# An Indicator for mortality: Thinking beyond external cause! (a.k.a. selecting a main injury)

Margaret Warner, Ph.D.
Li-Hui Chen, Ph.D.
Rolf Gedeborg,
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**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES**
**Centers for Disease Control and Prevention**
**National Center for Health Statistics**

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# Problem:
# Countries collect and report multiple cause of death data differently

- Past ICE work:
  - Average number of injuries per death reported varies between countries collecting MCOD data
- Existing  systems
  - No coding multiple cause of death
  - Coding all causes, do not select main injury
  - Coding all causes and select a main injury
  - Coding only a main injury

# Request from the Mortality Reference Group (MRG)

Who is the MRG?

     Part of WHO classification group who (1) decides on applications and interpretation of the ICD to mortality and  (2) recommends updates to ICD

MRG asked ICE to provide guidance to the

     Selection criteria changed in ICD-10

     Concerns over application of new criteria voiced

Selection criteria in ICD-9 and ICD-10:

     ICD-9     Selects most  "severe" (referred to as the Precedence list)

     ICD-10  Selects the injury which led to the death (similar to external cause selection)

# Selecting a main injury: Recommendations from MRG

1) Eliminate trivial injuries and superficial injuries from consideration

2) If obvious causal sequence, select injury which led to death

3) Select from among remaining injuries using severity ranking

4) Select first mentioned if several at same level of severity

# Solution:
# Develop severity measures

- **Severity ranking empirically derived based on Swedish data**

- **Use Survival Risk Ratios (SRRs) to determine severity ranking**

  - SRR is probability of survival with a range from 0 (unsurvivable) to 1 (no threat to life).
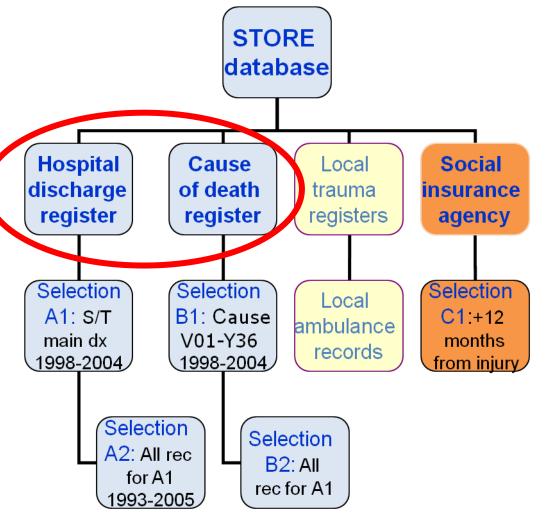
# Swedish injury data



- **Unique person identification number**
- **All residents** of Sweden have **equal access** to health services (tax funded). It is a **public sector responsibility**
  - The National Hospital Discharge Register – future research, not insurance, reimbursement etc.
  - Nation-wide and population-based
- **Cause of injury** - low proportion missing (~4%)

# Swedish injury data

- 1998-2004
- Person-based linked National Hospital Discharge Registry and Cause of Death Registry
- Hospital and department transfers merged
- 733,131 incident injury admissions [Epidemiology, Accepted 2008]
- Superficial injuries (defined by MRG) excluded

# Methods to get severity ranking

- SRRs calculated for each injury ICD-10 code for total injury deaths.

- $SRR_{code} = SH_{code}/(SH_{code} + D_{code})$,
  - where code=any non-excluded ICD-10 S or T code
  - $SH_{code}$ = weighted total mentions of *survived hospital* for each code
  - $D_{code}$ = weighted total mentions of *in-hospital* deaths + *pre-hospital deaths* for each code
  - where weighted total mention = 1/number of ICD codes reported for death

- SRRs for ICD injury codes were ranked into 6 ordinal levels of severity with roughly equal numbers of deaths in each severity level.

# Report to MRG

# ICD-10 Injury and poisoning codes by severity ranking

| | Least ⟵ | | Severity Ranking | | ⟶ Most | |
| --- | --- | --- | --- | --- | --- | --- |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Injuries to the head (S00-S09) | S01(.0-.5, .7-.9) | S03(.0, .3) | S02.1 | S02.9 | S06.9 | S07.1 |
| | S02(.0, .2-.8) | S04.9 | S06(.2,.5) | S05(.1,.7,.8) | | |
| | S03(.1,.2,.4,.5) | S05.7 | S09.9 | S07(.8,.9) | | |
| | S04(.0-.8) | S06(.3,.4,.6) | | | | |
| | S05(.2-.6,.9) | S07.0 | | | | |
| | S06.0 | S08.8 | | | | |
| | S08(.0,.1,.9) | S09.0 | | | | |
| | S09(.1,.2,.7,.8) | | | | | |
| Injuries to the neck (S10-S19) | S11(.0-.2,.8) | S11.7 | S15(.0,.3) | S11.9 | S18 | S15.9 |
| | S12.2 | S12(.0,.1,.7,.8) | S19(.7,.8) | S12.9 | | |
| | S13(.0,.5,.6) | S13(.1,.2,.4) | | S13.3 | | |
| | S14(.2-.5,.8) | S14(.0,.6) | | S14.1 | | |
| | S16 | S17.0 | | S15(.1,.2,.7) | | |
| | S17.8 | | | S17.9 | | |
| | | | | S19.9 | | |

# Five leading "main" injuries selected for deaths with two or more injury diagnoses*

| | United States | |
| --- | :---: | :---: |
| | Lowest used line | |
| **Leading injury** | | |
| **1** | **S29.9** | |
| **2** | **S06.9** | |
| **3** | **S19.9** | |
| **4** | **S09.9** | |
| **5** | **S21.9** | |
| | | |
| **Tie for highest ranked** | **16%** | |

NOTE: In both countries majority of deaths have one injury mentioned

# Five leading "main" injuries selected for deaths with two or more injury diagnoses

| Leading injury | United States | | Sweden |
|---|---|---|---|
| | Lowest used line | All | |
| 1 | S29.9 | S06.9 | |
| 2 | S06.9 | S29.9 | |
| 3 | S19.9 | T14.1 | |
| 4 | S09.9 | S09.9 | |
| 5 | S21.9 | T07 | |
| | | | |
| Tie for highest ranked | 16% | 19% | |

NOTE: In both countries majority of deaths have one injury mentioned

# Five leading "main" injuries selected for deaths with two or more injury diagnoses

| Leading injury | United States | | Sweden |
| | Lowest used line | All | All |
|---|---|---|---|
| 1 | S29.9 | S06.9 | S06.9 |
| 2 | S06.9 | S29.9 | T51.0 |
| 3 | S19.9 | T14.1 | T79.2 |
| 4 | S09.9 | S09.9 | S27.7 |
| 5 | S21.9 | T07 | S25.0 |
| | | | |
| Tie for highest ranked | 16% | 19% | 22% |

NOTE: In both countries majority of deaths have one injury mentioned

# Selection of main injury among common pairs

- Certain injury pairs account for high proportions of deaths with two or more injuries listed.
- For MRG to review methods, a main injury was selected for common pairs of fatal injuries in the US, Australia, New Zealand, and Sweden.

# Common pairs example

| Obs | Code1 | Code2 | Main | Code 1 SRR | Code 1 rank | Code 2 SRR | Code 2 rank |
|-----|-------|-------|------|-----------|-------------|------------|-------------|
| 1 | S02.9 = Fracture of skull and facial bones, part unspecified | S06.9 = Intracranial injury, unspecified | S06.9 | 0.72198 | 4 | 0.28098 | 5 |
| 2 | S02.1 = Fracture of base of skull | S06.9 = Intracranial injury, unspecified | S06.9 | 0.77487 | 3 | 0.28098 | 5 |
| 3 | S06.5 = Traumatic subdural haemorrhage | S09.9 = Unspecified injury of head | Same rank | 0.75509 | 3 | 0.72487 | 3 |

# Next steps

MRG is reviewing the report of the Injury ICE

- ICD expert review
- Practical test on a sample of injuries
- Compare main injury selected using current (ICD-10 method) and new method suggested (incorporating severity ranking)

ICE possible next steps:

- Ask medical experts to review empirically derived severity rankings.
- Compare severity rankings to updated ICDMAP (ICD-10 to AIS05) developed by Maria Segui-Gomez and colleagues

  Doing nothing is not an option for the U.S. because we would like to add a main injury indicator to the mortality file.