Measuring Injury Matters

Injury Indicators for Children and Youth in Canada – Vol. 1

Child & Youth Health RESEARCH NETWORK

Canadian Injury Indicators Development Team : Children & Youth

CIHR IRSC
Canadian Institutes of Health Research
Instituts de recherche en santé du Canada

MEASURING INJURY MATTERS

Injury Indicators for Children and Youth in Canada – Vol. 1

The Canadian Injury Indicators Development Team: Children and Youth is a multidisciplinary team funded by CIHR. The team's work takes the first steps in addressing gaps in injury surveillance through the development of a set of national injury indicators for Canadian children and youth which reflect and monitor identified prevention priorities.

ISBN: 978-1-55058-416-5

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SUGGESTED CITATION:

Pike, I. *et al.* (2010). *Measuring Injury Matters: Injury Indicators for Children and Youth in Canada*. Vancouver, BC: UBC.

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ACKNOWLEDGEMENTS

Firstly, we would like to acknowledge the Canadian Institutes of Health Research (CIHR) and the BC Child and Youth Health Research Network (CYHRNet) for providing funds to conduct and support this study. We are very grateful for their support.

The development of injury indicators for children and youth was conducted by a team of qualified and experienced researchers and practitioners from across Canada. Team members were selected with a view to building future capacity by matching experienced researchers with newer investigators in a collaborative mentorship model. This model worked well, and we are especially grateful to Drs. Ronald Barr, Colin Macarthur and Parminder Raina for their guidance during the project. As well, Ms. Allyson Hewitt was instrumental in ensuring that indicators related to policy were included in this project. All members of the team contributed to a supportive network that resulted in a truly successful collaboration.

We were fortunate to have Ms. Joanne Vincenten and Ms. Morag MacKay, European Child Safety Alliance, as international consultants to the project. As well, Dr. Rod McClure of Monash University, Melbourne, Australia provided continual support throughout the project and enlightened us with a comprehensive overview of indicators as our keynote speaker in Alliston, Ontario. His expertise was an invaluable asset to our panel of 35 policy makers, advocates and practitioners as they determined our initial list of indicators.

Above all, we would like to recognize those 35 individuals who gave of their time, expertise and recommendations on Injury Indicators Day. Without their help, the team would not have been able to conduct this research. Many of those individuals went further to assist the project during the two stages of the modified Delphi process that followed. We are most grateful.

We wish also to acknowledge the Canadian Collaborative Centres for Injury Prevention and Control (CCCIPC), ThinkFirst Canada, Safe Communities Canada, Safe Kids Canada, SMARTRISK Foundation and Injury Prevention across the Life Span (IPALS) for engaging their memberships in the completion of the injury indicators survey.

Finally, the investigators owe a debt of gratitude to Ms. Shannon Piedt, Project Co-ordinator, for her continuing excellent work in ensuring the timely progress of the project, to Ms. Kate Turcotte for her clear thinking and writing that was instrumental in garnering needed resources, and to Ms. Alison Lynch whose skills in writing and editing allowed for this document. Thank you.

List of Injury Indicators

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Abbreviations

AFN	Assembly of First Nations
CCCIPC	Canadian Collaborative Centres for Injury Prevention and Control
CCYHC	Canadian Child & Youth Health Coalition
CDS	Comprehensive Data Set
CHILD	Child Health Indicators of Life and Development (Project)
CIHI	Canadian Institute for Health Information
CIHR	Canadian Institutes of Health Research
CSA	Canadian Standards Association
CYHRNet	BC Child and Youth Health Research Network
DAD	Discharge Abstract Database
FNIHB	First Nations and Inuit Health Branch, Health Canada
ICD-9	International Statistical Classification of Diseases and Health Related Problems 9th Revision
ICD-10-CA	International Statistical Classification of Diseases and Health Related Problems 10th Revision – Canadian Enhancement
ICE	International Collaborative Effort (on Injury Statistics)
IPALS	Injury Prevention Across the Life Span
ITK	Inuit Tapiriit Kanatami
NHPA	National Health Priority Area (Australia)
NTR	National Trauma Registry
OECD	Organization for Economic Co-operation and Development
PHAC	Public Health Agency of Canada
PTC	Pediatric Trauma Centre
RHS	First Nations Regional Longitudinal Health Survey
STAIR	Strategic Teams in Applied Injury Research
STIPDA	State and Territorial Injury Prevention Directors Association

EXECUTIVE SUMMARY

In Canada, injury is the leading cause of death and a major cause of hospitalization for children and youth, aged one to 19. It kills an average of 290 children ages 14 and under, and hospitalizes an estimated 21,000 each year. Every year, approximately one in every 300 Canadian children, age 14 and under, is hospitalized for a serious injury (Public Health Agency of Canada, 2009). Indeed, of all childhood conditions, injury accounts for the greatest number of days of hospital care and the highest proportion of discharges to either long-term care facilities or home health care (Rosenberg, Rodriguez & Chorba., 1990).

The economic burden of injury is also enormous. The direct and indirect costs of injury to Canadians of all ages were estimated at $19.7 billion in 2004. This represents the third highest source of direct health care costs to Canadians (SMARTRISK, 2009).

It was a welcome gesture, then, when in 2004 the Canadian Child & Youth Health Coalition (CCYHC), formerly the National Child and Youth Health Coalition, set out *injury prevention/ trauma* as one of four theme areas to establish Canadian Infant, Child and Youth Health Indicators. Their goal was "*to identify existing indicators and develop new indicators that will be used to monitor and evaluate the health of, and the health services provided to, infants, children, youth and their families.*" The aim was "*to improve services and, thereby, the health and well-being of infants, children, youth and their families*" (National Child and Youth Health Coalition, 2004).

In developing the initiative, CCYHC showed a clear understanding of how the development and validation of indicators enables progress to be assessed:

> *"The current lack of indicators and standards makes it difficult, if not impossible, to determine the current status of health and health care of Canadian infants, children, youth and their families, conduct comparative analyses to assess performance and establish benchmarks for the optimal level of health service delivery."*
> (National Child and Youth Health Coalition, 2004)

PURPOSE

The project outlined in this report flowed from CCYHC's indicators initiative. The purpose of this research project was to develop a set of injury indicators for monitoring and evaluating the health of (and health services provided to) children, youth and their families in relation to injury and injury prevention (primary, secondary and tertiary) in Canada.

METHOD

A multi-phase research design, following the methods described by Lindsay *et al.* (2002), was used to develop a comprehensive set of indicators that meet evidence-based criteria, are useful and will prompt action. The stages of this modified Delphi process included soliciting expert opinion, conducting an extensive literature review, assembling an expert panel meeting and administering an online survey.

The Canadian Injury Indicators Development Team brought together injury researchers, policymakers and practitioners to develop a list of indicators in the areas of:

- Overall Health Services Implications
- Motor Vehicle Injury
- Sports, Recreation and Leisure Injury
- Violence
- Trauma Care, Quality and Outcomes

Each indicator was rated by 132 Canadian and International injury experts and stakeholders on its ***usefulness*** and ***actionability*** (ability to prompt action) to reduce injury among Canadian children and youth.

RESULTS

From an initial list of 51 indicators, a refined set of 34 indicators was established. Indicators were grouped into three categories: Policy Indicators, Risk Indicators and Outcome Indicators.

Indicators related to motor vehicle injury were rated as most useful and most able to prompt action. Injury mortality rate and injury hospitalization rate were also ranked highly in both usefulness and ability to prompt action. Policy, violence, sport & recreation, and trauma indicators were all rated higher for usefulness, but somewhat lower for ability to prompt action.

Bangdiwala *et al*. (1985) provide an explanation of why national injury indicators for motor vehicle occupants are important: "The ultimate utility of any indicator or summary statistic is in providing a clearer picture of the nature and extent of the road accident problem in a country in order to facilitate the planning of appropriate countermeasures."

Sim and Mackie (2002) also provide a reason for defining accurate indicators:

> *"Public health systems across the world are being encouraged … to show evidence of health gain. Defining accurate indicators has become a major area of work for academics and professionals. … Getting such indicators right is essential since the effectiveness of [national and] local healthcare systems may be judged using such indicators. Perhaps more importantly, financial resources may flow—or be withheld—on the basis of such indicators."*

CONCLUSION

This project, using a systematic approach to define injury indicators, is a step forward in the understanding and prevention of injury among Canadian children and youth. The modified Delphi process was effective in establishing a set of indicators that will be helpful in furthering important aspects of injury prevention among Canadian children and youth.

The results of this study suggest that the use of the modified Delphi method was successful in generating a set of 34 useful and actionable child and youth injury indicators in Canada. Further research will demonstrate the utility of the indicators in furthering injury prevention research, policy and practice.

How to Use this Report

Icons Used in This Report

LEARN MORE: This icon is used to point to additional sources of information online.

NOTE: This icon provides further explanation of a term used in the document. These terms will appear in **green** *in the main text.*

Measuring Injury Matters is intended to be a practical resource for injury prevention professionals and practitioners, policymakers and non-governmental organizations with an interest or mandate in injury prevention programming.

It aims to promote a common set of child and youth injury indicators to be used across Canada. This allows comparisons to be easily made between all communities, regions or jurisdictions in Canada. It also encourages systematic injury surveillance and monitoring, allowing community practitioners, in particular, to think about the data and information they gather in their communities, effectively monitor the injury prevention systems in place and develop local initiatives based on what they learn. The indicators can then be used to monitor the effectiveness of these newly-established initiatives.

Measuring Injury Matters – Vol. 1

This document is divided into five sections:

1. **Introduction** – Covers the basics, broadly defining indicators and why they matter, and introduces the reader to the team who developed this set of injury indicators.
2. **Situation Analysis** – Explains the 'state of the nation' with regard to injury and injury indicators, detailing the burden of injury to children and youth in Canada, the need for injury indicators, what other countries have done to address the need, what Canada's approach has been and what data sources are available.
3. **Methods** – Describes the process used to define this set of injury indicators.
4. **Results –** Outlines the 34 injury indicators resulting from the process and their ratings for usefulness and ability to prompt action.
5. **Discussion and Future Directions –** Provides a glance into the future of injury prevention in Canada, including the next steps for the Canadian Injury Indicators Team.

Measuring Injury Matters – Vol. 2

The second volume of Measuring Injury Matters can be found on the mini-disc attached to the cover of this report. This volume

contains the report's **Indicator Specification Tables**, which clearly define and specify all 34 injury indicators. The goal is that these tables will enable injury prevention professionals and practitioners, policymakers and non-governmental organizations with an interest or mandate in injury prevention programming to understand the indicators and apply them in a consistent manner.

Volume 2 also includes special *Indicators in Action* sections. These sections showcase real-life examples from Canada that demonstrate how indicators have been used to support the implementation of injury prevention policies and practices.

CONCLUSION

In short, this document allows you to take in as much or as little detail as you wish. If you're completely new to the idea of using indicators, begin with the Introduction section. If you're only interested in the indicators themselves, skip straight to Volume 2.

1. Introduction

It is difficult to fix what you do not fully understand. Such is the present state of injury prevention in Canada. Gaps in data collection, analysis and reporting make it difficult to accurately assess the impact of injury in the lives of Canadian children and youth. Consequently, it is difficult to implement programs and policies that could reduce the incidence and impact of such injuries.

The Canadian Injury Indicators Development Team's work is a step forward in addressing these gaps by developing a set of national injury indicators for Canadian children and youth which reflect and monitor identified prevention priorities.

Measuring Injury Matters fully defines and specifies the 34 developed indicators, enabling practitioners to begin clearly documenting, analyzing and reporting on injury data. The ultimate payoff will be a clear understanding of the burden of injury for the country's children and youth, and an indication of where to devote resources to injury prevention.

What is an indicator?

Indicators are extremely important forms of measurement that can be used for understanding how a system works, for monitoring how a system is performing and for accountability (Pencheon, 2008).

> *"**Indicators** are succinct measures that aim to **describe** as much about a system as possible in as few points as possible. Indicators help us **understand** a system, **compare** it and **improve** it."*
>
> *Pencheon, 2008*

Take, for example, the gauges on a car's dashboard. These feedback mechanisms give information about the car's speed, fuel tank or engine temperature, allowing drivers to closely monitor the measurements and quickly and easily view any changes. The gauges also prompt action. A gas gauge teetering toward empty, for example, should prompt a stop at the pumps. A speedometer needle approaching 70km/h in a 50 km/h zone should prompt a foot to come down on the brake pedal.

Over time, the indicators also build a picture of the automobile's overall health. A temperature gauge that's running hotter than previously might indicate a problem with the car's radiator. A gas tank that begins emptying faster than normal might suggest a fuel leak or perhaps an overdue tune-up.

Injury indicators work much in the same way. In the short term, they help us answer questions like 'how much,' 'how many' and 'to what extent' for different injury-related matters within a community.

In the long term, established indicators can be tracked to create a picture of how injury data within a community change over time and to compare this picture with pictures in other

communities. Injury indicators help us determine the burden of injury in our community and whether or not existing programs and policies are working to improve this situation.

THE TEAM

The Canadian Injury Indicators Development Team, a multidisciplinary group of researchers and practitioners from five provinces, was formed in 2006 with funding from the BC Child and Youth Health Research Network (CYHRNet) and the Canadian Institutes of Health Research (CIHR) to ***develop a set of national injury indicators for Canadian children and youth*** which reflect and monitor identified prevention priorities.

The team also aimed to:

1) Establish national and international linkages to inform the indicator domains of:
    - Overall Health Services Implications
    - Motor Vehicle Injury
    - Sport, Recreation and Leisure Injury
    - Violence
    - Trauma Care, Quality and Outcomes
2) Build research capacity by mentoring junior researchers; involving a new investigator; involving research trainees; involving injury prevention community agencies and practitioners in aspects of indicator development and validation; and involving seasoned researchers, new to injury research, from other related disciplines.

The team was formed to reflect the knowledge and experience of its members and to create a productive and supportive network for successful collaboration. Team members were selected based on experience in child and youth injury research and practice, related relevant research, as well as an indication on the part of each member that they were able to fully commit the time necessary to successfully complete this project. Further, every effort was made to ensure that the specific qualifications/expertise/experience of each member combined to meet the multidisciplinary requirements of the project. Finally, team members were selected with a view to building future capacity by matching experienced researchers with newer investigators in a collaborative mentorship model. For a full list of team members and affiliations, see Appendix A.

2. Situation Analysis

OECD *stands for Organization for Economic Co-Operation and Development. Established in 1961, this organization has a membership of 30 countries and promotes economic and social welfare by providing a forum for governments to compare experiences, discuss shared problems and seek solutions.*

To view a full version of the report **Reaching for the Top** *by Canada's Advisor on Healthy Children and Youth, visit Health Canada's homepage at* http://www.hc-sc.gc.ca.

Burden of Injury to Children and Youth in Canada

Injury is the number one cause of hospitalization and death among Canadians aged one to 44 years (Health Canada, 1999). Indeed, each year Canadians spend billions on the cost of injury. In 2004, the direct costs of injury were $7.2 billion; indirect costs of injury were $8.97 billion (SMARTRISK, 2009).

Injuries kill more children and young adults than all diseases combined (CIHR, 2008). Injuries are responsible for almost 15% of hospitalizations of children and youth ages 19 and under. Each year, injury kills an average of 290 children aged 14 and under, and hospitalizes approximately 21,000 (Public Health Agency of Canada, 2009).

National consultations on injury research have consistently highlighted the need for ongoing surveillance and support of evidence-based practice. Most recently, Dr. K. Kellie Leitch, Canada's Advisor on Healthy Children & Youth, reported that Canada ranks a shocking 22nd out of 29 **OECD** countries when it comes to preventable childhood injuries and deaths (Leitch, 2007).

In her 2007 report entitled *Reaching for the Top*, Dr. Lietch indicates the need for a National Injury Prevention Strategy that will:

- Establish a mission statement focused on a "Zero Vision" and achieving international pre-eminence in childhood injuries by striving to have no Canadian child or youth die of a preventable injury
- Establish a framework to determine where and how to most effectively focus injury prevention efforts
- Establish indicators, benchmarks and targets to measure progress toward the achievement of the strategic mission over a five-year timeframe

Current Status of Injury Indicators

Prior to the work of the Canadian Injury Indicators Development

Team, there has been no common set of validated injury indicators in use across Canada. The Canadian Institute for Health Information (CIHI) developed indicators for primary health care and released a report in 2006. The specifications for injury indicators that follow in this report replicate the format used by CIHI so that there is consistency in how health indicators and injury indicators in Canada are specified.

This project drew upon prior injury/health indicator work from other countries including, but not limited to:

- Australian National Health Priority Area (NHPA) Technical Review (Harrison and Steenkamp, 2002)
- Developing Valid Injury Outcome Indicators: A report for the New Zealand Injury Prevention Strategy (Cryer, Langley & Stephenson, 2004)
- European Child Safety Alliance Child Safety Report Card (MacKay and Vincenten, 2007)
- Child Health Indicators of Life and Development (CHILD) project of the European Community Health Monitoring Programme (Rigby, Kohler, Blair *et al.*, 2003)
- Development of Environment and Health Indicators for European Union Countries (Farchi, Molino, Rossi *et al.*, 2006)
- U.S. Centre for Disease Control State Injury Indicators Report (Centre for Disease Control, 2001)

The indicators developed in this Canadian project are well aligned with the indicators in the Australian NHPA Technical Review. Both sets use mortality and hospital separations rate as indicators, and both have indicators related to access to trauma care. In addition, the NHPA Technical Review contains one indicator related to injury prevention policy: "Number of States and Territories requiring separation of domestic pools from houses" (Harrison and Steenkamp, 2002). The Canadian list of indicators includes eight policy-related indicators.

The European Child Safety Alliance published a Child Safety Report Card in 2007 in which they use deaths due to each type of injury as injury indicators (MacKay and Vincenten, 2007). They have also developed a way to assess European countries on their adoption, implementation and enforcement of national level, evidence-informed, policy measures. A similar assessment strategy is used in the specifications of several of the policy and violence indicators in the newly developed Canadian list.

Canadian Child & Youth Health Coalition Initiative

This project began with the Canadian Child & Youth Health Coalition's (CCYHC) launch of the Indicator Program in 2004. With the ultimate goal of improving child heath in Canada, the objectives of this initiative were to identify existing indicators and to develop new ones that could be used to monitor and evaluate the health of and health services provided to infants, children, youth and their families (Canadian Child and Youth Health Coalition, 2007). For more information on the program, see Appendix B.

Primary, secondary and tertiary prevention: *Primary prevention includes actions taken to avoid disease or injury; secondary prevention seeks to minimize the severity of diseases or injuries that occur (that cannot be prevented); and tertiary prevention involves efforts following incidents of disease or injury that seek to optimize the outcomes, regardless of severity.*

For more information on the **National Trauma Registry** *or to request data, visit* http://www.cihi.ca/ntr.

Six expert panels were formed, including one focused on Injury Prevention/Trauma. This panel conducted a literature review and international scan for existing injury indicators as well as their validation.

This panel noted that national injury prevention priorities, including **primary, secondary and tertiary prevention**, must be determined and that proposed injury indicators to be developed and validated should reflect these priorities.

With a focus on motor vehicle occupant injury, two key recommendations were made:

1. To develop and validate motor vehicle occupant injury mortality indicators for children, including urban/rural and First Nations/Inuit status:
    a) Improve and standardize occupant restraint data collection
    b) Improve the capture and coding of First Nations and Inuit status data
    c) Improve accuracy of death certificate completion
2. To use the model for future injury indicator development

In terms of indicators reflecting tertiary prevention and health system performance, pediatric trauma centre quality indicators were identified as an existing and promising initiative.

Available Data Sources

Because indicators require data to make them useful, it is important to include an assessment of available data sources in a situation analysis. Some types of data are easy to obtain, while others prove quite difficult to access.

Also problematic is the issue that data are often a few years behind: for example, the most recent year of data available through Statistics Canada may be two or three years older than the current year. Also, due to privacy issues, data are not reported for very small numbers (usually less than five).

Indicators Using Mortality Data

The central ***Vital Statistics Registry*** in each province and territory provides data from death registrations to ***Statistics Canada***.

National death datasets may also be collected through CIHI's ***National Trauma Registry*** (NTR) as plans are underway to incorporate data from the Chief Coroner's Office pending the development of a national coroner's database. For more

information on participating facilities and provinces for NTR's Comprehensive Data Set (CDS), see Appendix C.

Indicators Using Hospitalization Data

Hospital separations data, which measure the number of in-patients who leave hospital through discharge or death, are contained in the ***Discharge Abstract Database*** (DAD) and are provided by CIHI and analyzed by Health Canada. Classification of hospital discharge data using **ICD-10-CA** has been implemented gradually beginning in fiscal year 2001-02.

Since a small proportion of the records sent to CIHI are not subject to verification for inclusion of external causes of morbidity (V-Y codes), previously coded as **E-Codes** in ICD-9, the discharge data should be considered a minimum estimate of the number of hospitalizations for treatment of injuries. ***Hospital discharge*** data are presented by fiscal years (e.g. April 1, 2001 - March 31, 2002).

ICD-10-CA *is the Canadian revision of ICD-10 (International Statistical Classification of Diseases and Health Related Problems Tenth Revision), an international core classification of diseases, injuries and causes of death. The ICD is published by the World Health Organization and designed to promote international comparability in the collection, processing, classification and presentation of the statistics.*

E-Code *stands for External Cause of Injury, used in version 9 of the International Classification of Diseases (ICD-9) to describe external causes of injury and death. ICD-10 has replaced E-Codes with V01-Y98 codes.*

3. Methods

Study Design

The Canadian Injury Indicators Development Team employed a multi-phase research design, following the methods described by Lindsay *et al.* (2002), to develop a comprehensive set of child and youth injury indicators. This methodology, initially used to develop quality indicators for emergency departments, was comprised of several stages including expert opinion, a literature review, an expert panel meeting and an online survey. For a full timeline of the injury indicators project, see Appendix D.

Phase I: Defining Criteria and Establishing Domains

The first task was to build consensus around the criteria to be used in the selection of injury indicators. Five domains were established to group indicators. These domains were based upon the burden of injury (including the incidence and severity of the injuries) and the collective expertise of the research team. Domains selected were:

- Health Services Implications
- Motor Vehicle Injury
- Sport, Recreation and Leisure Injury
- Violence
- Trauma Care, Quality and Outcomes

Two additional domains, indicators that span "All Domains" and "Other Policy" indicators (those that do not fall within the five domains) were added later in the indicator development process.

Criteria for indicator selection were established during a face-to-face meeting of the research team who agreed to use those proposed by Rigby *et al.* (2003). See Table 1 below.

Table 1: Indicator selection criteria

- Evidence-based, underpinned by research
- Significant burden to society, the family and the individual
- Representative of significant population groups
- Data availability
- Topic amenable to effective action
- Understandable to broad audience
- Regularity and repeatability to enable trend analysis

The Canadian Injury Indicators Development Team also agreed that each indicator on the long list should have specific characteristics described by Rigby *et al.* (2003). See Table 2 below.

Table 2: Characteristics of an indicator established by Rigby *et al.* (2003)

- Defined (based on group definition)
- Valid/Reliable/Repeatable
- Consistent
- Sensitive
- Feasible

Phase II: Literature Review

The team conducted a review of relevant literature to reveal previously established child and youth injury indicators that were evidence-based, had been validated or had been used successfully elsewhere. Databases searched included Medline, Ovid, Transport, TRIS, SPORTDiscus, CINAHL, Embase, PsychInfo, HealthSTAR and HAPI from 1985 to 2006.

In addition, all team members and international experts were contacted to find further relevant reports and data sources. Studies and reports were selected that listed injury indicators and/or commented on indicator validity. In total, 37 studies were selected and summarized in an Injury Indicator Literature Review Summary Table (see Appendix E).

Phase III: Selection of existing indicators and creation of new ones - Expert panel meeting

The selection of relevant existing indicators and the creation of new ones were undertaken by a panel of 35 national and international injury experts. Panel members were invited to an Injury Indicators Day, held in Alliston, Ontario, based on their recognized expertise in injury indicators, injury data and/or injury prevention. Regional representation was also ensured and participants from First Nations, Inuit and government organizations were included.

Expert panel members were divided into small group discussion tables according to their expertise or interest in a particular injury domain. Each group came to consensus in order to recommend between five and 10 indicators in their specific domain.

In total, 51 indicators were proposed:

- 5 Indicators Spanning Across All Domains
- 8 Overall Health Service Implications Indicators
- 18 Motor Vehicle Injury Indicators
- 5 Sport, Recreation and Leisure Injury Indicators
- 7 Trauma Care, Quality and Outcomes Indicators
- 8 Violence Indicators

Modified Delphi Process *is an empirically validated expert consultation process used to identify agreement among a group of experts who are often geographically separated. Experts complete a series of written surveys; though there are variations on the technique, it usually involves asking experts to rate items on a Likert scale (1–9). Typically there is a series of 2–3 rounds that build on previous results. Responses are collated and respondents are sent their response and the response of the group as a whole (CIHI, 2006).*

Phase IV: Modified Delphi Process

Following the expert panel meeting, participants were asked to evaluate the list of 51 indicators according to 22 criteria arising from the literature review. Cryer, Langley, Jarvis, *et al*., (2005) and the Child Health Indicators of Life and Development (CHILD) Project (Rigby *et al.*, 2003) provided the evaluation criteria.

All participants, as well as six external collaborators – a total of 41 people – were sent a questionnaire stratified by domain. Participants and collaborators were asked to indicate whether or not each indicator met each specific criterion.

A total of 16 participants and collaborators responded to the questionnaire – a 39% response rate. 'Yes' to 'No' ratios were established for each indicator, and indicators were retained if the ratio of 'yes' to 'no' was four to one or greater. Further inclusion or exclusion of indicators was determined through discussion and consensus by the research team members. Twenty-six indicators in six domains were established.

The final step of Phase IV was a face-to-face research team meeting to discuss the 'face' validity of the 26 indicators. Team members determined that, while there were none generated earlier in the process, policy indicators were necessary in order to be able to measure the impact of legislation and policy on the burden of injury to children and youth. As a result, eight policy indicators were added to the 26 highly-ranked injury indicators.

Phase V: Specification of Indicators

Each indicator was then fully defined and specified. A search of the related grey-area literature resulted in the identification of three technical reports that specified injury indicators.

An evaluation and comparison of these documents, from Australia (Harrison and Steenkamp 2002), New Zealand (Cryer, Langley & Stephenson, 2004), and Europe (Carroquino, MacKay, Ramirez *et al.*, 2005) together with the Pan-Canadian Primary Health Care Indicators Report (Canadian Institute for Health Information, 2006) guided the specification of injury indicators for Canadian children and youth.

A standard specification template was created using specifications included in at least two of the four documents cited above (see Table 3). The specification format chosen was developed to be similar to the CIHI document. Please note, however, that the indicator specification tables included in Volume 2 of this report will not match the specifications depicted

in Table 3 exactly. Rather, those presented here have been modified for ease of reading.

Table 3: Template of specifications for injury indicators	
Indicator Definition	
Definition of Relevant Terms	
Justifications for this Indicator	
Operational Definition of a Case	
Method of Calculation	
Numerator	
Denominator	
Data Sources, Availability and Quality/Years Represented	
Units of Measurement	
Guide for Use	
Scope of Indicator	
Specifications of Data Needed	
Limitations	
How to Use this Indicator	

Indicators specification was completed by the research team. Once the 34 indicators were fully specified, the core research team met in person to discuss, revise and refine the indicators and their specifications. Indicators were then classified as Policy Indicators, Risk Indicators and Outcome Indicators:

1) ***Policy Indicators*** capture data regarding legislation and policies currently in place. More work is needed to develop a score or index which reflects the degree to which best practice is reflected within legislation and policy. Graduated Driver Licensing or helmet laws and the degree to which they reflect best practice are examples of policy indicators.

2) ***Risk Indicators*** capture data regarding the use or non-use of protective equipment. Child restraint use, seatbelt use, bicycle helmet use and measurable aspects of playground safety such as surface performance are all examples of risk indicators.

3) ***Outcome Indicators*** capture the sequelae of injuries. The number of children and youth who die or who are injured and the causes of those injuries give us a picture of the burden of injury in Canada. Mortality rate and hospital separations rate (with specific injuries as the cause of death or hospitalization) are examples of outcome indicators.

PHASE VI: MODIFIED DELPHI II - BROADER INPUT

A further phase within the modified Delphi Process was used to solicit opinions and evaluation of the indicators from a broader group of injury prevention researchers, policymakers and practitioners. A survey was sent to the distribution lists of five major injury prevention organizations in Canada:

- Canadian Collaborating Centres for Injury Prevention and Control (CCCIPC)
- ThinkFirst Canada
- Safe Communities Canada
- Safe Kids Canada
- Injury Prevention Across the Life Span (IPALs)

Definitions for each indicator and a link to the specification details were provided. Respondents were asked to rate each indicator based on perceived *usefulness* and ability to *prompt action* to reduce injuries among Canadian children and youth.

The survey used a nine-point, Likert-type scale with a low of one (not useful, not actionable) to a high of nine (very useful, very actionable) to elicit the ratings from respondents; 132 individuals responded to the survey. For each domain, indicators were ranked from *most useful/most actionable* (nine points) to *least useful/least actionable* (one point) based on the average score from all survey responses. Results were graphed for each indicator in each domain.

4. Results

The 34 injury indicators, grouped by domain, and their rankings are listed in Table 4. In every case, each indicator ranked higher for ***usefulness*** than for ***actionability***. The mean rating for indicator usefulness ranged between 5.99 (*SD* = 2.0) and 7.93 (*SD* = 1.5). The mean ratings for indicator actionability ranged between 5.26 (*SD* = 2.2) and 7.62 (*SD* = 1.6).

In general, indicators related to motor vehicle injury and overall injury indicators ranked the highest for both usefulness and likelihood to prompt action. Violence indicators, pediatric trauma system indicators and policy indicators ranked lower in terms of usefulness and their ability to prompt action. Indicators which ranked highest on likelihood to prompt action were those related to motor vehicle injury. Indicators related to injury mortality rate, diagnosis-specific hospital separations rate, hospital admission severity and violent crime rate ranked high in both usefulness and likelihood to prompt action.

Table 4: Child and youth injury indicator ratings of usefulness and likelihood to prompt action

Grouping	Indicator name	Average Rating (SD)	
		Usefulness	*Actionability*
Indicators Spanning Across All Domains	1. Mortality Rate	7.75 (1.6)	7.33 (2.1)
	2. Potential Years of Life Lost	6.43 (2.1)	5.99 (2.3)
	3. Hospital Separations Rate	6.95 (1.8)	6.46 (2.2)
Overall Health Service Implications Indicators	4. Diagnosis-Specific Hospital Separations	7.37 (1.7)	6.96 (2.0)
	5. Hospital Admission - Injury Severity 1	7.40 (1.5)	7.01 (1.8)
	6. Hospital Admission - Injury Severity 2	7.05 (1.7)	6.61 (1.8)
	7. Length of Stay in Hospital	6.42 (1.8)	5.85 (2.1)
Motor Vehicle Injury Indicators	8. Cost of Motor Vehicle Injuries	7.28 (1.9)	6.97 (2.1)
	9. Crash Rate	7.45 (1.7)	7.01 (1.9)
	10. Intersection Crash Rate	6.82 (1.9)	6.32 (2.0)
	11. Rural Roadways	7.10 (1.8)	6.58 (1.9)
	12. Drunk Driving	7.85 (1.5)	7.62 (1.6)
	13. Speed	7.55 (1.5)	7.22 (1.7)

Motor Vehicle Injury Indicators, Continued	14. Young Drivers	7.72 (1.5)	7.47 (1.6)
	15. Graduated Driver Licensing	7.13 (1.9)	6.68 (2.1)
	16. Child Restraints	7.64 (1.7)	7.31 (1.8)
	17. Unrestrained Injuries	7.93 (1.5)	7.52 (1.8)
	18. Child Restraint Laws	7.02 (1.8)	6.67 (2.0)
Sport, Recreation and Leisure Injury Indicators	19. Bicycle Helmet Laws	7.15 (1.8)	6.63 (2.0)
	20. Cost of Sport, Recreation and Leisure Injuries	6.90 (1.7)	6.23 (2.0)
	21. Percentage of Sport Specific Injuries (Participation Rates)	6.83 (1.9)	6.22 (2.1)
	22. Requirements that Playgrounds Meet CSA Standards	6.68 (1.9)	6.22 (2.1)
	23. Legislation Requiring Pool Fencing	6.58 (2.0)	5.98 (2.3)
Other Policy Indicators	24. Window Guard By-Law	6.15 (2.0)	5.66 (2.3)
	25. Provincial Standards for Hot Water Tap Temperature	6.45 (1.9)	5.96 (2.2)
Violence Indicators	26. Violent Crime Rate	7.38 (1.6)	6.57 (2.1)
	27. Abusive Head Trauma Rate	7.12 (1.8)	6.34 (2.0)
	28. Suicide Prevention	6.60 (2.2)	6.13 (2.3)
	29. Anti-Violence/Anti-Bullying Policies	6.87 (1.9)	6.22 (2.1)
Trauma Care, Quality and Outcomes Indicators	30. Access to Pediatric Trauma Centre (PTC)	6.50 (2.1)	5.89 (2.3)
	31. Appropriate Use of Pediatric Trauma Centre (PTC)	5.99 (2.0)	5.26 (2.3)
	32. Quality of Trauma System	6.59 (2.2)	5.88 (2.3)
	33. Pre-hospital Transport Time	6.64 (2.1)	6.07 (2.2)
	34. Presence of a Coordinated Pediatric Trauma System	6.55 (2.1)	5.88 (2.3)

5. Discussion & Future Directions

This modified Delphi approach resulted in a set of 34 child and youth injury indicators which can be used for injury surveillance in Canada. Experts ranked these indicators as likely to be *useful in child and youth injury prevention and also likely to prompt action* to reduce injuries. While some variation in the degree to which experts rated the *usefulness* and likelihood to *prompt action* of each indicator exists, there was general consistency and agreement. With the exception of Trauma Care, Quality and Outcome Indicators, and Other Policy Injury Indicators, the experts rated the indicators as highly *useful* and likely to *prompt action.*

The somewhat lower ratings attributed to Trauma Care, Quality and Outcome Indicators, and Other Policy Injury Indicators may be due to a lack of familiarity on the part of the respondents with these indicators.

This project, using a systematic approach to defining injury indicators, is a step forward in the understanding and prevention of injury among Canadian children and youth.

This study generated a list of indicators using a systematic, interdisciplinary method, and involved many Canadian injury prevention experts, as well as international expert input and guidance. Criteria for indicator selection and development, and the utilization of a previously tested and published process were used (Rigby et al., 2003, and Lindsay et al., 2002). Feedback from experts and stakeholder organizations from across Canada suggests that these injury indicators are likely to be u*seful* and to *prompt action* in the prevention of child and youth injury.

> *"Defining accurate indicators has become a major area of work for academics and professionals. … Getting such indicators right is essential since the effectiveness of … health care systems may be judged using such indicators. Perhaps more importantly, financial resources may flow – or be withheld – on the basis of such indicators."*
>
> *Sim and Mackie, 2002*

The process, however, is not without limitations. Although the indicators were fully defined and specified, not all of the suggested or required data and/or information are available in Canada at this time. Further, the indicators lack formal validation, which may prove difficult due to the lack of a 'gold standard' as a basis for comparison. This concern has been raised by previous authors, who have advocated for processes similar to the one employed in this study. Future research will demonstrate the utility of the indicators to monitor and further injury prevention research, policy and practice.

The **Assembly of First Nations** *is the national representative organization of the First Nations of Canada. It aims to protect rights, treaty obligations, ceremonies and claims.*

Inuit Tapiriit Kanatami *is the national Inuit organization in Canada, representing Nunatsiavut (Labrador), Nunavik (northern Quebec), Nunavut and the Northwest Territories Inuvliat Settlement Region.*

The **First Nations Regional Longitudinal Health Survey (RHS)** *is the only First Nations-governed national health survey in Canada. The longitudinal survey collects information based on both Western and traditional understandings of health and well-being.*

Pauktuutit Inuit Women of Canada *is the national voice of Inuit women in Canada. It works to ensure their input on national issues of concern to Aboriginal Peoples, and to increase their participation in federal policies and programs.*

Parallel Injury Indicator Development for First Nations and Inuit Children and Youth

During the fall of 2006, the Canadian Injury Indicators Team was invited by the First Nations and Inuit Health Branch (FNIHB), Health Canada to begin a process of developing injury indicators for First Nations and Inuit children and youth. The team was pleased to do this as it made it possible to address two of the recommendations made by the Canadian Child & Youth Health Coalition (CCYHC) in regards to indicators:

1. Develop and validate motor vehicle occupant injury mortality indicators for children, including urban/rural children and children with First Nations/Inuit status
2. Improve the capture and coding of First Nations and Inuit status data

On April 30 and May 1, 2007, participants were invited from the **Assembly of First Nations** (AFN), **Inuit Tapiriit Kanatami** (ITK), FNIHB, **First Nations Regional Longitudinal Health Survey** (RHS), RCMP, Indian and Northern Affairs Canada, SMARTRISK, the Plan-it Safe Child and Youth Injury Prevention Centre, Katenies Research and Management Services, Statistics Canada, Nunatsiavut Department of Health and Social Development, and **Pauktuutit Inuit Women of Canada** to take part in a modified Delphi process similar to the process used in the original indicators project.

Of an original list of 62 indicators, 27 have been identified as most reflective of the injury issues facing children and youth within First Nations and Inuit communities. This parallel process continues and is at the stage of specifying the indicators. A report titled *Developing Injury Prevention Indicators for First Nations Children & Youth in Canada* is available at www.injuryresearch.bc.ca (Pike *et al.*, 2010). An Inuit indicators report will also become available soon.

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APPENDICES

APPENDIX A – CANADIAN INJURY INDICATORS DEVELOPMENT TEAM: CHILDREN AND YOUTH

NAME	POSITION	INSTITUTION	ROLE/EXPERTISE
Principal Applicants			
Ian Pike Vancouver, BC	Director Assistant Professor	BC Injury Research and Prevention Unit Department of Pediatrics, Faculty of Medicine, University of British Columbia	- *Injury surveillance* - *Injury prevention* - *Intentional injury* - *Social determinants of health*
Alison Macpherson Toronto, ON	Associate Professor	School of Kinesiology and Health, York University	- *Epidemiology* - *Child injury prevention* - *Health services*
Co-Applicants			
Ronald Barr Vancouver, BC	Director Professor	Centre for Community Child Health Research Department of Pediatrics, Faculty of Medicine, University of British Columbia	- *Pediatric health* - *Intentional injury* - *Shaken baby syndrome*
Lynne Warda Winnipeg, MB	Medical Director	IMPACT, Manitoba Institute of Child Health Research	- *Childhood injuries*
Shelina Babul Vancouver, BC	Sports Injury Specialist	BC Injury Research and Prevention Unit	- *Sport, recreation and leisure injuries*
Morad Hameed Vancouver, BC	Assistant Professor	Department of Surgery Faculty of Medicine, UBC	- *Trauma surgery* - *Critical care medicine* - *Shock resuscitation* - *Social determinants of health*

Edi Desapriya Vancouver, BC	Research Associate	BC Injury Research and Prevention Unit	-	*Road safety and motor vehicle injury prevention*
Parminder Raina Hamilton, ON	Associate Professor	Clinical Epidemiology and Biostatistics McMaster University	- - - -	*Epidemiology* *Biostatistics* *Injury surveillance* *Injury prevention*
Colin Macarthur Toronto, ON	Associate Professor	Dept. Health Policy, Management & Evaluation School of Grad Studies, University of Toronto	- - -	*Health services delivery* *Children's health* *Public and population health*
Natalie Yanchar Halifax, NS	IWK Trauma Program	IWK Health Centre	-	*Trauma indicators*
Pamela Fuselli (formerly Allyson Hewitt) Toronto, ON	Executive Director	Safe Kids Canada	- - -	*Public policy* *Vulnerable populations* *Family violence*
Project Coordination and Administration				
Shannon Piedt Vancouver, BC	Research Co-ordinator	BC Injury Research and Prevention Unit spiedt@cw.bc.ca		

APPENDIX B – BACKGROUND ON THE CANADIAN CHILD AND YOUTH HEALTH INDICATORS PROGRAM

The **Canadian Child & Youth Health Coalition (CCYHC)** launched the Indicator Program in 2004 to *"identify existing indicators and develop new indicators that will be used to monitor and evaluate the health of, and the health services provided to, infants, children, youth and their families. The aim is to improve services and, thereby, the health and wellbeing of infants, children, youth and their families".*

Six expert panels were created, harnessing the expertise of over 80 professionals from coast-to-coast: **Patient Safety, Injury Prevention/Trauma, Mental Health, Primary Care, Chronic Conditions** and **Efficiency**. Borrowing from the Canadian Institute for Health Information (CIHI)/ Statistics Canada Indicator Framework, each panel identified key questions that needed to be addressed to advance the health and healthcare of Canadian infants, children and youth, reviewed the literature for existing indicators and recommended the development of new indicators with a focus on future research. Potential partners and funding sources were also identified.

A Steering Committee was then created, comprised of the co-chairs of the six Expert Panels and key partner organizations - CIHI, the Canadian Institutes of Health Research (CIHR), Accreditation Canada (formerly the Canadian Council on Health Services Accreditation) and the Public Health Agency of Canada (PHAC). With input from an expert consultation community of over 100 health researchers, practitioners, administrators and decision-makers, a **"Strategic Pathways"** plan was developed to transform the expert panels' visions and recommendations into concrete strategies that could yield both immediate successes and long term impact.

(Canadian Child and Youth Health Coalition, 2007).

Appendix C – Participating Facilities and Provinces, National Trauma Registry Comprehensive Data Set

TABLE 1: PARTICIPATING FACILITIES AND PROVINCES, NTR CDS 2004-2005

PROVINCE	NAME
British Columbia	Vancouver General Hospital
	Children's & Women's Health Centre of BC
	Royal Columbian Hospital
	St. Paul's Hospital
	Lions Gate Hospital
	Victoria General Hospital
	Prince George Regional Hospital
	Kelowna General Hospital
	Royal Inland Hospital
Alberta	Foothills Medical Centre
	Royal Alexandra Hospital
	Alberta Children's Hospital
	University of Alberta Hospital (includes Stollery Children's Hospital)
Manitoba	Health Sciences Centre
Ontario	Hamilton Health Sciences Corporation
	Hospital for Sick Children
	Hotel Dieu-Grace Hospital
	Kingston General Hospital
	London Health Sciences Centre
	Ottawa Hospital
	St. Michael's Hospital
	St. Joseph's Health Centre
	Sunnybrook and Women's College Health Science Centre
	Thunder Bay Regional Hospital
	Children's Hospital of Eastern Ontario
Quebec	Hôpital Charles-Lemoyne
	Hôpital de Montréal pour enfants
	Hôpital du Sacré-Coeur de Montréal
	Hôpital Général de Montréal
	Hôpital Ste-Justine
	CHA Pavillon Enfant-Jésus
New Brunswick	Atlantic Health Sciences Corporation
Nova Scotia	IWK Health Centre

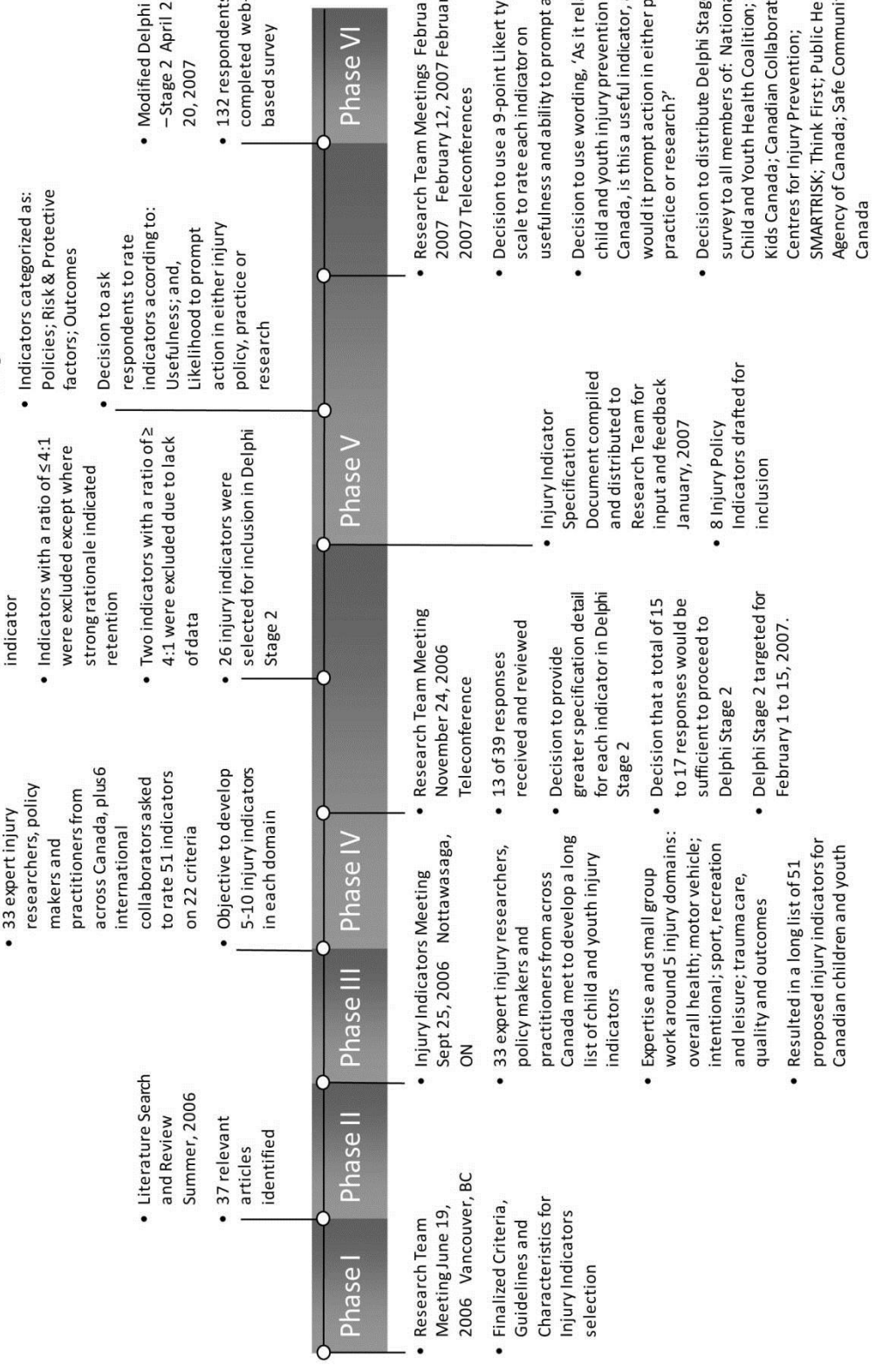
	Queen Elizabeth II Health Sciences Centre
	Aberdeen Hospital
	Cape Breton Health Care Complex
	Colchester Regional Hospital
	Health Services Association of the South Shore
	St. Martha's Regional Hospital
	Valley Regional Hospital
	Yarmouth Regional Hospital
	Cumberland Regional Health Care Centre
Newfoundland	Health Science Centre
	St. Clare's Mercy Hospital
	Dr. Charles A. Janeway Child Health Center

In previous years, the number of participating provincial/regional trauma registries and facilities has differed slightly in the NTR CDS. Therefore, trends over time should be interpreted with caution. Table 2 lists participating provincial/regional trauma registries by fiscal year of data.

TABLE 2: PARTICIPATING PROVINCES, NTR CDS 1996-1997 THROUGH 2003-2004

PROVINCE	NAME
1996-1997	BC, AB, ON, QC, NS, NL
1997-1998	BC, AB, ON, QC, NS, NL
1998-1999	BC, AB, ON, NS, NL
1999-2000	BC, AB, MB, ON, NS
2000-2001	BC, AB, MB, ON, QC, NB, NS
2001-2002	BC, AB, MB, ON, QC, NB, NS
2002-2003	BC, AB, MB, ON, QC, NB, NS
2003-2004	BC, AB, MB, ON, QC, NB, NS, NL
2004-2005	BC, AB, MB, ON, QC, NB, NS, NL

APPENDIX D – INJURY INDICATORS PROJECT TIMELINE



APPENDIX E – INJURY INDICATOR LITERATURE REVIEW SUMMARY TABLE

ALL INJURY/ALL DOMAINS		
Reference		Jurisdiction
Summary	Injury Indicators	Characteristics and Quality of Indicators
Cryer, C. (2005). Injury outcome indicators –Validation matters. *International Journal of Injury Control and Safety Promotion*, 12(4), 219-224.		New Zealand – total population
The International Collaborative Effort on Injury Statistics (ICE) Criteria was used for investigating the validity of indicators. Examples of indicators that have been found to be valid using these criteria are presented. In contrast, examples of national road safety indicators are also presented in the article, whose validity is questionable. The New Zealand Injury Prevention Strategy serious injury indicators are presented (in next column) as indicators with no identifiable threats to validity.	• Age standardized injury mortality rate, per person-years at risk • Number of injury deaths • Age standardized serious non-fatal injury rate per 100,000 person-years at risk • Number of cases of serious non-fatal injury	No threat to validity when assessed against ICE criteria.
McClure, R.J., Cameron, C.M., Purdie, D.M., & Kliewer, E.V. (2005). Indicators of injury burden: which types are the most important? *International Journal of Injury Control and Safety Promotion, 12 (4), 213-217.*		Manitoba, Canada
The object of the study was to identify the types of injury responsible for the major component of the population health burden of injury in a large cohort in Manitoba, Canada. Injury cases (ICD-9-CM 800-995) aged 18-64 years were identified from all Manitoba hospital data between 1988 and 1991. This work was conducted as part of a larger cohort study of 10-year health outcomes for a cohort of injured and matched cohort of noninjured, involving the analysis of administrative health data from Manitoba, Canada. A total of 21 032 injured cases met the study inclusion criteria.	• Fracture of lower limb • Fracture of neck & trunk • Poisonings • Intracranial injury • Fracture of upper limb • Fracture of skull	Monitoring the frequency in the community of just these six injury types will allow the measurement of incidence-based changes in the majority of the burden of injury. The task is now to explore methods to validly and reliably measure the incidence of these six injury types.
Thomas, C., Butler, J., Davies, M., & Johnson, R. (Eds.). (2004). *State Injury Indicators Report, Second Edition --- 1999 Data.* Retrieved August 10, 2006, from http://www.cdc.gov/ncipc/pubres/indicators/		United States
Each State used a total of five data sets to report on 21 indicators: the Fatality Analysis Reporting System, the state-based Youth Risk Behavior Survey, the Behavioral Risk Factor Surveillance System, state vital records, and state hospital discharge data. Because injury rates often vary dramatically by sex, overall age-adjusted rates for hospitalization and fatal indicators were calculated as the weighted average of the male and female rates for each indicator. However, in low-incidence indicators, it was not always possible to calculate a stable rate for females. In these cases, the overall age-adjusted rate was calculated using the sum of the male and female cases and the sum of the male and female populations by age within the state.	*1. All Injury Indicators* • Hospitalizations for All Injuries (a) Overall, (b) by Sex and (c) by Age, 1999 *2. Traumatic Brain Injury (TBI) Indicators* • TBI Hospitalizations (a) Overall, (b) by Sex and (c) by Age, 1999 • TBI Fatalities (d) Overall, (e) by Sex and (f) by Age, 1999 *3. Drowning Indicators* • Near Drowning Hospitalizations (a) Overall, (b) by Sex and (c) by Age, 1999 • Drowning Fatalities (d) Overall, (e) by Sex and (f) by Age, 1999 *4. Fire-Related Indicators* • Fire-Related Hospitalizations (a) Overall, (b) by Sex and (c) by Age, 1999 • Fire-Related Fatalities (d) Overall, (e) by Sex and (f) by Age, 1999 • (g) Percentage of Homes with Smoke Alarms Tested in the Last Month, 1999*	This report does not comment on the characteristics or validity of the indicators.

	• (h) Percentage of Homes without Smoke Alarms,1999* *5. Motor Vehicle Indicators* • Motor Vehicle Traffic and Non-Traffic Hospitalizations (a) Overall, (b) by Sex and (c) by Age, 1999 • Percentage of Adults Reporting Driving After Perhaps Having Too Much to Drink in the Past Month, (d) Overall, (e) by Sex and (f) by Age, 1999* • Percentage of High School Students Reporting Always Using Safety Belts, (g) Overall and (h) by Sex, 1999** • (i) Alcohol-Related Crash Deaths, 1999 *6. Poisoning Indicators* • Poisoning Hospitalizations (a) Overall, (b) by Sex and (c) by Age, 1999 • Poisoning Fatalities (d) Overall, (e) by Sex and (f) by Age, 1999 *7. Firearm-Related Indicators* • Firearm-Related Hospitalizations (a) Overall, (b) by Sex and (c) by Age • Firearm-Related Fatalities (d) Overall, (e) by Sex and (f) by Age. *8. Homicide Indicators* • Homicide (a) Overall, (b) by Sex and (c) by Age *9. Suicide Indicators* • Suicide Attempt Hospitalizations (a) Overall, (b) by Sex and(c) by Age • Suicide (d) Overall, (e)by Sex and (f) by Age • Percentage of High School Students Reporting Suicide Attempt During Past 12 Months, (g) Overall and (h) by Sex, 1999** **Behavioural Risk Factor Surveillance System* ***Youth Risk Behaviour Survey*	
Rigby, M.J., Kohler, L.I., Blair, M.E., & Metchler, R. (2003). Child Health Indicators for Europe: A priority for a caring society. *European Journal of Public Health*, 13 (3 supplement), 38-46.		European Community member states and the European Economic Area
The Child Health Indicators of Life and Development (CHILD) project is the only population group-specific project seeking to determine a holistic set of measures. The project undertook a structured search of published evidence to seek to identify and validate indicators of health and illness. The remit was to identify and recommend indicators of the health of children, ages one week to 15 years in a scientific and evidence based way. A systematic approach was used to identify valid indicators and assemble a balanced composite list of 38 core desirable national indicators. Only those indicators pertaining to injury are listed here. A full list of all indicators can be found in the article.	• Total mortality rate between birth and exactly five years of age • Total under-20 years mortality rate per 100,000 • Cause specific mortality rates per 100,000 population for: a) burns b) poisoning c) transport accidents d) drowning e) suicide f) assault and homicide • Annual rate of overnight hospital inpatient admissions of children suffering burns • Annual rate of overnight hospital inpatient admissions of children suffering from poisoning • Annual incidence per 100,000 population of fracture of long bones • Annual incidence of attempted suicide,	The published final report of the European Community Health Monitoring Program (HMP) contains a detailed template, giving the rationale for the indicator, its technical definition, the likely data sources, and the published evidence on which the recommendation is based.

	defined by inpatient hospital stays with a discharge diagnosis of attempted suicide • Percentage of children in the country protected by law against physical punishment a) in schools and other places where children are looked after b) in the home or by parents and family members • Percentage of children attending schools with a written anti-bullying policy in operation • Existence and actual enforcement of legislation and regulations establishing mandatory requirements for safe mobility and transport for children • Existence of policies aimed at assessing and reducing the exposure of babies and young children to potentially harmful noise in ICU units, day-care centres, schools and kindergartens *Indicators for further discussion:* • Percentage of children reporting that they undertake vigorous activity outside of school hours for at least two hours a week • Percentage of children reporting that they smoke every week • Percentage of children aged 15 reporting that they have been drunk from alcohol consumption on two or more occasions • Percentage of 15 year old school children who report they have a) used cannabis more than twice during the last 30 days b) ever used heroin c) ever used ecstasy	
McClure, R.J., Peel, N., Kassulke, D. & Neale, R. (2002). Appropriate indicators for injury control. *Public Health*, 116(5), 252-256. Retrieved Aug. 17, 2006, from http://www.sciencedirect.com		Brisbane, Australia
A criterion validity, population-based, prospective cohort study was conducted in Brisbane over a 12-month period between Jan and Dec of 1998. The study population was defined as all people over the age of 14 resident in the Greater Brisbane Region during the study period. Study participants included all those from the population at risk who were injured in the area and who were admitted for more than 24 hours to any of the 14 hospitals in the region for acute treatment of a condition codeable to an ICD9-CM category between 800.0 and 995.0.	• Number of cases admitted to hospital with primary diagnosis of fracture of femur or other long bone fracture	With the high number of false negatives and false positives, the presence of a serious long bone fracture can be considered a poor marker of serious injury.
Lindsay, P., Schull, M., Bronskill, S., & Anderson, G. (2002). The Development of Indicators to Measure the Quality of Clinical Care in Emergency Departments Following a Modified-Delphi Approach. *Academic Emergency Medicine, 9, 1131-1139.*		Ontario, Canada
An extensive literature review was conducted to identify clinical conditions frequently treated in most emergency departments (EDs), and clinically relevant outcomes to evaluate these conditions. Based on this review, a set of condition-outcome pairs was	• Percentage of patients who present to the ED with an ankle/foot injury who receive radiography • Percentage of radiographs for ankle/foot injury that are negative	• Feasibility was demonstrated by calculating several of the indicators in this paper from currently available administrative data • The involvement of clinical

defined. An expert panel was convened and a modified Delphi process was used to identify specific condition-outcome pairs where the panel felt there was a link between quality of care for the condition and a specific outcome. Next, for highly rated condition – outcome pairs, specific measurable indicators were identified in the literature. The panelists rated these indicators on their relevance to ED performance and need for risk adjustment. The feasibility of calculating these indicators was determined by applying them to a routinely collected data set.	Only those indicators pertaining to injury are listed here. Other indicators relevant to ED performance can be found in the article.	experts and front-line staff early in the process ---those who provide direct care, manage care provision, or extract data regarding care – early in the process of identifying condition and specific indicators increased both the face validity and content validity of the indicators.
Bardehle, D. (2002). Minimum Health Indicator Set for South Eastern Europe. *Croatian Medical Journal Public Health and Peace, 43(2), 170-173.* Retrieved Aug. 17, 2006, from http://www.cmj.hr		South Eastern Europe
One of the identified priorities of national public health development is the definition of a Minimum Indicator Set for all countries of South Eastern Europe (SEE). A Task Force of the PH-SEE Network has proposed a Minimum Indicator Set on the basis of the list of the 224 indicators of the World Health Organization (WHO) Health for All (HFA) 21 strategy. The indicators selected follow the selection criteria as defined by expert groups of WHO and the European Commission. A list of 32 indicators was agreed at a workshop in Ohrid, Macedonia, in September 2001. Some indicators are related specifically to the SEE post-war situation, such as indicators on suicide and homicide, literacy rate, average number of calories per person a day and average number of persons per room. Only those indicators pertaining to injury are listed here. A full list of health, lifestyle, and environment indicators can be found in the article.	• Age-standardized rate, external causes, injuries, and poisoning per 100,000 population by sex, all ages • Age-standardized rate, suicide and self-inflicted injuries per 100,000 population by sex, all ages • Age-standardized rate, homicide and purposely inflicted injury by other persons per 100,000 population by sex, all ages • Mortality rate for children aged 1-4 years per 100,000 of the age group by sex • Average length of hospital stay (all hospitals) • Total health expenditure, of which on inpatient care (US$) • Gross national product (US$) and its fraction for health expenditure *Indicators for further discussion:* • Unemployment rate (%) • Literacy rate in population aged 15 years • Pure alcohol consumed per person annually (L) • Average number of calories per person a day (kcal) or % of total energy available from proteins • Population (%) with connection to water, total or population (%) with access to hygienic sewage disposal, total • Average number of persons per room in an occupied housing unit	In terms of their validity, indicators usually cannot be better than the health statistics they are based on. All 11 indicators derived from mortality statistics are therefore valid only if both of the official major statistics – population statistics and mortality statistics – are conducted correctly.
Harrison, J.E. And Steenkamp, M. (2002). Technical review and documentation of current NHPA injury indicators and data sources. *Injury Research and Statistics Series Number 14. Adelaide: AIHW (AIHW cat no. INJCAT 47).*		Australia
This document contributes to a data development plan for the Injury Prevention and Control National Health Priority Area by undertaking a technical review and documentation of the current NHPA injury indicators and data sources. This is achieved by: • Presenting an updated situation analysis of developments in regard to current data sources relevant to the indicators, highlighting the limitations of these sources and discussing the status of current indicators;	*List of NHPA Injury Indicators* 1.1 Death rate for injury and poisoning in the total population 1.2 Hospital separation rate for injury and poisoning in the total population 2.1 Death rate ratio comparing the injury status of Indigenous and non-Indigenous populations 2.2 Death rate ratio comparing the injury status of males and females 2.3 Death rate ratio comparing the injury status among males aged 25.54 years from low socioeconomic groups with	*Criterion 1: Case definition in terms of specified anatomical or physiological Damage.* As they are stated in the 1997 NHPA report, none of the current indicators of injury occurrence is specified in terms of anatomical or physiological damage. All of the indicators of injury occurrence based on mortality and hospital morbidity data are specified solely in terms of the presence of a range of ICD External Causes of injury codes, and not in terms of anatomical or physiological damage.

• providing specifications to improve the technical adequacy of the indicators reported on previously through developing a framework and writing complete specifications for the injury indicators to the extent possible; • undertaking a thorough technical review and documentation of the current indicators; and • identifying actions and processes required to achieve further improvements in indicators and data sources, by providing a summary of improvements proposed in this and a previous NHPA Report and summarizing the information developments required if the foreshadowed improvements are to be achieved.	males from high socioeconomic groups 2.4 Death rate ratio comparing the injury status among people living in rural and remote areas and the general population 2.5 Hospital separation rate ratio comparing the injury status among Indigenous and non-Indigenous populations 2.6 Hospital separation rate ratio comparing the injury status among males aged 25.54 years from low socioeconomic groups with males from high socioeconomic groups 3.1 Death rate for road transport-related injury in the total population 3.2 Death rate for road transport-related injury among males aged 15.24 years 3.3 Hospital separation rate for road transport-related injury in the total population 3.4 Hospital separation rate for road transport-related injury among males aged 15.24 years 4.0 Work-related injury 5.1 Death rate for falls among people aged 65 years and over 5.2 Hospital separation rate for falls among people aged 65 years and over 5.5 Hospital separation rate for falls among children aged 0.4 and 5.9 years 6.1 Hospital separation rate for sport and recreation-related injuries 6.2 Non-hospital admitted sport and recreation-related injuries 7.1 Death rate for homicide among people aged 20.39 years 7.2 Death rate for homicide among children aged 0.9 years 8.2 Emergency department attendances resulting from product-related injury 9.1 Death rate for injury resulting from fire, burns and scalds among people aged 55 years and over 9.2 Hospital separation rate for injury resulting from fire, burns and scalds among children aged 0.4 years 9.3 The proportion of houses equipped with smoke detectors and earth leakage breakers 10.1 Hospital separation rate due to poisoning among children aged 0.4 years 11.1 Death rate for drowning in the total population and among children aged 0.4 years 11.2 Hospital separation rate for near drowning among children aged 0.4 years 11.3 Number of States and Territories requiring separation of domestic pools from houses 11.4 The proportion of domestic pools with approved child-resistant fences, gates and barriers 11.5 The proportion of children and young people aged 10.16 years who have successfully completed a water safety and lifesaving course	This approach is retained in the *Minimal Change* model. Most of the indicators are presently specified in terms of injury and a type of External Cause. Some of the external causes imply the nature of resulting injury (e.g. .poisoning, and perhaps .fire, burns and exposure to fire). There may be advantages in re-specifying some of these to make greater use of diagnosis information. Reasons to consider doing so are presented in the report, in relation to Criterion 3. Note that some of the indicators of injury incidence are defined in terms of the presence of codes for particular injury diagnoses, without mention of external cause (i.e. the indicators for brain injury and spinal cord injury). *Criterion 2: Cases included should be all of those that the indicator aims to reflect, or a well-defined sample of them.* This criterion is considered separately for injury deaths and for injury cases admitted to a hospital. Neither of these sources currently sample cases, though this was formerly the practice for hospital separations in New South Wales. Hence the issue is whether these sources collect all of the cases that the indicators of injury incidence aim to reflect. Indicators based on deaths data and hospital data appear to be adequately specified at present in terms of completeness of ascertainment. Quality assurance is the major issue (see Section 4.5 of report). It is not presently practicable to specify indicators of injury incidence (or other aspects of occurrence) other than deaths and hospitalized cases because relevant data sources are not available. *Criterion 3: Probability of case ascertainment should be independent of extraneous factors.* Several issues are described in this section and are reflected in the *Technically Revised* model presented in Appendix A4 of the report. Chapter 3 describes the process used to review the technical specifications of the current injury indicators, and presents the framework that was developed for the purpose. Appendix 4 provides the most complete technical documentation of these indicators that was achievable at the time of writing. This greatly reduces potential ambiguity concerning matters such as data sources, criteria for case inclusion, specification of populations for the calculation of rates, formulae for calculations (including age

	12.1 Access of injured patients to optimal trauma care 13.1 Access of people with trauma injuries to comprehensive rehabilitation programs and appropriate long-term care and community support 14.0 Annual incidence rate of persistent spinal cord injury from traumatic cases 15 .0 Brain injury	standardization), etc. *Summary:* A range of issues concerning indicator specification were considered, and potential improvements were identified. Those assessed to be of potential value and as being capable of implementation on the basis of existing data sources have been included in the *Technically Revised* model. Others have been proposed for further consideration or investigation. Table 4.3 of the report provides a summary. Full specification of the indicators other than the incidence indicators must await more complete specification of purposes and topics, which fall beyond the scope of this technical review. The indicators have been documented as far as possible given this constraint.
Tamburlini, G., Ronfani, L., & Buzzetti, R. (2001). Development of a child health indicator system in Italy. *European Journal of Public Health, 11(1), 11-17.* Retrieved August 11, 2006, from http://eurpub.oxfordjounals.org		Italy
As part of a Ministry of Health project, a working group was established in Italy in order to develop a proposal for a minimum set of health indicators to be adopted at the regional and local health authority levels. The informing principles for the choice were relevance to the main health problems, availability of a reliable data collection system, feasibility of the collection and analysis process at the two health system levels proposed and extent to which the information provides clues for policy options. The process of putting these principles into practice involved a series of meetings and discussions, with input provided by many professionals working in the sector of child public health as well as in specific problem areas. Consensus was finally reached on a minimum set of indicators which can be defined in traditional terms as being either of the outcome (mortality and morbidity) or process type.	• Number of deaths per 100,000 population 1-14 years • Number of deaths due to accidents per 100,000 population 1-14 years • Number of deaths per 100,000 population 15-24 years • Number of deaths due to accidents per 100,000 population 15-24 years • Number of deaths due to suicide per 100,000 population 15-24 years • Number of new cases of child abuse and neglect detected per year in children 0-14 years of age per 1,000 children 0-14 years • Number of new cases of sexual abuse detected per year in children 0-14 years of age per 1,000 children 0-14 years Only those indicators pertaining to injury are listed here. The full set of indicators for infant, child and adolescent health can be found in the article.	Research projects were commenced in order to evaluate the feasibility and impact of the suggested CHIS at different levels of the NHS. A first pilot project was carried out during 1998 to assess the feasibility of collecting the data regarding 12 of the indicators in five health districts belonging to three health authorities in the Campania region. The results point to difficulties in collecting reliable data with breakdown at the district level, but show that data are useful in identifying critical areas for intervention. A major project was financed by the Italian Ministry of Health and started in November 1998. It is aimed evaluating the feasibility of the proposed CHIS and its impact on the present health plans in two Italian regions (Friuli-Venezia Giulia and Calabria), which were chosen as samples of very different socioeconomic and health systems.
Cryer, P.C., Jarvis, S.N., Edwards, P. & Langley, J.D. (2000). Why the Government was right to change the 'Our Healthier Nation' accidental injury target. *Public Health, 114, 232-237.* Retrieved September 1, 2006, from http://www.sciencedirect.com AND Cryer, P.C., Jarvis, S.N., Edwards, P. & Langley, J.D. (1999). How can we reliably measure the occurrence of non-fatal injury? *International Journal for Consumer & Product Safety, 6(4), 183-191.*		United Kingdom and New Zealand
Criteria for a good indicator of non-fatal injury are postulated, and an indicator based on serious long-bone fractures is proposed. Inferences from the literature and the various non-fatal injury data to which we have access are used to justify the criteria, and to test the proposed indicator of serious injury against the criteria.	• Occurrence of serious long bone fracture as an indicator of the occurrence of serious injury, defined as those cases admitted to hospital with a primary diagnosis of fracture of the femur, or for fractures of the other long bones of the upper and lower limbs for which some operative procedure of the bones	• The indicator reflects the occurrence of injury satisfying a case definition of anatomical damage since it is designed to identify all cases of fractured femur, or all displaced fractures of other long bones. • Almost all long bone fractures satisfying the given definition have

	(excluding the hands and feet) was carried out.	AIS = 3. These injuries are associated with a range of serious consequences. • The great majority of serious injuries are admitted to hospital and so are potentially identifiable from routine data • The probability of a case being identified will be largely independent of social, and health services supply and access factors, since close to complete ascertainment of these cases can be expected.
Healthy People 2010 Volume II (second edition) Objectives for Injury and Violence. (2002). Retrieved August 11, 2006, from http://www.healthypeople.gov/Document/HTML/Volume2/15Injury.htm		United States
One of the Leading Health Indicators for Healthy People 2010 is Injury and Violence. The Leading Health Indicators reflect the major public health concerns in the United States and were chosen based on their ability to motivate action, the availability of data to measure their progress, and their relevance as broad public health issues. The process of selecting the Leading Health Indicators mirrored the collaborative and extensive efforts undertaken to develop Healthy People 2010. The process was led by an interagency work group within the U.S. Department of Health and Human Services. Individuals and organizations provided comments at national and regional meetings or via mail and the Internet. A report by the Institute of Medicine, National Academy of Sciences, provided several scientific models on which to support a set of indicators. Focus groups were used to ensure that the indicators are meaningful and motivating to the public. In the Healthy People 2010 Volume 2 Summary of Objectives, the goal under injury and violence prevention is to reduce injuries, disabilities and deaths due to unintentional injuries and violence.	*Injury Prevention* • Non-fatal head injuries • Non-fatal spinal cord injuries • Firearm related deaths • Proper firearm storage in homes • Non-fatal firearm related injuries • Child fatality review • Nonfatal poisonings • Deaths from poisoning • Deaths from suffocation • Emergency department surveillance systems • Hospital discharge surveillance systems • Emergency department visits *Unintentional Injury Prevention* • Deaths from unintentional injuries • Nonfatal unintentional injuries • Deaths from motor vehicle crashes • Pedestrian deaths • Nonfatal motor vehicle injuries • Nonfatal pedestrian injuries • Safety belts • Child restraints • Motorcycle helmet use • Graduated driver licensing • Bicycle helmet use • Bicycle helmet laws • Residential fire deaths • Functional smoke alarms in residences • Deaths from falls • Hip fractures • Drownings • Dog bite injuries • Injury protection in school sports *Violence and Abuse Prevention* • Homicides • Maltreatment and maltreatment fatalities of children • Physical assault by intimate partners • Rape or attempted rape • Sexual assault other than rape • Physical assaults • Physical fighting among adolescents • Weapon carrying by adolescents on school property	This report does not comment on the validity or characteristics of the indicators.
Peoples-Sheps, M., Guild, P.A., Farel, A.M., Cassady, C.E., Kennelly, J., Potrzebowski, P.W. & Waller, C.J. (1998). Model Indicators for Maternal and Child Health: An Overview		United States

of Process, Product, and Applications. *Maternal and Child Health Journal, 2(4), 241-256.*		
This article describes development key characteristics, and major applications of a set of Maternal Child Health Model Indicators (MCH MI). A conceptual model with five domains was created to organize and guide development of the indicators. The development process included systematic specification of concepts, formulas, age/gender groups, and data sources, as well as recommendations for frequency of surveillance. Information sources included published reports and expert opinion. Included here are the recommended MCH model indicators that pertain to injury. A full list of model indicators by domain and category can be found in the article.	• Motor vehicle-occupant injury hospitalization rate • Motor vehicle-pedestrian injury hospitalization rate • Motor vehicle-pedal cycle injury hospitalization rate • Non-automobile motor vehicle injury hospitalization rate • Fire/hot object injury hospitalization rate • Poisoning incidence rate • Firearm injury hospitalization rate • Fall injury hospitalization rate • Cut/pierce injury hospitalization rate • Assault injury incidence rate • Motor vehicle-pedestrian mortality rate • Motor vehicle-pedal cycle mortality rate • Other transport vehicle mortality rate • Drowning/submersion mortality rate • Mortality due to suffocation rate • Asthma mortality • Homicide rate • Suicide rate	The article does not comment on the validity or characteristics of the indicators

OVERALL HEALTH SERVICES IMPLICATIONS OF INJURY

Reference		Jurisdiction
Summary	Injury Indicators	Characteristics and Quality of Indicators
Shanahan, M. and Gousseau, C. (1999). Using the POPULIS Framework for Interprovincial Comparisons of Expenditures on Health Care. *Medical Care, 37(6), JS83-JS100.* Retrieved August 11, 2006, from Ovid database.		Canada
This study is a descriptive project designed to inform the health policy process by comparing indicators of need and expenditure across Canada. Population characteristics that are known to influence the need for health care constitute the comparative data categories. The analyses of population characteristics was done in three steps: 1) Initially, provinces were ranked according to age-standardized mortality. 2) Provinces were compared on indicators of health status, socio-economic status, and demographics, all of which might be expected to be related to health care expenditures. 3) Relationships among the three series of characteristics were examined. Next, the expenditure data for each province were examined.	• Age-standardized mortality, death rates per 100,000 population • Infant mortality, infant deaths (less than 1 year) per 1,000 live births, 3 yr. average • Self-rated health status, self-rated excellent health as % of population • Smoking, %population >12 yrs. Current smokers • PYLL, Years of life lost prior to age 70, per 1,000 population • Educational attainment, %population > 20 years with less than high school • Income<Poverty level, %of population below 1992 low income cut-off points, taking into account household size & regional cost of living • Poverty rates children in lone-parent families, %children in lone-parent families under poverty income cut-offs • Unemployment rate, %population > 15yr • Labour force participation of women, % of females > 15 years in workforce • Income inequality, Gini coefficient, measure of income inequality, 0=perfect equality in income, 1.0=one family receiving all the income and the rest receive nothing • Mean value occupied dwelling • Gross domestic product, GDP per capita • % Population 65+ • % Population >65, projected for 2011	The authors state that in this project, both conceptual and data validity issues made the identification of convergent validity difficult. They do not comment on the validity of the indicators.

TRAUMA CARE, QUALITY AND OUTCOMES		
Reference		Jurisdiction/Population
Summary	Injury Indicators	Characteristics and Quality of Indicators
Ashton, C. and Wray, N. (1996). A conceptual framework for the study of early readmission as an indicator of quality of care. *Social Science & Medicine. 43(11), 1533-1541.*		Hospital patients in whom substandard care processes lead to premature discharge.
Authors devised a conceptual model for the use of unscheduled readmission within 31 days as an indicator of the quality of medical-surgical inpatient care for adults, and then conducted a systematic review of the readmission literature to determine the extent to which the evidence supports the proposed relationships.	• Unscheduled early readmission to hospital within 31 days	A fairly complex web of relationships influences the association between the process of inpatient care and early readmission. From the evidence to date, it is impossible to say with confidence that early readmission is or is not a valid and useful quality indicator.
Pieper, P. and Tepas, J.J.III. (1996). Jacksonville Pediatric Injury Control System: A Multidisciplinary Quality Improvement Program. *International Journal of Trauma Nursing, 2, 49-55.*		Jacksonville, Florida (USA)
The authors present the Jacksonville Pediatric Injury Control System as a multidisciplinary forum created to identify, discuss, and recommend actions that improve the care of pediatric trauma patients in the Jacksonville, Florida, area. Daily events that affect the outcome of injured children are measured. The authors argue that outcome can no longer be measured by merely decreasing mortality and patient impairment but must also include how efficiently this is achieved. To improve the ability to treat pediatric injury, factors that undermine this efficiency must be controlled. The Jacksonville Pediatric Injury Control System accomplishes this in a manner that uses existing resources to focus the pursuit of excellence for an entire community of professionals committed to improved care for the injured child. The authors do not specify how the list of indicators was developed.	• No protective device • Preexisting disease/anomaly • No protective device available • Hypothermia • Adverse weather conditions • Deficient visibility • Adverse geographic conditions • Scene time >20 minutes • Inaccurate scoring • Improper triage • Inadequate/inaccurate documentation • Inadequate patient monitoring • Delayed upward triage (>6 hr) • Inappropriate placement in follow-up Facility • No autopsy • No organ donation • Inadequate medical control • Inadequate initial care • Incorrect initial care • Delayed diagnosis • Delay to definitive care • Error in diagnosis • Missed injury • Delayed physician interaction • Inappropriate intravenous fluid (vol/type) • Inadequate nutritional support • Rehabilitation not consulted within 48 hours of admission • Delayed placement • Extubated within 24 hours of endotracheal intubation • Fluid/electrolyte imbalance • Blood dyscrasia/coagulopathy • Sepsis • Organ system failure • Unplanned return to operating room • Pneumonia • Wound problem • Decubitus/stasis anomaly • Contracture/joint limitation • Readmission for injury-related problem • Late injury-related death	The article does not comment on the validity of the indicators.

Nayduch, D., Moylan, J., Long Snyder, B., Andrews, L., Rutledge, R. & Cunningham, P. (1994). American College of Surgeons Trauma Quality Indicators: An Analysis of Outcome in a Statewide Trauma Registry. *Journal of Trauma, 37(4), 565-575.*		North Carolina State Trauma Registry
The purpose of this study was to analyze the ability of the American College of Surgeons trauma patient audit filters to predict adverse patient outcome following injury requiring review. The study population consisted of 44,019 patients from the North Carolina State Trauma Registry. The filters were tested against the data base as a whole, including both pediatric and adult patients since only one filter specifies the adult population. The nine filters selected for review were those with data available in the statewide trauma registry. The plan of analysis compared the outcomes for patients who met the audit filter criteria (indicator) with those who did not meet the audit filter criteria (non-indicator). Mean values and frequencies were calculated for the dependent variables, mortality, length of stay (LOS), and hospital charges, and compared between groups. Categorical variable frequencies were compared with the Chi-square test and continuous variables were compared using Student's *t* test.	• Ambulance scene time > 20 minutes • Comatose trauma patient leaving ED before mechanical airway established • Any patient sustaining a gunshot wound to the abdomen who was managed nonoperatively • Patients requiring laparotomy, which was not performed within 2 hours of arrival at ED • Patients with EDH or SDH receiving craniotomy more than 4 hours after arrival at ED, excluding those performed for ICP monitoring • Patients transferred to another health care facility after spending > 6 hours in the initial hospital • Trauma patient admitted to hospital under care of admitting or attending physician who is not a surgeon • Nonfixation of femoral diaphyseal fracture in adult trauma patient • All trauma patients developing DVT, PE, decubitus ulcer	The study suggests that audit filters should be data driven and based upon analyses of large populations of injured patients and their outcomes to be valid quality assurance/quality improvement tools.

MOTOR VEHICLE OCCUPANT INJURY

Reference		Jurisdiction/Population
Summary	Injury Indicators	Characteristics and Quality of Indicators
Farchi, S., Molino, N., Giorgio Rossi, P., Borgia, P., Krzyzanowski, M., Dalbokova, D., Kim, R., Working Group ER (2006). Defining a common set of indicators to monitor road accidents in the European Union. *BMC Public Health, 6(1), 183.*		European Union
This paper reports the methodology and the results of a project set forth by the European Union (EU) and coordinated by the WHO aimed at identifying and evaluating a core set of indicators to monitor the causal chain of road accident health effects. A group of experts (WG), identified 14 Environment and Health indicators after a review of the information collected at the EU level, each of them representing a specific aspect of the DPSEEA (Driving, Pressure, State, Exposure, Effect, Action) model applied and adapted to the road accidents. Each indicator was scored according to a list of 16 criteria chosen by the WG. 11 of the 14 indicators were found to have a high score and were analyzed to determine if they were compatible with EU legislation and then tested in the feasibility study.	1. Age of vehicle fleet 2. Person time spent on the road 3. Passengers-kilometres by mode of transportation 4. Use of vehicle safety device 5. Mortality due to drunk driving 6. Speed limit excesses 7. Mortality due to road accidents 8. Injury rate 9. Potential years of life lost 10. DALY lost for road accidents 11. Road accident rate	Results of Feasibility Testing: • Ready and recommended for immediate implementation – 1, 3, 7, 8, 9, 11 • Desirable, though requiring further developmental work – 2, 4, 5, 6, 10

Cryer, C., Langley, J.D., Jarvis, S.N., Mackenzie, S.G., Stephenson, S.C.R., Heywood, P. & on behalf of the International Collaborative Effort on Injury Statistics Injury Indicators Working Group (2005). Injury outcome indicators: the development of a validation tool. *Injury Prevention, 11, 53-57.* Retrieved June 5, 2006, from http://injuryprevention.bmj.com/		Canada, New Zealand, and United Kingdom
This paper presents an early step in the development of a tool for validating injury indicators, as well as some directions that can be taken in its further development. Previously proposed criteria were shared for comment with members of the International Collaborative Effort on Injury Statistics (ICE) Injury Indicators Group over a period of six months. Immediately after, at a meeting of Injury ICE in Washington, DC in April 2001, revised criteria were agreed over two days of meetings. The criteria were applied, by three raters, to six non-fatal indicators that underpin the national road safety target for Canada, New Zealand, and the United Kingdom. Consistency of ratings was judged.	• Number of road users killed and seriously injured in motor vehicle traffic crashes (Canada) • Number of vulnerable (pedestrians, motorcyclists and cyclists) road users killed and seriously injured in motor vehicle traffic crashes (Canada) • Reported injuries resulting from motor vehicle accidents per 100,000 people (New Zealand) • Number hospitalized (discharges) people for reported injuries resulting from motor vehicle accidents (New Zealand) • Number of road users killed and seriously injured in road accidents (United Kingdom) • Number of people slightly injured in road accidents per 100 million vehicle kilometers (United Kingdom)	• For all the indicators, there was reasonable consensus between the three raters that case definition was poorly satisfied (ratings inconsistent with the UK indicators) • Serious injury was either poorly satisfied or the ratings of indicators were inconsistent • There was reasonable consensus across all the indicators that case ascertainment was satisfied to a moderate degree, with the exception of the first United Kingdom indicator for which the results were inconsistent • There was reasonable degree of consistency of rating across all indicators that representativeness was satisfied.
Langley, J., Stephenson, S., & Cryer, C. (2003). Measuring Road Traffic Safety Performance: Monitoring trends in nonfatal injury. *Traffic Injury Prevention, 4(4), 291-296.*		New Zealand
The aim of the research described in this article was to compare trends in the official indicators with trends in selected threat-to-life indicators. The two threat-to-life measures used were the New Injury Severity Score and the International Classification of Diseases-based Injury Severity Score.	• Reported injuries • Reported injuries per 10,000 vehicles • Reported injuries per 100,000 people • Number of persons hospitalized	The authors state that given the prominence of motor vehicle crashes as a cause of unnecessary morbidity, more thought needs to be given to deriving valid indicators for measuring trends in serious nonfatal injury.
Road Safety to 2010 (2003). *Land Transport Safety Authority and New Zealand Health Information Service.* Retrieved September 6, 2006, from http://www.ltsa.govt.nz/strategy-2010/strategy-road-saf-outcome-nz.html		New Zealand
This report outlines a strategy that uses an 'outcomes management' framework that links what we do (outputs) to what we are trying to achieve (outcomes), and focuses attention on providing the safest possible road network for New Zealanders. The report states goals for social cost, deaths and hospitalizations to 2010.	• Death rate per billion vehicle-km • Death rate per 100,000 person • Death rate per 10,000 vehicles • Hospitalization rate per billion vehicle-km • Hospitalization rate per 100,000 person • Hospitalization rate per 10,000 vehicles • Hospitalizations for more than 1 day • Hospitalizations for more than 3 days • Number of driver deaths with excess alcohol • % of all driver deaths • % of vehicle occupants wearing safety belts (front) • % of vehicle occupants wearing safety belts (back) • % of children (under 15) restrained • Pedestrians: total • Pedestrians: more than 1 day's hospitalization • Pedestrians: more than 3 days' hospitalization • Pedestrians per million hours travelled: total	The report does not comment on the validity or characteristics of the indicators.

	• Pedestrians per million hours traveled: more than 1 day's hospitalization • Pedestrians per million hours traveled: more than 3 days' hospitalization • Cyclists: total • Cyclists: more than 1 day's hospitalization • Cyclists: more than 3 days' hospitalization • Cyclists per 100 million km cycled: total • Cyclists per 100 million km cycled: more than 1 day's hospitalization • Cyclists per 100 million km cycled: more than 3 days' hospitalization	
Gutoskie, P. (2001). Canada's Road Safety Targets to 2010. *Transport Canada, Minster of Public Works and Government Services.* Retrieved September 8, 2006 from http://www.tc.gc.ca/roadsafety/tp/tp13736/pdf/CRS_Target.pdf		Canada
Canada's inaugural national road safety vision – "to have the safest roads in the world," and plan, Road Safety Vision 2001, were adopted by the Council of Ministers of Transportation and Highway Safety in 1996. Road Safety Vision 2010 will retain the Vision and its strategic objectives, and also include an overall national target and sub-targets. The national target calls for a 30% decrease in the average number of road users killed and seriously injured during the 2008-2010 period over comparable 1996-2001 figures. The sub-targets include a 20-40% decrease in each of the indicators of injury listed here.	• Rate of seatbelt wearing and proper use of child restraints • Number of unbelted fatally or seriously injured occupants • % of road users fatally or seriously injured in crashes involving a drinking driver • # of road users killed or seriously injured in speed and intersection related crashes • % of drivers who commit three high-risk driving infractions (two if they are alcohol-related) within a two-year time frame • # of young drivers/riders (those aged 16-19 years) killed or seriously injured in crashes • # of road users killed or seriously injured in crashes involving commercial carriers • # of vulnerable road users (pedestrians, motorcyclists and cyclists) killed or seriously injured • # of road users fatally or seriously injured on rural roadways	The report does not comment on the validity or characteristics of the indicators.
Simon, B.J. (1994). Vehicular trauma triage by mechanism: avoidance of the unproductive evaluation. *Journal of Trauma-Injury Infection & Critical Care. 37(4), 645-649.*		Vehicular-related Trauma victims >16 years of age at a level I trauma center
An instrument was developed using routinely available field data to identify the sizable subgroup of stable vehicular trauma victims initially triaged to the trauma center by mechanism indicators alone who are in reality at minimal risk for serious injury. The six most common vehicular mechanism indicators seen at a level I trauma center were evaluated. Outcome indicators were used to classify patients into two groups. A checklist was developed for Mechanism vehicular trauma and a single positive element would define trauma team activations.	• Rollover • Head-on greater than 30 mph • Intrusion • Prolonged extrication • Other death in same vehicle • Ejection	The authors do not comment on the validity or characteristics of the indicators.
Planek, T.W., Hoskin, A.F., Fearn, K.T., Miller, T.A., & Race, K.E.H. (1990). Exploration of impact measures of safety belt use laws. Volume 1. Final Report. *National Safety Council, National Technical Information Service, PB90-256082/WTS.*		Springfield, VA (USA)
This project identified, evaluated, and recommended indicators of safety belt use law (SBUL) impact, as well as institutional sources that collect them. The project involved an extensive literature review,	• The "KABC" injury scale used on police accident reports • The Abbreviated Injury Scale used on medical records and its derivative Injury Severity Score • Occupant ejections from vehicles head and face	Valid and reliable SBUL impact indicators are not immediately available from the many existing sources and it is unlikely that they can be generated quickly.

indicator assessment, and a survey of data sources. Four indicators out of 52 candidates were judged to have the highest potential for assessing SBUL impacts	injuries including cranium, brain, and concussive injuries, but excluding ear and eye injuries	
Bangdiwala, S., Anzola-Perez, E., & Glizer, I.M. (1985). Statistical considerations for the interpretation of commonly utilized road traffic accident indicators: implications for developing countries. *Accident Analysis and Prevention, 17(6), 419-427.*		Selected countries in the Americas
This paper focuses on the national and international level mortality indicators most commonly used with the intent of providing a statistical and epidemiological interpretation of the indicators most readily available in the developing countries. The goal is to provide a helpful guide to health planners in such countries for improving their data collection systems and, therefore, their information available for health care planning.	• Number of accidents • Number of injuries from traffic accidents • Number of deaths from traffic accidents • Mortality "rate" for traffic accidents per 10,000 motor vehicles • Mortality "rate" for traffic accidents per 100 million km-vehicles • Accident "rate" • Mortality "rate" for traffic accidents per 100,000 inhabitants • Mortality "rate" for traffic accidents per 100 million km passengers • Motorization index • Index of mortality from road traffic accidents • Proportion of traffic accidents as a cause of mortality	The authors state that the quality of the information summarized in the various statistical indictors depends entirely on the quality of the original data collected by the police or other sources. They do not comment on the validity of the indicators.
OTHER MOTOR VEHICLE OCCUPANT INJURY ARTICLES		
Elvik, R. (1995). The validity of using health state indexes in measuring the consequences of traffic injury for public health. *Social Science and Medicine, 40(10), 1385-98.*		
SPORT, RECREATION & LEISURE INJURY INDICATORS		
Reference		Jurisdiction
Summary	Injury Indicators	Characteristics and Quality of Indicators
Kopjar, B. (2000). Population preventable fraction of bicycle related head injuries. *Injury Prevention, 6,235-238.* Retrieved August 21, 2006, from http://injuryprevention.bmj.com/		Stavanger, Norway
This study analyzes the population attributable fraction (PAF) of bicycle head injuries due to non-helmet use. The concept of the PAF and Levin's formula for its calculation were used to develop mathematical models for estimation of: (i) attributable fraction of bicycle related head injuries in the population due to non-helmet use, (ii) expected proportion of helmeted cases among all head injuries, and (iii) estimate of the helmet use rate in the population based on patient case information. The PAF was calculated for a sample of injuries from Stavanger, Norway.	• Fraction of bicycle related head injuries attributable to helmet non-use by helmet use rate and helmet effectiveness • Estimated number of preventable cases of bicycle related bicycle injuries • Injuries among helmet users (non-preventable) • Preventable cases among helmet nonusers • Non-preventable cases occurring among helmet non-users	If applied correctly, the PAF is a valid and useful indicator for the population effects of bicycle helmets.
INTENTIONAL INJURY INDICATORS		
No articles were found that listed only intentional injury indicators; rather, they were listed in the literature with other types of indicators.		
HEALTH INDICATORS		
Reference		Jurisdiction
Summary	Injury Indicators	Characteristics and Quality of Indicators
Arah, O.A. & Westert, G.P. (2005). Correlates of health and healthcare performance: applying the Canadian health indicators framework at the provincial-territorial level. *BMC Health Services Research, 5:76. Retrieved August 14, 2006, from* http://www.biomedcentral.com/1472-6963-5-76		Canada
The authors conducted univariate correlational	• Self-rated health (excellent or very good)	No information is provided on

analyses with health and healthcare performance as outcomes using recent Canadian data and the ten Canadian provinces and three territories as units of the analyses. For health, 6 indicators were included. Sixteen healthcare performance indicators, 12 non-medical determinants of health and 16 indicators of community and health system characteristics were also included as independent variables for the analysis. A set of decision rules was applied to guide the choice of what was considered actual and preferred performance associations. They used recent (2001 to 2003) secondary data on the performance of the thirteen Canadian provinces and territories usually reported on by the government. The data which cover 95% of the Canadian population are appropriately age, population and gender weighted.	• Body mass index higher than 27 • Functional health (perfect or very good) • Satisfied with family doctor • Satisfied with health care services • Satisfied with community health care • Difficulties accessing routine care • Difficulties accessing health information • Ambulatory care sensitive conditions	the validity, characteristics, or criteria of these indicators. This study suggests that relatively better performance on non-medical determinants of health is related to better health. Healthcare performance is, however, less frequently related to health. In addition, health is relatively better associated with community/health system characteristics than healthcare performance is.
Casebeer, A., Deis, K., & Doze, S. (1999). Health Indicator Development in Alberta Health Authorities: Searching for Common Ground. *Canadian Journal of Public Health, 90, Supplement 1, S57-61.*		Alberta, Canada
A collaborative approach to indicator identification and classification was forwarded through the creation of a targeted survey. Simplicity and user-friendliness were the overriding principles for survey development. SEARCH participants in all regions were involved and they, in turn, sought out several local stakeholders in order to complete the indicator survey. The survey tool was used to collect information related to indicator definition, method of calculation, users of the indicator, and the data source. By integrating the CIHI indicator framework with the dimensions of quality proposed by the Canadian Council on Health Services Accreditation (CCHSA), a new conceptual model for framing and organizing the inventory emerged. Following the development of the framework, the indicators submitted by the regions and provincial health authorities were categorized. Indicators were collapsed using a two-stage small group process to allow for verification, to ensure consistency in the grouping of the indicators, and to reduce duplication and retain validity.	• Proportion of population living below the low income cut-off • Proportion of regular smokers • Number referred to and from Specific Service or Program • Number of admissions to Specific Program or Service • Number served/Number of visits/Number of consultations • Average length of stay • Number of separations/ discharges • Wait Lists • Proportion of People who do not perceive themselves in good health/subjective health ratings • Hospitalization rate • Mortality by cause, age, gender and location and trending • Potential years of life lost	A lack of standardization and validation of indicators as evident.
Healthy People 2010 Volume II (second edition) (2002). Retrieved August 11, 2006, from http://www.healthypeople.gov/Document/html/uih/uih_4.htm		United States
The Leading Health Indicators reflect the major public health concerns in the United States and were chosen based on their ability to motivate action, the availability of data to measure their progress, and their relevance as broad public health issues. The process of selecting the Leading Health Indicators mirrored the collaborative and extensive efforts undertaken to develop Healthy People 2010. The process was led by an interagency work group within the U.S. Department of Health and Human Services. Individuals and organizations provided comments at national and regional meetings or via mail and the Internet. A report by the Institute of Medicine, National Academy of Sciences, provided several scientific models on which to support a set of indicators. Focus groups were used to ensure that the indicators are meaningful and motivating to the public.	• Physical activity • Overweight and obesity • Tobacco use • Substance abuse • Responsible sexual behaviour • Mental health • Injury and violence • Environmental quality • Immunization • Access to health care	This report does not comment on the validity or characteristics of the indicators.

Keppel, K.G., Pearcy, J.N., & Wagener, D.K. (2002). Trends in racial and ethnic-specific rates for the Health Status Indicators: United States, 1990-98. In: *Healthy People Statistical Notes. No. 23. Hyattsville, Md: National Center for Health Statistics.* Retrieved September 1, 2006, from http://www.cdc.gov		United States
In this report national trends in racial and ethnic-specific rates for 17 Health Status Indicators (HSIs) are examined for the period from 1990-98. Under the auspices of the Centers for Disease Control and Prevention, a group of public health professionals, known as Committee 22.1, was convened to identify a set of HSIs. Through a rigorous consensus process, a list of 18 HSIs was developed and published in 1991. Rates or percents are shown for five racial/ethnic groups. Where appropriate, the data for the HSIs are age adjusted to control for differences in age composition among the racial/ethnic groups. The quality of racial and ethnic data is known to vary; however, the effect on the findings presented here cannot be specified.	• Infant mortality rates • Low birthweight (percent) • No prenatal care in first trimester(percent) • Live birth rates for women age 15-17 years • Total death rates • Heart disease death rates • Stroke death rates • Lung cancer death rates • Female breast cancer death rates • Motor vehicle crash death rates • Suicide death rates • Homicide death rates • Work-related injury death rates • Tuberculosis case rates • Primary and secondary syphilis case rates • Children under age 18 years in poverty (percent) • Percent with poor air quality	This report does not comment on the validity or characteristics of these indicators. It does mention that two indicators were omitted due to being invalid indicators
Li, G. and Baker, S. (1996). Exploring the malefemale discrepancy in death rates from bicycling injury: The Decomposition Method. *28(4), 537-540.*		United States
This study was undertaken to quantitatively examine the major determinants of the male-female discrepancy in death rates from bicycling injury by applying the Decomposition Method innovated by the authors. This study demonstrates that decomposition of death rates is a comprehensive method for exploring discrepancies observed in death rates among different populations or among different time periods.	• Population death rate	The population-based death rate is a measure reflecting the collective effect on mortality of many factors such as age and sex composition, environment, and exposure to the risk of disease or injury. The differences in death rates among different populations or for a given population among different time periods are easy to identify but are usually difficult to explain because of the many attributable factors.

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