WHO/EHA/SPI/96.1
Distr.: General

# STANDARDS FOR SURVEILLANCE OF NEUROTRAUMA

*EDITORS*

DAVID J. THURMAN, M.D., M.P.H.

JESS F. KRAUS, M.P.H., PH.D.

CLAUDE J. ROMER, M.D., M.P.H.

World Health Organization
Safety Promotion and Injury Control
Division of Emergency and
Humanitarian Action
Geneva, Switzerland
1995

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION
National Center for Injury Prevention and Control
Atlanta USA

# Standards for Surveillance of Neurotrauma

*Editors*
David J. Thurman, M.D., M.P.H.
Jess F. Kraus, M.P.H., Ph.D.
Claude J. Romer, M.D., M.P.H.

World Health Organization
Safety Promotion and Injury Control
Division of Emergency and Humanitarian Action
Geneva, Switzerland

1995

## ACKNOWLEDGEMENT

We are grateful to the International Brain Injury Association, Inc., for the support it has provided to this project and thanks to whom this document has be produced.

## Contents

## I. Introduction

Among all types of injury, neurotrauma—injury to the central nervous system—has especially grave consequences. Estimates of brain and spinal cord injury occurrence indicate that these injuries cause enormous losses to individuals, families, and communities.

The World Health Organization recognizes a critical need for more effective ways to prevent these injuries and care for those injured. Public health prevention programs are essential. These programs require accurate information from surveillance systems and epidemiologic studies. Information is needed on the numbers of persons affected, the severity of injuries, external causes, and persons at increased risk of injury. However, most countries have not yet established the surveillance systems necessary to provide this information.

The purpose of this monograph is to promote the development of surveillance of neurotrauma. Included is a discussion of methods to develop surveillance, sources of data, standard definitions, and the types of data needed. The ultimate goal of this surveillance is effective prevention and control of these injuries in countries throughout the world.

## II. Methods of Neurotrauma Surveillance

David J. Thurman, M.D., M.P.H.
National Center for Injury Prevention and Control
Centers for Disease Control and Prevention
Atlanta, Georgia, U.S.A.

Yvette Holder, M.P.H.
Caribbean Epidemiology Centre
Pan American Health Organization
Port of Spain
Trinidad, W.I.

Injuries to the central nervous system—the brain and spinal cord—result in a large proportion of deaths and impairments leading to permanent disability.[1] At present, data on these injuries in most parts of the world are not adequate. Many countries need to develop surveillance systems and conduct epidemiologic studies to measure the impact of neurotrauma among their people and to guide the development of more effective methods for preventing them. This section addresses methods for traumatic brain and spinal cord injury surveillance and epidemiology.

### Purposes of Surveillance and Epidemiologic Studies

*Surveillance* is defined as the ongoing systematic collection, analysis, and interpretation of health data necessary for designing, implementing, and evaluating public health prevention programs. This collection of basic information can lay the foundation for more focused *epidemiologic studies* which are needed to collect extensive data in a finite period and test hypotheses regarding specific questions of etiology.

A major purpose of epidemiologic studies and surveillance is to provide the information necessary for *primary prevention* (avoiding the occurrence of injuries) and *secondary and tertiary prevention* (mitigating the sequelae of injury and reducing consequent disability). To assess the public health importance of injuries and to design and implement effective injury prevention programs, it is necessary to describe

- the *magnitude* of the problem (e.g., total number of cases, incidence and mortality rates, and prevalence of resultant impairments)

- the *populations at highest risk* of injury,
- the *causes* (external causes and circumstances of injury), and
- the *severity and outcome* (e.g., type of injury, case-fatality ratio, patient disposition, resulting disability, and cost of care).

Surveillance is also necessary to evaluate and monitor the effectiveness of injury prevention programs and to plan programs to provide medical care and services for people with disabilities. To serve these purposes, it is important that surveillance data be comparable over time and between locales. Inclusion criteria based on *standard case definitions* are important. Comparing data from different countries or locales is difficult if the definitions of what constitutes a case of injury vary. Surveillance systems in different locales should also collect *comparable data elements* as described below.

**Important Attributes of Injury Surveillance Systems**

A number of attributes of public health surveillance systems determine their success. Surveillance systems that lack one or more of these attributes are likely to fail to meet their objectives or may be unsustainable over time. The following are among the most important attributes for injury surveillance:[2]

- *Simplicity.* Simple surveillance systems reduce the costs and time required to collect and analyze data. Successful systems avoid collecting unnecessary data and rely as much as possible on data from existing collection systems.
- *Acceptability.* Surveillance systems require the acceptance and cooperation of many persons and organizations involved in reporting cases. Successful systems do not place costly, difficult, or unacceptable burdens on those who provide data.
- *Sensitivity.* This is the proportion of cases of injury detected by the surveillance system. Sensitivity is low if many true injury cases are unreported (or misclassified as non-cases), and hence, the calculated incidence rates will be too low.
- *Predictive value positive.* This is the proportion of surveillance- identified cases of injury that have actually sustained the injury. If the system misclassifies as cases many persons whose conditions do not really meet the case definition (i.e., false positives), then the predictive value positive of the reporting system is low and the calculated incidence rates will be too high.
- *Representativeness.* A representative surveillance system accurately measures and describes the occurrence of injury over time.

Representativeness is critical if data are gathered in only a sample of injury cases.

- *Sustainability*. The sustainability of a surveillance system depends in part on its simplicity, acceptability, and the use made of surveillance data for prevention programs. Additional factors affecting sustainability include system costs and political necessities.

**Primary Sources of Data**

Following are sources of data that may be useful for surveillance systems for brain and spinal cord injuries. These sources contain data that have already been compiled and often have been coded and entered into a computer data set.

- *Death certificates*.
- *Hospital discharge data*. Hospitals may maintain lists with basic summary data for all admitted patients. These lists may contain information regarding the age, sex, and residence of patients; the diagnoses of the nature of injury; charges and use of services; dates of hospital admission and discharge, disposition following discharge, and survival status. Sometimes information is provided on the cause of injury, using E-codes from the *International Classification of Disease, Ninth Revision* [3] (ICD-9) E-codes.
- *Medical examiner or coroner records*. These records contain more detailed information on the nature of injury and the external cause of death.
- *Emergency medical service records*. Records maintained by emergency responders may contain detailed information concerning the circumstances of injury, indicators of injury severity, transport time, emergency medical procedures used.
- *Trauma registries*. Major referral hospitals for the treatment of acute injuries may maintain separate registries of injured patients. A major purpose of these registries is to enable audits of the quality of medical care. It should be noted, however, that registries are often not population-based and may not represent the distribution of injuries in the entire population at risk.

**Supplementary Sources of Data**

These data may provide additional information, once a case of neurotrauma has been ascertained:

- *Hospital medical records*. Medical records—the full documentation made

by health care providers—usually contain more information about the nature of injury, severity and outcome, external cause of injury, as well as diagnostic procedures and treatments. Since reviewing medical records is time-consuming, this may not be feasible in all jurisdictions or for all cases of injury. As an alternative, some surveillance systems abstract medical records for a representative sample of reported injuries.

- *Records from social service or national insurance systems*. These are especially useful where injury alters a person's ability to work, attend school, or results in extended disability.
- *Police and other public safety records*. These records are a valuable source of information on the circumstances of injury and the external cause of injury, especially in cases involving motor vehicle crashes, homicide, and suicide.

**Definitions of Traumatic Brain and Spinal Cord Injuries**

Following are summaries of the WHO definitions of traumatic brain injury and spinal cord injury. The complete definitions are provided in Section III.

A case of **traumatic brain injury** is either:

- an occurrence of injury to the head with at least one of the following:
  - observed or self-reported alteration of consciousness or amnesia due to head trauma,
  - neurologic or neuropsychological changes or diagnoses of skull fracture or intracranial lesions that can be attributed to the head trauma;
- or an occurrence of death resulting from trauma with head injury or traumatic brain injury listed in the sequence of conditions that resulted in death.

A case of **spinal cord injury** is an occurrence of an acute traumatic lesion of neural elements in the spinal canal, resulting in temporary or permanent sensory deficit, motor deficit, or autonomic dysfunction.

**Data to Be Collected by Surveillance Systems**

The following categories of data, selected on the bases of need and availability, are of value for injury surveillance systems and injury prevention programs:

- *Demographic*. Important demographic variables include age, sex, ethnicity, and occupation. Demographic information can direct injury

prevention programs to those groups at highest risk.

- *Diagnosis*. ICD-coded diagnoses describe the nature of injury and give some information on severity.
- *External cause of injury*. An understanding of the causes of injury is essential to designing programs for primary prevention. E-codes are especially useful, although simpler classifications can be used, such as those contained in Section III of this document.
- *Circumstance of injury*. Variables addressing circumstances of injury include the date and time of injury, the place of injury, work relatedness, intentionality, and alcohol use.
- *Severity*. Coded indices of severity include the Glasgow Coma Scale,[4] the Abbreviated Injury Score (AIS),[5] and the Injury Severity Score (ISS).[6] Other indicators of severity include duration of unconsciousness, intracranial or intraspinal traumatic lesions, and abnormal neurologic function.
- *Outcome*. Some uncomplicated descriptors of outcome in common use are survival status, duration of hospitalization, hospital discharge disposition, Glasgow Outcome Scale,[7] and a modification of the Frankel classification.[8] Another simple scale proposed to describe global impairment after injury is the Injury Impairment Scale.[9]

**Analysis of Surveillance Data**

Descriptive analyses of surveillance data may suffice for many purposes. Information regarding incidence—total numbers of injuries and population-based rates of injuries, stratified by cause and by demographic variables—is required for developing primary prevention programs. Outcome evaluations of primary prevention programs require continued measurements of risk factors for injury events and also monitoring of incidence rates over time. Planning secondary and tertiary prevention programs that address acute care, rehabilitation services, and long-term support services requires information on incidence, severity, and outcome.

Since surveillance systems collect information derived from many sources, duplicate reports of single cases are likely. These duplicates must be identified when data are linked and merged.

## Differences in Epidemiologic Resources among Countries

The kinds of data available for injury surveillance differ greatly among countries. To the extent that nations and states or provinces do not provide health care for their entire populations, do not collect complete information, or do not have the capacity for extensive analyses of health data, effective injury surveillance for the purposes of primary and secondary prevention will be limited. Under these conditions, it is expedient to restrict surveillance to a minimum data set of standardized variables that should be available even in constrained environments. This information may be supplemented by the following studies:

- Limited epidemiologic studies restricted to a few representative localities within the country,
- Limited studies of selected injury risk factors or risk behaviors in a selected population, or
- Mortality studies only, if morbidity data are not available.

## Conclusions

Neurotrauma is an important public health problem that deserves the attention of the world health community. Public health surveillance of these injuries is essential in order to design more effective programs to prevent and treat them. It is important to compare the epidemiologic characteristics of these injuries across time and between countries and localities. This requires surveillance systems that employ uniform definitions and collect data elements as set forth in Section III of this document.

## References

1. Kraus JF. Epidemiologic features of injuries to the central nervous system. In: Anderson DW, ed. *Neuroepidemiology: A Tribute to Bruce Schoenberg.* Boca Raton, USA: CRC Press, 1991; 333-57.

2. Klaucke DN, Buehler JW, Thacker SB, *et al.* Guidelines for evaluating surveillance systems. *MMWR* 1988;(37) S-5:1-18.

3. World Health Organization. *International classification of diseases, 9th revision* (ICD-9). Geneva, Switzerland: World Health Organization, 1977.

4. Teasdale G, Jennett B. Assessment of coma and impaired consciousness: a practical scale. *Lancet* 1974; 2:81-4.

5. Association for the Advancement of Automotive Medicine. *The abbreviated injury scale, 1990 revision.* Des Plains, IL, USA: AAAM, 1990.

6. Baker SP, O'Neill B, Haddon W, Long WB. The injury severity score: a method of describing patients with multiple injuries and evaluating emergency care. *J Trauma* 1974; 14:187-97.

7. Jennett B, Bond M. Assessment of outcome after severe brain damage: a practical scale. *Lancet* 1975; 1:480-7.

8. American Spinal Injury Association, International Medical Society of Paraplegia. *Standards for neurological and functional classification of spinal cord injury*. Chicago, USA: American Spinal Injury Association, 1992.

9. States JD, Viano DC. Injury impairment and disability scales to assess the permanent cnsequences of trauma. *Accid Anal & Prev* 1990; 22:151-60.

## III. Uniform Standards for Neurotrauma Surveillance

Public health surveillance of traumatic brain and spinal cord injuries is essential in order to design more effective programs for their prevention and treatment. It is important to compare the epidemiologic characteristics of these injuries across time and between countries and localities. Such comparisons require surveillance systems that employ uniform case definitions and collect similar data elements.

Countries or localities conducting surveillance of neurotrauma may elect to identify cases from clinical records or from existing health data collection systems. The case definitions that follow contain specifications for each source of case ascertainment.

The WHO Steering Committee on Neurotrauma Prevention and Management developed these case definitions and recommended data elements at two meetings held in Brussels, Belgium in December 1993 and in Copenhagen, Denmark in May 1995. They are adapted from the U.S. Centers for Disease Control and Prevention *Guidelines for Surveillance of Central Nervous System Injury*.[1]

**Traumatic Brain Injury Case Definition**

*Clinical Case Definition*

A case of traumatic brain injury (craniocerebral trauma) is either:

- an occurrence of injury to the head (arising from blunt or penetrating trauma or from acceleration-deceleration forces) with at least one of the following:
  - observed or self-reported alteration of consciousness or amnesia[a] due to head trauma,
  - neurologic or neuropsychological changes[b] (determined from neurologic and neuropsychological examinations) or diagnoses of skull fracture or intracranial lesions[c] (determined from radiological examination or other neurodiagnostic procedures) that can be attributed to the head trauma,
- or an occurrence of death resulting from trauma with head injury or traumatic brain injury listed on the death certificate, autopsy report, or medical examiner's report in the sequence of conditions that resulted in death.

*The clinical definition of traumatic brain injury excludes: 1) lacerations, avulsions, or contusions of the face, eye, ear, scalp, or forehead without the other criteria listed above; 2) fractures of facial bones without the other criteria listed above; 3) birth trauma; 4) cerebral anoxia that is not a complication of brain trauma; 5) inflammatory, infectious, toxic, or metabolic encephalopathies that are not complications of brain trauma; 6) neoplasms; 7) brain infarction (stroke) or intracranial hemorrhage without associated trauma.*

---

[a] Amnesia may include loss of memory for the episode that gave rise to the injury and for events subsequent to the injury.

[b] Examples of neurologic changes include abnormalities of motor function, sensory function, or reflexes; abnormalities of speech (aphasia or dysphasia); or seizures acutely following head trauma. Examples of neuropsychological abnormalities include amnesia as described previously; agitation or confusion; and other changes in cognition, behavior, or personality.

[c] Examples of diagnosed intracranial lesions include intracranial hematomas or hemorrhage (epidural, subdural, subarachnoid, or intracerebral), cerebral contusions or lacerations, or penetrating cerebral injuries (e.g. gunshot wounds).

*ICD-9 Code Specification*

For surveillance systems receiving case reports from coded death certificates or hospital discharge data, the following *International Classification of Diseases, Ninth Revision*[2] (ICD-9) or *International Classification of Diseases, Ninth Revision, Clinical Modification*[3] (ICD-9-CM) diagnosis codes[a] are included in the definition of traumatic brain injury:

| | |
|---|---|
| 800.0-801.9 | Fracture of the vault or base of the skull, |
| 803.0-804.9 | Other and unqualified and multiple fractures of the skull, and |
| 850.0-854.1 | Intracranial injury, including concussion, contusion, laceration, hemorrhage, or diffuse axonal injury. |

Additional cases of brain injury may be ascertained from among cases coded as follows[b]:

| | |
|---|---|
| 873.0-873.9 | Other open wound of head. |

---

[a] In place of ICD-9 codes listed in the *International Classification of Diseases, 9th Revision*, ICD-9-CM codes listed in the *International Classification of Diseases, 9th Revision, Clinical Modification* are used for hospital discharge data in some countries. ICD-9-CM codes include a fifth digit not found in ICD-9 codes, but are otherwise comparable. These codes will be supplanted by corresponding codes from the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision*[4] (ICD-10) when the latter is implemented.

[b] Correctly used, ICD-9 codes 873.0 - 873.9 should not be applied to intracranial injuries. However, reviews of multiple cause mortality data from death certificates in the United States indicate that a substantial number of cases of intracranial injury, especially gunshot wounds, are mistakenly given these codes.[5] Suspected cases of brain trauma that have been so coded may be confirmed by review of medical records or death certificates.

*ICD-10 Code Specification*

For surveillance systems receiving case reports from coded data using the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision*[4] (ICD-10), these diagnosis codes are proposed for inclusion in the definition of traumatic brain injury:[a]

| | |
|---|---|
| S02.0-S02.1 | Fracture of skull |
| S02.7, S02.9 | Fracture(s) of skull and facial bones |
| S06.0-S06.9 | Intracranial injury |
| S07.1, S07.9 | Crushing injury of skull or head, part unspecified |
| T06.0 | Other injuries involving brain, cranial nerves, and spinal cord at neck level |

[a]Cases of traumatic brain injury may occasionally be coded under the following ICD-10 rubrics:

| | |
|---|---|
| S01.7-S01.9 | Open wound(s) of head |
| S07.8 | Crushing injury of other parts of head |
| S09.7-S09.9 | Multiple, other, and unspecified injuries of head |
| T04.0 | Crushing injuries involving head with neck |

Since these categories are less specific, confirmation of potential cases coded under these rubrics will require review of individual medical or other records to obtain further information on the nature of injury.

**Spinal Cord Injury Case Definition**

*Clinical Case Definition*

A case of spinal cord injury is an occurrence of an acute traumatic lesion of neural elements in the spinal canal (spinal cord and cauda equina), resulting in temporary or permanent sensory deficit, motor deficit, or autonomic dysfunction. These deficits or dysfunctions may be incomplete or complete.

*ICD-9 Code Specification*

The following International Classification of Diseases, Ninth Revision (ICD-9) diagnostic codes are included in the case definition of acute spinal cord injury[a]:

| | |
|---|---|
| 806.0-806.9 | Fracture of vertebral column with spinal cord lesion, and |
| 952.0-952.9 | Spinal cord lesion without evidence of spinal bone injury. |

*Intervertebral disc disease (ICD-9 722) is excluded from the definition of acute traumatic spinal cord injury.*

---

[a] Cases of acute SCI may occasionally be coded under the following ICD-9 rubrics:

| | |
|---|---|
| 342 | Hemiplegia |
| 344 | Other paralytic syndromes |
| 805 | Fracture of vertebral column without mention of spinal cord lesion |
| 839 | Other, multiple and ill-defined dislocations |
| 907.2 | Late effect of spinal cord injury |
| 953 | Injury to nerve roots and spinal plexus |

Since these categories are less specific, confirmation of potential cases coded under these rubrics will require review of individual medical or other records to obtain further information on the nature of injury.

*ICD-10 Code Specification*

For surveillance systems receiving case reports with ICD-10-coded data, these diagnosis codes are proposed for inclusion in the definition of spinal cord injury:[a]

| | |
|---|---|
| S14.0-S14.1 | Injury of cervical spinal cord |
| S18 | Traumatic amputation at neck level |
| S24.0-S24.1 | Injury of thoracic spinal cord |
| S34.0-S34.1 | Injury of lumbar spinal cord |
| S34.3 | Injury of cauda equina |
| T06.0-T06.1 | Other injuries involving spinal cord in combination with injuries involving brain, cranial or other nerves, or other multiple body regions |
| T09.3 | Injury of spinal cord, level unspecified |
| T09.6 | Traumatic amputation of trunk, level unspecified |

---

[a]Cases of spinal cord injury may occasionally be coded under the following ICD-10 rubrics:

| | |
|---|---|
| S14.2 | Injury of nerve root of cervical spine |
| S19.7 | Multiple injuries of neck |
| S24.2 | Injury of nerve root of thoracic spine |
| S34.2 | Injury of nerve root of lumbar and sacral spine |
| T04.0-T04.1 | Crushing injuries involving head with neck, or thorax, abdomen, lower back or pelvis |
| T05.8 | Traumatic amputations involving other combinations of body regions (e.g., abdomen or thorax) |
| T09.4 | Injury of unspecified nerve, spinal nerve root, and plexus of trunk |

These categories are less specific; therefore, confirmation of potential cases coded under these rubrics will require review of individual medical or other records to obtain further information on the nature of injury.

**Standard Data Elements in Neurotrauma Surveillance**

The following data elements or *variables* are recommended as standards for central nervous system injury surveillance. These variables will enable the collection of traumatic brain and spinal cord injury data that can be compared between different investigators and different countries and localities.

The variables are divided into two categories:

- **Core variables** are considered the minimum necessary to describe the incidence, demographics, causes, nature of injury, and severity of central nervous system injuries. Most of these variables can be obtained from hospital discharge data. A few can be obtained only through medical records review or autopsy records review.

- **Optional variables** provide valuable details on the causes and severity of these injuries and can be obtained only by reviewing medical and other records. Because of the cost of obtaining this information, it is expected that the optional variables will be obtained in only a sample of reported traumatic brain injuries or in limited geographic areas.

## Core Data Variables

The core variables are divided into five categories: demographic, diagnosis, cause of injury, injury circumstance, severity and outcome, and other.

### Demographic

*Case Identifier Number*

Description: A required, unique identification code assigned by the agency collecting data

Field length: 6

Values: Unique numeric code, range 000001 to 999999

*Birth Date*

Description: Date of birth

Field length: 8

Values: Numeric field, format (YYYYMMDD)
*Examples: 19500714 = 14 July 1950*
*19780599 = May 1978 but day of birth is unknown*

Notes: The value "99" can be entered for an unknown month and/or day. If the date including year is unknown, "99999999" should be entered.

*Age*

Description: Person's age in years at time of injury

Field length: 3

Values: 0-120 years
999 = Age unknown

Note: If the precise age is uncertain, an approximation can be used. Infants younger than 1 year of age are coded "0" or "000."

*Sex*

Description: Sex of injured person

Field length: 1

Values: 1 = Male
2 = Female
9 = Unknown

*Locality of Residence*

Description: One or two variables that code the region and locality of the injured person's residence at the time of injury, not the region or locality in which the injury occurred

Field length: Varies according to coding systems specific to each country

Values: Vary according to coding systems specific to each country

Note: Some countries may have two variables describing residence locality: the first denoting a province, state, or other large jurisdictional unit; the second denoting a county or other local jurisdictional unit.

**Diagnosis**

*Diagnostic Codes (ICD-9 N-codes [nature-of-injury codes] and diseases codes*

Description: The medical conditions related to a hospitalization or death due to injury. Values are coded according to the ICD-9 or ICD-9-CM "Classification of Diseases and Injuries."[2,3] Up to 8 codes can be recorded. Codes for traumatic brain injury or spinal cord injury should be listed first.

Field length: 5 for each of up to 8 codes

Values: The following ranges of ICD-9 or ICD-9-CM codes should be entered:

**Nature-of-injury**

800.0 - 999.9

Refer to ICD-9 or ICD-9-CM for specific codes

**Complications or aggravating conditions**

| | |
|---|---|
| 348.1 | Anoxic brain damage |
| 303.0 - 305.9 | Drug or alcohol intoxication or dependence |
| 320.0 - 325 | Central nervous system infection |

*Example: 8511 = Cortex (cerebral) contusion with open intracranial wound*

Note: Decimal indicators are not entered.

In some countries the *International Classification of Diseases, 9th Revision, Clinical Modification*[3] (ICD-9-CM) may be used for hospitalized persons, while the *International Classification of Diseases, 9th Revision*[2] (ICD-9) is used for fatalities ascertained from death certificates. The codes are similar except that ICD-9-CM codes are 5 digits in length whereas ICD-9 codes are 4 digits in length. *If only a 4-digit ICD-9 code has been assigned, the fifth digit space should be left blank in this variable.* "0" should *not* be added to fill in this space, as this may change the meaning of the code. ICD-9-CM codes 850.0-850.9 (concussion) do not require a fifth

digit.

These eight fields for ICD-9 or ICD-9-CM codes should be used to record:

- all nature-of-injury codes derived from a clinical record or death certificate—traumatic brain and spinal cord injury codes *and* other associated injury codes;
- codes for complications and aggravating conditions listed above.

Codes for other medical conditions present that are not related to the injury and do not complicate or aggravate traumatic brain injury need not be entered under this variable.

**Cause of Injury**

*External-cause-of-injury codes (E-Code)*

Description: The external cause of the injury. Values are coded according to the ICD-9 or ICD-9-CM "Supplementary Classification of External Causes of Injury and Poisoning."[2,3]

Field length: 5 for each of up to 2 codes

Values: Refer to ICD-9 or ICD-9-CM
*Example: 8810 = Injury due to fall from ladder*

Notes: Decimal markers and the letter "E" are not entered under this variable.

The fifth digit space should be left blank if external cause coding is carried only to 4 digits.

**Injury Circumstances**

*Locality of injury*

Description: One or two variables that code the region and locality of injury

Field length: Varies according to coding systems specific to each country

Values: Vary according to coding systems specific to each country

Note: Some countries may have two variables describing injury locality: the first denoting a province, state, or other large jurisdictional unit; the second denoting a county or other local jurisdictional unit.

*Date of Injury*

Description: Date the injury occurred

Field length: 6

Values: Date is reported in YYMMDD format. "99" can reflect unknown month or day.
*Examples: 940321 = 21 March 1994*
*940599 = May 1988 with day of injury unknown*

Note: If the *Date of Injury* is not known, the *Admission/Evaluation Date* can be assumed to approximate the date of injury in most instances.

**Severity and Outcome**

*Level of Consciousness*

Description: Qualitative description of the injured person's level of consciousness at the time of first reliable medical evaluation

Field length: 1

Values:
- 1 = Coma: patients who do not open eyes, obey commands, or utter words; corresponds approximately to a Glasgow Coma Score of 8 or less
- 2 = Moderate impairment of consciousness: patients who are difficult to arouse, e.g. requiring noxious stimuli, who cannot obey simple commands, and whose speech is inappropriate or incomprehensible; corresponds approximately to a Glasgow Coma Score of 9 to 12
- 3 = Minimal or no impairment of consciousness: patients who are awake or easily aroused by verbal stimuli, who can obey some simple commands, and who can speak comprehensibly, although some disorientation may or may not be present; corresponds to a Glasgow Coma Score of 13 to 15
- 9 = Unknown or documentation inadequate

Notes: Coding this variable requires a review of medical records by a person knowledgeable in clinical descriptions.

*Survival status*

Description: Vital status at the time of completion of acute care, if the patient is hospitalized, or at the completion of medical evaluation, if not hospitalized

Field length: 1

Values: 1 = Survival
2 = Death
9 = Unknown

Note: A person who dies at the injury scene, while receiving emergency care, or during hospitalization for acute care is assigned the value "2." A person who is discharged alive from an acute care hospital is given the value "1," regardless of whether the person later dies at home, during rehabilitation, or in a long-term care facility.

**Other**

*Admission/Evaluation Date*

Description: The date of first admission as a hospital inpatient or first medical evaluation if not admitted to a hospital

Field length: 6

Values: See codes under *Injury Date*

Note: If the person was not admitted as a hospital inpatient, the date on which the patient was first treated in an emergency department or other medical care facility should be used.

If the person died without receiving medical attention, the date of death should be used.

*Discharge date*

Description: The date of discharge from acute care. This is the date the

patient leaves acute care to enter a rehabilitation unit or rehabilitation hospital, to enter a long-term care facility, to go home, or to go to some other destination.

Field length: 6

Values: See codes under *Injury Date*

Note: If the patient is transferred from one acute care hospital to another, the date of discharge should be recorded from the last acute care hospital where treatment was provided.

If the injured person was not admitted to a hospital, the date of discharge from care in an emergency department or other medical care facility should be entered.

Record date of death for fatalities occurring at the injury scene, while receiving emergency care, or during hospitalization for acute care.

*Type of Care*

Description: The type of medical care or evaluation received

Field length: 1

Values:
1 = Prehospital death: persons found dead at the injury scene or on arrival at a hospital emergency department
2 = Hospitalized: injured persons who are admitted as inpatients to hospital acute care wards or intensive care units, including those who die as inpatients in a hospital
3 = Emergency department care only: injured persons who are treated in a hospital emergency department but are not admitted for inpatient service, including those who die while being treated in an emergency department
4 = Other medical care: injured persons who receive care or evaluation only at other medical facilities, such as a physician's office or an outpatient clinic
9 = Unknown: medical care or evaluation not known

## Optional Data Variables

The optional variables are divided into five categories: demographics, diagnosis, cause of injury, injury circumstances and other risk factors, severity and outcome, and other.

### Demographics

*Race or ethnicity*

Description: Categories of race, nationality, or ethnicity

Field length: 1 or 2

Values: Codes assigned according to classifications specific to each country

### Diagnosis

*Injury diagnosis*

Description: The type of injury being reported. Necessary variable if data collection includes both spinal cord and traumatic brain injuries and if ICD-9 nature-of-injury coding may be incomplete.

Field length: 1

Values: 1 = Spinal cord injury
2 = Traumatic brain injury
3 = Both traumatic brain injury and spinal cord injury

**Cause of Injury**

*Etiology*

Description: Identifies the external cause of the traumatic brain injury or spinal cord injury

Note: Both *Etiology* and *E-code* variables convey similar information; therefore, *Etiology* is not needed when *E-code* is used. In the absence of E-coded data, *Etiology* may be useful, since it has a simpler coding scheme that can be quickly employed when abstracting medical records.

Field length: 2

Values: Vehicular and animal transportation: operator or passenger

- 01= Automobile: injured while driving or riding in a passenger car
- 02= Truck, light: injured while driving or riding in a pickup truck, utility vehicle, or other light motor truck or van
- 03= Truck, heavy: injured while driving or riding in a heavy motor truck or lorry, such as a tractor-trailer truck
- 04= Truck, unspecified: injured while driving or riding in a motor truck not otherwise specified
- 05= Bus: injured while driving or riding in a bus
- 06= Motorcycle: injured while driving or riding a motorcycle, motorized dirt bike, scooter, or moped
- 07= All-terrain vehicle (ATV) or snowmobile: injured while driving or riding an ATV or snowmobile
- 08= Bicycle-motor vehicle collision: injured while riding a pedal cycle that collided with motor vehicle, including automobile, truck, bus or motorcycle
- 09= Bicycle–other: injured while riding a pedal cycle that did not collide with a motor vehicle; includes non-collision events and collisions with fixed objects, animals, and trains
- 10= Vehicle–unknown type: injured while riding in or driving a motor vehicle not otherwise specified
- 11= Railway: injured in a train or other railway car as a

result of a train collision, derailment or other mishap

12= Animal transport: injured while being transported by animal drawn vehicle or while riding animal

13= Other transport: injured while riding in a vehicle or transport craft other than those listed in 01 - 11, including watercraft and aircraft

Values: Vehicular and animal transportation: pedestrian

21= Pedestrian - motor vehicle: pedestrian injured in a collision with an automobile, truck, bus, or motorcycle

22= Pedestrian - bicycle: pedestrian struck by a bicycle

23= Pedestrian - train: pedestrian struck by a moving train or other railway vehicle

24= Pedestrian - animal: pedestrian injured by animal-drawn vehicle or by trampling from animal being ridden or drawing vehicle

25= Pedestrian - other conveyance: pedestrian injured by some other, specified conveyance (e.g., streetcar)

29= Pedestrian–not specified: pedestrian injured in a collision with an unknown type of vehicle

Values: Firearms and Other Objects Used as Weapons

31= Firearm–handgun

32= Firearm–other: injury caused by any type of firearm other than handgun

33= Firearm–unspecified: injury caused by unspecified or unknown type of firearm

34= Cutting or piercing instrument: injury caused by person using instrument designed for cutting or piercing (e.g. knife, axe)

35= Blunt instrument: injury caused by person using blunt instrument or object

38= Other weapon–specified type

39= Weapon–unknown type

Note: Injuries caused by firearms, piercing and blunt instruments, or other objects used as weapons should be coded as such, even if another listed activity (e.g. transportation or sports) was also involved.

These injuries may be intentional or unintentional. Intent is described in the *Intentionality* variable.

Values: Violence Without Use of Firearms or Other Weapons

41= Altercation or assault not involving firearm, cutting or piercing instrument, blunt instrument, or other weapon (e.g. person struck with fist or kicked)

42= Assault by pushing from high place

43= Jump from high place with intent of suicide

Values: Sports / Recreation

51= Rugby or North American football

52= Soccer football

53= Diving

54= Snow-skiing

55= Other snow or ice sports or recreation (e.g. sledding, skating)

56= Boxing/prize-fighting

58= Sports/recreation, other specified

59= Sports/recreation, not specified

Note: When an injury is associated with a sport or recreation **and** a vehicle, the injury should be coded as vehicular.

When an injury is associated with a sport or recreation **and** a fall, the injury should be coded as a sport or recreation.

Countries may elect to eliminate some sport categories or include others, depending on the popularity of sports of risk within the country.

Values: Falls

71= Unintentional fall from one level to another

72= Unintentional fall on same level

73= Fall on same level, pushed by other person, not in sports

78= Fall–other specified

79= Fall–not specified

Note: These injuries may be intentional or unintentional. Intent

should be described in the *Intentionality* variable.

Values: Other
91= Struck by falling object
98= Other. Other specified or known cause of injury
99= Unknown

*Intentionality*

Description: Specifies whether the injury was unintentional or the result of interpersonal violence or suicidal behavior

Field length: 1

Values:
1 = Self-inflicted, suggestive of suicidal intent
2 = Self-inflicted, unintentional or not suggestive of suicidal intent
3 = Self-inflicted, suicidal intent undetermined
4 = Inflicted by other, suggestive of interpersonal violence
5 = Inflicted by other, unintentional or not suggestive of harmful intent
6 = Inflicted by other, harmful intent undetermined
8 = Not applicable: unintentional injury, determination of infliction by self or other is not relevant
9 = Unknown: infliction by self or other source undetermined

*Examples:*
*4= assault with a blunt instrument*
*5= a small child with a gun shot a playmate*
*1= self-inflicted gunshot wound with apparent suicidal intent*

Note: This variable is mainly used to characterize injuries from firearms and blunt and cutting or piercing instruments. With other causes of injury this variable should be coded "8" unless it is necessary to describe a violent or suicidal intent that is not already implicit in the definition of the cause of injury (e.g., an automobile homicide).

Injuries from interpersonal violence include injuries from rape, domestic violence, child abuse, elder abuse, robberies,

or assaults. Injuries resulting from actions intended to frighten or coerce are included.

**Injury Circumstances and Other Risk Factors**

*Work-relatedness*

Description: Specifies whether the injury occurred in the course of gainful employment. Included among work-related injuries are agricultural injuries, and injuries to volunteer firefighters and volunteer emergency medical workers.

Field length: 1

Values:
0 = Not work-related
1 = Work-related
9 = Unknown

*Position, Vehicle-related*

Description: Identifies whether a person injured in a motor vehicle was the driver or a passenger

Field length: 1

Values:
1 = Driver/operator
2 = Passenger
3 = Occupant: driver or passenger status not specified
8 = Not applicable: injury was not motor-vehicle-related or the person injured was a pedestrian
9 = Unknown

*Personal protective equipment*

Description: Reflects whether the injured person used a safety belt, child restraint, airbag, or helmet at the time of injury; applies to vehicular and some non-vehicular causes of injury, but not to pedestrians

Field length: 1

Values: 1 = Personal protective equipment (safety belt, child restraint or helmet) in use
2 = Personal protective equipment (safety belt or child restraint) **and** airbag in use
3 = Airbag only in use
4 = No safety belt, child restraint, airbag, or helmet in use
8 = Not applicable (not a non-pedestrian vehicular cause of traumatic brain or spinal cord injury)
9 = Unknown whether personal protective equipment was used

*Examples:* *1= Safety belt worn by individual involved in automobile crash*
*8= Traumatic brain injury is a result of diving; protective equipment not applicable*

Note: Safety belt, child restraint, and airbag use is relevant to automobile- and truck-related trauma. Helmet use is relevant to trauma associated with motorcycles, bicycles, all-terrain vehicles, and snowmobiles, as well as some sports and recreation activities. Use of helmets and other personal protective equipment is also relevant to some work-related injuries.

*Alcohol Use / Blood Alcohol Concentration*

Description: Describes evidence of alcohol use **by the injured person** before injury; includes the injured person's laboratory-determined blood alcohol concentration (BAC) if available

Field length: 3

Values: 000-699 = BAC in mg/dl
700 = BAC exceeds 699 mg/dl
777 = BAC not done, but clinical or other evidence of alcohol use is present
888 = BAC not done, clinical records indicate alcohol was not used
999 = Unknown. Available information insufficient to code this variable

Note: If more than one blood alcohol level is recorded, the first laboratory-determined value obtained after the injury should be recorded.

Laboratories may report blood alcohol concentrations in grams per deciliter (g/dl) or milligrams per deciliter (mg/dl). A level of .08 g/dl corresponds to a level of 80 mg/dl.

"Clinical or other evidence of alcohol use" is defined as a smell of alcohol on the breath, an admission of alcohol use or intoxication at the time of injury by the injured person or a witness, or a positive breath test or saliva dipstick test.

**Severity and Outcome**

*Spinal Cord Injury Level*

Description: Describes the level of the spinal injury as reflected by the lowest (most caudal) neurological segment with normal motor **and** sensory function

Field length: 1

Values: 1 = Paraplegia
2 = Tetraplegia
8 = Not applicable (isolated traumatic brain injury)
9 = Unknown

Notes: "Paraplegia" refers to impairment or loss of motor or sensory function as a result of injury to the thoracic, lumbar, or sacral segments of the spinal cord, conus medullaris, or cauda equina. Upper extremity function is spared, but some impairment of trunk, lower extremity, or pelvic organ (bowel or bladder) function is present.

"Tetraplegia" ("quadriplegia") refers to impairment or loss of motor or sensory function as a result of injury to cervical segments of the spinal cord. Upper extremity function is impaired, in addition to lower extremity and pelvic organ function.

The terms "paraparesis" and "tetraparesis" (or "quadriparesis") are sometimes used to denote incomplete degrees of paraplegia or tetraplegia. They are coded as paraplegia or tetraplegia.

*Spinal Cord Injury Extent*

Description: Describes the extent of the spinal cord lesion **at the time of discharge from the treating acute care hospital**

Field length: 1

Values:
1 = Complete
2 = Incomplete, nonfunctional
3 = Incomplete, functional
4 = Normal
8 = Not applicable (traumatic brain injury only)
9 = Unknown

Note: These categories are adapted from the Impairment Scale (IS) of the American Spinal Injury Association and International Medical Society of Paraplegia.[6]

"Complete" refers to an injury that leaves no preserved motor or sensory function in the sacral segments S4-S5 (IS Class A).

"Incomplete, non-functional" refers to a lesion that leaves **any** preserved sensory or voluntary motor function below the neurological level of the injury, including sacral segments, but **without useful** preservation of motor function below this level, i.e., most key muscle groups in the affected segments are too weak to perform against gravity (IS Classes B and C).

"Incomplete, functional" refers to a lesion that leaves functionally useful voluntary motor activity below the neurological level of injury, i.e., most key muscle groups in the affected segments have sufficient strength to perform against gravity (IS Class D).

"Normal" refers to the full return of all motor, sensory and autonomic function. Minimal reflex abnormalities alone may persist (IS Class E).

*Glasgow Coma Score*

Description: The severity of injury as reflected by the total Glasgow Coma Scale[7,8] score

Field length: 2

Values:
- 03-15 = Glasgow Coma Score
- 88 = Not applicable (for deaths prior to hospital admission)
- 99 = Unknown

Note: When presenting to an emergency department and when admitted to a hospital, a patient may have more than one Glasgow Coma Score recorded in the medical record. In that event, the first reliable assessment should be recorded.

*Intracranial Lesion*

Description: Specifies whether a **trauma-related** intracranial lesion was documented by radiologic imaging, neurosurgical procedure, or autopsy

Field length: 1

Values:
- 0 = No intracranial lesion found with brain scan or autopsy
- 1 = Intracranial lesion documented by brain scan, neurosurgery, or autopsy
- 8 = No radiologic imaging, neurosurgery, or autopsy performed
- 9 = Unknown

Notes: Radiologic imaging procedures include computed tomography (CT) brain scans, magnetic resonance imaging (MRI) brain scans and cerebral angiography. Intracranial lesions can also be inferred from skull X-ray studies showing penetrating bodies.

Examples of intracranial lesions which are trauma-related include: epidural and subdural hematomas; traumatic subarachnoid hemorrhage; and contusions, lacerations, traumatic hemorrhages, or trauma-induced edema of the brain or brainstem. Skull fractures alone should not be coded as intracranial lesions.

Coding this variable will require a review of medical records by a person knowledgeable in clinical descriptions.

*Neurologic abnormalities*

Description: Specifies whether trauma-related abnormalities of neurologic function were noted by an examining physician, nurse practitioner, or physician's assistant at any time from arrival at a health care facility through the course of hospitalization or care

Field length: 1

Values:
0 = No neurologic abnormalities noted
1 = Neurologic abnormalities noted
8 = Not applicable (patient died before examination)
9 = Unknown or documentation inadequate

Note: Abnormalities of neurologic function include impairments of motor function, sensory function, or abnormal reflexes attributable to acute traumatic brain or spinal cord trauma. Also included are impairments of language function (aphasia or dysphasia) and focal or generalized seizures of new onset attributable to brain trauma.

This variable does not address abnormalities of mental status such as decreased level of consciousness or amnesia. Level of consciousness (and confusion and disorientation) are addressed by the *Glasgow Coma Score* and *Level of Consciousness* variables. Amnesia is addressed by the *Amnesia* variable.

Coding this variable will require a review of medical records by a person knowledgeable in clinical descriptions.

*Amnesia*

Description: Specifies whether amnesia is documented in the medical record at any time during the course of acute medical care

Field length: 1

Values:
0 = No documentation of amnesia
1 = Amnesia documented
8 = Not applicable (i.e., persisting coma, or death prior to return of consciousness; isolated spinal cord injury)
9 = Unknown or documentation inadequate

Notes: This variable includes both **retrograde amnesia** (loss of memory for events immediately preceding the injury occurrence) and **post-traumatic amnesia** (loss of memory for events following the injury occurrence).

Coding this variable will require a review of medical records by a person knowledgeable in clinical descriptions.

*Abbreviated Injury Scale (AIS) Scores*

Description: The **most severe** Abbreviated Injury Scale[9] (AIS) score for the **Head Region** (first *AIS* variable) and for the spine region (second *AIS* variable)

Field length: 1

Values:
1 = Minor injury
2 = Moderate injury
3 = Serious injury--not life-threatening
4 = Severe injury--life threatening, but survival probable
5 = Critical injury--survival uncertain
6 = Maximum injury--untreatable and virtually unsurvivable

8 = Not applicable
9 = Unknown

Notes: The Abbreviated Injury Scale, 1990 Revision, a manual by the Association for the Advancement of Automotive Medicine, should be consulted in scoring the AIS variables.

These variables are reserved for AIS scoring that is accomplished by review of individual medical records. Computer-calculated scores derived from ICD-9-CM codes should not be entered under these variables. Coding these variables will require medical records review by a person trained in the use of the AIS.

AIS scores of "1" for the head and spinal regions are not consistent with the WHO clinical case definitions of traumatic brain injury and spinal cord injury, respectively.

*Injury Severity Score (ISS)*

Description: The Injury Severity Score[10], an indicator of the cumulative severity of **all** injuries sustained by the patient

Field length: 2

Values: 1-75 = ISS score
88 = Unable to calculate ISS due to lack of data
99 = ISS calculation not attempted

Note: The ISS is the sum of squared values of the highest AIS score in each of the three most severely injured body regions. Only AIS scores 1 through 5 are used to calculate this sum of squared values. If one or more AIS scores is 6, then an ISS score of 75 is assigned.

*Glasgow Outcome Scale* (Traumatic brain injury)

Description: The functional outcome of the traumatic brain injury as assessed at the time of discharge from acute-care hospitalization using the Glasgow Outcome Scale.[11] Deaths

occurring in-hospital will be coded "1."

Field length: 1

Values:
1 = Death
2 = Persistent vegetative state
3 = Severe disability: conscious and at least somewhat responsive, but disabled and dependent for daily support
4 = Moderate disability: disabled, but independent with respect to daily life; able to participate in activities indicating self-sufficiency beyond dressing and minimal self-care
5 = Good recovery: independent, may have minor deficits which do not prevent resumption of "normal" life; actual return to work at pre-injury levels or return to work at all is not a requirement
8 = Not applicable (isolated spinal cord injury)
9 = Unknown

Note: If medical records of traumatic brain injury cases do not already contain a Glasgow Outcome Score, coding this variable will require a review of the records by a person knowledgeable in clinical descriptions.

*Discharge disposition*

Description: The disposition of the patient at the time of discharge from the treating acute care hospital

Field length: 1

Values:
0 = Transfer to other acute care hospital
1 = Home—not requiring supportive services
2 = Home—requiring supportive services
3 = Inpatient rehabilitation
4 = Residential facility
5 = Died
9 = Unknown

*Examples: 4= Patient was discharged **from acute care** to a nursing home*

*3= Patient was transferred from an inpatient acute care ward to an inpatient rehabilitation unit*

Note: If the patient is not admitted to a hospital, the disposition at the time of discharge from hospital emergency room or other medical care facility should be used.

"0" should only be used if the patient has been transferred from one acute care hospital to another, but does not have records available from the second acute care hospital. If records are available for all acute care received, this variable should be coded according to the discharge disposition from the hospital at which acute care is concluded.

"2" should be used with home dispositions in which the injured person requires continued outpatient rehabilitation treatments, regular home visits by a health care provider, a personal attendant, or a day treatment program.

"3" includes dispositions to transitional living centers.

"4" includes nursing homes.

Fatalities occurring either before or after discharge from acute care are coded "5."

**Other**

*Source*

Description: Code used by data collection agency to indicate source of case record

Field length: 2

Values:
- 01= Hospital report
- 02= Emergency medical service agency
- 03= Other medical care provider report
- 04= Death certificate
- 05= Autopsy, medical examiner, or coroner report
- 98= Other
- 99= Unknown

**References**

1. Thurman DJ, Sniezek JE, Johnson D, Greenspan A, Smith SM. *Guidelines for Surveillance of Central Nervous System Injury.* Atlanta: Centers for Disease Control and Prevention, 1995.

2. World Health Organization. *International Classification of Diseases, 9th Revision.* Geneva: World Health Organization, 1977.

3. U.S. Department of Health and Human Services. *International Classification of Diseases, 9th Revision, Clinical Modification*, Third Edition (ICD-9-CM). Washington DC: U.S. Department of Health and Human Services, 1989.

4. World Health Organization. *International Statistical Classification of Diseases* and Related Health Problems, *Tenth Revision.* Geneva: World Health Organization, 1992.

5. Sosin DM, Nelson DE, Sacks JJ. Head injury deaths: The enormity of firearms. *JAMA* 1992; 268:791.

6. American Spinal Injury Association, International Medical Society of Paraplegia. *Standards for neurological and functional classification of spinal cord injury.* Chicago: American Spinal Injury Association, 1992.

7. Teasdale G, Jennett B. Assessment of coma and impaired consciousness: A practical scale. *Lancet* 1974; 2:81-4.

8. Jennett B, Teasdale G. *Management of head injuries.* Philadelphia: F. A. Davis Co., 1981; 77-84.

9. Association for the Advancement of Automotive Medicine. *The Abbreviated Injury Scale, 1990 Revision.* Des Plains, Illinois: AAAM, 1990.

10. Baker SP, O'Neill B, Haddon W, Long WB. The injury severity score: a method of describing patients with multiple injuries and evaluating emergency care. J *Trauma* 1974; 14:187-97.

11. Jennett B, Bond M. Assessment of outcome after severe brain damage: A practical scale. *Lancet* 1975; 1:480-7.

## Appendix

### Participants of the WHO Steering Committee on Neurotrauma Prevention and Management

I. Badran, Cairo, Egypt
P. Carli, Paris, France
R.M. Chestnut, San Francisco, USA
H. Delooz, Leuven, Belgium
W. Dick, Mainz, Germany
P. Dollfus, Mulhouse, France
J. Ghajar, New York City, USA
G. Gururaj, Bangalore, India
Y. Holder, Port of Spain, Trinidad
T. Ikata, Tokushima, Japan
J.F. Kraus, Los Angeles, USA
F.J. Krause, Washington DC, USA
L. Mackay, Bloomfield CT, USA
A.S. Morgan, Hartford, USA
F.M. Murillo Cabezas, Seville, Spain
V. Nell, Johanesburg, South Africa
P. Quinn, New York City, USA
C.J. Romer, Geneva, Switzerland
A. Rossier, Zurich, Switzerland
A.M. Salazar, Washinton DC, USA
F. Servadei, Cesena, Italy
S. Snowball, Brussels, Belgium
A. Swetloff-Coff, Geneva, Switzerland
D.J. Thurman, Atlanta, USA
J.-L. Truelle, Brussels, Belgium
A. Venema, Amsterdam, Netherlands
H. von Holst, Stockholm, Sweden
D.W. Yates, Salford, United Kingdom
G.A. Zitnay, Washington DC, USA