taken and the final outcome (Wolkin et al., 2006).

The NPDS is a "near real-time" poison surveillance system as data is coded immediately during the management of a call (Bronstein et al., 2010; Simone & Spiller, 2010). New cases and updates to previous cases are continuously auto-uploaded to the national database every four to 10 minutes, and each upload period takes 19.9 minutes to complete (Wolkin et al., 2006; Bronstein et al., 2010; Watson et al., 2005). The NPDS has a web-based system that supports querying and reporting, amongst other uses, and is made accessible to individual poison control centers and other public health agencies (Bronstein et al., 2010). "Near real-time" surveillance allow these poison control centers and public health agencies to monitor any abnormal changes in poisoning trends, their location, and the demographics of its callers on a day-to-day basis (Simone & Spiller). This type of information is available at local, regional, and national levels (Bronstein et al., 2010).

NPDS data is generally consistent over time and seasonal variation by poisoning category is predictable (Watson et al., 2005). Watson et al. (2005) notes that exposures to substances such as household cleaners, plants, bites and stings, pesticides, cough and cold medications, and antipyretics are subject to seasonal fluctuations. As well, incidences of poisonings are lower on the weekends and holidays (Watson et al., 2005). Given the consistency and predictability of NPDS data, experts are able to determine a baseline to monitor case volume – "forty-two comparable hourly intervals occurring in a 14-day period around the date being evaluated during the previous 3 years" (Watson et al., 2005, p. 608). Poisoning incidences are "flagged" when the number of new incidences from a poison control centre exceeds the hourly baseline mean by a mean of three positive standard deviations (Watson et al., 2005). Identified abnormalities are auto-reported by email, including a summary data of all poison control centers within the past 24 hours (Watson et al., 2005). Any abnormal trends not yet flagged at other poison control centers are done so at this time (Watson et al., 2005). Data is analysed in this manner 12 times in each 24 hours (Watson et al., 2005). The NPDS has previously identified a surge in the volume of poisonings on February 1, 2003, when a space shuttle broke up over Texas and Louisiana, leaving debris within the surrounding areas (Watson et al., 2005). As well, in August 2003, NPDS identified a surge in poisonings related to contaminated water from an electrical blackout in the Northeast United States (Watson et al., 2005).

Another surveillance method employed by the NPDS involves monitoring the clinical effects of reported poisoning incidences (Watson et al., 2005). All 131 different clinical effects are analysed for their relation to the reported poisoning incidence and data is

analysed using the aforementioned baseline, except a mean of two positive standard deviations is used as the threshold level (Watson et al., 2005). An auto-reported email of observed and expected clinical effects is delivered should this threshold level be exceeded (Watson et al., 2005). On May 13, 2003, the NPDS identified 28 incidences of poisonings resulting from exposure to a biological weapon (Watson et al., 2005).

Clusters of poisonings can be identified by the NPDS by analysing the geographic distribution of poisonings. The AAPCC conducted a pilot study that involves the use of geographical information systems (GIS) to geographically map poisonings by type (i.e. pesticide exposures, fatal poisonings, substance abuse etc) and by region. This technology displays aggregated data for three different time intervals by either case counts or population-adjusted rates (Watson et al., 2005).

The following is a list of planned improvements for the NPDS, taken from the American Association of Control Centres' 2009 Annual Report (Bronstein et al., 2010):

- Enhancements to NPDS Real-time geographic information system (GIS) with more data display options for appropriate data analyses;
- Improvements in data quality edits;
- Security paradigm enhancements to support product specific product access for reports and surveillance;
- Aggregate enterprise report modifications to span multiple years or parts of years;
- Enterprise report enhancements;
- New auto-upload requirements and improved solution;
- Lexicon based analysis – the use of information technology as a method of word recognition, by means of "word-shapes" (Taboada , Brooke, Tofiloski, Voll, K. & Stede, 2011) – of the current generic code system to better meet current exposure tracking and surveillance needs.

One of the limitations of the NPDS is that poisonings are reported on a voluntary basis (Gryzlak, Wallace, Zimmerman & Nisly, 2007). Most callers seek the advice of poison control centers for diagnostic, treatment, and informational purposes (Watson et al., 2005). Thus, the records of poisonings collected by NPDS may result in underreporting of some types of poisonings, such as those resulting from substance abuse (Watson et al., 2005). It is also known that poisoning-related deaths are underreported to poison control centers (Gryzlak et al., 2005). This indicates that the NPDS's poisoning data may not reflect incidences of poisonings within the general population (Gryzlak et al., 2007). Studies based on independent local or regional data reveal that poisonings among lower income, ethnic, and population-dense groups are under-represented by poison control centres (Gryzlak et al., 2007). Caution must be used however, as regional or local data may not be indicative of poisoning data of the NPDS (Gryzlak et al., 2007). Further, NPDS does not collect demographic information such as ethnicity, income level, and educational level (Gryzlak et al., 2007) . These types of data would be useful for analysis of socio-economic factors that may affect patterns in poisonings. And finally, "case narratives" are not provided to NPDS; rather, they are retained by the individual poison control centers

(Watson et al., 2005). This inhibits the ability of public health agencies and poison control centers to analyse poisoning data using contextual information.

National Electronic Injury Surveillance System

The National Electronic Injury Surveillance System (NEISS) is a consumer product-related injury surveillance system operated by the U.S Consumer Product Safety Commission (CPSC) (CPSC, n.d.). This system is comprised of a stratified random sample of 100 hospitals with 24-hour emergency departments and a minimum of six beds, selected from more than 5300 hospitals within the United States (CPSC, n.d.). This random sample is stratified by hospital size, geographical location, and hospital type (general and paediatric hospitals) (Mendelsohn, 2005; McDonald, 2000). Hospital size is measured by the number of visits to the emergency department and they are divided into four strata (McDonald, 2000). A fifth stratum is designated for paediatric hospitals (McDonald, 2000). Hospitals are recruited by the CPSC and most hospitals agree to participate, as compensation is provided (McDonald, 2000). On the rare occasions, when a hospital declines, another hospital is selected from the same stratum and geographical location (McDonald, 2000). Hospitals remain in NEISS until a sample redesign reselects another stratified random sample (McDonald, 2000). Sample redesigns maintain the validity of injury estimates by accounting for changes in hospital size, new hospitals, and hospitals that are no longer in operation. Data collected from NEISS support processes related to product recall, educational awareness campaigns, and setting product safety standards (CPSC website, n.d.).

When a patient presents to the emergency department of a participating NEISS hospital with consumer-product related injuries, injury data is collected by an emergency department staff member (CPSC website, n.d.). The following information is collected from the patient: 1) age; 2) sex; 3) injury diagnoses; 4) body part injured; 5) discharge disposition (i.e. treated and released, hospitalized, transferred, or deceased); 6) consumer product(s) involved in the injury; 7) location of the injury; 8) work-relatedness; and 9) intent (Quinlan, Thompson, Annest, Peddicord, Ryan, Kessler & McDonald, 1999). Patient narratives are recorded to derive additional data such as the external cause (i.e. fall, cut/pierce, poisoning etc.) (Quinlan et al., 1999). At the end of each day, the NEISS coordinator "codes" the collected data, following the coding rules set by the NEISS coding manual into a personal computer provided by the CPSC (CPSC website, n.d.). The coding manual is guided by the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) (Quinlan et al., 1999). The entered data is edited by an interactive software – all fields must be completed and only acceptable entries are allowed (CPSC website, n.d.). Every morning, the CPSC office auto-collects the newly entered data from each hospital over telephone lines (CPSC website, n.d.). The data undergoes a second round of automated-editing and all acceptable entries are recorded into the permanent NEISS database (CPSC website, n.d.). Analysis begins the same morning – each record is reviewed and checked for quality control (CPSC website, n.d.). Analysts of the Directorate of Epidemiology screen for emerging injury hazards (CPSC website, n.d.).

National estimates for nonfatal injuries are obtained from NEISS by assigning a sample weight to each injury case (Davis et al., 1996). The national estimate can be calculated by summing these weights across all hospitals (Davis et al., 1996). This sample weight is based on the inverse of the probability of selecting a hospital within each stratum (Davis et al., 1996). Davis et al. (1996) assert that several factors affect the accuracy of national estimates. NEISS does not account for newly emerging hospitals between sampling resigns, nor does it account for annual fluctuations in the number of injuries presenting to emergency departments (Davis et al., 1996). This may significantly change a hospital's size (Davis et al., 1996). Additionally, the large concentration of hospitals in the Northeast and the limited number of large hospitals in the West may pose an accuracy issue for national estimates, despite the sampling method being statistically sound (Davis et al., 1996).

An evaluation of NEISS by Quinlan et al. (1999) reveals that it is a nationally representative surveillance system that is timely, sensitive, and adaptable. In terms of sensitivity, NEISS has a high ability of detecting emerging injury problems (Quinlan et al., 1999). Regarding adaptability, NEISS has the ability to adapt to expanding definitions for consumer products (Quinlan et al., 1999). The adaptability of NEISS is evident in the system's expansion to include all injuries - NEISS All Injury Program - and injuries related to adverse drug events -NEISS Cooperative Adverse Drug Event Surveillance.

National Electronic Injury Surveillance System – All Injury Program

In July 2000, NEISS was expanded to collect data from all injuries including poisonings, presented to the emergency departments of participating NEISS hospitals (CPSC, 2006). As of 2006, data for the NEISS All Injury Program (NEISS AIP) is being collected at a subsample of 66 hospitals from NEISS's current randomly stratified sample of 100 emergency-based hospitals (CPSC, 2006). This sample contains five strata, of which four are based on hospital size (i.e. very large, large, medium, and small) and one stratum designated for paediatric hospitals (Budnitz, Pollock, Weidenbach, Mendelsohn, Schroeder & Annest, 2006). Approximately 500,000 injury records are collected by NEISS AIPP annually, and again, participation in NEISS AIP is voluntary (Budnitz et al., 2006).

National Electronic Injury Surveillance System – Cooperative Adverse Drug Event Surveillance

The Cooperative Adverse Drug Event Surveillance (CADES) is a component of NEISS-AIP and collects injury data from patients presenting to a participating hospital emergency department related to drug-use or drug-specific adverse effects (Budnitz, Pollock, Weidenbach, Mendelsohn, Schroeder & Annest, 2005). This includes allergic reactions of medication, "undesirable pharmacologic effects at recommended doses" (Budnitz et al., 2006), unintentional overdoses, and secondary effects related to drugs such as falls, choking etc. (Budnitz et al., 2006). Injuries related to drug abuse, drug withdrawal, intentional self-harm, and drug therapeutic failures are excluded from NEISS-CADES (Budnitz et al., 2006). Drug therapeutic failures differ from adverse drug events in that expected drug effects do not occur following a treatment (Franceschi, Tuccori, Bocci,

Vannozzi, Paolo, Barbara, . . . Del Tacca, 2004). NEISS defines drugs as prescription medications, over-the-counter medications, vaccines, vitamins, herbal products and dietary supplements (Budnitz et al., 2005; Jhung, Budnitz, Mendelsohn, Weidenbach, Nelson & Pollock, 2007). Drugs such as alcohol, tobacco, illegal substances, and cosmetics are excluded from NEISS-CADES (Budnitz et al., 2005).

NEISS CADES operates out of 63 24-hour emergency-based hospitals with a minimum of six beds, selected from randomly stratified sample of emergency-based hospitals that fits the above criteria (Jhung et al., 2007). Again, this sample includes five strata -- four based on hospital size and one consisting of paediatric hospitals (Jhung et al., 2007).

Coders at each participating NEISS CADES hospital review clinical records to identify drug-related injuries and enter the records into a computer-based data entry system (Jhung et al., 2007). Patient characteristics (i.e. name, treatment, disposition, diagnoses etc.) hospital characteristics (i.e. region etc.), and drug characteristics (drug name, route of administration, dosage, frequency, and duration of use etc.) are recorded for up to two drugs (Jhung et al., 2007; Budnitz et al., 2005). Circumstantial and contextual information is recorded from the patient narrative (Jhung et al., 2007). All NEISS CADES records are electronically transmitted to CPSC for initial review (Jhung et al., 2007).

As with NEISS and NEISS AIP, there are several limitations to NEISS CADES (Budnitz et al., 2005). A study conducted by Budnitz et al, (2005a) reveals that adverse drug event-related injuries presenting to family physicians, clinics, urgent care centers, and other facilities will not be captured by the system. Some incidences may be directly admitted to a hospital, thereby bypassing documentation at the emergency department stage (Budnitz et al., 2005) . Additionally, identifying adverse drug events from clinical records may affect the system's ability to identify these cases without using expert opinion, thus, decreasing the system's sensitivity (Budnitz et al., 2005). However, Budnitz et al. (2006) cautions that this study was conducted in only nine hospitals and may not be representative of NEISS CADES itself.

Drug Abuse Warning Network

The Drug Abuse Warning Network (DAWN) is a national surveillance system that collects data involving drug-related visits to hospital emergency departments and drug-related deaths investigated by medical coroners and examiners (DAWN, n.d.). Initiated in 1988, Dawn collects information for the following drugs: 1) illegal drug abuse; 2) prescription and over-the-counter medications; 3) dietary supplements; 4) non pharmaceutical inhalants; alcohol in combination with other drugs for both children and adults; alcohol alone (<21 years of age) (DAWN, n.d.; Hughes et al., 2007). The types of cases collected by DAWN include drug abuse and misuse; suicide attempts; overmedication; adverse reactions; accidental ingestions; malicious poisoning; underage drinking; patients seeking detoxification or drug abuse treatment (DAWN, n.d.). DAWN collects patients data from hospital emergency department records, and medical examiner and coroner case files (DAWN, n.d.).

DAWN is a nationally representative sample. Participating DAWN hospitals are selected by scientific sampling based on size, location, and type (private versus public). There are hundreds of DAWN hospitals across the United States and only general hospitals with 24-hour emergency departments, short-term stays, and non-Federal facilities are asked to participate (DAWN, n.d.).

Patient data are submitted within one week to one month of the collection date using an internet-based entry system (DAWN, n.d.). This ensures DAWN's ability to serve as a "warning network" in near real-time. Data from medical coroners and examiners may take longer for submission as cases take longer to close (DAWN, n.d.).

Europe

The European Injury Database (IDB) is an injury surveillance system that collects accident and injury data from Member States under the European Home and Leisure Accident Surveillance System (EHLASS) (IDB, 2006). Data is collected by selected hospital emergency departments of individual Member States and thus, collection of data vary between countries (Meerding, Polinder, Lyons, Petridou, Toet, van Beeck & Mulder, 2010). There is no formal standardized sampling method used across the Member States – some systems are nationally representative and others are not (Meerding et al., 2010). Injury data from these databases are often difficult to compare and injury incidence rates are difficult to derive (Kisser, Latarjet, Bauer & Rogmans, 2009).

The Council of European Union recently recommended that an injury surveillance and reporting mechanism be developed in order to better coordinate injury surveillance efforts across Member States (Kisser et al., 2009). The Council also recommended that injury surveillance systems need to be representative and data must be comparable. Several other recommendations for improvement were recommended by Anamort – a project that analyses injury-related mortality within the European Union (Kisser et al., 2009). These recommendations are listed by Anamort as follows: 1) Standardisation of coding process and international comparison; 2) Electronic certification and coding system; 3) Timeliness of data provision; 4) Develop multidimensional classification in ICD11; and 5) Complementariness with ICD morbidity data (Kisser et al., 2009).

Another European Union funded project concludes that there is a need to establish a "one-stop information centre" that is made accessible to stakeholders and individual Member States (Kisser et al., 2009). This project will provide comparable information based on "harmonised" injury mortality and morbidity data (Kisser et al., 2009). Kisser et al. (2009) specifies that data from individual Member States need to be comprehensive and include specific injury information, such as the circumstance, the external case of the injury, consumer-products involved in the injury, and descriptive details of the place of injury. Implementation of these recommendations by individual Member States will result in a comprehensive IDB that will be beneficial for disseminating injury information, increasing public awareness, and developing injury prevention initiatives. No firm timeline has been

established for these recommendations or the Anamort recommendations (Kisser et al., 2009; Institut de Veille Sanitaire, n.d.).

United Kingdom

The United Kingdom's Home Accident Surveillance System (HASS) and the Leisure Accident Surveillance System (LASS) contributed to the European Injury Database as a Member State under EHLASS until 2002, when HASS/LASS operations ceased due to a lack of funding (DTI, 2003). HASS/LASS was initiated in 1978 to collect data on home and leisure injuries presented to hospitals in the UK (DTI, 2003). The two databases contain records for five million patients, detailing 30 different fields of data and over 1,500 consumer products (DTI, 2003).

Between 16 to 18 hospitals participate in HASS/LASS at any given time. These hospitals are representative of all home and leisure accidents presenting to the hospital within the UK. Participating hospitals are selected using the following sampling conditions: 1) geographic location; 2) urbanisation; 3) population size; and 3) size of the hospital accident and emergency units (DTI, 2003). These hospitals must provide 24-hour service, take ambulance cases, and attend to more than 10,000 accident and emergency cases per year (DTI, 2003).

HASS/LASS collects information concerning patient demographics (i.e. age and gender), details of the accident, circumstances surrounding the accident, the sustained injury or injuries, and any consumer products that may have been a contributing factor (DTI, 2003). Information on fatal accidents is occasionally captured by the system, but because few deaths occur during or after a visit to the accident and emergency department, these do not represent all injury-related fatal accidents (DTI, 2003).

Information is collected from patients by specially trained interviewers who are employed by the hospital (DTI, 2003). Interviewers conduct face-to-face interviews with injured patients during peak hours and supplement the interview with information collected from the patient's hospital medical records (DTI, 2003). If an interview with the patient could not be obtained, only information from their medical records are used (DTI, 2003). The collected data is entered into the computer and the system auto-validates the data (DTI, 2003). This data is transferred overnight via ISDN lines to a central collection system for further validation. It is then transferred to the central database at the Department of Trade and Industry (DTI, 2003). National estimates are calculated using 95% confidence intervals (DTI, 2003).

HASS/LASS data is currently being managed by the Royal Society for the Prevention of Accidents (RoSPA) and are available to the public (DTI, 2003). The HASS/LASS database can be searched for injury data for the years 2000 to 2002 (RoSPA, n.d.). Earlier data must be requested from the RoSPA information centre (RoSPA, n.d.). Data after 2002 is not available, due to HASS/LASS ceasing operations (RoSPA, n.d.)

A collaborative effort between RoSPA, Electrical Safety Council and Intertek is currently in works to assess the feasibility of building a new injury surveillance system within the UK (Project Update, June 2008). Some of the injury surveillance models being discussed involve using a representative sample of hospital emergency departments from each country in the British Isles (Project Update, June 2008). Data collected by these hospital emergency departments will be centralised at a main database and will contribute to the European Injury Database (Project Update, June 2008). Another model being discussed uses patient self-reported data and medical details provided by hospital emergency department staff (Project Update, June 2008). The use of touch-screen systems for patient self-reporting is currently being evaluated (Injury Causation Database, May 2010). Additionally, there are discussions of creating systems that allow receptionists of hospital emergency departments to collect preliminary injury information at the time of presentation (Injury Causation Database, May 2010). These evaluations and feasibility findings are scheduled to be presented by December 2010 (Injury Causation Database, May 2010).

Wales

The All Wales Injury Surveillance System (AWISS) was initiated in 1996, with funding by the Welsh Office (Lyons, Jones, Kemp, Sibert, Shepherd, Richmond, . . . Palmer, 2002). It was created to collect injury data resulting in fractures, burns and scalds, head injuries, and unintentional poisonings for children under five (Lyons et al., 2002). These injuries began collection from all 17 hospital accident and emergency departments within Wales (Lyons et al., 2002). The number of participating hospitals fluctuated by 1999 due to computerisation system changes (Lyons et al., 2002). This and patients seeking treatment from hospitals in England, affect the ability of AWISS to provide accurate national estimates (Lyons et al., 2002).

After an evaluation of AWISS by the National Assembly for Wales, it was decided that the system be expanded to collect data from all injuries (Lyons et al., 2002). Data fields collected include, but are not limited to patient demographics; hospital information; time and date of injury; time and date of arrival at the hospital; mode of arrival; location and place of injury; diagnoses; treatment; hospital disposition; and follow-up information (Lyons et al., 2002).

One of the limitations of AWISS is related to the variability of hospital computer systems and the amount of data collected by hospitals, particularly information related to location and activity (Lyons et al., 2002). Additionally, not every hospital provides patients with a free-text section on the questionnaire (Lyons et al., 2002). While it is possible to aggregate the data collected, variability limits the ability to compare data across hospitals. Hospitals have been encouraged to standardise information as much as possible, as complete standardisation is limited by computer systems, staff capacity, and a lack of additional funding (Lyons et al., 2002).

Data collected by AWISS is used in six major purposes, as listed by Lyon et al. (2002): 1) identifying areas with high injury rates; 2) identifying types of premises with high injury rates; 3) identification of the magnitude and risk factors for sports injuries; 4) evaluation of

a [road] speed reduction partnership; 5) international collaboration; and 6) development of a national injury prevention network. There are future plans to link AWISS with ambulatory data and inpatient records to increase the comprehensiveness of data collected (Lyons et al., 2002). There have also discussions of linking a unique patient identifier between datasets in order to track patient information between a variety of healthcare data systems (Lyons et al., 2002). Lyon et al. (2002) notes that this option would need to consider applying to the Patient Information Advisory Committee in order to allow the use of potentially identifiable information for public health research.

The Netherlands

The Consumer Safety Institute's Dutch Injury Surveillance System (LIS) is a member of the European Injury Database and collects information from patients presenting to a hospital emergency department with an injury or poisoning (LIS, 2009). Participating hospitals are selected as a random sample of general and university hospitals in the Netherlands (LIS, 2009). Currently there are 12 hospitals participating in LIS (LIS, 2009). Information collected by LIS is used to generate national estimates, trend analysis, and to identify high-risk groups and high-risk factors in order to establish injury prevention measures (LIS, 2009). Occasionally, follow-up studies on a sample of patients in LIS are conducted to provide additional analyses on certain high-risk groups (Consumer Safety Institute, 2004).

Patient information can be separated into two main categories – basic data and injury event information (LIS, 2009). Basic data includes personal and admissions information, details of the accident, diagnosis, treatment, and hospital disposition (LIS, 2009). Injury event information includes the cause and circumstances of the accident (LIS, 2009). Injury even information is divided into home and leisure, sports, traffic and occupational, violence, and self-mutilation (LIS, 2009).

There is no standard method for collecting injury data across LIS hospitals (LIS, 2009). Generally, the hospital receptionist completes an emergency form for hospital administration, including injury event data (Consumer Safety Institute, 2004). This data is sent electronically to the central database at the Consumer Safety Institute (Consumer Safety Institute, 2004). Identifiable information, such as patient name, is removed in order to conform to the Dutch Personal Data Protection Act (Consumer Safety Institute, 2004).

Data is validated through several means: 1) software checks; 2) qualitative checks; and 3) quantitative checks (Consumer Safety Institute, 2004; LIS, 2009). For software checks, invalid codes and impossible combination (i.e. tongue fracture) of codes generate an error message that needs to be corrected before further information can be entered (Consumer Safety Institute, 2004). Improbable combination of codes generates a warning message that prompts further examination (Consumer Safety Institute, 2004). Variables are automatically selected upon entering particular codes, in order to ensure that all relevant variables are entered (Consumer Safety Institute, 2004). Other variables can be automatically derived from existing ones, such as age derived from a patient's date of birth (Consumer Safety Institute, 2004). For qualitative checks, staff members at the Consumer

Safety Institute perform random checks on records that have been entered into the system and corrects any error that have been found (LIS, 2009). With regards to quantitative checks, reports are generated by the staff at the Consumer Safety Institute to check for any discrepancies that may be present (i.e. discrepancies in the number of records entered (LIS, 2009). Other measures to ensure quality data are taken by the Consumer Safety Institute, such as introductory training; an internal help-desk to assist with data entry questions; information bulletin containing data entry tips, LIS newsletter reporting on injury trends and statistical analyses; annual evaluation interviews with the hospitals; a refresher day for information exchange; and studies to assess the reliability, validity, and representativeness of LIS (LIS, 2009).

For future developments, LIS is investigating how to establish formal linkages with other databases and how to increase the automation of processes within hospital emergency departments (LIS, 2009). The Consumer Safety Institute is working towards establishing LIS as an adaptable system that can effectively respond to the changing environments of injury prevention. Finally, the Consumer Safety Institute is assessing opportunities to improve the quality and efficiency of LIS, and how to better integrate LIS with daily hospital administrative operations (Consumer Safety Institute, 2004).

Australia

The National Injury Surveillance Unit (NISU) in Australia began operations in 1986 and has gone through significant changes. The first generation of injury surveillance used data from mortality and morbidity statistics (Harrison & Tyson, 1993). While these datasets are representative, simple, and low cost for injury surveillance, because of the data elements available and their classification, it is difficult to identify important types of injury cases and injury information was limited (Harrison & Tyson, 1993; Harrison, n.d.). There were also significant delays in terms of data availability (Harrison & Tyson, 1993).

The second generation of injury surveillance, the National Injury Surveillance and Prevention Project (NISPP), developed and piloted the Injury Surveillance Information System (ISIS) in 1995 (Australian Institute of Health and Welfare, 2011). Adopted from CHIRPP, ISIS was first developed to focus on child injuries but was later expanded to include all injuries of all ages (Harrison & Tyson, 1993). It has since gone three revisions (Australian Institute of Health and Welfare, 2011). A questionnaire is given to the injured person presenting at the hospital emergency department (Harrison & Tyson, 1993). Information on injury circumstance, injured body part, intention, hospital disposition, time of injury, place of injury, consumer products and/or safety equipment involved in the injury, and whether the injury occurred on the job are collected from the patient (Harrison & Tyson, 1993). The US Consumer Product Safety Commission codes, ICD-9 codes, the Australian Bureau of Statistics, and the Swedish Work Injury and Disease Surveillance System inform ISIS data classifications (Harrison & Tyson, 1993). Data from completed questionnaires are entered into a database maintained by regional injury surveillance groups (Harrison & Tyson, 1993).

There are several limitations to ISIS. No formal random sampling method is used at the national level and there is an over-representation of rural hospitals in ISIS (Harrison & Tyson, 1993). Additionally, there is variability in the definition of an 'injury' – some cases of trauma or poisoning may not be captured by the system, thereby introducing bias to the system (Harrison & Tyson, 1993).

In 1993, planned future directions for the national injury surveillance included developing a reduced dataset, the Basic Routine Injury Surveillance (BRIS) – a comprehensive and representative dataset (Harrison & Tyson, 1993). This system was anticipated to be included in existing data systems within hospital emergency departments, and perhaps coroner data systems, trauma registers, hospital in-patient data systems, and other systems that may collect information on injuries (Harrison & Tyson, 1993). National standards for injury information were to be developed in order to increase comparability between different data sources, including ISIS (Harrison & Tyson, 1993). Potential data elements to be collected included hospital identifier, sex, date of birth, date of attendance, area of residence, outcome, country of birth, Aboriginal status, employment status, occupation, and preferred language (Harrison & Tyson, 1993). Optional data elements included injury severity, blood alcohol level, place of injury, seating position in a vehicle, context, and mechanism of injury (Harrison & Tyson, 1993). Thus far, these improvements have not been implemented (Australian Institute of Health and Welfare, 2011).

Currently, formal links between NISU are being developed with other injury prevention efforts in other sectors and agencies, such as those for consumer product safety, intentional injury, sport and recreation (Harrison & Tyson, 1993). Formal links have already been established with the road safety sector (Harrison & Tyson, 1993). These links will assist NISU, and other sectors and agencies to increase effective injury prevention efforts in a variety of areas.

ANALYSIS

Linking Databases

In 1963, Alexander Lanmuir claimed that, "good surveillance does not necessarily ensure the making of the right decisions, but it reduces the chances of wrong ones" (Lanmuir, 1963, p.191). All surveillance systems have limitations and will "seldom be truly comprehensive or representative" (Stone, Morrison & Ohn, 1998, p. 110). Fielden & Marsh (2007) conclude that using information from multiple databases can provide a more complete picture of the potential for a drug overdose outbreak. Increasing the comparability between databases through linking data systems and standardizing data collection has a number of advantages. William et al. (1994) claim that individual datasets, such as hospital data sets and trauma register data, have limited utility in terms of injury surveillance because the information pertains to a subset of the injured population. Information from data sources such as ambulance, healthcare workers, general practitioners, and poison control centers can help to reduce information gaps (Fielden &

Marsh, 2007), understand injury risk factors and outcomes (Horan & Mallonee, 2003) associated with poisonings, and aid the analysis of poisoning events in Canada.

Examples of linking databases were found in the jurisdictional scan for the European Union, the United Kingdom, Wales, the Netherlands, and Australia. The Anamort project and the Council of European Union recommend that coordination of injury surveillance efforts between Member States should be strengthened so that comparison of injury data across different databases can be achieved (Kisser et al., 2009). Standardizing the coding process and complementing ICD morbidity data can increase uniformity between injury databases and improve the ease of comparison (Kisser et al., 2009). RoSPA, the Electrical Safety Council, and Intertek are discussing ways of centralizing injury data from hospital emergency departments among countries of the British Isles at a main database system, as a means of contributing to the European Injury Database (Project Update, June 2008). The All Wales Injury Surveillance System acknowledges the variability of hospital computer systems and the data collected as a limitation for comparing data across hospitals, and it has been recommended that data standardisation be encouraged as much as possible (Lyons et al., 2002). One of the future developments of the Consumer Safety Institute's Dutch Injury Surveillance System is to establish formal linkages with other databases (LIS, 2009). Finally, future directions for injury surveillance in Australia include integrating injury surveillance in existing data systems within databases such as the coroner data systems, trauma registers, hospital in-patient data systems, as well as other systems that collect information on injuries (Harrison & Tyson, 1993). National standards will be developed to increase the comparability between different data sources (Harrison & Tyson, 1993). Formal linkages are currently being developed between different injury prevention sectors and agencies in Australia, and have already been established with the road safety sector (Harrison & Tyson, 1993).

The California Pesticide Illness Surveillance Program can be used as another example. Comparable data elements from fatality, hospitalization, and poison control records were abstracted and linked electronically using a computer assisted process. For ease of comparison and linkage, databases should be standardized according to widely-used data standards such as the International Classification of Diseases (Mehler, Schenker, Romano & Samuels 2006; Harrison, n.d.).

Physician claims databases are another source of information that may be advantageous for analyzing poisoning incidences within Canada. These data sources provide information from almost all physicians within healthcare systems with fee-for-services reimbursement systems - which is the case in Quebec and many other parts in Canada (Kostylova, Swaine & Feldman, 2005). The agency responsible for administering health insurance within Quebec collect information such as physician's identification number, patient's provincial health insurance number, data and location of visit, the type of consultation, services provided, the cost of the service, and the patient diagnoses – coded using ICD-9-CM (Kostylova et al., 2005). Kostylova et al. (2005) note that physician claims databases provide several advantages and they are: 1) large samples of geographically dispersed patients; 2) longitudinal studies; 3) convenience; and 4) defined sampling frames.

Information from different databases can be linked using a unique personal health identification number (Cameron et al., 2007). The Manitoba Centre for Health Policy contains nearly 100 databases, some dating back to 1970 (Finalyson, 2011). These databases are linked using the patient's Personal Health Identifier Number (Finalyson, 2011). All personal identifiers are removed and the Personal Health Identifier Number is scrambled to ensure that patient privacy is protected (Finalyson, 2011). In order to address privacy concerns across jurisdictions, shared data should be accessible by appropriate authorities for public health purposes only (Pavline, Mostashari, Kortepeter, Hynes, Chotani, Mikol, . . . Kelley, 2003) and aggregated data should be used for analysis.

Data Sampling

Statistical sampling is used to select a population subset that is representation of the population for the purposes of making statistical inferences (Upton & Cook, 2008). Although a representative sample of emergency department-based hospitals may not reflect all poisoning incidences within a country, it will enable the collection of data that accurately reflects poisoning incidences within a country's emergency department-based hospitals.

Obtaining poisoning data that is representative of all poisoning incidents within a country would require a random sample of all health care facilities where poisoning incidences are seen or reported. This sample may be statistically stratified based on size, type of health care facility, and location. This is ambitious and costly; it will also require the cooperation of all participants, from personnel(s) responsible for the management and collection of poisoning information at each individual collection site, to data entry clerks, research analysts, and administrators of the central database. This strategy is contingent on health care facilities agreeing to participate should they be statistically selected. In the case a health care facility declines participation, another health care facility would have to be statistically selected as a replacement. Another method of obtaining statistically representative data is to administer population-based surveys; however, this may be counterintuitive for health surveillance, as poisoning information will not likely be collected as they occur.

Examples of random sampling were found in the jurisdictional scan for the United States, the United Kingdom, the Netherlands, and Wales. In the United States, stratified random sampling is utilize for NIESS, NEISS AIP, and NEISS Cades, where hospital emergency departments are selected randomly based on hospital size, geographical location, and hospital type (CPSC, n.d.; Mendelsohn, 2005; McDonald, 2000; United States Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Injury Prevention and Control & United States Consumer Product Safety Commission, 2009; Budnitz et al., 2006; Jhung et al., 2007). For the Drug Abuse Warning Network, the nationally representative sample of hospitals are selected by scientific sampling based on size, location, and hospital type (DAWN website, n.d.). In the UK, participating hospitals of HASS/LASS were sampled based on geographic location, urbanization, population size, and size of the hospital accident and emergency units (DTI,

2003). Hospitals of the Consumer Safety Institute's Dutch Injury Surveillance System are selected as a random sample of general and university hospitals in the Netherlands (LIS, 2009), and for the All Wales Injury Surveillance System, injury data is collected from all 17 hospital accident and emergency departments within the country (Lyons et al., 2002).

Real-Time Surveillance

Waring et al. (2006) assert that early detection of subtle changes at the population level by means of surveillance ensures timely public health intervention. Because of advancements in information technology, data collection and trend identification can approach "near real-time surveillance". Examples of "near real-time", "real-time", or timely surveillance were found in the jurisdictional scan for the United States, the United Kingdom, and the Netherlands. The United States' National Poison Data System is a "near real-time" poison surveillance system (Bronstein et al., 2010; Simone & Spiller, 2010). Data is coded immediately during each individual call to the poison control centres and cases are auto-uploaded to the national database every four to 10 minutes; individual uploads typically take 19.9 minutes for completion (Bronstein et al., 2010; Simone & Spiller, 2010; Wolkin et al., 2006; Watson et al., 2005). Abnormalities in poisoning trends are also detected using a comparable baseline, calculated using data from the previous three years (Watson et al., 2005). The National Electronic Injury Surveillance System auto-collects newly entered information from hospitals on a daily basis (CPSC website, n.d.). Data is auto-edited using an interactive software and analysis begins the same morning that data is collected (CPSC website, n.d.; Quinlan et al., 1999). The Drug Abuse Warning Network is a "near real-time" surveillance system; patient data are submitted using an internet-based entry system within one week to one month of the collection date (DAWN, n.d.).

In the United Kingdom, the Home Accident Surveillance System and the Leisure Accident Surveillance System receives data overnight via ISDN lines after the collected information has been entered into the computer and auto-validated at each individual collection site (DTI, 2003). In the Netherlands, the Dutch Injury Surveillance System is research methods of increasing the automation of data collection processes within hospital emergency departments (LIS, 2009).

Data Elements

Poisoning information collected should be relevant and useful for intervention and policy-making purposes. Poison control centres in Gryzlak et al.'s (2007) study of herbal dietary supplement exposures were classified as having minor, moderate, or major adverse effects. Including a data element such as adverse effects will be useful for analysis and poison prevention, particularly if prevention efforts were focused on poison incidences of high frequency and having major adverse effects.

Another useful data element relates to defining the severity of a poisoning incident. A number of methods for scoring injury severity have been proposed, including length of

hospitalization and the nature of the injury (Alexandrescu, O'Brien & Lecky, 2009). The Abbreviated Injury Scale is an anatomically-based injury description system that assigns a severity score from 1 to 6 for over 1200 serious injuries (Alexandrescu et al., 2009). The Injury Severity Score provides an overall injury severity score for patients with multiple injuries by summing the squares of the highest Abbreviated Injury Scale scores in three body areas. The New Injury Severity Score is also used to measure the severity of multiple injuries and is measured based on the three most severe injury sustained, regardless of body part (Alexandrescu et al., 2009). The Paediatric Trauma Score was developed for children and is calculated using: 1) weight; 2) blood pressure; 3) ability to maintain airway; 4) level of consciousness; 5) and the presence of a fracture and/or wound (Alexandrescu et al., 2009). Because poisoning is a systemic injury, the utility of some of the abovementioned methods of measuring severity may be low. As an alternative, analyzing the adverse effects of a poisoning incidence with the level of toxicity of the poisoning agent, amongst other information such as length of hospitalization, may provide an indication of the severity of poisoning.

Alexandrescu et al. (2009) assert that defining the severity of an injury is an epidemiological challenge. Although the usage of data elements to classify injury severity was not present in the jurisdictional scan, trauma registries within the United Kingdom employ the Abbreviated Injury Scale to classify injury severity (Alexandrescu et al., 2009). Examples of adverse effects as a potential data element are found in the National Poison Data System and the National Electronic Injury Surveillance System – Cooperative Adverse Drug Event Surveillance within the United States (Gryzlak et al., 2007).

Training

The Dutch Injury Surveillance System is a good example of optimizing training to reduce bias and systematic data capture errors (LIS, 2009). Uniformity of training is imperative to achieving data that is accurate and representative of the target population. Hospital staff responsible for collecting data need to be adequately trained to recognize cases of poisonings and identify them as injuries. In order to decrease bias and systematic data capture errors, both daytime and overnight hospital staff responsible for collecting data need to receive the same level of training with regards to administrating a poisoning surveillance program. Hospital staff need to be kept motivated and training sessions need to be conducted on a regular basis. It is also important that data collection duties are integrated within the daily work routine of hospital staff as a core responsibility. At head office, analysts and data entry personnel should clarify any ambiguous codes, terms, and definitions in order to increase inter-rater reliability. Consensus with regards to coding should be maintained to ensure accurate and quality data.

Summary

Below is a table summarizing the jurisdictional scan:

Table 4
Summary of jurisdictional scan

	Representative	Near real-time surveillance	Data elements	Training	Linking databases
Canada					
CAPCC					
DAD	√ (Québec excluded)				
HBD	√				
NACRS	√ (Ontario only)				
U.S.A					
NPDS		√	√ (adverse effects)		
NEISS	√ (data sampling)	√			
NEISS – AIP	√ (data sampling)	√			
NEISS – CADES	√ (data sampling)	√	√ (adverse effects)		
DAWN	√ (data sampling)	√			
Europe					
IDB					√
HASS/LASS	√ (data sampling)	√			
AWISS	√				
LIS	√ (data sampling)			√	
Australia					
NISU					

QUANTITATIVE STUDY

Purpose

The primary purpose of this study is to compare the rate of capture for poisonings using two databases, CHIRPP and NACRS, for Canada, Ontario, and Kingston. The Z-test for two independent proportions will be employed to assess how the rate of capture for CHIRPP compares to NACRS, a population-based database for Ontario.

Methods

Records for all injuries were extracted from the CHIRPP database for Ontario, and Kingston for the fiscal years 2007 and 2008; this time period runs from April 1st 2007 to March 31st 2009. Within this extraction, poisoning records were identified for Ontario and Kingston if the nature of injury was poisoning (code 50), the mechanism of injury was ingested, inhaled, multiple routes, and chemical (code 41, 42, 44, and 49), the intent was unintentional (code 10), and age groups were for patients 19 years and under. A semi-automated process was used to clean the poisoning dataset.

As mentioned before, NACRS collects data from hospital emergency departments, outpatient clinics, and day surgeries. In Ontario, data submission for hospital emergency department visits, day surgeries, dialysis, cardiac catheterization, and oncology are mandated; thus, NACRS provides a population-based database to which CHIRPP can compare injuries seen in emergency departments. Kingston was chosen as a comparative for analysis because it is the only region in Canada that has complete community coverage in CHIRPP; thus, it is population-based. The NACRS database was searched for all injuries for Ontario and Kingston, for the fiscal years 2007 and 2008; like CHIRPP, this time period runs from April 1st 2007 to March 31st 2009. Because individual hospital codes within NACRS are encrypted, records for the Kingston region were searched using resident postal codes' Forward Sortation Area (FSA) codes (first three elements). The CHIRPP dataset was subsequently narrowed down using Kingston's FSA codes to provide a direct comparison with the Kingston FSA records in NACRS. As this comparison is more accurate, Kingston FSAs are subsequently used for the Kingston comparison.

Poisoning records within NACRS were identified if the accident codes were related to 'accidental poisoning by and exposure to noxious substances' (ICD-10 codes X40-X49). These records, like CHIRPP, exclude the administration of noxious substances "with suicidal or homicidal intent, or intent to harm", and includes accidental poisoning by and exposure to substances including narcotics, hallucinogens, and alcohol (WHO, 2004). Records for all injuries and poisonings within NACRS were further narrowed to include patients 19 years of age and under.

Poisonings as a percentage of all injuries for Ontario and Kingston FSAs in CHIRPP were calculated and compared to poisonings as a percentage of all injuries for Ontario and Kingston FSAs in NACRS. The Z-test for two independent proportions was employed to compare the percentages from CHIRPP with the percentages from NACRS, as converted from their proportions. Figures for the number of records for all injuries and the number of records for poisonings for Ontario and Kingston FSAs are also provided as a comparative.

Results

Tables 1 and 2 show the results of the quantitative study. As expected, NACRS captures far more injuries and poisonings for Ontario than CHIRPP does; overall numbers are more comparable for Kingston, although NACRS still captures more cases.

The null hypothesis for the Z-tests is that poisonings (as a percentage of total injuries) are captured at the same rates by CHIRPP and NACRS. The p-value shows the 95% probability (α=0.05) that the null hypothesis is not rejected (i.e. rates of capture are the same). The null hypothesis is rejected for Ontario in both years and for Kingston in 2008. (Statistically significant results are bolded in the tables.)

Table 5
Ontario Quantitative Study Results

	All Injuries	**Poisonings**	**Poisonings as a % of Injuries**	**Z test on CHIRPP vs NACRS %**	**p-value CHIRPP & NACRS %s Same**
2007					
CHIRPP	26,756	304	1.14%	**-5.27**	**p<.001**
NACRS	368,562	5,692	1.54%		
2008					
CHIRPP	28,058	351	1.25%	**-5.52**	**p<.001**
NACRS	368,158	6,212	1.69%		

(PHAC, 2011a)

Table 6
Kingston Quantitative Study Results

	All Injuries	**Poisonings**	**Poisonings as a % of Injuries**	**Z test on CHIRPP vs NACRS %**	**p-value CHIRPP & NACRS %s Same**
2007					
CHIRPP	3,400	22	0.65%	0.1	0.92
NACRS	4,612	29	0.63%		
2008					
CHIRPP	3,430	31	0.90%	**-2.16**	**0.03**
NACRS	4,970	71	1.43%		

(PHAC, 2011a)

Discussion

Systematic data capture errors for poisonings mentioned by Macarthur and Pless (1999) may have contributed to underestimations of poisoning cases by CHIRPP. Hospital registration clerks may fail to recognize poisonings as an injury (Macarthur & Pless, 1999). Likewise, and direct admittances and overnight injuries are more likely to be missed by the CHIRPP system (Macarthur & Pless, 1999). Furthermore, it is important to note that CHIRPP records for Ontario represented five major emergency departments, whereas the NACRS database represents every emergency department-based hospital. Differences in the rate of capture across different regions within Ontario may have contributed to CHIRPP's underestimation of poisoning cases. Another issue that must be considered relates to inter-rater reliability; CHIRPP coders may have different interpretations of what constitutes a poisoning and thus, an incorrect code may be assigned to a poisoning record and vice versa.

CONCLUSION AND RECOMMENDATIONS

The purpose of this report was to provide a broad overview of injury and toxic-surveillance systems across jurisdictions in order to develop recommendations that may be used by the Division and its stakeholders to enhance the usefulness of the CHIRPP system. A quantitative study was conducted to examine the representativeness of CHIRPP within Ontario. The results of the quantitative study revealed significant differences between the percentages of poisonings captured (of all injuries) between NACRS and CHIRPP. Further studies comparing the percentages of poisonings captured in CHIRPP and NACRS by the classification of exogenous substances using the International Classification of Diseases standards is recommended; this will provide insight as to what types of poisoning incidences are being captured by the two databases.

Recommendations have been grouped into short-term (1-2 years), medium-term (2-3 years), and long-term (3 years or more).

Short-term recommendation:

1. Establish a working group between multiple databases (i.e. poison control centres, CHIRPP, hospital and morbidity, ambulatory, physician claims databases, and other independent injury and poison research agencies) and relevant stakeholders of poison prevention across different agencies, organizations, and jurisdictions, in order to assess the feasibility of increased collaboration, integration, and data standardization.

Because of the inability of many surveillance systems to be truly representative and comprehensive, individual surveillance systems and databases may be linked to provide a more comprehensive analysis of poisoning incidences in Canada. A national poison working group should be established amongst all relevant stakeholders in order to assess the feasibility of formally linking fragmented poisoning information from individual

databases and standardizing their data collection, coding, data reporting processes. This will increase the comparability of databases for ease of analysis and reporting. Adopting widely-used data standards such as the International Classification of Diseases can aid in this process. These stakeholders should include, but are not limited to, the following key players: CHIRPP; poison control centres; CIHI's Discharge Abstract Database, Hospital Morbidity Database, and National Ambulatory Care Reporting System; and independent injury and poison research agencies.

The success of this recommendation is dependent on the cooperation and collaboration of relevant stakeholders. In order to spearhead this initiative, leadership from the Division is needed to initiate a joint discussion concerning the costs, benefits, and feasibility of implementing linked databases and data standardization.

Medium-term recommendations:

2. Include new data elements useful for analysis and poison prevention

CHIRPP will benefit from new data elements that will be useful for analysis and poison prevention, such as adverse effects and levels of toxicity as an indication of poisoning severity. Adverse effects may be classified as minor, moderate, or major; poisoning severity may be determined from length of hospitalization and toxicity of poisoning agent. These new data elements may be incorporated in the CHIRPP form and collection of these data elements may begin immediately. These data elements should be reassessed as new noxious substances are introduced into the market, in order to ensure long-term comparability.

3. Increase the timeliness of the CHIRPP system to "real-time" or "near real-time" surveillance

A redevelopment of CHIRPP is in process to increase the timeliness of data collection and entry processes. Further improvements can be made with the adoption of advanced information technology (i.e. auto-editing, auto-upload of data, and auto-trend detection). The Division should work with information technologists and software engineers, either in-house or on a contractual basis, to implement these advanced information technologies and to establish a comparable baseline of poison data for the detection of abnormalities in poisoning trends. This initiative may be implemented in a three-part process: 1) adoption of auto-editing and auto-upload of data technologies; 2) establish a comparable baseline of poison data; and 3) adoption of auto-trend detection technologies.

4. Implementation of regular evaluations and assessments of CHIRPP

Employing evaluations and assessments of CHIRPP informally every year and formally every five years is needed to assess whether CHIRPP is meeting its long and short-term objectives and outcomes. Additionally, this provides the opportunity to assess the validity

and reliability of CHIRPP data. Evaluations may be conducted informally in-house and formally by a third-party expert evaluation team.

Long-term recommendations:

5. Establish uniform and regular training among CHIRPP hospital staff and administrators, analysts, and data entry personnel

Regular training is needed to decrease bias and systematic data capture errors, and to ensure CHIRPP data is accurate and representative of the target population. Workshops, question and answer sessions, and periodic reviews of CHIRPP protocol should be implemented on a bi-annual basis to clarify and document ambiguous codes, terms and definitions, and to establish consensus with regards to coding, amongst analysts and data entry personnel. Likewise, workshops, question and answer sessions, and periodic reviews of data collection protocols at CHIRPP hospitals should be implemented on an annual basis to ensure uniformity of data collection processes.

6. Select a population that is representative of national hospital emergency-departments for the CHIRPP system using statistical sampling methods

This recommendation will enable CHIRPP to collect poisoning data that accurately reflects poisoning incidences within the country's emergency department-based hospitals. A sample size should be determined and a sampling methodology should be selected to produce a sample population that accurately represents hospital emergency-departments within Canada. Stratified-random sampling is recommended; hospital emergency-departments may be stratified according to size, hospital type, and location. This recommendation is contingent on the cooperation of the selected hospital emergency-departments, and the feasibility of this system is dependent on the financial, human resource and cooperative capacity of the Division and its stakeholders. Should resources be available, the Division should formulate a plan of action to engage hospital emergency departments across the nation in this initiative.

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APPENDIX A – Example of a CHIRPP Form

Front page

Winnipeg Children's Hospital

C.H.I.R.P.P. Injury/Poisonings Reporting Form

* **Complete only at first visit for this injury**
* **Please give as much detail as possible**
* **Please print clearly**

1 A. When did the injury happen?

_____/_____/_____

Day (17) Month (May) Year 2007)

1 B. What time of day did it happen?

(time)

a.m. p.m.

2. Where did the injury happen? Outdoors Indoors Circle one of A, B or C below for more detail.

A. In a home or yard: Own home (example: bedroom, backyard, deck etc.)

Other person's home

B. On the road (example: bus stop, alley, bike path, sidewalk etc.)

C. Other place (example: school classroom or gym, campground, office etc.)

3. Was the injured person working for pay? Yes No

4. What was the injured person doing when the injury happened? Circle one of A, B, or C and provide further details as requested.

A. Participating in a sport? (example: hockey/tennis) or physical activity - (example: inline skating, hiking etc.)

What sport or activity?

Did this activity or sport include coaches, instructors or officials? Yes No

B. In or on a motorized vehicle: Circle vehicle type: Car Truck Van Motorcycle ATV Snowmobile

Where was the patient riding? (example: driver or passenger seat ,in truck bed, or pulled behind vehicle) _____

C. Other (example: playing,dancing,hobbies,video games etc.)

5. Please tell us how the injury happened.

A. What went wrong? (example: chased by dog and lost control of bike and fell/knocked over coffee mug/swallowed a magnet etc.)

B. What actually caused the injury? (example: hit head on concrete/grass/rocks OR hot coffee/soup burned arm etc.)

6.Was any safety equipment in use when the injury occurred?

Yes (check all that apply)

Helmet	Hard Hat	Seat Belt	Mouthguard
Sports Padding	Protective boots, gloves or clothing	Inflated Air Bag	Baby gate
Life Jacket	Protective eye wear or face mask	Infant Car Seat/Child Booster Seat	

Other Safety Equipment (example: floormats, post covers)

No

Unknown

SOMETIMES WE NEED TO CONTACT PATIENTS (OR THEIR GUARDIANS) FOR MORE INFORMATION ABOUT AN INJURY.

May we contact you if we need additional information?

Yes, you may contact me if needed

No, I do not wish to be contacted

Back page

PHYSICIAN'S INJURY SUMMARY

Complete only for first attendance for this injury.
Please check that the front of the form is complete.

Front of Form Completed by: Patient / Coordinator / Both

ER VISIT DATE:
DD _____ Month_____ Year_____

1 NATURE OF INJURY

Select up to 3 codes

Most severe 1._____
Second 2._____
Third 3._____

10 Superficial (e.g. bruise,abrasion)
11 Open wound/laceration
12 Fracture
13 Dislocation
14 Sprain or strain
15 Injury to nerve
16 Injury to blood vessel
17 Injury to muscle or tendon
18 Crushing injury
19 Traumatic amputation
20 Burn or corrosion
21 Frostbite
22 Bite (with or without invenomation)
23 Electrical injury
24 Eye injury
25 Dental injury — use body part 135
26 Injury to internal organ
27 Soft tissue injury

31 Foreign body in external eye
32 Foreign body in ear canal — use body part 135
33 Foreign body in nose
34 Foreign body in respiratory tract
35 Foreign body in alimentary tract
36 Foreign body in genito-urinary tract
37 Foreign body in soft tissue

41 Minor head injury
42 Concussion — use body part 135
43 Intracranial injury

50 Poisoning or toxic effect
51 Drowning or immersion
52 Asphyxia or other threat to breathing — use body part 900
53 Systemic over-exertion; heat/cold stress

60 Multiple injuries of more than one nature
70 No injury detected
75 Pulled elbow

N.B. For multiple system trauma (serious injuries of more than 3 types and body parts) use 60 + 700

Is substance use by the patient or other person suspected as a factor in this injury?
Unknown
No Yes If Yes: Alcohol
Other (specify) _____

2 BODY PART(S)

Write the body part code for each of the injuries in NATURE OF INJURY at left.

Select up to 3 codes

Most severe 1._____
Second 2._____
Third 3._____

Head and Neck

110 Scalp, skull,head
120 Face (including ear)
130 Internal mouth
135 Specified head injury (specified by nature of injury)
140 Neck EXCL spine/spinal cord/disc/nerves/vertebrae
141 Injury to internal organs/structure of neck (tracheo esophagus)

Spine and Spinal Cord (INCL IV discs and spinal nerves)

210 Cervical
220 Thoracic
230 Lumbar
240 Sacrum and coccyx
250 Spine, nfs

Trunk

310 Thorax (INCL lungs,heart)
315 Upper back EXCL scapula
321 Abdomen (INCL all abdominal organs)
322 Lower back
323 Pelvis and pelvic contents (bladder,internal genetalia)
324 Perineum and anogenital area
325 Groin
330 Back, nfs

Shoulder and Arm

410 Shoulder
415 Clavicle
420 Upper arm
430 Elbow
440 Forearm
450 Wrist
460 Hand
470 Finger

Hip and Leg

510 Hip
520 Thigh
530 Knee
540 Lower Leg
550 Ankle
560 Foot
570 Toe

900 Body part NOT REQUIRED
700 Multiple injuries of more than one body part (e.g. systemic injury, no injury detected)

3 INTENT

Select one code

4 PATIENT DISPOSITION

Select one code

1 Left without being seen by physician
2 Advice only, Diagnostic testing, Referred to family doctor (no treatment in ED)
3 Treated in ED with follow-up PRN
4 Observation in ED with follow-up PRN
5 Observation in ED with follow-up Required
6 Treated in ED, follow-up required, Referred to other hospital or specialist clinic for injury treatment
7 Admitted to this or another hospital primarily for treatment of injury
8 Admitted primarily for reason other than injury treatment
9 DOA or died in ED

5 EVENT ID

1 _____

2 _____

APPENDIX B - Classifications of Noxious Substances in CHIRPP

Alcohol	beverages containing alcohol
Anaphylactic agents	substances inducing an anaphylactic reaction
Caffeine/energy drinks	caffeine-related products and/or energy drinks
Chemicals	chemicals and pesticides, not pertaining to household cleaners or personal use products
Cigarettes	ingestion of tobacco cigarettes
Combinations of alcohol and illegal substances	a combination of beverages containing alcohol and substances subjugated to drug prohibition laws in Canada
Fumes	gases, vapour, or smoke
Household cleaners	household cleaning products
Illegal substances	substances subjugated to drug prohibition laws in Canada
Infant formula	ingestion of concentrated infant formula
Kitchen ingredients	kitchen ingredients, including baking powder and baking soda
Lead	substances containing lead
Medications	prescription and non-prescription medications
Multiple agent types	combinations of two or more different classifications of noxious substances, excludes the classification "Combinations of alcohol and illegal substances"
Personal use products	personal use products, including skincare products, hygiene products, hair products, fragrances and cologne, and topical medications applied to the skin
Plants	organisms belonging to the Kingdom Plantae
Rocks/dirt	pesticides and chemicals found in rocks/dirt
Toys	playdough and liquids found in children's toys

APPENDIX C – Data Tables for Figures

Poison-related injuries; by agent and age group; CHIRPP; 0-19 years, 1990 – 2008

Poison	Age Group (years)						Total	Total %
	< 1	1	2-4	5-9	10-14	15-19		
Medications	469	2513	7,421	794	718	703	**12,618**	**49.8**
Alcohol	3	18	29	10	1,141	1,535	**2,736**	**10.8**
Chemicals	188	1,041	1,087	182	108	51	**2,657**	**10.5**
Household cleaners	138	930	707	94	39	23	**1,931**	**7.6**
Personal use products	165	679	757	54	33	23	**1,711**	**6.8**
Fumes	151	75	180	196	240	155	**997**	**3.9**
Illegal substances	16	36	22	4	273	474	**825**	**3.3**
Plants	96	153	223	96	14	23	**605**	**2.4**
Combinations of alcohol and illegal substances	0	0	1	0	173	255	**429**	**1.7**
Cigarettes	142	118	13	2	3	3	**281**	**1.1**
Multiple agent types	0	16	20	9	67	102	**214**	**0.8**
Other	59	67	94	39	34	32	**325**	**1.3**
Total	**1,427**	**5,646**	**10,554**	**1,480**	**2,843**	**3,379**	**25,329**	
Total %	**5.6**	**22.3**	**41.7**	**5.9**	**11.2**	**13.4**		**100.0**

Poison-related injuries; Poisoning by disposition; CHIRPP; 0-19 years; 1990 – 2008

Disposition	# of cases	% of cases
Treated, medical follow-up if necessary	**9,040**	**35.7**
Short stay, observation in emergency	**6,196**	**24.5**
Advice only	**5,288**	**20.9**
Admitted	**2,640**	**10.4**
Treated, medical follow-up required	**1,882**	**7.4**
Left without being seen	**272**	**1.1**
Dead on arrival or died in emergency	**9**	**0.04**
Unknown	**2**	**0.01**
Total	**25,329**	**100.0**