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Hospital Costs of Trauma Admissions in Canada, 2000/2001

Injuries, which are considered largely preventable, pose an economic burden to society, including hospital systems. In March 2002 the Ontario Trauma Registry (OTR) estimated that the hospital costs of Ontario trauma admissions in 1999/2000 exceeded \$433 million¹. Lacking comprehensive national and provincial cost estimates, this report expands upon the OTR study by estimating the hospital costs associated with trauma admissions in Canada that occurred in fiscal year 2000 (April 1, 2000 through March 31, 2001). Information about injury hospitalizations is drawn from the National Trauma Registry Minimal Data Set (NTR MDS), which is a subset of the Hospital Morbidity Database (HMDB). The Canadian Institute for Health Information (CIHI) manages both these databases. The source of hospital cost information is the Ontario Case Costing Initiative (OCCI), which is an initiative of the Ontario Ministry of Health and Long-Term Care.

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¹ Canadian Institute for Health Information (CIHI). Hospital Costs of Trauma Admissions in Ontario, 1999/2000. Toronto, ON: CIHI, 2002.

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A. DATA SOURCES

Information about trauma hospitalizations is taken from the National Trauma Registry Minimal Data Set (NTR MDS), a subset of the Canadian Institute for Health Information's (CIHI) Hospital Morbidity Database (HMDB). The NTR MDS contains demographic, diagnostic and procedural information on trauma-related admissions to all acute care hospitals across Canada. NTR MDS cases are selected from the HMDB based on specific External Cause of Injury Codes (E Codes) within the International Classification of Disease, 9th revision (ICD-9). Trauma is defined as injury resulting from the transfer of energy. Examples of causes of injury that are excluded from this definition are poisonings by drugs and gases, adverse effects of drugs and biological substances, and late effects of injury. For details about NTR MDS inclusion criteria, refer to Appendices C and D.

Hospital cost information is from the Ontario Case Costing Initiative (OCCI), a Ministry of Health and Long-Term Care initiative. Selected Ontario hospitals submit costing data about acute inpatient cases to the OCCI. The case costing methodology used by participating hospitals is based on CIHI's Management Information Systems (MIS) Guidelines. OCCI methodology assigns hospital costs to one of two categories. **Direct costs** include patient care costs such as diagnostic imaging, nursing, and laboratory services. **Indirect costs** are those accrued administering and providing support to patient care such as health records, housekeeping, and financial services. The **total cost** for each case is the sum of direct and indirect costs. For further information about the OCCI and the case costing methodology visit www.occp.com.

B. SCOPE

The case costing information provided by OCCI represents approximately 90% of all costs of providing services to patients while they are hospitalized. Some hospital-based costs, such as those associated with research and some professional care (e.g., physician care) are excluded. Other trauma care costs such as pre-admission and post-discharge care are also excluded, as are broader societal costs such as wages foregone while in hospital or due to inability to return to work.

For this study, average total hospital costs per case treated in Ontario are applied to trauma hospitalization volumes in Canada and in each province. Provincial variations exist in the delivery of hospital care and the associated costs. Accordingly, the estimates presented should not be interpreted as exact. However, this methodology does provide a useful estimate of the economic burden of injuries on the hospital care system.

C. OVERVIEW

Leading Causes of Injury by Volume and Average Total Hospital Cost per Case

In 2000/2001 there were 198,040 trauma hospitalizations in Canada. Falls were the leading specific cause of admission, followed by motor vehicle collisions. In contrast, railway incidents were characterized by the highest associated average total cost per case, followed by injuries caused by fire and flames. Table 1 compares the leading causes of injury by volume and average total cost.

Table 1: Total volume and average total cost per case by leading causes of trauma hospitalization, Canada, 2000/2001

NTR MDS		OCCI	
Leading Causes of Injury	Total Volume	Leading Cost per Injury Case	Average Total Cost per Case ⁺ (\$)
1. Unintentional Falls	110,862	1. Railway Incidents	14,532
2. Other Incidents	32,840	2. Fire and Flames	13,277
3. Motor Vehicle (Traffic)	23,128	3. Legal Intervention	13,253
4. Assault-related	7,959	4. Operations of War	10,605
5. Motor Vehicle (Non-traffic)	5,364	5. Attempted Suicide	10,126
Other Causes of Injury	Total Volume	Other Costs per Injury Case	Average Total Cost per Case ⁺ (\$)
6. Attempted Suicide	3,812	6. Motor Vehicle (Traffic)	9,897
11. Fire and Flames	1,339	8. Unintentional Falls	8,374
17. Railway Incidents	84	10. Motor Vehicle (Non-traffic)	6,431
18. Legal Intervention	73	12. Assault-related	5,713
19. Operations of War	18	14. Other Incidents	4,914

⁺ For reporting purposes, all costs rounded to the nearest dollar.

D. NATIONAL HOSPITAL COST ESTIMATES, 2000/2001

The following formula was used to estimate the total hospital cost by cause of injury (E Codes):

$$\sum (\text{Average total cost per case for each E Code group} \times \text{E Code group volume})^2$$

Based on E Codes, the estimated total hospital cost of trauma hospitalizations in Canada was \$1.5 billion (\$1,510,795,461) in 2000/2001. Although the average cost per case for unintentional falls ranked 8th among all causes, Figure 1 shows that these injuries accounted for more than 60% of the total estimate. This is due to the fact that falls were the leading cause of trauma admissions in 2000/2001, accounting for 56% of all injury hospitalizations in the NTR MDS.

² Refer to Appendix A for cause-specific volume and cost information.

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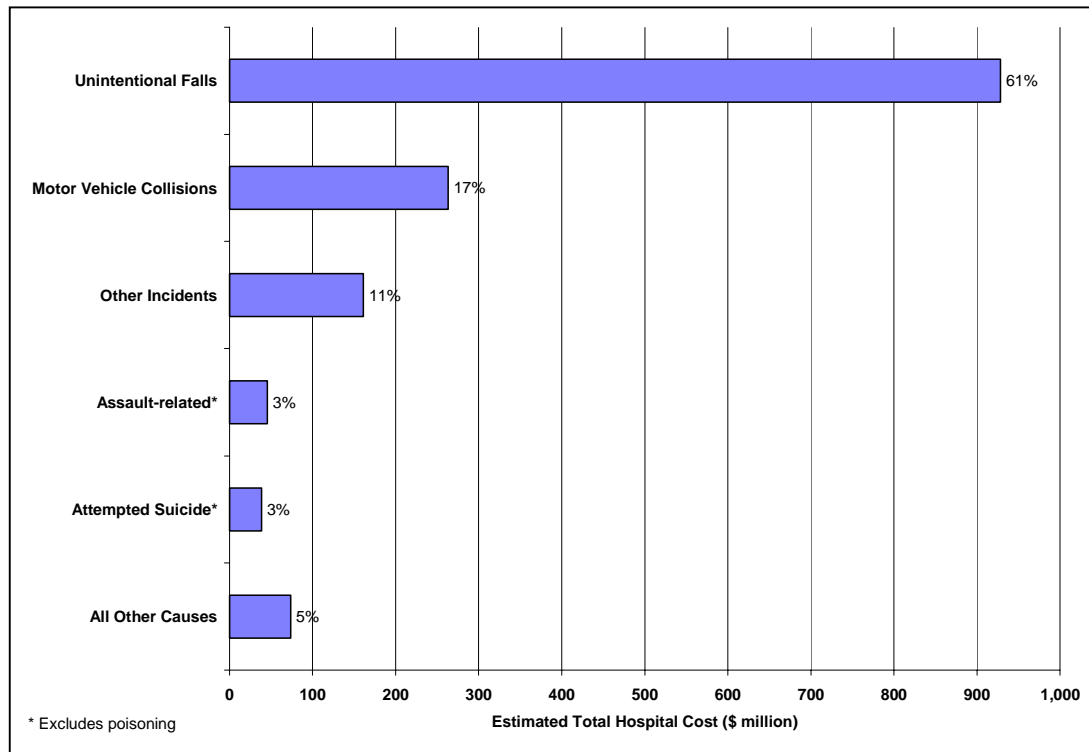


Figure 1: Estimated total hospital cost by cause of injury, Canada, 2000/2001

Age-group and sex comparison

The following formula was applied to estimate age group- and sex-specific costs for unintentional falls and motor vehicle collisions (traffic and non-traffic), the leading specific causes of trauma hospitalizations in the NTR MDS:

$$\sum (\text{Average total cost per case for each sex-specific age group} \times \text{sex-specific age group volume})$$

I. Unintentional Falls

Using the age- and sex-specific method shown above, the total hospital cost associated with hospitalizations due to falls in 2000/2001 was estimated at **\$911 million** (\$911,116,528). This estimate differs from the value of \$928 million reported in Appendix A because cost estimates specific to each age group and sex were used, rather than a less precise average cost per case for all fall hospitalizations.

Females accounted for 59% of the total estimate, which is similar to their representation among all fall injury admissions. Figure 2 shows that among the three lowest age groups, the hospital costs attributed to male patients exceeded those for females. Among cases 65 years of age and older the opposite was true.

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Cases over the age of 65 years accounted for 73% of the estimated total hospital cost for unintentional falls, and the proportion was even greater among female patients (82%). This proportion of the estimate attributed to those over the age of 65 years was greater than their 57% representation among all fall injury admissions. In contrast, 14% of NTR MDS cases were under the age of 25 years, but this age group accounted for only 5% of the estimated total hospital cost. This indicates that for fall-related trauma hospitalizations, it is relatively more expensive to treat older cases. Conversely, it is relatively less expensive to treat younger cases.

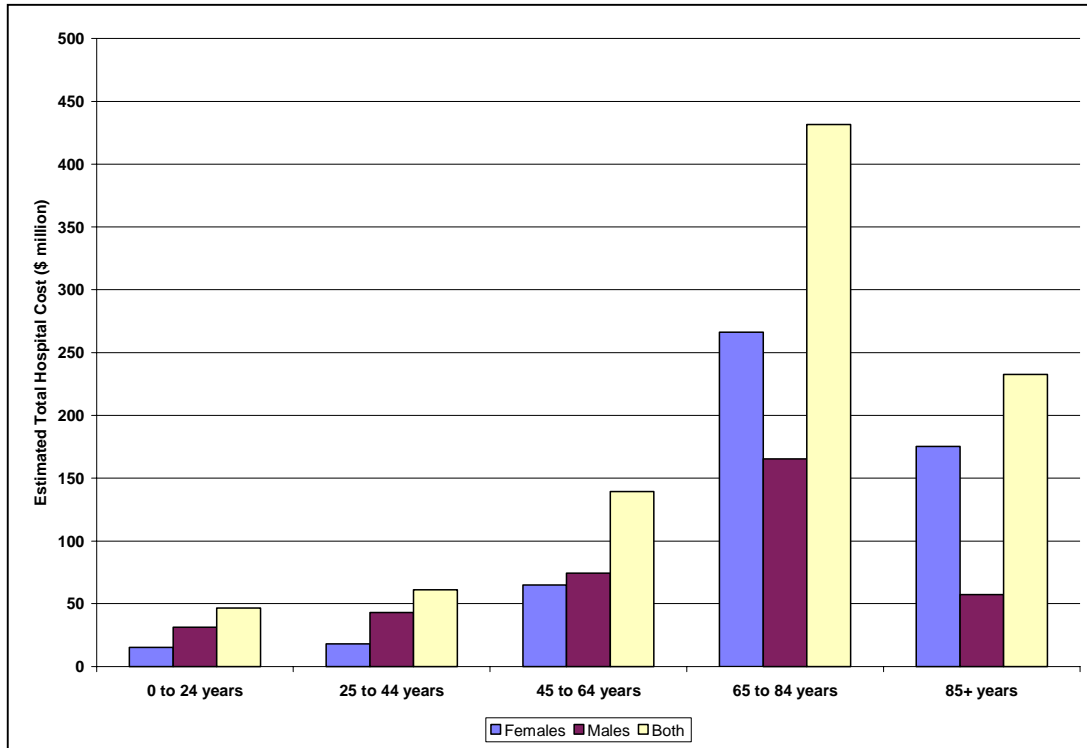


Figure 2: Estimated total hospital cost of unintentional falls by age group and sex, Canada, 2000/2001

II. Motor Vehicle Collisions (Traffic and Non-traffic)

The estimated total hospital cost for motor vehicle collisions using age group- and sex-specific average case costs was \$271 million (\$270,902,310). This value exceeds the estimate of \$263 million reported in Appendix A. Again, this is because age- and sex-specific cost estimates were used.

Males accounted for 69% of the hospital costs estimated for motor vehicle collisions, a proportion similar to their representation among all motor vehicle collision hospitalizations (64%). Figure 3 shows that across all age groups the costs attributed to males exceed those for females.

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The greatest proportion of the estimated total hospital cost for motor vehicle collisions, 31%, was attributed to those under the age of 25, which was slightly less than their proportion among motor vehicle collision hospitalizations (34%). Twenty-four percent of the estimated total hospital cost was attributed to cases between the ages of 25 and 44 years, which is lower than their representation of 32% among hospitalizations. In contrast, cases over the age of 65 years represented only 14% of hospitalizations but accounted for 23% of the estimate. Similar to unintentional falls, it appears that older patients hospitalized due to motor vehicle collisions are more expensive to treat than their younger counterparts.

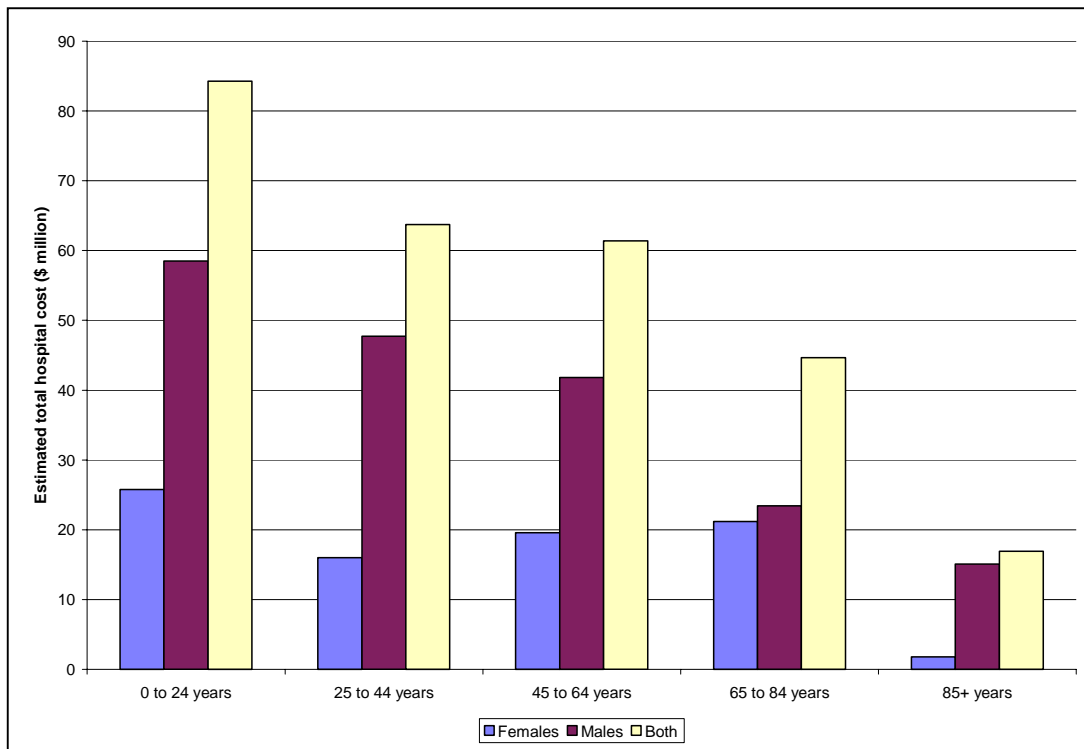


Figure 3: Estimated total hospital cost of motor vehicle collisions by age group and sex, Canada, 2000/2001

E. PROVINCIAL/TERRITORIAL HOSPITAL COST ESTIMATES, 2000/2001

For each province, the following formula was used to estimate the total hospital cost by cause of injury (E Codes):

$$\sum (\text{Average total cost per case for each E Code group} \times \text{E Code group volume})$$

Figure 4 shows that trauma hospitalizations in Ontario accounted for the greatest proportion of the estimated total hospital cost (33%), followed by those treated in Quebec (20%)³. Provincial estimates ranged from less than \$1 million (\$660,964) for trauma cases hospitalized in Nunavut to over \$5 million (\$504,585,346) for those treated in Ontario.

It is important to note that the same case costing information, based on Ontario hospitals, was applied to province-specific volumes. As a result, these estimates reflect the proportion of trauma hospitalizations treated in each province. Some jurisdictions transfer a portion of trauma cases out of the province or territory for hospitalization and other jurisdictions treat these transfer patients.

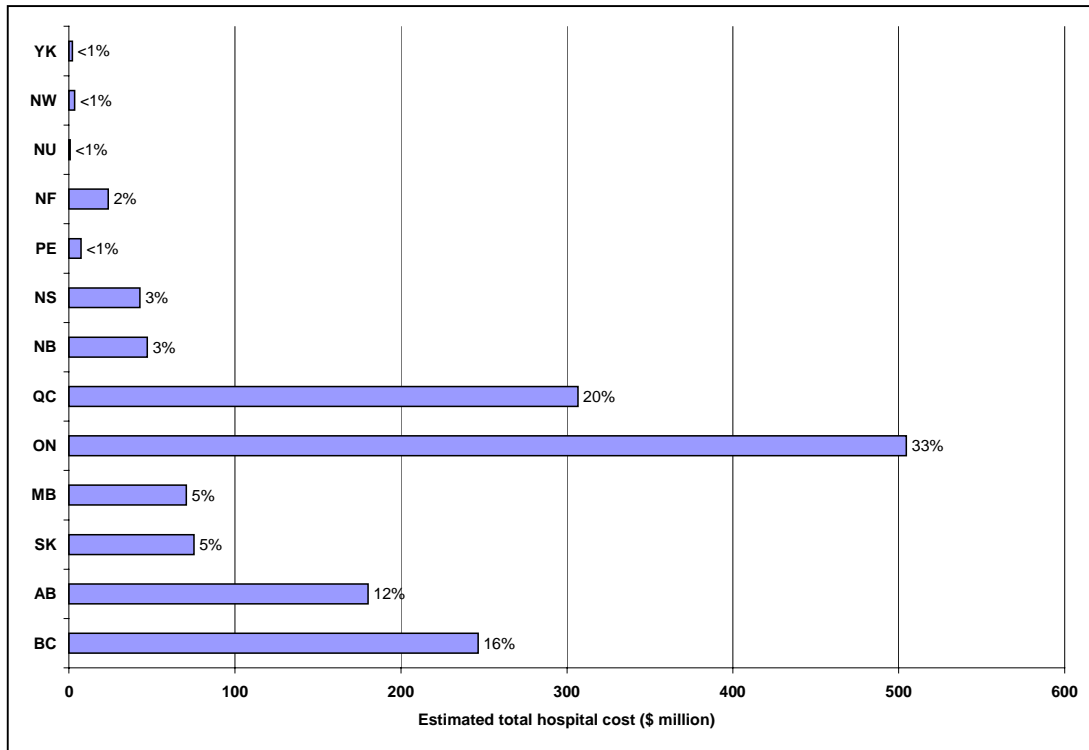


Figure 4: Estimated total hospital cost by province, Canada, 2000/2001

³ Refer to Appendix B for province-specific volume and cost information.

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F. ISSUES TO CONSIDER

In addition to average cost per case, fluctuations in total case volume heavily influence the total hospital cost estimates presented in this bulletin. This should be considered when comparing cost estimates by geography, cause of injury, age groups, and sex.

The costing information provided by OCCI was drawn from eight hospitals in Ontario, four of which are lead trauma facilities. Average case costs from Ontario were applied to all Canadian acute care facilities, regardless of size or geography. Information characterizing these select hospitals does not represent the average hospital costs for all acute care facilities in Canada. Regional differences in case mix, injury severity, care delivery, and combinations of these and other factors exist and all influence hospital care costs. Given this fact, province-specific values are baseline estimates only.

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Appendix A: Estimated Total Hospital Cost by Cause of Injury (E Code)

Cause of Injury	2000 / 2001		
	NTR Volume	Average Total Cost per Case	Estimated Total Hospital Cost
Unintentional fall	110,862	8,374	\$928,322,473
Motor vehicle traffic incident	23,128	9,897	\$228,888,107
Other incidents	32,840	4,914	\$161,383,603
Homicide and injury purposely inflicted (excluding poisoning)	7,959	5,713	\$45,473,030
Suicide and self-inflicted injury (excluding poisoning)	3,812	10,126	\$38,601,667
Motor vehicle non-traffic incident	5,364	6,431	\$34,493,381
Fire and flames	1,339	13,277	\$17,777,246
Natural and environmental factors	2,920	4,407	\$12,867,502
Pedal cycle incident	3,757	3,343	\$12,560,177
Foreign bodies (excluding choking)	2,387	4,361	\$10,409,729
Other road vehicle incidents	1,515	3,717	\$5,630,997
Undetermined whether unintentionally or purposely inflicted	514	9,415	\$4,839,086
Water transport incidents	494	5,841	\$2,885,350
Drowning and suffocation	288	6,725	\$1,936,853
Railway incidents	84	14,532	\$1,220,717
Air and space transport incidents	237	5,053	\$1,197,556
Vehicle incidents not elsewhere classified	449	2,560	\$1,149,611
Legal intervention	73	13,253	\$967,484
Operations of war	18	10,605	\$190,892
TOTAL	198,040		\$1,510,795,461

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Appendix B: Estimated Total Hospital Cost by Province

Province / Territory	2000 / 2001			
	NTR Volume	Estimated Total Hospital Cost	Estimated Total Hospital Cost <i>Falls</i>	Estimated Total Hospital Cost <i>MVCs</i>
Yukon	259	\$2,016,971	\$929,478	\$463,635
Northwest Territories	468	\$3,311,618	\$1,649,614	\$541,759
Nunavut	88	\$660,964	\$192,595	\$159,304
Newfoundland and Labrador	3,163	\$23,669,323	\$13,489,992	\$4,628,276
Prince Edward Island	921	\$7,251,095	\$4,680,885	\$1,408,234
Nova Scotia	5,492	\$42,762,845	\$28,445,378	\$6,643,211
New Brunswick	6,258	\$47,130,247	\$27,465,657	\$9,043,753
Quebec	40,128	\$306,642,788	\$187,561,970	\$57,367,693
Ontario	65,329	\$504,585,346	\$332,401,444	\$76,281,840
Manitoba	9,389	\$70,715,089	\$42,864,848	\$10,837,130
Saskatchewan	10,031	\$75,226,835	\$43,945,052	\$13,108,373
Alberta	24,359	\$180,259,167	\$99,052,214	\$34,773,964
British Columbia	32,155	\$246,563,170	\$145,643,347	\$48,124,316
TOTAL	198,040	\$1,510,795,461	\$928,322,473	\$263,381,487

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Appendix C: NTR Definition of Trauma – E Code Inclusions

The NTR definition of trauma is injury resulting from the transfer of energy. The following table lists the E Code categories included in this definition. The terms 'accident' and 'accidental' used in ICD-9 definitions have been substituted with 'incident' and 'unintentional'.

E Code Inclusions	
E Code Category	Definition
E800 – E807	Railway incidents
E810 – E819	Motor vehicle traffic incidents
E820 – E825	Motor vehicle non-traffic incidents
E826	Pedal cycles
E827 – E829	Other road vehicle incidents
E830 – E838	Water transport incidents
E840 – E845	Air and space transport incidents
E846 – E848	Vehicle incidents not elsewhere classifiable
E880 – E888	Unintentional falls
E890 – E899	Incidents caused by fire and flame
E900 – E902, E906 – E909	Incidents due to natural and environmental factors
E910, E913	Incidents caused by drowning and suffocation
E914 – E915	Foreign bodies (excluding choking)
E916 – E928	Other incidents
E953 – E958	Suicide and attempted suicide (excluding poisoning)
E960 – E961, E963 – E968	Assault-related (excluding poisoning)
E970 – E976, E978	Legal intervention
E983 – E988	Injury undetermined whether unintentionally or purposely inflicted
E990 – E998	Injury resulting from operations of war

Appendix D: NTR Definition of Trauma – Diagnosis Code Inclusions

The following table lists the diagnosis code categories included in the NTR.

Diagnosis Code Inclusions	
Diagnosis Code Category	Definition
800-801, 803-804	Fractured skull
802, 830	Facial injuries
805	Fractured vertebrae
806	Fractured vertebrae with spinal cord injury
839.0 – 839.5	Dislocations of vertebrae
807.0 – 807.4	Fractured ribs or sternum
807.5, 807.6	Fractured larynx or trachea
808	Fractured pelvis
809	Other bones of the trunk
810 – 819, 831 – 834	Fractures and dislocations of upper limbs
820 – 829, 835 – 838	Fractures and dislocations of lower limbs
839.6 – 839.9	Other dislocations
840 – 848	Sprains and strains
850 – 854	Intracranial injury
860 – 869	Internal injuries to the chest, abdomen, or pelvic organs
870 – 879	Open wounds of the head, neck, or trunk
880 – 884, 890 – 894	Open wounds of the limbs (excluding amputations)
885 – 886, 895	Traumatic amputation of digits
887	Traumatic amputation of upper limb
896 – 897	Traumatic amputation of lower limb
900 – 904	Vascular injuries
910 – 919, 920 – 924	Superficial injuries or contusions
925, 929	Crushing injuries
930 – 939 (excluding 933.1)	Foreign bodies (excluding choking)
940 – 949	Burns
952	Spinal cord injury with no bony abnormality
950 – 951, 953 – 957	Other nerve injuries
959, 990 – 994 (excluding 994.2, 994.3, 994.6)	Other and unspecified injuries