

Package ‘icdpic’

January 28, 2021

Type Package

Title 'ICD' Programs for Injury Categorization in R

Version 1.0.0

Description Categorization and scoring of injury severity typically involves trained personnel with access to injured persons or their medical records. 'icdpic' contains a function that provides automated calculation of Abbreviated Injury Scale ('AIS') and Injury Severity Score ('ISS') from International Classification of Diseases ('ICD') codes and may be a useful substitute to manual injury severity scoring. 'ICDPIC' was originally developed in 'Stata', and 'icdpic' is an open-access update that accepts both 'ICD-9' and 'ICD-10' codes.

License MIT + file LICENSE

LazyData TRUE

Encoding UTF-8

RoxygenNote 7.1.1

Imports stringr (>= 1.0.0)

Depends R (>= 2.10)

Suggests testthat, knitr, rmarkdown, dplyr

VignetteBuilder knitr

NeedsCompilation no

Author Adam Black [aut, cre, cph],
David Clark [aut, cph]

Maintainer Adam Black <ablack3@gmail.com>

Repository CRAN

Date/Publication 2021-01-28 12:20:02 UTC

R topics documented:

cat_trauma	2
icdpicr	4
injury	6

Index	8
--------------	----------

cat_trauma	<i>Categorize trauma by adding AIS and ISS to a dataframe</i>
------------	---

Description

For each observation this function will

1. assign a severity (AIS) and ISS body region values to each valid ICD-9-CM or ICD-10-CM trauma code,
2. add variables for maximum severity of each body region,
3. calculate ISS
4. select first 4 e-codes/mechanism codes along with major mechanism, minor mechanism, and intent

Usage

```
cat_trauma(df, dx_pre, icd10, i10_iss_method, calc_method = 1, verbose = FALSE)
```

Arguments

df	A dataframe in wide format containing ICD-9 and/or ICD-10 diagnosis codes with a common column name prefix. Diagnosis codes should be character strings and may have a decimal or not.
dx_pre	Prefix for diagnosis code column names (example: dx1, dx2, etc.)
icd10	Should ICD 10 codes be included? Must be one of: TRUE, FALSE, "cm", or "base". <ul style="list-style-type: none"> • TRUE ICD10CM codes will be processed by the program • FALSE - No ICD codes will be considered by cat_trauma(). Any ICD10 codes in the data will be ignored. • "cm" - ICD10CM codes will be processed by the program • "base" - ICD10 (international) codes will be processed by cat_trauma() <p>If the icd10 argument is not set to FALSE then the method used to map ICD 10 codes to AIS is determined by the i10_iss_method argument.</p>
i10_iss_method	Method for calculating ISS from ICD10 codes. Ignored if icd10 = FALSE. Must be one of:

- "roc_max_NIS" Table derived empirically from National Inpatient Sample (NIS) using ROC c-stat as the objective. For ICD10 codes not in NIS the mapping based on TQIP data will be used as a backup. This option is recommended if the users data is similar to NIS data. Details of the mapping algorithm included in ICDPIC-R package help documentation.
 - "roc_max_TQIP" Table derived empirically from the Trauma Quality Improvement Program data using ROC c-stat as the objective. For ICD10 codes not in TQIP the mapping based on NIS data will be used as a backup. This option is recommended if the user's data is similar to the TQIP data.
 - "roc_max_NIS_only" Table derived empirically from National Inpatient Sample using ROC c-stat as the objective. Injury ICD10 codes not in the NIS dataset will be ignored.
 - "roc_max_TQIP_only" Table derived empirically from Trauma Quality Improvement Program data using ROC c-stat as the objective. Injury ICD10 codes not in the TQIP dataset will be ignored.
 - "gem_max" Table derived by mapping ICD 10 to ICD 9 using the CMS general equivalence mapping tables and then to ISS using the original ICD-PIC table. Mapping conflicts handled by taking the max ISS.
 - "gem_min" Same as "gem_max" except that mapping conflicts are handled by taking the min ISS.
- calc_method ISS calculation method: Method 1 (default) will assign an ISS of 75 if any AIS is 6. Method 2 will change any AIS = 6 to 5 and then calculate ISS normally.
- verbose Should updates be printed to the console? TRUE or FALSE (default). This can be helpful for long running computations.

Details

Data should be in wide format:

ID	dx1	dx2	dx3
31416	800.1	959.9	E910.9
31417	800.24	410.0	

Codes for AIS severity:

- 1 = Minor
- 2 = Moderate
- 3 = Serious
- 4 = Severe
- 5 = Critical
- 6 = Unsurvivable
- 9 = Unknown

Value

A dataframe identical to the dataframe passed to the function with the following additional variables added:

- sev_1-sev_n: AIS severity for diagnosis codes 1..n
- issbr_1-issbr_n: ISS body region for diagnosis codes 1..n
- mxaisbr1-mxaisbr6: maximum AIS severity for each of the 6 ISS body regions
- maxais: maximum AIS severity over all ISS body regions
- riss: computed injury severity score
- niss: new injury severity score
- ecode_1-ecode_4: first 4 mechanism/E-Codes (including ICD10 if requested) found in each row of data
- mechmaj1-mechmaj4: CDC external cause of injury major mechanism for each E-Code captured
- mechmin1-mechmin4: CDC external cause of injury minor mechanism for each E-Code captured
- intent1-intent4: intent for each E-Code captured
- lowmech: lowest CDC external cause of injury major mechanism for all E-Codes captured
- mortality_prediction: The model predicted probability of mortality. (only added if using ICD 10 codes with roc_max method)

Examples

```
df_in <- read.table(header = TRUE, text = "
  ident  dx1    dx2    dx3
  31416  800.1  959.9  E910.9
  31417  800.24 410.0  NA
")
df_out <- cat_trauma(df_in, "dx", icd10 = FALSE)
```

icdpicr

ICDPICR

Description

International Classification of Diseases Programs for Injury Categorization. The ICDPICR package is an adaptation of the ICDPIC package originally written for Stata. ICDPIC is a collection of Stata programs for injury categorization and is available as a Stata download or online at <https://ideas.repec.org/c/boc/bocode/s457028.html>

Version

Version 0.1.0 ICDPICR is adapted from the ICDPIC Version 3.0 Stata program. Some of the functionality of the original program has been reduced in the interest of providing updates for only the most useful elements of the original ICDPIC program. ICDPICR is designed to work with both ICD-9 and ICD-10 codes. ICDPICR is open source and all code and documentation can be found at <https://github.com/ablack3/icdpicr>.

Description

ICDPICR is an R package that currently consists of a single function that performs the same task that the "trauma" program does in the Stata version of ICDPIC. The intention of these ICDPIC programs is to provide inexpensive methods for translating International Classification of Diseases (ICD) diagnosis codes into standard injury categories and/or scores. Initial development of the ICDPIC Stata programs occurred as part of research projects funded by the National Center for Injury Prevention and Control through the Harvard Injury Control Research Center (CDC R49/CCR 115279) and by the Maine Medical Center Research Strategic Plan. The translation of ICDPIC to R was supported by funding from the Maine Medical Center Division of Trauma and Surgical Critical Care and Center for Outcomes Research and Evaluation. The authors are grateful for this support and would also appreciate suggestions or corrections from any user of the software. Bug reports or feature requests may be submitted at <https://github.com/ablack3/icdpicr/issues>. Publications of studies in which these programs or tables are used should cite the authors.

Methods

For each valid ICD-9-CM or ICD-10-CM injury diagnosis, ICDPIC-R is programmed to generate an approximate AIS and body region, using the original AIS anatomic classification (as modified by Baker and colleagues) into six body regions: Head and neck, face, chest, abdomen and pelvic contents, extremities and pelvic bones, and general. In addition, each code referring to a mechanism of injury is categorized as recommended or proposed by the CDC. For each injured person, ICDPIC-R determines the maximal AIS in each body region and overall, an Injury Severity Score (RISS), and a CDC mechanism category.

Mapping of ICD-9-CM E-codes to CDC mechanism categories simply involved translation of the programming code from Stata into R, using essentially the same table. Mapping of ICD-10-CM codes to mechanism categories was based on a similar table published by the CDC.

The National Trauma Data Standard used by NTDB considers valid ICD-10-CM injury codes to be those in the ranges S00-S99, T07, T14, T20-T28, and T30-32. ICDPIC-R recognizes only these codes in the calculation of injury severity from ICD-10, and also requires that the codes have a decimal point in the fourth position and the letter "A" in the eighth position (indicating an initial encounter). Mapping of ICD-10-CM codes to AIS severity is performed in two ways, as described below.

“ROCmax” mapping method for ICD-10-CM codes: For each NTDB subject k with 1 to N_k valid ICD-10 codes, each code was given a score of 0 if the subject survived and a score of $1/N_k$ if the subject died (as recorded either in the Emergency Department file or in the Discharge file). A fractional hospital mortality (HMF) was derived as the average score for each subject with a given ICD-10 code. Different cutpoints were investigated to assign each ICD-10 code to an AIS severity based on HMF. Body regions were assigned using the proposed CDC classification. For each combination of cutpoints, the discrimination of the resulting ISS for predicting mortality was determined using a C-statistic. Among the combinations resulting in a maximum C-statistic (to two decimal places), the combination was chosen that most closely approximated the ISS that had been calculated by hospital trauma registrars (ISSAIS).

"GEM" mapping method for ICD-10-CM codes: ICD-10-CM codes are first mapped to ICD-9-CM codes using the General Equivalency Mapping (GEM) tables provided by the Centers for Medicare and Medicaid Services (CMS), and then those ICD-9-CM codes are mapped to AIS using the table inherited from the Stata version of ICDPIC. The user is given the option to ignore ICD-10-CM codes if desired. Otherwise, if the GEM maps an ICD-10-CM code to two or more ICD-9-CM

codes associated with different severities, the user is given the option whether to assign the greater or lesser of these severities (“GEMmax” or “GEMmin”). When the GEM maps an ICD-10-CM code to two or more ICD-9-CM codes associated with different AIS body regions, the verbal description of the ICD-10-CM code in the GEM table is used to assign a body region.

The GEM mapping method is necessary when injuries have been coded with ICD-9-CM codes only, and may be preferable when they have been coded with a mix of ICD-9-CM and ICD-10-CM.

For any of the ICD-9 or ICD-10 mapping methods in ICDPIC-R, the maximum AIS Severity for each AIS body region (MXAISBR1 ... MXAISBR6 in the output) is 0 if there are no valid injury codes for that body region. It is recorded as “missing” if there are valid codes for that body region, but their severity cannot be determined. Otherwise, it is the maximum known severity (1 through 6) for that body region. Maximum AIS Severity (MAXAIS in the output data) is the maximum of (MXAISBR1 ... MXAISBR6); MAXAIS will thus be 0 if there is no diagnosis code associated with an AIS severity.

Injury Severity Score (RISS) is calculated according to the classic description of Baker and colleagues, namely the sum of the squares of the three largest elements of (MXAISBR1 ... MXAISBR6). The user can choose whether to assign RISS=75 when any injury is assigned a severity of 6, or to reassign a severity of 5 to these injuries and calculate RISS as above. The first option, RISS = 75 when any severity = 6, is the default in ICDPIC-R, since by definition an AIS severity of 6 should denote an injury that is uniformly fatal and thus should rarely be found in hospital data.

Functions

cat_trauma provides various classifications and characterizations of trauma based on ICD-9-CM or ICD-10-CM diagnosis codes.

injury

ICD10CM injury codes

Description

A dataset containing a sample of trauma registry for use in examples and tests.

Usage

injury

Format

A data frame with 100,477 rows and 11 variables:

- dx1** 1st ICD-10-CM injury code recorded on an encounter.
- dx2** 2nd ICD-10-CM injury code recorded on an encounter.
- dx3** 3rd ICD-10-CM injury code recorded on an encounter.
- dx4** 4th ICD-10-CM injury code recorded on an encounter.
- dx5** 5th ICD-10-CM injury code recorded on an encounter.

- dx6** 6th ICD-10-CM injury code recorded on an encounter.
- dx7** 7th ICD-10-CM injury code recorded on an encounter.
- dx8** 8th ICD-10-CM injury code recorded on an encounter.
- dx9** 9th ICD-10-CM injury code recorded on an encounter.
- dx10** 10th ICD-10-CM injury code recorded on an encounter.
- died** A binary indicator variable for death. 1 = died. 0 = survived. ...

Index

* **datasets**

injury, 6

cat_trauma, 2

icdpicr, 4

injury, 6