National Trauma Data Bank©

NTDB Research Data Set
Admission Year 2010

User Manual

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NTDB
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www.ntdb.org

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TERMS OF USE

The American College of Surgeons established the National Trauma Data Bank (NTDB) as a public service to be a repository of trauma related data voluntarily reported by participating trauma centers. *Please note that the NTDB is not a population-based dataset. NTDB also provides National Sample Project which is intended for population-based research use.*

The American College of Surgeons, Committee on Trauma collects and maintains the National Trauma Data Bank® (NTDB). Therefore, use of any information from the NTDB must include a prominent citation. The citation is to read as follows, filling in the version number and year as:

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Table of Contents

Appendices

HISTORY OF NTDB

Injury remains a public health problem of vast proportions, although much has been done to reduce its incidence and mitigate its effects. A recent report from the Institute of Medicine (IOM) has stressed the need for accountability in all phases of emergency care systems, and called for measurements of quality that "evaluate the performance of individual providers within the system, as well as that of the system as a whole."[1]

As part of their pioneering work in the development of trauma centers during the 1970's, Boyd and colleagues developed a hospital trauma registry for research and monitoring.[2] As trauma centers and personal computers became more widespread, the use of registries grew to include entire trauma systems,[3] and standards were developed at a national level.[4] Starting in 1982, the American College of Surgeons Committee on Trauma (ACSCOT) coordinated the Major Trauma Outcome Study (MTOS), which until recently served as a standard reference database of seriously injured patients in the United States, and was the basis for many of the analytic methods that have become familiar to trauma surgeons.[5]

At the conclusion of MTOS in 1989, the ACSCOT renewed its commitment to trauma research and quality improvement by developing trauma registry software, with the intention that multiple users of this product could combine their results to produce a national database. After several years of slow progress, a recommendation was made to separate the development of a national database from the development of registry software.[6] This recommendation was implemented in 1997, and a subcommittee was established to direct the National Trauma Data Bank (NTDB), which would combine data from various trauma registry products.

Currently, the NTDB contains detailed data (see Appendix A) on over five million cases from over 900 registered U.S. trauma centers. The data have been shared with hundreds of researchers, and numerous articles have been published based upon the NTDB. The annual NTDB Call for Data (CFD) runs from February to May and all hospitals with trauma registries are encouraged to participate. After the conclusion of the CFD, the data are cleaned and summarized in the NTDB Annual Report and distributed in September. The National Trauma Data Bank has adopted the National Trauma Data Standard (NTDS) as the basis for data collection. The NTDS is a standardized definition of the trauma injury information submitted to the NTDB by participating hospitals (see www.ntdsdictionary.org).

Additional information about the NTDB, annual reports, and this user manual is available at www.ntdb.org.

NTDB CONFIDENTIALITY POLICY

NTDB data are maintained in a secure database with limited internal access. External users must gain permission to the database and data; users are then supplied data at the aggregate level only. Use of NTDB data is in strict compliance with the Health Insurance Portability and Accountability Act of 1996 (HIPAA).[7] The NTDB does not distribute or report hospital information in any manner that allows the reporting hospital to be identified without the express written permission of the hospital. The dataset collected by NTDB is considered a limited dataset under HIPAA, and the research dataset that ACS releases is a de-identified dataset.

CURRENT LIMITATIONS OF NTDB DATA

1. Data quality in NTDB

NTDB has worked hard to improve the data quality and introduced a new dataset in 2008. However, the data quality of NTDB is dependent on how well the NTDS is implemented for the data submitted by the individual hospital. The NTDB is continually cleaning and standardizing the data to improve data quality. Data files received from contributing hospitals are screened upon submission by the Validator, NTDB's edit check program (see Appendix 3 of the NTDS Data Dictionary, 2010 Admissions). Any files receiving a level 1 or 2 error are rejected, but can be resubmitted after corrections. Other errors are shown on reports generated by the Validator, to provide information about the data submission.

2. NTDB is not a population-based dataset

The NTDB is subject to the limitations of all "convenience samples." It includes a disproportionate number of larger hospitals with younger and more severely injured patients. The data may not be representative of all trauma hospitals in the nation and thus do not allow statistically valid inferences about national injury incidence and prevalence.

The NTDB National Sample Project (NSP), a nationally representative sample based on NTDB, has been created in a partnership between the Center for Disease Control National Center for Injury Prevention and Control (NCIPC) and the American College of Surgeons Committee on Trauma (ACSCOT). The goal of the NSP is to make statistically valid inferences about patients cared for in Level I-II trauma centers in the US. More specifically, the NSP is used for producing national baseline estimates of variables and indices associated with hospitalized traumatic injuries such as pre-hospital diagnosis and management, trauma outcomes, and other variables that characterize the different dimensions of trauma treatment. The NSP is a stratified sample of 100 hospitals with admission data from years 2003–2010 and can be requested from the NTDB website.

3. Selection and information bias in NTDB

As a "convenience sample," NTDB is subject to various forms of bias. The NTDB data are submitted voluntarily from hospitals that have shown a commitment to monitoring and improving the care of injured patients. These may not be representative of all hospitals, and have not been systematically selected to represent any population base. By definition, cases not admitted to a hospital will not be included in the NTDB, including injury victims who die before they can be transported to a hospital. Hospitals may have differing criteria for including deaths on admission, deaths in the Emergency Department, or other cases, which should be evaluated before making comparisons.

Some of the theoretical issues resulting from the use of trauma registries to assess institutional performance were discussed as part of the Skamania Symposium on Trauma Systems in 1998.[8-10] The most obvious problems are selection bias, the inconsistency with which clinical variables can be measured, and inter-hospital differences other than quality of care. MTOS was limited to selected trauma centers and utilized centralized coding to maximize the consistency of data, while NTDB has become more inclusive and depends on decentralized data entry at contributing hospitals.

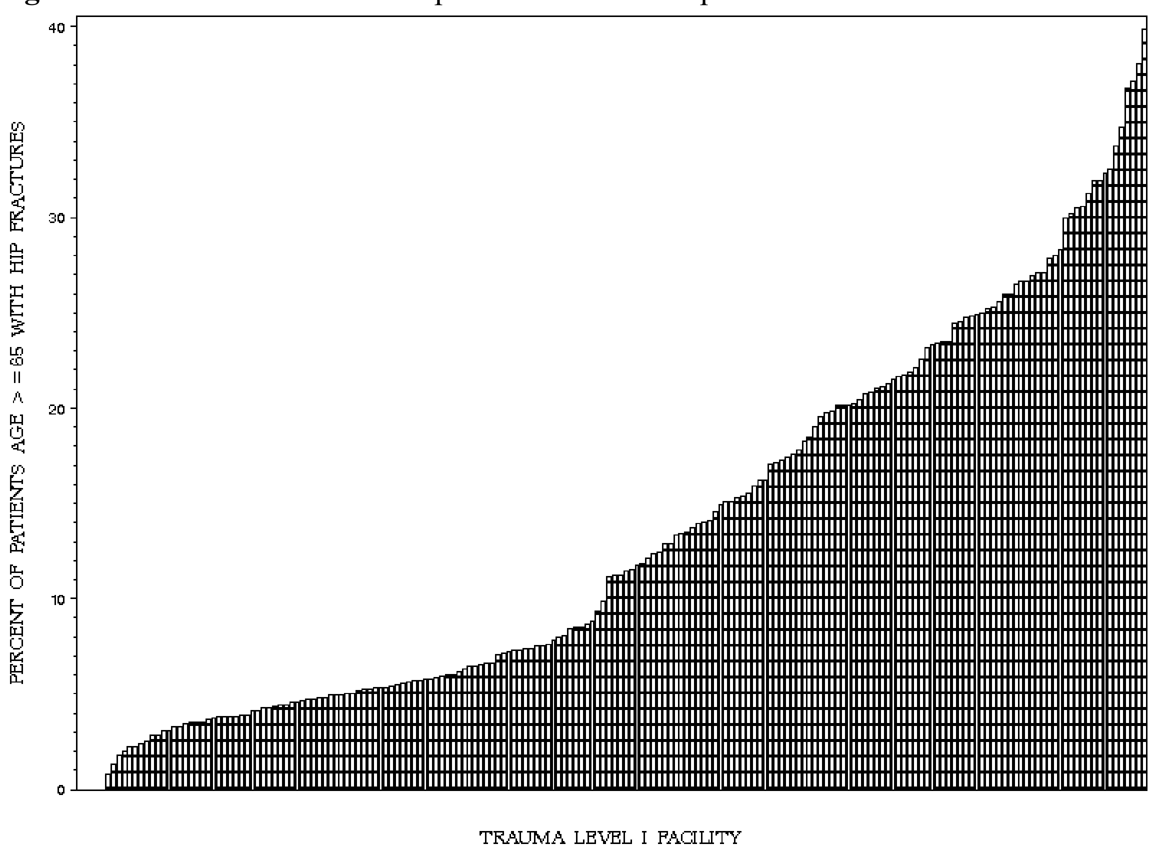
The variability in trauma registry inclusion criteria across the country has been noted, [11] and the ACSCOT has participated in the resulting national effort to standardize data elements for trauma registries. Focused review of "outlier" hospitals is expected to reveal differences in data entry and patient inclusion criteria that could be made more uniform before concluding that outcome differences among hospitals are truly related to differences in care.

Selection bias refers to an apparent difference between two groups that is actually caused by different inclusion criteria. For example, if one trauma center includes isolated hip fractures in its registry and another does not, and if mortality for this injury is lower than for other injuries with the same severity score, the hospital that included isolated hip fractures will appear to have a lower "risk-adjusted" mortality. Any difference in inclusion/exclusion criteria could produce a selection bias.

The NTDB data have been evaluated with respect to several possible sources of selection bias, including the inclusion of hip fractures, transferred patients, or Dead on Arrival (DOA) patients in submitted data. Hip fractures comprise about 45% of injuries requiring hospitalization in the U.S. population over age 65.[12] As mentioned above, a difference in the mortality for this population could produce an apparent difference in overall mortality depending whether or not they were included. Some surgeons consider hip fractures a degenerative disease and "not really trauma," and some believe that the effort to gather data on this population may not be worthwhile for quality improvement by their trauma services. In NTDB Admission Year 2010 the percent of patients over 65 with hip fractures (ICD-9-CM code 820, AIS codes 850699.1, 850606.1, 850610.2, 850614.2, 850618.2) for the 192 trauma level I centers ranges between 0 - 40% (Figure 1). Also, patients transferred from one institution to another have obviously been able to survive an initial resuscitation, but the reason for transfer is often that the injuries are more severe or that other risk factors are present. Transferred patients thus represent a different population from those admitted directly. The proportion of patients in NTDB Admission Year 2010 which were transferred into or out of level I trauma centers ranges drastically (Figure 2). Lastly, patients may arrive at an institution only to be declared "Dead on Arrival" (DOA), but the definition of this term is itself unclear. Some hospitals exclude such cases, while some do not. The proportion of patients recorded as DOA in NTDB varies considerably for level trauma I centers in NTDB (Figure 3). Deaths on arrival are not consistently submitted but historically, distributions indicate that DOA varies greatly from hospital to hospital.

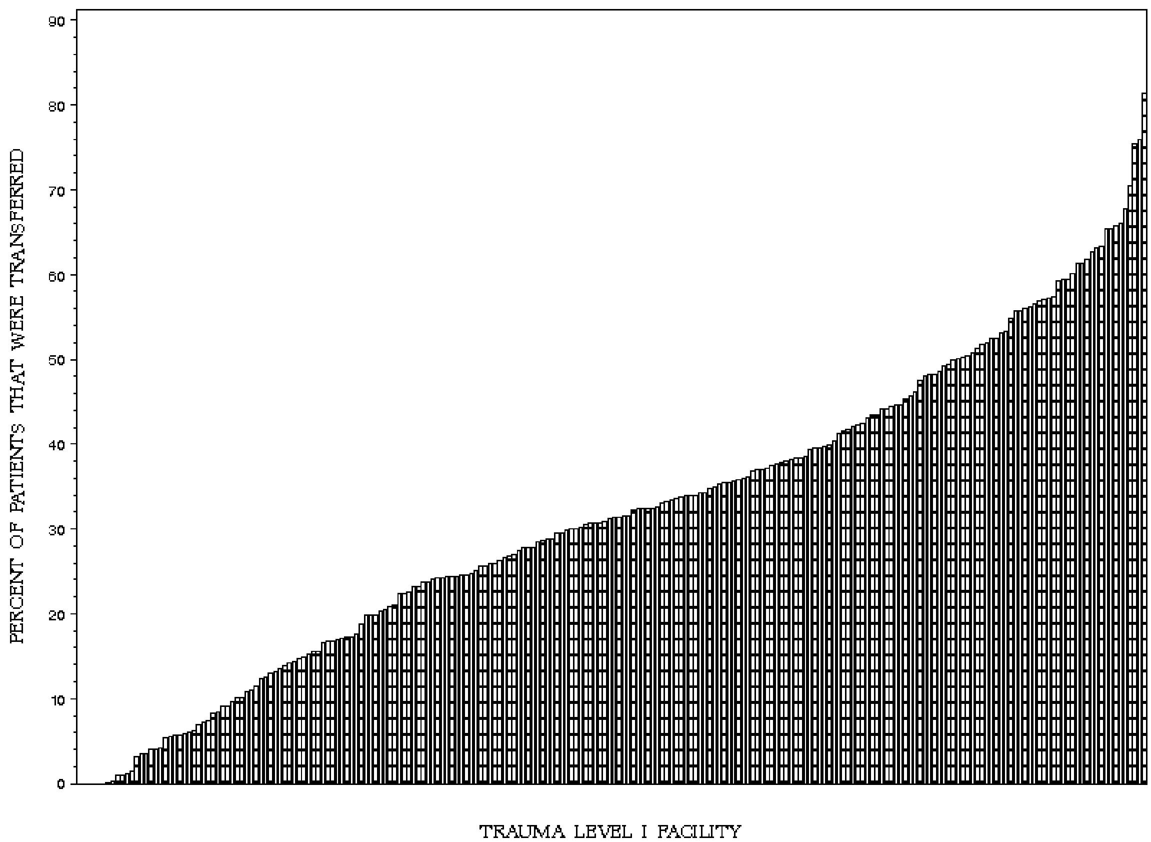
When analyzing NTDB data we encourage researchers to be aware of these limitations and use inclusion criteria for their analysis in order to create a homogenous population. Reviewing the "Facility" file may suggest subgroups of hospitals that are comparable. For certain types of analysis, a given injury (e.g., hip fractures) could either be excluded or analyzed separately; another approach would be to designate cases included by some but not all hospitals using an indicator term (0 if absent, 1 if present) added to a regression equation. For some analyses, all the data from hospitals with excessive missing or unreliable data might be excluded. These decisions are the most difficult part of conducting research on a database like NTDB, and require good judgment and scientific honesty more than computing skill or mathematical training.

Figure 1: Percent of incidents for patients ≥ 65 with hip fractures.



Note: 6 trauma centers out of the 192 level I trauma centers had 0% incidents with hip fractures in patients over 65 years old and were not included in the figure.

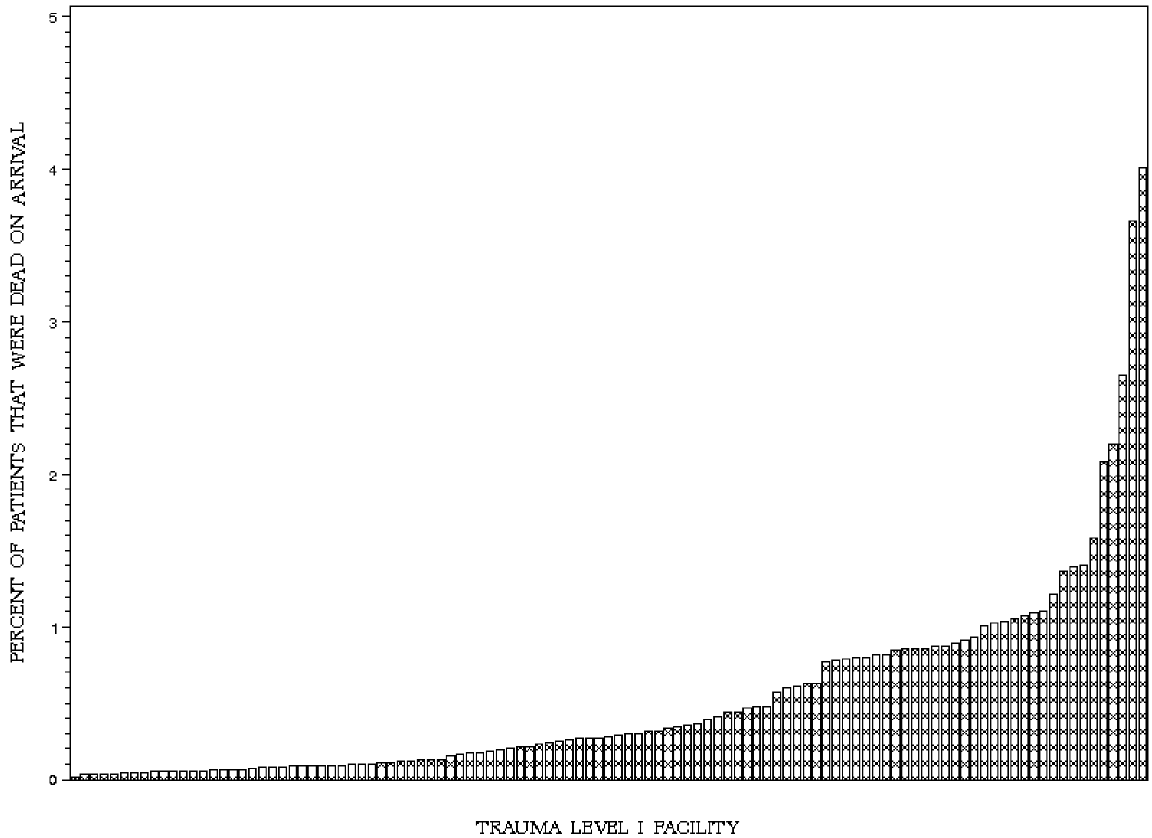
Figure 2: Percent of patients that were transferred in per facility for level I trauma centers.



Note: 6 trauma centers out of the 224 level I trauma centers had 0% incidents transferred in and were not included in the figure.

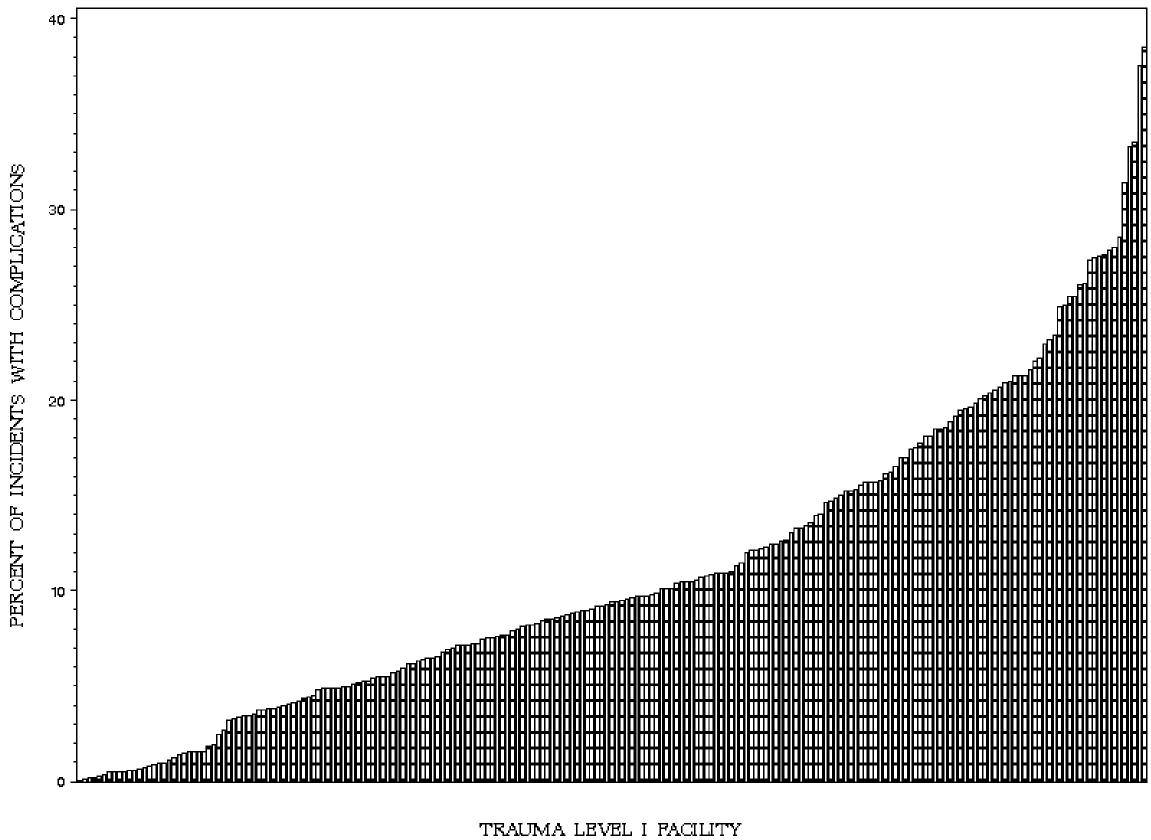
Information bias refers to an apparent difference between two groups that is actually caused by a difference in the data available to compare them. With regard to certain fields, differences in the proportion of cases with missing data may be responsible for apparent differences among hospitals. Lucas et al, have found that injury severity scores are calculated differently by different registry programs.[13] In an attempt to account for this, NTDB uses an ISS that is derived from the ICDMAP-90 crosswalk based on the ICD-9-CM codes that are required by NTDB. Some centers do provide their own ISS and AIS, but not all submit those data. Nor are all the submitted ISS and AIS calculated in the same way.

Figure 3: Percent of incidents that were dead on arrival (DOA) per facility for level I trauma centers.



If one hospital has incomplete data on patients with complications, for example, it may falsely appear to be delivering better quality care than a hospital that diligently records every complication. Level I trauma centers had percentages of complications that range from 0 –40% (Figure 4).

Figure 4: Percent of incidents with NTDS specified complications per facility for level I trauma centers.



4. Missing data in NTDB

The proportion of missing data varies across data elements in NTDB, but it is important to decide how to deal with missing data when doing analyses. In most cases NTDB data are not missing at random and analyses, therefore, are subject to bias if missing data are ignored. That is, the results may be misleading when excluding all observations with missing data. Excluding observations with missing values is the default for most software programs when running statistical analyses.

Another option is to provide plausible values for the missing data, by either single or multiple imputation. A single imputation of a value may be an educated guess at the value, substitution of the mean value, or substitution based on a regression equation using other (observed) values. For example, one can assume that the verbal component of the Glasgow Coma Scale (GCS) for intubated patients would be approximately the same as for non-intubated patients with the same Motor and Eye GCS.[14] Most statistical software packages can do imputations without much difficulty. However, it is important to explore the impact of missing data with sensitivity analyses. That is, repeat an analysis with and without imputation and see whether there are any important differences.

GETTING STARTED WITH NTDB DATA

The Research Dataset (RDS) is a set of relational tables and consists of 20 data files. These files are provided in ASCII-CSV format (comma separated value), standard SAS data tables, and DBF format (DBASE version 2.0), which can be easily imported to most statistical software (i.e. SAS, SPSS and Stata). Thirteen of the data files include a unique incident identifier (inc_key) for merging the data files together. One data file (RDS_FACILITY) includes the facility information for the 697 participating hospitals and these data can be merged to RDS_ ED, RDS_DEMO, and RDS_DISCHARGE, by using the unique facility identifier (fac_key). The remaining three data files (RDS_ECODEDES, RDS_DCODEDES, and RDS_PCODEDES) are look-up tables with the description of the AIS code, ICD-9 E-Code, ICD-9 Diagnosis code, and ICD-9 procedure codes, respectively. The look-up tables can be merged with the unique RDS_DCODE, RDS_ECODE, and RDS_PCODE tables.

Included on the downloading website are three sample programs to help researchers get started with merging files and creating statistical output. These sample programs are available for SAS and Stata. A copy of the source codes of these programs can be found in Appendix F. We hope that you will contact us with any concerns or suggestions on how to make these sample programs more useful in the future. Table 1 is a listing of the NTDB files with a short description for each data file. A detailed data dictionary of each variable in the data sets can be found in Appendix A.

Table 1: Data files and descriptions

File name	Description
RDS_AISPCODE	The AIS (Abbreviated Injury Scale) code submitted by the hospital (excluding AIS version 2005)
RDS_AISCCODE	The AIS (Abbreviated Injury Scale) code globally calculated with ICDMAP-90.
RDS_AIS98PCODE	The AIS (Abbreviated Injury Scale) code globally mapped to AIS version 1998. If the hospital does not submit AIS98, then ISS is based on AIS derived from ICDMAP-90.
RDS_COMORBID	Pre-existing comorbidity information
RDS_COMPLIC	Any NTDS complications
RDS_DEMO	Demographic information
RDS_DCODE	ICD-9-CM Code of Diagnosis Information
RDS_DCODEDES	Look-up table of the description of the ICD-9-CM diagnosis codes
RDS_DISCHARGE	Includes discharge and outcome information
RDS_ECODE	Includes the ICD-9 external cause of injury code.
RDS_ECODEDES	Ecode look up table
RDS_ED	Emergency Department information
RDS_FACILITY	Facility Information
RDS_PCODE	Procedure codes
RDS_PCODEDES	Look-up table for procedures
RDS_PROTDEV	Protective devices
RDS_TRANSPORT	Transport information
RDS_VITALS	Vital signs from EMS and ED

FREQUENTLY ASKED QUESTIONS ABOUT USING NTDB

1. What are the system requirements of downloading the NTDB?
Minimum of 500MB of disk space for CSV version
Minimum of 1GB of disk space for DBF version
Minumum of 1GB of disk space for SAS version
Minimum of 1GB of RAM strongly recommended

2. Can I estimate the number of patients based on NTDB?
The NTDB is an incident database and there are no patient identifiers in the database. If a patient has more than one trauma incident during an admission year, this patient will be in the database twice.

3. How can I merge the data sets in NTDB?
The NTDB data files can be merged by using the unique incident key for each incident (inc_key). SAS source code is provided to help you get started.

4. What are the differences between the CSV and DBF files
CSV files are comma separated value files and DBF files are from the FoxPro database format. Some statistical packages will handle one file type better than the other. We are aware that SAS handles CSVs inconsistently while using PROC IMPORT. Please use caution and check your datasets prior to analysis, including checking variable values against the variable list. The inconsistencies include: truncation of values, and changing of variable type (numeric to character). We are working to improve these inconsistencies, but strongly recommend the use of DBF files with SAS.

5. What are the patient inclusion criteria for the NTDB?
All patients with ICD-9-CM discharge diagnosis 800.00–959.9

- Excluding 905-909 (late effects of injury)
- Excluding 910-924 (blisters, contusions, abrasion, and insect bites)
- Excluding 930-939 (foreign bodies)

AND who were admitted; or died after receiving any evaluation or treatment; or were dead on arrival.

6. How do I handle the BIU values, i.e., why are there negative values for certain variables when there should not be any?
For definition of the BIU values please see Appendix A. The BIU values for numerical values are coded with the numbers -2 and -1. It is recommended to either exclude or set these values to missing before doing any statistical analyses of these values.

7. There are multiple types of Injury Severity Scores (ISS) in the ED file, which one do I use?

There are four different Injury Severity Score (ISS) in NTDB. The ISSLOC is the ISS submitted by the hospital to NTDB and no further changes are made to this value. There are also two ISS scores calculated in the database: ISSAIS is the ISS score that is derived from the AIS scores submitted by the hospitals. ISS98 is the ISS score that has been derived from a mapping of existing AIS codes to AIS98 for consistency. ISSICD is the ISS score that is derived from the AIS score that is calculated from the ICD/AIS map, ICDMAP-90, 1995 update (computer program: ICODERI.DLL, Windows version. Johns Hopkins University, 1997.) Each injury is allocated to one of six body regions based on the Abbreviated Injury Scale (AIS) score according to:

- Head or neck
- Face
- Chest
- Abdominal or pelvic contents
- Extremities or pelvic girdle
- External

The 3 most severely injured body regions have their AIS severity score squared and added together to produce the ISS score. Only the highest AIS score in each body region is used.

7. There are multiple types of Abbreviated Injury Scale (AIS) score files in the dataset. Which one do I use?

Three Abbreviated Injury Scale scores are included in NTDB. RDS_*AISPCODE* is the AIS score that is submitted to the NTDB for the trauma diagnosis. RDS_*AISCCODE* is the AIS score that is calculated from the ICDMAP90 crosswalk for the trauma diagnosis and RDS_*AIS98PCODE*.which contains AIS codes that have been mapped or "crosswalked" to a common AIS 98 code for consistency.

8. There seem to be some inconsistencies between fields, how do I decide what data to include?

NTDB has been working to improve the quality of the data and with the new data standard, the quality and consistency has improved, but is of course not perfect. It is always important that the researcher makes sure that the data that are used for analyses are consistent and valid for their purpose. For further information on the valid values for teach variable please see Appendix A. There is very limited cleaning of data when it comes to consistencies between variables, in order to avoid incorrectly deleting values. That is, there are instances where the ICU length of stay (ICUDAYS) is greater than the total hospital length of stay (LOSDAYS) and it is up to the researchers to decide how to use that information.

9. Where can I find the external cause of injury and how many of them are available in the data set?

The RDS_ECODE table includes the primary (first-listed) ICD-9 external cause of injury code. There are two ICD-9 external-cause-of-injury codes per incident. Appendix C contains the standard matrix of ICD-9 external-cause-of-injury code groupings used for reporting of injury mortality (defined by ICD-9-CM codes) and morbidity (defined by ICD-9-CM codes) data systems.

10. Where can I find the diagnosis? How many diagnoses per incident are available in the data set?
The RDS_DCODE table includes all of the ICD-9-CM Codes of Diagnosis for each incident. The AISPCODE and AISCCODE tables include all the AIS codes for each incident. These diagnosis codes are not listed in hierarchical order and there is no way to identify the principal diagnosis.

11. What data cleaning was performed on the dataset before release?
Logical inconsistencies and out of range values were corrected in the dataset by replacing the values with the appropriate common null value.
Vent days > LOS are set to BIU -2
ICU days > LOS are set to BIU -2
ED or LOS times > 364 days are set to BIU -2.
EMS times > 28 days set to BIU -2.
YOADMIT or YOPROC >2010 are set to BIU -2.
YOINJ < 2009 is set to BIU -2
YOBIRTH ≥2011 is set to BIU -2
YOINJ >2010 is set to BIU -2

RESOURCES FOR EVALUATION OF NTDB DATA

1. Background of injury severity scoring

Classifying trauma incidents in terms of injury severity scoring has a long and interesting history, which has been reviewed in numerous publications.[15-17] When doing trauma research it is important to classify trauma injuries in order to evaluate the effects of treatment. Some of the most frequently used methods to classify trauma data in the NTDB are described below:

<u>A. Classification by anatomy</u>

In 1971, the American Medical Association Committee on Medical Aspects of Automotive Safety published the **Abbreviated Injury Score** (AIS), which divided the body into five regions (head or neck, chest, abdomen, pelvis/extremities, and general) and classified the severity of injuries in each region based on clinical experience (1=minor; 2=moderate; 3=severe, not life-threatening; 4=severe, life-threatening, survival probable; 5=critical, survival uncertain; 6-9=fatal).[18] Three years later, Baker and colleagues[19] extended the AIS to account for multiple injuries by adding another body region (face), reclassifying each fatal injury to an AIS score less than 6, and squaring the maximum AIS value in each of the six body regions. The **Injury Severity Score** (ISS) was developed from AIS and is defined as the sum of the squares of the three highest AIS values.

The most publicized alternative to AIS and ISS has been the **ICD-9 Injury Severity Score** (ICISS), proposed in 1996.[20] ICISS was almost identical to the Estimated Survival Probability index originally proposed by Levy and colleagues in 1978.[21]

Statewide discharge data from North Carolina were used to predict mortality in patients hospitalized after injury using the observed mortality of patients with the same ICD-9 principal diagnosis code. Osler, Rutledge, and colleagues[20] then extended this approach by calculating a "survival risk ratio (SRR)" for each of 2,034 principal or secondary injury diagnoses sustained by 314,402 patients in the 1990-1995 North Carolina data, and assumed that the probability of survival for a given patient could be estimated by the product of their "SRRs." One difficulty of the ICISS approach is that a reference database for calculation of SRRs must be defined. A table of SRRs (by Meredith, Kilgo, and Osler) has been developed based on a sample of 170,853 cases from a previous version of the NTDB. [22]

Sacco, MacKenzie, Champion and colleagues have recently advocated a Modified Anatomic Profile[23] using a new definition of AIS body regions, severity scores within these regions, and coefficients derived from data on 14,392 cases collected by four trauma centers from 1982–1987. Meredith and colleagues have compared this and several others anatomic scoring algorithms using an earlier version of the NTDB (containing 76,871 cases).[24] The latter study has stimulated further discussion about comparison of predictive models for trauma outcomes.[25]

B. Classification by mechanism

The Major Trauma Outcomes Study (MTOS)[5] considered only blunt versus penetrating injuries for injury classification. Since that time, the use of ICD-9 E-Codes for injury mechanisms has become much more common, and a standard categorization has been provided by the CDC.[26] Hannan and colleagues have suggested the use of separate prediction equations for different mechanisms.[27]

C. Classification by physiology

The **Glasgow Coma Scale** (GCS) was originally developed as a clinical tool, and is still widely used for this purpose, but has been useful in outcomes research as well.[28] This simple scale gives 1 to 6 points for motor activity, 1 to 5 points for verbal activity, and 1 to 4 points for eye-opening. The total GCS is simply the sum of the three components, therefore ranging from 3 (minimal or no neurologic function) to 15 (normal or nearly normal).

The **Revised Trauma Score** (RTS)[29] was based on systolic blood pressure, respiratory rate (RR), and total GCS on presentation to the ED, with a logistic regression equation derived from MTOS. A principal drawback is that many severely injured patients are intubated and sedated prior to arrival to the ED, so that observations of RR and GCS are of questionable accuracy. Because of the calculation requirements, the RTS has not been used as a clinical tool.

D. Classification by comorbidity

Charlson and colleagues[30] developed the widely-used **Charlson Score** for general medical patients, adding weights of 6 for the presence of AIDS or metastatic solid tumor, 3 for severe liver disease, 2 for any malignancy, renal failure, or complications of diabetes, and 1 for a history of myocardial infarction, peripheral vascular disease, dementia, chronic lung disease, rheumatic disease, mild liver disease, or uncomplicated diabetes. The Charlson Score has been used in trauma patients.[17,31] Morris, Mackenzie et al[32,33] developed a similar classification of pre-existing conditions, including coagulopathy, for trauma patients. NTDB records information on multiple comorbidities, most of which could be mapped to the Charlson or Morris/Mackenzie categories. The proper classification and modeling of their effects on injured patients is an important area for future research.[34-35]

2. Outcomes

Mortality is a fundamentally important outcome, and easy to clinically identify. However, hospital mortality is not necessarily the same as short-term mortality, especially in the older patients who are often discharged to long-term care facilities within a few days of injury.[12] Unfortunately, mortality after discharge from a hospital is not as easily determined and is generally not available in registry data. Hospital length of stay has been used as a measure of cost, but is likewise confounded by discharge destination and early mortality. Inter-hospital comparisons using any of these variables should be undertaken with an understanding of their limitations.[36]

Intermediate outcomes, such as hospital complications, are potential measures of quality; however, they may also be complicated by information bias due to incomplete case ascertainment or occurrence of the complication only after hospital discharge. It may be important to separate the incidence of a given complication from the ultimate outcome attributable to the quality of managing the complication ("rescue"). Functional measurements at the time of discharge or at a specified time after injury are also appealing,[37] but currently also have significant limitations; this remains an important area for future research.[38]

3. Analytic methods

Risk Adjustment

In complicated clinical situations, it is rarely appropriate to compare the outcome of two groups using raw data without adjusting for potential differences in their risk factors. Sometimes it is possible to exclude cases from both groups until they are judged to be similar except for the one factor under study; sometimes, the factor of interest can be analyzed for several strata of a potentially confounding factor or factors (e.g., spleen injuries in stable patients with age<55 and ISS<16, age<55 and ISS≥16, age≥55 and ISS<16, and age≥55 and ISS≥16). However, most studies of injured patients have so many factors to analyze that the only practical way is to estimate a mathematical regression model in which the outcome (dependent variable) can be expressed in terms of multiple risk factors (independent variables).

For analysis of binary outcomes (e.g., mortality) influenced by multiple factors (e.g., injury severity, comorbidity, hospital) the standard analytic method is currently logistic regression. Many computer programs are now available to implement this approach, and excellent introductory textbooks have been published.[39-40] However, logistic regression does entail certain assumptions and potential misinterpretations, and a formal course and/or statistical consultation are highly desirable before using this methodology.

For certain mathematical reasons, results of logistic regression are generally expressed in terms of odds rather than probability. Odds are defined as

$$\text{Odds }(A) = \frac{P(A)}{P(\overline{A})} = \frac{P(A)}{1 - P(A)}$$

where P(A) means the probability that A is true, and $P(\overline{A})$ means the probability that A is not true. Note that when P(A) is small, there is not much difference between the probability and the odds. Also, note that the above equation can be rearranged as

$$P(A) = \frac{\text{Odds}(A)}{1 + \text{Odds}(A)}$$

The effect of a factor (e.g., a given hospital) on the outcome of interest can be expressed as an odds ratio, that is, the odds when the factor is present divided by the odds when the factor is not present. The odds ratio is generally a reasonable approximation for the risk ratio (the probability of an outcome when the factor is present divided by the probability when the factor is not present), especially when the outcome is relatively infrequent (for example, mortality).

TRISS

The Trauma and Injury Severity Score (TRISS) was introduced by Champion and colleagues[41] and later described in detail by Boyd and colleagues.[42] The method is fundamentally a regression equation predicting the log odds of survival, as

$$bx = b_0 + (b_1 * \text{RTS}) + (b_2 * \text{ISS}) + (b_3 * \text{Age} \geq 55).$$

Raising the constant e (the base of natural logarithms, approximately 2.71828) to the power bx gives the predicted odds of survival, since by definition $e^{\text{log odds}}$ = odds, and the predicted probability of survival can then be calculated from the predicted odds using

$$\text{Probability} = \frac{\text{odds}}{1 + \text{odds}} = \frac{e^{bx}}{1 + e^{bx}} = \frac{1}{1 + e^{-bx}}$$

TRISS was popularized as a result of MTOS[5], and has been a standard calculation by trauma registries since that time. Separate equations have been used for penetrating or blunt injuries. Although the developers of TRISS chose to predict the “probability of survival" rather than the "probability of death" after injury, it is easier to interpret a logistic regression model presented in terms of the less common binary event (e.g., death rather than survival). This results in odds that are nearly the same as the corresponding probabilities, and makes the effects of covariates more apparent. For example, if the probability of death is 5% or 0.05 then the odds of death is 0.05/0.95 = 0.053, whereas if the probability of survival is 90% or 0.90 then the odds of survival is 0.95/0.05 = 19.

It may be simpler to consider the RTS categories individually, that is:

GCS	SBP	RR	Coded value
13-15	>89	10-29	4
9-12	76-89	>29	3
6-8	50-75	6-9	2
4-5	1-49	1-5	1
3	0	0	0

Similarly, we can categorize ISS (as earlier suggested by MTOS researchers[43]), or create other groups of maximal AIS scores in different body regions. Using this approach, we can create multiple variables equal to 1 for patients belonging to a given category and 0 for those who do not. Then, logistic regression can be carried out and the coefficients exponentiated to present an odds ratio for each of these categories. This skips the intermediate step of calculating RTS, and the distraction of explaining logarithms and exponentials. It also removes the assumption of a linear effect on the log odds of survival due to stepwise increases in each category.

We should hesitate to discard the familiar scoring systems completely unless we can find methods that are significantly better (not just in the statistical sense of "significance," but in the practical sense). The increased number of data elements available in the NTDB may allow for improvements, and the availability of the data to multiple researchers should encourage progress in this area. Models that account for some of the new patient and institutional variables contained in NTDB need to be explored, as well as approaches based upon outcomes other than simply hospital survival.[44,45] It will take some time to reach consensus about whether another mortality model should be considered a standard to succeed TRISS.

Modeling may involve different equations for different injury mechanisms, or (equivalently) allowing for interaction terms between these mechanisms and other factors. Other clinically significant interactions could also be explored.[46] Approximating the effect of continuous covariates by splines or other polynomial functions has been suggested, but may result in a model that is difficult to interpret.[47] A good mathematical model not only predicts an outcome with satisfactory precision, but also helps to explain the factors that affect the outcome.

Models must be kept reasonably simple so that they can be accurately interpreted and trusted by clinicians. There is generally more familiarity with ratio measurements (e.g., adjusted mortality rates) rather than difference measurements (e.g., the risk difference or "W statistic"). Computation of confidence intervals is more complicated with ratios, but most clinicians are not concerned with this aspect and the necessary mathematical formulas can be programmed for the computer to calculate.

4. Inter-hospital comparisons

MTOS proposed a "Definitive outcome-based evaluation" to compare hospital trauma mortality to a reference population.[5] Z-scores were calculated for individual hospitals by summing the TRISS "Probability of Survival" (p) for each patient to obtain an expected number of survivors, and comparing this to the observed number of survivors. It can be shown[48] that if p is known, this difference will theoretically have a normal distribution with variance equal to the sum of ((p)(1-p)) for each patient, and therefore that Z = (observed-expected) / $\sqrt{(\text{variance})}$ will have a normal distribution with mean zero and variance 1. As a consequence, 95% of hospitals would be expected to have a Z-score between -1.96 and +1.96.

While there is nothing mathematically wrong with the calculation of a Z-score using the method described by Flora[48] and popularized by MTOS, it may be easier to use the logistic regression methods. We can include a variable in the regression equation equal to 1 if the case is identified as coming from a particular hospital and 0 otherwise. The odds ratio and a test for its significance can then be estimated, for example from the equation

$$\text{log odds (died)} = b_0 + (b_1 * \text{RTS}) + (b_2 * \text{ISS}) + (b_3 * \text{Age} \geq 55) + (b_4 * \text{Penetrating}) + (b_5 * \text{Hospital X}).$$

MTOS further proposed a "W statistic", defined as

$$W = (\text{observed-expected}) / (n/100)$$

which may be interpreted as the number of unexpected survivors (or deaths, if negative) per hundred cases, where n is the total number of cases for a given hospital and the "expected" number of survivors has been derived from TRISS. A "test-based" 95% confidence interval can be calculated for each W, consistent with the corresponding Z-scores[49,50] as

$$W \pm 1.96 \frac{\sqrt{\sum p(1-p)}}{n/100}$$

The ad hoc "W statistic" is essentially the same as a standard epidemiologic statistic called the Risk Difference (RD)[49]

$$RD = (\text{observed-expected}) / n$$

multiplied by a factor of 100. Hollis and colleagues[50] have proposed stratifying the W statistic based upon categories of survival probability, in order to give a better estimate of effect if the test population has a distribution of survival probabilities different from that of the reference population. The necessary strata for this adjustment are approximately as follows: 0.68% had $0 \le p \le .25$, 0.46% had $.25 < p \le .50$, 0.70% had $.50 < p \le .75$, 1.67% had $.75 < p \le .90$, 3.27% had $.90 < p \le .95$, and 93.21% had $.95 < p \le 1$.

The clustering of individuals within units of observation (e.g., hospitals) also needs to be considered when analyzing the outcomes from a given unit.[51] The advantages of multilevel or hierarchical models for this purpose have been increasingly advocated for hospital profiling. Typically, these methods result in fewer outliers and allow the incorporation of smaller centers into the analysis.[52-53]

PUBLICATIONS

In addition to the studies specifically cited above, we are pleased to note the increasing number of publications utilizing the NTDB, a listing of which we try to keep updated on our website. We recognize that the quality of these studies is variable, and that some of them fail to acknowledge the limitations we have described above. We request that researchers using NTDB notify us of any publications, and hope that the criticism of these studies will also help us find ways to improve the quality of the database. Authors should be aware that the following recommendations have been provided to the editors of journals most likely to publish articles based upon NTDB data:

Recommendations for Peer Review of Studies using the NTDB
(from the NTDB Subcommittee, ACS Committee on Trauma, March 2007)

The ACS Committee on Trauma does not presume or desire to involve itself directly in the editorial process by which manuscripts are selected for publication. However, we do wish to inform this process and maximize the quality of these publications by making editors and reviewers aware of the obligations of licensees to the National Trauma Data Bank (NTDB®), as well as some of the technical issues posed by research involving this database.

Licensees have agreed to include a statement in their manuscripts acknowledging that "the NTDB remains the full and exclusive copyrighted property of the American College of Surgeons. The American College of Surgeons is not responsible for any claims arising from works based on the original Data, Text, Tables, or Figures."

Licensees have further agreed to include language indicating which version of the NTDB (e.g., Version 6.1 issued in January 2007) they are using. This is important since the database is updated frequently, and other researchers should be provided with sufficient information to allow replication of the findings using the same data set.

The NTDB files provide only general information about contributing institutions, such as trauma center verification status and categorical number of beds. We and our licensees are committed to maintaining the confidentiality of contributing institutions and patients as mandated by federal law. Studies claiming to add information about hospitals or patients from sources outside the NTDB should therefore be evaluated with great caution. Reviewers may wish to verify assertions about the characteristics of contributing hospitals against the characteristics actually available in the research data set.

Like any large database, the NTDB does not have complete data for all cases; therefore authors should be expected to state how they dealt with missing data (exclusion, imputation, etc.). Similarly, the NTDB is not a population-based dataset; therefore statements about the incidence of specific conditions are inappropriate if based only on NTDB data. A Reference Manual, which describes these and other sources of potential bias inherent to the NTDB, has been provided to all researchers with the database files. Reviewers are advised to look for explicit discussion of these biases and their possible effects on the analysis.

Our web site (www.ntdb.org) includes the data use agreements, data dictionaries, a list of prior publications, the Reference Manual, and other related material. Please feel free to contact the NTDB office for further information.

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APPENDIX A: VARIABLE DESCRIPTION LIST

This section includes the definition, format and length of each variable in each of the NTDB Admission Year 2010 data sets. Please see the external NTDS dictionary (http://www.ntdsdictionary.org/dataElements/datasetDictionary.html) for further details on each variable. The data sets are listed in alphabetic order.

NOTE: **All data fields have Common Null Values (blank inappropriate values, here forth known as BIU Values) as valid values unless specified.**

Field Values
1 Not Applicable (-1)

2 Not Known/Not recorded (-2)

- *Not Applicable*: This null value code applies if, at the time of patient care documentation, the information requested was "Not Applicable" to the patient, the hospitalization or the patient care event. For example, variables documenting EMS care would be "Not Applicable" if a patient self-transports to the hospital.

- *Not Known/Not recorded*: This null value applies if, at the time of patient care documentation, information was "Not Known" to the patient, family, or health care provider. This documents that there was an attempt to obtain information but it was unknown by all parties involved at the time of documentation. For example, injury date and time may be documented in the hospital patient care report as "Unknown."

File Name: RDS_*AISPCODE*
Definition: The AIS (Abbreviated Injury Scale) code version 1980, 1985, 1990, and 1998 submitted by the hospital for the trauma diagnosis
Frequency: Unlimited number of records per incident

Field Name	Definition	Data Type	Length	Valid Values	Notes
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values allowed	
AIS Version (AISVER)	The version of AIS used to code the particular incident.	Numeric	4	1980 1985 1990 1998	

Field Name	Definition	Data Type	Length	Valid Values	Notes
AIS Predot Code (PREDOT)	The Abbreviated Injury Scale (AIS) predot codes that reflect the patient's injuries.	Numeric	6		
AIS Severity (SEVERITY)	This represents the Abbreviated Injury Scale severity code that reflects the patient's injuries.	Numeric	3	1 to 6, 9	

File Name: RDS_*AIS98PCODE*
Definition: The crosswalked AIS (Abbreviated Injury Scale) code. All hospitals' codes are set to AIS98 with the exception of those hospitals that do not code in AIS. In those cases, the AIS Code is filled with the mapped code from ICDMAP-90.
Frequency: Unlimited number of records per incident

Field Name	Definition	Data Type	Length	Valid Values	Notes
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values allowed	
AIS Version (AISVER)	The version of AIS used to code the particular incident.	Numeric	4	1998	
AIS Predot Code (PREDOT)	The Abbreviated Injury Scale (AIS) predot codes that reflect the patient's injuries.	Numeric	6		
AIS Severity (SEVERITY)	This represents the Abbreviated Injury Scale severity code that reflects the patient's injuries.	Numeric	3	1 to 6, 9	

File Name: RDS_*AISCCODE*
Definition: The AIS (Abbreviated Injury Scale) codes calculated from ICD90MAP for the trauma diagnosis
Frequency: Unlimited number of records per incident

Field Name	Definition	Data Type	Length	Valid values	Notes
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values allowed	
AIS Version (AISVER)	The version of AIS used to code the particular incident.	Numeric	4	1980 1985 1990 1998	
AIS Predot Code (PREDOT)	The Abbreviated Injury Scale (AIS) predot codes that reflect the patient's injuries.	Numeric	6		
AIS Severity (SEVERITY)	This represents the Abbreviated Injury Scale severity code that reflects the patient's injuries.	Numeric	3	1 to 6, 9	

File Name: *RDS_COMORBID*
Definition: Information pertaining to any pre-existing comorbid conditions a patient had upon arrival in the ED/hospital
Frequency: Unlimited number of records per incident

Field Name	Definition	Data Type	Length	Valid Values	Notes
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values allowed	
Comorbidity Code (COMORKEY)	NTDS comorbid conditions.	String	50	See the NTDS data dictionary	
Comorbidity Description (COMORDES)	Description of comorbid conditions.	String	100	See the NTDS data dictionary	

File Name: *RDS_COMPLIC*
Definition: Information pertaining to any complications during the course of patient treatment

Frequency: Unlimited number of records per incident

Field Name	**Definition**	**Data Type**	**Length**	**Valid Values**	**Notes**
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values allowed	
Complication Code (COMPLKEY)	NTDS hospital complications	String	50	See the NTDS data dictionary	
Complication Description (COMPLDES)	Description of complications.	String	100	See the NTDS data dictionary	

File Name: *RDS_DEMO*
Definition: Includes information about the patient and incident demographics
Frequency: One record per incident

Field Name	**Definition**	**Data Type**	**Length**	**Valid Values**	**Notes**
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values allowed	
Year of Birth (YOBIRTH)	The patient's birth year.	Numeric	4	1917 to 2007	Patients with age >89 are presented with YOBIRTH of -99
Age (AGE)	The patient's age at time of injury	Numeric	5	0-89	Patients with age >89 are presented with AGE of -99
Age Units (AGEU)	The patient's unit of age if the patient was under 1 year of age	Character	150	Years Months	
Sex (GENDER)	The patient's gender at admission	String	100	Male Female	
Race1 (RACE1)	The patient's race	String	100	Asian Native Hawaiian or Other Pacific Islander Other Race American Indian Black or African American White	
Race2 (RACE2)	The patient's race (additional)	String	100	Asian Native Hawaiian or Other Pacific Islander	

Field Name	Definition	Data Type	Length	Valid Values	Notes
				Other Race American Indian Black or African American White	
Ethnicity (ETHNIC)	The patient's ethnicity	String	100	Hispanic or Latino Not Hispanic or Latino	
Facility Key (FAC_KEY)	Unique identifier for each facility	Numeric	4	No Null Values allowed	

File Name: *RDS_DCODE*
Definition: Includes the ICD-9-CM diagnosis codes
Frequency: One record per incident

Field Name	Definition	Data Type	Length	Valid Values	Notes
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values allowed	
ICD-9-CM Diagnosis (DCODE)	ICD-9-CM Diagnosis Code	String	6		Maximum of 50 diagnoses per patient. This field includes cormorbid conditions and complications.

File Name: *RDS_DCODEDES*
Definition: Lookup table ICD-9-CM diagnoses codes
Frequency: One record per ICD-9-CM diagnoses codes DCODE

Field Name	Definition	Data Type	Length	Valid Values	Notes

Field Name	Definition	Data Type	Length	Valid Values	Notes
Diagnosis Code (DCODE)	Unique ICD-9-CM diagnosis code	String	6		This field includes cormorbid conditions and complications.
Diagnosis Code Description (DCODEDES)	Description for ICD-9-CM diagnosis codes	String	100		
Nature of Injury (DXTYPE)	Nature of injury as defined by the Barell Injury Diagnosis Matrix	String	50		For full Barell Matrix see Appendix B
Body Region 1 (REGION1)	ICD-9 body region as defined by the Barell Injury Diagnosis Matrix	String	50		For full Barell Matrix see Appendix B
Body Region 2 (REGION2)	Second ICD-9 body region as defined by the Barell Injury Diagnosis Matrix	String	50		For full Barell Matrix see Appendix B
Body Region 3 (REGION3)	Third ICD-9 body region as defined by the Barell Injury Diagnosis Matrix	String	50		For full Barell Matrix see Appendix B

File Name: *RDS_DISCHARGE*
Definition: Includes discharge information
Frequency: One record per incident

Field Name	Definition	Data Type	Length	Valid Values	Notes
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values allowed	
Discharge Year (YODISCH)	Year the patient was discharged from the facility	Numeric	4	2007, 2008	
Hospital Discharge Disposition	The disposition of the patient at hospital	String	100	See the NTDS data dictionary	

Field Name	Definition	Data Type	Length	Valid Values	Notes
(HOSPDISP)	discharge.				
Length of Stay (Minutes) (LOSMIN)	Total Length of Stay in minutes	Numeric	5		
Length of Stay in Days (LOSDAYS)	Total Length of Stay in days	Numeric	5	1-364	
Intensive Care Unit Days (ICUDAYS)	Total number of days spent in the Intensive Care Unit	Numeric	5	1-364	
Ventilator Days (VENTDAYS)	Total number of days spent on the Ventilator	Numeric	5	1-364	

File Name: *RDS_ECODE*
Definition: Includes ICD-9-CM E-Codes (Mechanism of Injury)
Frequency: One record per incident

Field Name	**Definition**	**Data Type**	**Length**	**Valid Values**	**Notes**
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values allowed	
Primary E-Code (ECODE)	ICD-9-CM External Cause of Injury Code	String	5		
ICD-9-CM Additional E-Code (ECODE2)	Additional ICD-9-CM External Cause of Injury Code	String	5		

File Name: *RDS_ECODEDES*
Definition: Look-up table for ICD-9-CM E-Codes
Frequency: One record per ICD-9-CM E-Code

Field Name	Definition	Data Type	Length	Valid Values	Notes
E-Code (ECODE)	Unique ICD-9-CM E-Code	String	5		To merge ECODE2 with descriptions, must change this variable name to ECODE2
Primary E-Code Description (ECODEDES)	Description of each ICD-9-CM E-Code	String	100		
Trauma Type (INJTYPE)	Indication of the type (nature) of trauma produced by an injury	String	4000	Blunt Burn Penetrating Other/Unspecified	See Appendix C for more information
Injury Intent (INTENT)	Injury Intentionality as defined by the CDC Injury Intentionality Matrix	String	4000	Unintentional Self-inflicted Assault Undetermined Other	See Appendix C for more information
Mechanism of Injury (MECHANISM)	ICD-9-CM Mechanism of Injury E-Code	String	4000		See Appendix C for more information

File Name: *RDS_ED*
Definition: ED and Injury information
Frequency: One record per incident

Field Name	Definition	Data Type	Length	Valid Values	Notes
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values allowed	
Year of Injury (YOINJ)	The year when the patient was injured	Numeric	4	2006, 2007	
Admission	The year when the	Numeric	4		

Field Name	Definition	Data Type	Length	Valid Values	Notes
Year (YOADMIT)	patient was admitted				
Work-Related (WORKREL)	Work-relatedness of the injury	String	50	Yes No	
Industry of Work (INDUSTRY)	Occupation	String	50		
Location E-Code (LECODE)	ICD9-CM External Cause of Injury code	String	50	0-9	Value is *x* in 849.x code
Location Description (LOCATION)	Location where injury occurred	String	100		
Inter-hospital Transfer (TRANSFER)	Inter-hospital transfer	String	50		
Alcohol Use (ALCOHOL)	Whether patient used alcohol	String	100	Yes [confirmed by test (beyond legal limit)] No (Not suspected, not tested)	
Drug Use (DRUG1)	Whether patient used drugs	String	100	Yes [confirmed by test (illegal drug use)] No (Not suspected, not tested)	
Drug Use (DRUG2)	Whether patient used drugs	String	100	Yes (confirmed by test (beyond legal limit) No (Not suspected, not tested)	
Emergency Department Disposition (EDDISP)	Disposition of the patient at the time of discharge from the ED	String	100		
Emergency Department	Type of death incurred while the	String	100		

Field Name	Definition	Data Type	Length	Valid Values	Notes
Death (EDDEATH)	patient was in the ED				
EMS Response Minutes (EMSRESP)	Total elapsed time from dispatch of the EMS transporting unit to scene arrival of the EMS transporting unit	Numeric	10	1 - 40,320 min (28 days)	
EMS Scene Time (EMSSCENE)	Total elapsed time from dispatch of the EMS transporting unit to arrival at the facility	Numeric	10	1 - 40,320 min (28 days)	
Total Number of EMS Days (EMSDAYS)	Total elapsed days from dispatch of the EMS transporting unit to hospital arrival of the EMS transporting unit.	Numeric	10	1 – 28 days	
Total Number of EMS Minutes (EMSMINS)	Total elapsed time from dispatch of the EMS transporting unit to hospital arrival of the EMS transporting unit.	Numeric	10	1 - 40,320 min (28 days)	
Total Number of Minutes in the ED (EDMIN)	Total elapsed time the patient was in the emergency department	Numeric	10	1 - 524,160 min (364 days)	
Total Number Days in the ED (EDDAYS)	Total elapsed time the patient was in the emergency department	Numeric	10	1 - 524,160 min (364 days)	
Local ISS (ISSLOC)	The Injury Severity Score (ISSLOC) reflecting the patient's injuries directly submitted by the facility regardless of the method of calculation	Numeric	3	1- 75	
AIS derived ISS (ISSAIS)	The Injury Severity Score (ISSAIS) is calculated from AIS submitted directly by	Numeric	3	1- 75 and the number is a sum of 3 squared values ranging	

Field Name	Definition	Data Type	Length	Valid Values	Notes
	hospitals			from 1 to 6. If any component is 6 then the value is set to 75	
ICDMAP-90 derived ISS (ISSICD)	The Injury Severity Score (ISSICD) is derived by converting ICD-9 codes to AIS using the ICD 90 Mapping program and then calculating ISS with the resulting AIS severity scores	Numeric	3	1- 75 and the number is a sum of 3 squared values ranging from 1 to 6. If any component is 6 then the value is set to 75	
AIS 98 crosswalked ISS (ISS98)	The Injury Severity Score (ISSICD) is derived by converting ICD-9 codes to AIS using the ICD 90 Mapping program and then calculating ISS with the resulting AIS severity scores	Numeric	3	1- 75 and the number is a sum of 3 squared values ranging from 1 to 6. If any component is 6 then the value is set to 75	
Facility Key (FAC_KEY)	Unique identifier for each facility	Numeric	4	No Null Values allowed	

File Name: RDS_*FACILITY*
Definition: Information pertaining to the facility dataset
Frequency: One record per facility

Field Name	Definition	Data Type	Length	Valid Values	Notes
Facility Key (FAC_KEY)	Unique identifier for each facility	Numeric	10	No Null Values allowed.	
Hospital Type (HOSPTYPE)	Facility Tax Status	String	4000	Public Private	
Teaching Status (TEACHSTA)	Hospital teaching status	String	4000	Community Non-Teaching University	
ACS Verification	ACS Verification	String	4000	I	

Field Name	**Definition**	**Data Type**	**Length**	**Valid Values**	**Notes**
Level (ACSLEVEL)				II III IV Not Applicable	
ACS Pediatric Verification Level (ACSPEDL)	ACS Pediatric Verification	String	4000	I II Not Applicable	
State Designation (STATELEV)	State Designation	String	4000	I II III IV V Other Not Applicable	
State Pediatric Designation (STATEPL)	State Pediatric Designation	String	4000	I II II IV Other Not Applicable	
Bedsize (BEDSIZE)	Number of licensed beds in facility	String	4000	≤200 200-400 401-600 >600 Not Provided	
Comorbidity Recording (COMORCD)	How a facility records comorbidities	String	4000	Derived from ICD-9 coding Chart abstraction by trauma registrar Calculated by software registry program Not collected	
Complication Recording (COMPLCD)	How a facility records complications	String	4000	Derived from ICD-9 coding Chart abstraction by trauma registrar Calculated by software registry program	

Field Name	Definition	Data Type	Length	Valid Values	Notes
				Not collected	
Number of Adult Beds (ADULTBED)	Number of beds dedicated adult patients	Numeric	10		
Number of Burn Beds (BURNBED)	Number of beds dedicated to burn patients	Numeric	10		
Number of ICU Burn Beds (ICUBRBED)	Number of ICU beds dedicated to burn patients	Numeric	10		
Number of ICU Beds (ICUTRBED)	Number of ICU beds dedicated to trauma patients	Numeric	10		
Number of Pediatric Beds (PEDBED)	Number of beds dedicated to pediatric patients	Numeric	10		
Number of Certified Trauma Registrars (TRCERREG)	Number of trauma registrars certified by ATS	Numeric	10		
Number of Neurosurgeons (NEUROSUR)	Number of neurosurgeons at your facility	Numeric	10		
Number of Orthopedic Surgeons (ORTHOSUR)	Number of orthopedic surgeons at your facility	Numeric	10		
Number of Trauma Registrars (TRAMREG)	Number of Trauma Registrars at your facility	Numeric	10		
Number of Trauma Surgeons (TRAUMSUR)	Number of core trauma surgeons at your facility	Numeric	10		
Pediatric Hospital Association (PEDASSOC)	Is your facility associated with a pediatric facility?	String	5	True False	
Care for Injured Children (PEDCARE)	How do you care for injured children?	String	4000	No children (N/A) Shared role	

Field Name	Definition	Data Type	Length	Valid Values	Notes
				with another center Provide all acute care services	
Pediatric ICU Unit (PEDICU)	Do you have a pediatric ICU unit?	String	5	True False	
Pediatric Transfer (PEDTRANS)	Do you transfer pediatric patients?	String	5	True False	
Pediatric Ward (PEDWARD)	Do you have a pediatric ward?	String	5	True False	
Oldest Pediatric Patient (PEDAGECT)	How old is your oldest pediatric patient?	String	4000	14, 15, 16, 17, 18, 19, 20, 21, none	
Transfers In (TRANSIN)	Are transfers into the facility included?	String	4000	All transfers Within 12 hours Within 24 hours Within 48 hours Within 72 hours	
Transfers Out (TRANSOUT)	Does your facility transfer patients out to other facilities?	String	5	True False	
Length of Stay (LOSINCL)	What length of stay is included?	String	4000	All Admissions 23 hour holds ≥24 hours ≥48 hours ≥72 hours	
Deaths After (DEATHAFT)	Deaths after 15 minutes in the ED	String	5	True False	
DOAs included (DOAINC)	Dead on Arrival included in registry	String	5	True False	
Hip Fractures Included (HIPINCL)	The age cutoff for including hip fractures in non-elderly patients, if applicable	String	4000	None Patients ≤ 18 years Patients ≤ 50 years Patients ≤ 55 years Patients ≤ 60 years Patients ≤ 65	

Field Name	Definition	Data Type	Length	Valid Values	Notes
				years Patients ≤ 70 years All	
Excluded AIS Codes (AISEXCL)	Range of AIS Codes excluded from registry	String	500		
Included AIS Codes (AISINCL)	Range of AIS Codes included in registry	String	500		
ICD-9 Exclusion Range (ICD9EXCL)	ICD-9-CM codes the facility Excludes in their registry	String	500		
ICD-9 Inclusion Range (ICD9INCL)	ICD-9-CM codes the facility includes in their registry	String	500		
ICD-9 Inclusion Range the same as NTDB (ICD9NTDB)	ICD-9 Inclusion Criteria is 800-959.9, excluding 905-909, 910-924, and 930-939	String	5	True False	
Inclusion/Exclusion Other (OTHERINC)	Does the facility have any other inclusion/exclusion criteria	String	5	True False	
Inclusion/Exclusion Other Specify (INCSPEC)	Explanation of other inclusion/exclusion criteria	String	1050		Only present when OTHERINC is 'True"
Geographic Region (REGION)	Geographic region for the hospital	String	40	"Midwest", "Northeast", "South", "West"	

File Name: *RDS_PCODE*
Definition: ICD-9-CM procedure codes
Frequency: Multiple records per incident

Field Name	**Definition**	**Data Type**	**Length**	**Valid Values**	**Notes**
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values Allowed	
ICD-9-CM Procedure Code (PCODE)	ICD-9-CM Procedure Code	String	5		
Year of Procedure (YOPROC)	Year in which the procedure occurred	String	100	2006, 2007	
Procedure Start Time (PROC_TIME)	Time when the procedure began	String	14	00:00 to 24:00	
Days to Procedure (DAYTOPROC)	Number of days until the beginning of procedure	String	10	1-364	
Hours to Procedure (HOURTOPRO)	Number of hours until the beginning of procedure	String	10	1 - 8736 (364 days)	

File Name: RDS_*PCODEDES*
Definition: Look up table for ICD-9-CM Procedure Codes
Frequency: One record per procedure code

Field Name	**Definition**	**Data Type**	**Length**	**Valid Values**	**Notes**
ICD-9-CM Procedure Code (PCODE)	ICD-9-CM Procedure Code	String	5		
Procedure Description (PCODEDESCR)	Descriptor for procedure codes	String	100		

File Name: RDS_*PROTDEV*

Definition: Information on protective devices
Frequency: Multiple records per incident

Field Name	Definition	Data Type	Length	Valid Values	Notes
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values Allowed	
Protective Device Description (PROTDEV)	Descriptor for protective devices	String	100		
Airbag Description (AIRBAG)	Descriptor for airbags	String	100		
Child Restraint Description (CHILDRES)	Descriptor for child restraints	String	100		

File Name: RDS_*TRANSPORT*
Definition: Information on mode of transportation to the ED
Frequency: Multiple records per incident

Field Name	Definition	Data Type	Length	Valid Values	Notes
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values Allowed	
Transport Type (TRANTYPE)	Type of Transportation	String	7	Primary Other	Indicates either primary or other mode of transportation
Transportation Mode (TMODE)	Mode of Transportation	String	10		

File Name: RDS_*VITALS*
Definition: Information on patient vital signs for both EMS and ED
Frequency: Multiple records per incident

Field Name	Definition	Data Type	Length	Valid Values	Notes
Incident Key (INC_KEY)	Unique identifier for each record	Numeric	10	No Null Values allowed	
Vital Type (VSTYPE)	Type of vital sign: EMS or ED	String	3	EMS ED	
Systolic Blood Pressure (SBP)	Systolic blood pressure	Numeric	5	0-299	
Pulse Rate (PULSE)	The patient's pulse rate	Numeric	5	0-299	
Respiratory Rate (RR)	The patient's respiratory rate	Numeric	5	0-99	
Pulse Oximetry/Oxygen Saturation (OXYSAT)	First recorded oxygen saturation in the ED or hospital	Numeric	5	0-100	

Supplemental Oxygen (SUPPOXY)	Determination of the presence of supplemental oxygen during assessment of ED/hospital saturation	String	15	"Supplemental Oxygen" "No Supplemental Oxygen"	
Temperature (TEMP)	The patient's temperature in Centigrade	Numeric	5	0-45	
Glasgow Coma Scale: Eye (GCSEYE)	First recorded Glasgow Coma Score (Eye)	Numeric	5	1 to 4; See the NTDS data dictionary for detail	
Glasgow Coma Scale: Verbal (GCSVERB)	First recorded Glasgow Coma Score (Verbal)	Numeric	5	1 to 5; See the NTDS data dictionary for detail	
Glasgow Coma Scale: Motor (GCSMOT)	First recorded Glasgow Coma Score (Motor)	Numeric	5	1 to 6; See the NTDS data dictionary for detail	
Glasgow Coma Scale Total (GCSTOT)	First recorded Glasgow Coma Score (total)	Numeric	5	Range is from 3-15	
Glasgow Coma Scale Assessment Qualifier 1 (GCS_Q1)	Assessment Qualifier for Total GCS Score 1	String	100	See the NTDS data dictionary for detail	
Glasgow Coma Scale Assessment Qualifier 1 (GCS_Q2)	Assessment Qualifier for Total GCS Score 1	String	100	See the NTDS data dictionary for detail	
Glasgow Coma Scale Assessment Qualifier 1 (GCS_Q3)	Assessment Qualifier for Total GCS Score 1	String	100	See the NTDS data dictionary for detail	
Respiratory Assistance Description (RRAQ)	Respiratory assistance assessment qualifier	String	100		

Supplemental Oxygen Description (OXYGAQ)	Supplemental oxygen (intubation) qualifier	String	100		

APPENDIX B: THE BARELL INJURY DIAGNOSIS MATRIX, CLASSIFICATION BY BODY REGION AND NATURE OF INJURY

The Barell Matrix

The Barell Injury Diagnosis Matrix, Classification by Body Region and Nature of the Injury

based on 5 digit Icd-9 CM codes

Body region		ICD-9-CM codes	A FRACTURE 800-829	B DISLOCATION 830-839	C SPRAINS & STRAINS 840-848	D INTERNAL 850-854,860-869 952, 995.55	E OPEN WOUND 870-884, 890-894	F AMPUTATIONS 885-887, 895-897	G BLOOD VESSELS 900-904	H CONTUSION / SUPERFICIAL 910-924	I CRUSH 925-929	J BURNS 940-949	K NERVES 950-951 953-957	L UNSPECIFIED 959
Head and Neck – Traumatic Brain Injury	1 Type 1 TBI	800,801,803,804(.1-.4,.6-.9), (.03-.05,.53-.55) 850(.2-.4), 851-854, 950(.1-.3), 995.55	800,801,803,804(.1-.4,.6-.9) 800,801,803,804(.03-.05,.53-.55)	/	/	850(.2-.4) 851-854*, 995.55	/	/	/	/	/	/	950.1-.3	/
	2 Type 2 TBI	800,801,803,804(.00,.02,.06,.09) (.50,.52,.56,.59) , 850(.0,.1,.5,.9)	800,801,803,804(.00,.02,.06,.09), 800,801,803,804(.50,.52,.56,.59)			850(.0,.1,.5,.9)								
	3 Type 3 TBI	800,801,803,804(.01, .51)	800,801,803,804(.01,.51)	/	/	/	/	/	/	/	/	/	/	/
Head and Neck – Other head, face and neck	4 Other Head	873(.0-.1,.8-.9), 941.x6, 951, 959.01	/	/	/	/	873.0-.1,.8-.9	/	/	/	/	941.x6	951	959.01*
	5 Face	802, 830, 848.0-.1, 872, 873.2-.7, 941(.x1,.x3-.x5,.x7)	802	830	848.0-.1	/	872, 873.2-.7	/	/	/	/	941.x1,.x3-.x5,.x7	/	/
	6 Eye	870-871, 918, 921, 940, 941.x2, 950(.0,.9)	/	/	/	/	870-871	/	/	918, 921	/	940, 941.x2	950(.0,.9)	/
	7 Neck	807.5-.6, 848.2, 874, 925.2, 941.x8, 953.0, 954.0	807.5-.6	/	848.2	/	874	/	/	/	925.2	941.x8	953.0, 954.0	/
	8 Head, Face and Neck Unspecified	900, 910, 920, 925.1, 941.x0, .x9, 947.0, 957.0, 959.09	/	/	/	/	/	/	900	910, 920	925.1	941.x0,.x9, 947.0	957.0	959.09
Spine and back – Spinal Cord (SCI)	9 Cervical SCI	806(.0-.1), 952.0	806.0-.1	/	/	952.0	/	/	/	/	/	/	/	/
	10 Thoracic/ Dorsal SCI	806(.2-.3), 952.1	806.2-.3	/	/	952.1	/	/	/	/	/	/	/	/
	11 Lumbar SCI	806(.4-.5), 952.2	806.4-.5	/	/	952.2	/	/	/	/	/	/	/	/
	12 Sacrum Coccyx SCI	806(.6-.7), 952(.3-.4)	806.6-.7	/	/	952.3-.4	/	/	/	/	/	/	/	/
	13 Spine+ Back unspecified SCI	806(.8-.9), 952(.8-.9)	806.8-.9	/	/	952.8-.9	/	/	/	/	/	/	/	/
Spine and back – Vertebral Column (VCI)	14 Cervical VCI	805(.0-.1), 839(.0-.1), 847.0	805.0-.1	839.0-.1	847.0	/	/	/	/	/	/	/	/	/
	15 Thoracic /Dorsal VCI	805(.2-.3), 839(.21,.31), 847.1	805.2-.3	839.21,.31	847.1	/	/	/	/	/	/	/	/	/
	16 Lumbar VCI	805(.4-.5), 839(.20,.30), 847.2	805.4-.5	839.20,.30	847.2	/	/	/	/	/	/	/	/	/
	17 Sacrum Coccyx VCI	805(.6-.7), 839(.41-.42), 839(.51-.52), 847.3-.4	805.6-.7	839(.41-.42, .51-.52)	847.3-.4	/	/	/	/	/	/	/	/	/
	18 Spine+ Back unspecified VCI	805(.8-.9), 839(.40,.49), 839(.50,.59)	805.8-.9	839(.40,.49,.50,.59)	/	/	/	/	/	/	/	/	/	/
Torso	19 Chest (Thorax)	807(.0-.4), 839(.61,.71), 848(.3-.4), 860-862, 875, 879(.0-.1), 901, 922(.0-.1,.33), 926.19, 942.x1-.x2 953.1	807.0-.4	839.61,.71	848.3-.4	860-862	875, 879.0-.1	/	901	922(.0,.1,.33)	926.19	942.x1-x2	953.1	/
	20 Abdomen	863-866, 868, 879(.2-.5), 902(.0-.4), 922.2,942.x3, 947.3, 953(.2,.5)	/	/	/	863-866, 868	879.2-.5	/	902.0-.4	922.2	/	942.x3, 947.3	953.2, 953.5	/
	21 Pelvis & Urogenital	808, 839(.69,.79), 846, 848.5, 867,877-878 902(.5,.81-.82), 922.4, 926(.0,.12), 942.x5,947.4, 953.3	808	839.69,.79	846, 848.5	867	877-878	/	902(.5, .81-.82)	922.4	926(.0, .12)	942.x5, 947.4	953.3	/
	22 Trunk	809, 879(.6-.7), 911, 922(.8-.9), 926(.8-.9), 942(.x0,.x9), 954(.1,.8-.9), 959.1	809	/	/	/	879.6-.7	/	/	911, 922.8-.9	926.8-.9	942.x0, 942.x9	954.1, .8-.9	959.1
	23 Back and Buttock	847.9, 876, 922(.31-.32), 926.11, 942.x4	/	/	847.9	/	876	/	/	922.31-.32	926.11	942.x4	/	/
Extremities – Upper	24 Shoulder & upper arm	810-812, 831, 840, 880, 887(.2-.3), 912,923.0, 927.0, 943(.x3-.x6) ,959.2	810-812	831	840	/	880	887.2-.3	/	912, 923.0	927.0	943.x3-.x6	/	959.2
	25 Forearm & elbow	813, 832, 841, 881(.x0-.x1), 887(.0-.1), 923.1, 927.1, 943(.x1-.x2)	813	832	841	/	881.x0-x1	887.0-.1	/	923.1	927.1	943.x1-x2	/	/
	26 Wrist, hand & fingers	814-817, 833-834, 842,881.x2, 882, 883, 885-886, 914-915, 923(.2-.3) ,927(.2-.3), 944 ,959(.4-.5)	814-817	833, 834	842 /	/ /	881.x2,882, 883	885-886	/ /	914-915, 923.2-.3	927.2-.3	944 /	/ /	959.4-.5
	27 Oher & unspecified	818, 884, 887(.4-.7), 903, 913, 923(.8-.9), 927(.8-.9), 943(.x0,.x9), 953.4, 955, 959.3	818	/	/	/	884	887.4-.7	903	913,923.8,.9	927.8-.9	943.x0,.x9	953.4, 955	959.3
Extremities – Lower	28 Hip	820, 835, 843, 924.01, 928.01	820	835	843	/	/	/	/	924.01	928.01	/	/	/
	29 Upper leg & thigh	821, 897(.2-.3), 924.00, 928.00, 945.x6	821			/	/	897.2-.3	/	924.00	928.00	945.x6	/	/
	30 Knee	822, 836, 844.0-.3, 924.11, 928.11, 945.x5	822	836	844.0-.3	/	/	/	/	924.11	928.11	945.x5	/	/
	31 Lower leg & ankle	823-824, 837, 845.0, 897(.0-.1), 924(.10,.21), 928(.10,.21), 945(.x3-.x4)	823-824	837	845.0	/		897.0-.1	/	924.10,.21	928.10,.21	945.x3-.x4	/	/
	32 Foot & toes	825-826, 838, 845.1, 892-893, 895-896, 917, 924(.3,.20), 928 (.3,.20), 945 (.x1-.x2)	825-826	838	845.1	/	892-893	895-896	/	917, 924.3,.20	928.3,.20	945.x1-.x2	/	/
	33 Other & unspecified	827,844(.8-.9), 890-891, 894, 897(.4-.7), 904(.0-.8), 916, 924(.4-.5), 928(.8-.9), 945(.x0,.x9), 959.6-.7	827	/	844.8,.9	/	890-891,894	897.4-.7	904.0-.8	916, 924.4-.5	928.8,.9	945.x0,.x9	/	959.6-.7
Unclassifiable by site – Other & unspecified	34 Other/ multiple	819, 828, 902(.87,.89), 947(.1-.2), 953.8, 956	819, 828	/	/	/	/	/	902.87,.89	/	/	947.1-.2	953.8, 956	/
	35 Unspecified site	829, 839(.8-.9), 848(.8-.9), 869, 879(.8,.9), 902.9, 904.9, 919, 924(.8,.9), 929, 946, 947(.8,.9), 948, 949, 953.9, 957(.1,.8,.9), 959(.8,.9)	829	839.8-.9	848.8-.9	869	879(.8-.9)	/	902.9, 904.9	919, 924.8,.9	929	946, 947.8,.9 948, 949	953.9, 957.1,.8,.9	959.8,.9
Unclassifiable by site – System wide	36 System-wide & late effects	905-908, 909 (.0,.1,.2,.4,.9), 930-939,958, 960-994, 995.50-.54,.59, 995(.80-.85)	Foreign body (930-939), Early complications of trauma (958), Poisoning (960-979), Toxic Effects (980-989), Other and unspecified effects of external cause (990-994) Child and adult maltreatment (995.50-.54,.59, 995.80-.85) Late effects of injuries, poisonings, toxic effects and other external causes (905-909) excluding 909(.3, .5)											

Special diagnostic codes for trauma: Flail Chest (807.4) Pneumothorax (860)

For purposes of classification, head injuries are labeled as **Type 1** TBI if there is recorded evidence of an intracranial injury or a moderate or a prolonged loss of consciousness (LOC), Shaken Infant Syndrome (SIS), or injuries to the optic nerve pathways.

Type 2 TBI includes injuries with no recorded evidence of intracranial injury, and LOC of less than one hour, or LOC of unknown duration, or unspecified level of consciousness. **Type 3** TBI includes patients with no evidence of intracranial injury and no LOC.

* **Note from CDC**: 959.01 (added to ICD-9-CM in 1997) is not intended to be assigned to TBI cases; however, in the USA it has been assigned incorrectly to a substantial proportion of cases previously coded 854.

The Matrix is available on the net at www.cdc.gov/nchs/about/otheract/ice/barellmatrix.htm

APPENDIX C: GROUPING FOR PRESENTING INJURY MORTALITY AND MORBIDITY DATA (FEB 2007)

This matrix contains the ICD-9-CM external-cause-of-injury codes used for coding of injury mortality data and additional ICD-9-CM external-cause-of-injury codes, designated in bold, only used for coding of injury morbidity data. Further details and access to SAS input statements set up to define these groupings can be found at http://www.cdc.gov/nchs/injury.htm.

Mechanism / Cause	Manner / Intent				
	Unintentional	**Self-inflicted**	**Assault**	**Undetermined**	**Other[1]**
Cut / pierce	E920.0-.9	E956	E966	E986	E974
Drowning / submersion	E830.0-.9, E832.0-.9 E910.0-.9	E954	E964	E984	
Fall	E880.0-E886.9, E888	E957.0-.9	E968.1	E987.0-.9	
Fire / burn[3]	E890.0-E899, E924.0-.9	E958.1,.2,.7	E961, E968.0,.3, **E979.3**	E988.1,.2,.7	
Fire / flame[3]	E890.0-E899	E958.1	E968.0, **E979.3**	E988.1	
Hot object / substance	E924.0-.9	E958.2,.7	E961, E968.3	E988.2,.7	
Firearm[3]	E922.0-.3,.8, .9	E955.0-.4	E965.0-4, **E979.4**	E985.0-.4	E970
Machinery	E919 (.0-.9)				
Motor vehicle traffic[2,3]	E810-E819 (.0-.9)	E958.5	**E968.5**	E988.5	
Occupant	E810-E819 (.0,.1)				
Motorcyclist	E810-E819 (.2,.3)				
Pedal cyclist	E810-E819 (.6)				
Pedestrian	E810-E819 (.7)				
Unspecified	E810-E819 (.9)				

Mechanism / Cause	Manner / Intent				
	Unintentional	**Self-inflicted**	**Assault**	**Undetermined**	**Other**[1]
Pedal cyclist, other	E800-E807 (.3) E820-E825 (.6), E826.1,.9 E827-E829(.1)				
Pedestrian, other	E800-807(.2) E820-E825(.7) E826-E829(.0)				
Transport, other	E800-E807 (.0,.1,.8,.9) E820-E825 (.0-.5,.8,.9) E826.2-.8 E827-E829 (.2-.9), E831.0-.9, E833.0-E845.9	E958.6		E988.6	
Natural / environmental	E900.0-E909, E928.0-.2	E958.3		E988.3	
Bites and stings[3]	E905.0-.6,.9 E906.0-.4,**.5**,.9				
Overexertion	E927				
Poisoning	E850.0-E869.9	E950.0-E952.9	E962.0-.9, **E979.6,.7**	E980.0-E982.9	E972
Struck by, against	E916-E917.9		E960.0; E968.2		E973, E975
Suffocation	E911-E913.9	E953.0-.9	E963	E983.0-.9	
Other specified and classifiable[3,4]	E846-E848, E914-E915 E918, E921.0-.9, **E922.4,.5** E923.0-.9, E925.0-E926.9 **E928(.3-.5)**, E929.0-.5	E955.5,**.6**,.**7**,.9 E958.0,.4	E960.1, E965.5-.9 E967.0-.9, E968.4,**.6, .7** **E979 (.0-.2,.5,.8,.9)**	E985.5,**.6**,**.7** E988.0,.4	E971, E978, E990-E994, E996 E997.0-.2

Mechanism / Cause	Manner / Intent				
	Unintentional	Self-inflicted	Assault	Undetermined	Other[1]
Other specified, not elsewhere classifiable	E928.8, E929.8	E958.8, E959	E968.8, E969, E999.1	E988.8, E989	E977, E995, E997.8 E998, E999.0
Unspecified	E887, E928.9, E929.9	E958.9	E968.9	E988.9	E976, E997.9
All injury[3]	E800-E869, E880-E929	E950-E959	E960-E969, **E979,** E999.1	E980-E989	E970-E978, E990-E999.0
Adverse effects					E870-E879 E930.0-E949.9
Medical care					E870-E879
Drugs					E930.0-E949.9
All external causes					E800-E999

[1]Includes legal intervention (E970-E978) and operations of war (E990-E999).
[2]Three 4th-digit codes (.4 [occupant of streetcar], .5 [rider of animal], .8 [other specified person]) are not presented separately because of small numbers. However, because they are included in the overall motor vehicle traffic category, the sum of these categories can be derived by subtraction.
[3]Codes in bold are for morbidity coding only. For details see table 2.
[4]E849 (place of occurrence) has been excluded from the matrix. For mortality coding, an *ICD-9* E849 code does not exist. For morbidity coding, an *ICD-9-CM* E849 code should never be first-listed E code and should only appear as an additional code to specify the place of occurrence of the injury incident.

Trauma Type Calculation Based on Mechanism

Mechanism Code	Mechanism Description	Trauma Type Code	Trauma Type Description
1	Cut/pierce	2	Penetrating
2	Drowning/submersion	4	Other/unspecified
3	Fall	1	Blunt
4	Fire/flame	3	Burn
5	Hot object/substance	3	Burn
6	Firearm	2	Penetrating
7	Machinery	1	Blunt
8	MVT Occupant	1	Blunt
9	MVT Motorcyclist	1	Blunt
10	MVT Pedal cyclist	1	Blunt
11	MVT Pedestrian	1	Blunt
12	MVT Unspecified	1	Blunt
13	MVT Other	1	Blunt
14	Pedal cyclist, other	1	Blunt
15	Pedestrian, other	1	Blunt
16	Transport, other	1	Blunt
17	Bites and stings	4	Other/unspecified
18	Other natural/env	4	Other/unspecified
19	Overexertion	4	Other/unspecified
20	Poisoning	4	Other/unspecified
21	Struck by, against	1	Blunt
22	Suffocation	4	Other/unspecified
23	Other specified and classifiable	4	Other/unspecified
24	Other specified, not elsewhere classifiable	4	Other/unspecified
25	Unspecified	4	Other/unspecified
26	Adverse effects, medical care	4	Other/unspecified
27	Adverse effects, drugs	4	Other/unspecified

APPENDIX D: SOURCE CODE FOR SAMPLE PROGRAMS

NTDB has created two sample programs to help researchers get started with merging files and creating statistical output. These sample programs are available for both SAS and Stata. A description of the three sample programs can be found in the table below:

Sample Program Name	**Description**
ISS_gender	This program calculates the ISS frequency by Gender. The program merges the RDS_ED table with RDS_DEMO table and creates a frequency table of the ISS by Gender.
Spinal_cord_demo	This program will create summary statistics for demographics (age, gender) for all spinal cord incidents. The program selects all the spine injuries from the RDS_AISCODE and RDS_DCODE table and the corresponding demographics is merged into that file by using the RDS_DEMO table. Frequency table of the demographic variables are created for these incidents.

A copy of the source code for both the SAS and Stata version of these programs are included in this appendix. We hope that you will contact us with any concerns or suggestions on how to make these sample programs more useful in the future

SAS Source Code

2) ISS_gender.sas

```
/**********************************************************************/
/*                                                                    */
/*      Title:          ISS_gender.sas                                */
/*      Author:         S. Goble, Statistician NTDB                   */
/*                                                                    */
/*      Purpose: This program calculates the ISS frequency by Gender  */
/*                                                                    */
/*      Input data:     1. Data set with the ED data and edit flags per incident  */
/*                      Name: RDS_ED                                  */
/*                              Variables needed:       Name:         */
/*                              Incident ID             INC_KEY       */
/*                              ISS score               ISS           */
/*                                                                    */
/*         2. Data set with demographics for each incident            */
/*                       Name: DEMO                                   */
/*                              Variables needed:       Name:         */
/*                              Incident ID             INC_KEY       */
/*                              Gender                  GENDER        */
/*                                                                    */
/*      Output: Frequency count of the ISS by Gender                  */
/*                                                                    */
/*      Modified:  December 2008                                      */
/*                                                                    */
/**********************************************************************/

* Change the following:  'D:\data\RDS\NTDB8.1'          to  '\yourpathname\'; /*folder for
saving input data sets*/;
LIBNAME DAT 'D:\data\RDS\NTDB8.1';

*** Import data set with ed data (ISS)  ***;
PROC IMPORT FILE="D:\data\RDS\NTDB8.1\RDS_ED.dbf" OUT=ED DBMS=dbf
REPLACE;
RUN;

PROC SORT DATA=ED;
BY INC_KEY;
RUN;

**** Import the demographic data (Gender) *****;
```

```
PROC IMPORT FILE="D:\data\RDS\NTDB8.1\RDS_DEMO.dbf" OUT=DEMO DBMS=dbf
REPLACE;
RUN;
PROC SORT DATA=DEMO;
BY INC_KEY;
RUN;
*** MERGE DATA SETS ***;
DATA ANALYZE;
   MERGE ED DEMO;
   BY INC_KEY;
  KEEP INC_KEY ISS GENDER;
RUN;

PROC FREQ DATA=ANALYZE;
TABLE ISS*GENDER;
TITLE 'ISS SCORE BY GENDER';
TITLE2 'NOTE: YOU MIGHT WANT TO FILTER OUT INVALID ISS SCORES (EDIT
CHECK D)';
RUN;
```

3) Spinal_cord_demo.sas

```
/*************************************************************************/
/*                                                                       */
/*      Title:          spinal_cord_demo.sas                             */
/*      Author:         S. Goble, Statistician NTDB                      */
/*                                                                       */
/*      Purpose: This program will create summary statistics for simple */
/*        demographics (age, gender) for all spinal cord incidents       */
/*                                                                       */
/*      Input data:     1.      Data set with ICD-9 code for each incident */
/*                              Name: RDS_DIAGNOS                        */
/*                              Variables needed:       Name:            */
/*                              Incident ID             INC_KEY          */
/*                              Diagnosis code          DCODE            */
/*                                                                       */
/*          2. Data set with AIS coding for each incident                */
/*             Name: RDS_AISCODE                                         */
/*                              Variables needed:       Name:            */
/*                               Incident ID            INC_KEY          */
/*                               Body region            BODYREGION       */
/*                               AIS score              AISSCORE         */
/*                                                                       */
/*          3. Data set with demographics for each incident              */
/*             Name: RDS_DEMO                                            */
/*                              Variables needed:   Name:                */
/*                               Incident ID        INC_KEY              */
/*                               Gender             GENDER               */
/*                               Age                AGE                  */
/*                                                                       */
/*      Output: Frequency count and summary statistics for spinal cord   */
/*       injuries with outcome of paralysis                              */
/*                                                                       */
/*      Modified: December 2008                                   */
/*                                                                       */
/*************************************************************************/

* Change the following:  'D:\data\RDS\NTDB8.1'           to  '\yourpathname\'; /*folder for
saving input data sets*/;
LIBNAME DAT 'D:\data\RDS\NTDB8.1';

*** Import the data with diagnosis codes to identify the spinal cord injuries ***;
PROC IMPORT FILE="D:\data\RDS\NTDB8.1\RDS_AISCODE.dbf" OUT=AISCODE
DBMS=dbf REPLACE;
RUN;
```

```
**** KEEP INCIDENTS WITH SPINAL CORDS DIAGNOSIS***;
DATA AISCODE;
  SET AISCODE;
  IF BODYREGION='Spine' ;   /*spine injury */;
  KEEP INC_KEY;
  RUN;
***  ONE RECORD PER INCIDENT***;
PROC SORT DATA=AISCODE NODUPKEY;
BY INC_KEY;
RUN;

PROC IMPORT FILE="D:\data\RDS\NTDB810\RDS_DIAGNOS.dbf" OUT=DIAGNOS
DBMS=dbf REPLACE;
RUN;

**** SPINAL CORD INJURY USING ICD-9 ***;
DATA DIAGNOS;
 SET DIAGNOS;
 IF 806<=DCODE<807;                                    /*spine injury */;
 KEEP INC_KEY;
 RUN;
***ONE RECORD PER INCIDENT***;
PROC SORT DATA=DIAGNOS NODUPKEY;
BY INC_KEY;
RUN;
 *** ALL INCIDENTS WITH SPINAL CORD INJURY & SEVERITY = 5 ***;
 DATA SPINE;
   MERGE AISCODE DIAGNOS;
   BY INC_KEY;
 RUN;

**** Import the Age variable *****;
PROC IMPORT FILE="D:\data\RDS\NTDB8.1\RDS_DEMO.dbf" OUT=DEMO DBMS=dbf
REPLACE;
RUN;

PROC SORT DATA=DEMO;
BY INCIDENT_KEY;
RUN;
*** MERGE DATA SETS ***;
DATA ANALYZE;
   MERGE SPINE (IN=IN1) DEMO;
   BY INC_KEY;
   IF IN1;                        /*KEEP THE SPINAL CORD INCIDENTS */;
   KEEP INC_KEY AGE GENDER;
RUN;
```

```
PROC FREQ DATA=ANALYZE;
TABLE AGE GENDER;
TITLE 'AGE AND GENDER FOR SPINAL CORD INJURIES';
RUN;
PROC UNIVARIATE DATA=ANALYZE;
VAR AGE ;
TITLE 'SUMMARY STATISTICS FOR AGE FOR SPINAL CORD INJURIES';
RUN;
```

Stata Source code:

2) ISS_gender.do

```
/*********************************************************************/
/*      Title:   ISS_gender.do                                          */
/*      Author: S. Goble, Statitician NTDB                              */
/*      Purpose: This program calculates the ISS frequency by Gender    */
/*                                                                      */
/*      Input data:     1. Data set with the ED data and edit flags per  incident */
/*                      Name: RDS_ED                                    */
/*                              Variables needed:       Name:           */
/*                              Incident ID             INC_KEY         */
/*                              ISS score               ISS             */
/*                                                                      */
/*          2. Data set with demographics for each incident             */
/*                      Name: DEMO                                      */
/*                              Variables needed:       Name:           */
/*                              Incident ID             INC_KEY         */
/*                              Gender                  GENDER          */
/*                                                                      */
/*      Output: Frequency count of the ISS by Gender                    */
/*                                                                      */
/*      Modified:  December 2008                                        */
/*                                                                      */
/*********************************************************************/
clear
set memory 700000
set debug on

* Change the following:'D:\data\RDS\NTDB8.1\'            to '\yourpathname\'  /*folder for saving input data sets*/
* Change the following:'D:\data\Stata\RDS7.0\Sample_programs' to '\yourpathname\'/*folder for saving output data set*/

*Import data set with ed data (ISS)
insheet using D:\data\RDS\NTDB8.1\RDS_ED.csv
sort inc_key
save D:\data\Stata\RDS7.0\Sample_programs\ed.dta, replace
clear

*Import Demo data
insheet using D:\data\RDS\NTDB8.1\RDS_DEMO.csv
sort inc_key

*MERGE FILES
```

```
* KEEP ONLY RECORDS FROM BOTH DATA SETS
merge inc_key using D:\data\Stata\RDS8.1\Sample_programs\ed.dta
keep if _merge==3
drop _merge

* ISS SCORE BY GENDER
tab iss gender
```

3) Spinal_cord_demo.do

```
/*********************************************************************/
/*                                                                   */
/*      Title:          spinal_cord_demo.do                          */
/*      Author:         S. Goble, Statitician NTDB                   */
/*                                                                   */
/*      Purpose: This program will create summary statistics for simple */
/*        demographics (age, gender) for all spinal cord incidents   */
/*                                                                   */
/*      Input data:     1.      Data set with ICD-9 code for each incident */
/*                              Name: RDS_DIAGNOS                    */
/*                              Variables needed:       Name:        */
/*                              Incident ID             INC_KEY      */
/*                              Diagnosis code          DCODE        */
/*                                                                   */
/*          2. Data set with AIS coding for each incident            */
/*            Name: RDS_AISCODE                                      */
/*                              Variables needed:       Name:        */
/*                               Incident ID            INC_KEY      */
/*                               Body region            BODYREGION   */
/*                               AIS score              AISSCORE     */
/*                                                                   */
/*          3. Data set with demographics for each incident          */
/*            Name: RDS_DEMO                                         */
/*                              Variables needed:   Name:            */
/*                               Incident ID        INC_KEY          */
/*                               Gender             GENDER           */
/*                               Age                AGE              */
/*                                                                   */
/*      Output: Frequency count and summary statistics for spinal cord */
/*       injuries with outcome of paralysis                          */
/*                                                                   */
/*      Created: NOVEMBER, 2007                                      */
/*                                                                   */
/*********************************************************************/
clear
set memory 700000
set debug on

* Change the following:'D:\data\RDS\NTDB7.0\'         to '\yourpathname\'  /*folder for saving
input data sets*/
* Change the following:'D:\data\Stata\RDS7.0\Sample_programs' to '\yourpathname\'/*folder for
saving output data set*/

*** Import the data with diagnosis codes to identify the spinal cord injuries
insheet using D:\data\RDS\NTDB7.0\RDS_AISCODE.csv
```

```
keep if bodyregion=="Spine"
keep inc_key
sort inc_key
** delete duplicate observations
quietly by inc_key: gen dup = cond(_N==1,0,_n)
drop if dup>1
save D:\data\Stata\RDS7.0\Sample_programs\aisscode.dta, replace
clear

insheet using D:\data\RDS\NTDB7.0\RDS_DIAGNOS.csv
*** convert dcode to nummeric ****
describe
destring dcode, replace force
describe
keep if inrange(dcode,806,806.99)
keep inc_key
sort inc_key
** delete duplicate observations
quietly by inc_key: gen dup = cond(_N==1,0,_n)
drop if dup>1

*MERGE FILES
merge inc_key using D:\data\Stata\RDS7.0\Sample_programs\aisscode.dta
drop _merge
sort inc_key
save D:\data\Stata\RDS7.0\Sample_programs\spinaldata.dta, replace
clear

**** Import the Age variable *****;
insheet using D:\data\RDS\NTDB7.0\RDS_DEMO.csv
keep inc_key age gender
sort inc_key
save D:\data\Stata\RDS7.0\Sample_programs\Demo.dta, replace

*** MERGE DATA SETS *
* KEEP ONLY RECORDS FROM BOTH DATA SETS
merge inc_key using D:\data\Stata\RDS7.0\Sample_programs\spinaldata.dta
keep if _merge==3
drop _merge

*SUMMARY STATISTICS FOR AGE FOR SPINAL CORD INJURIES
tab age
tab gender
tab age gender
sum age
```