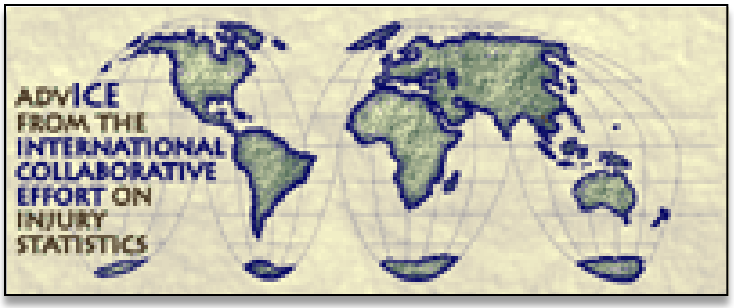
Internationally Comparable Diagnosis-Specific Survival Probabilities for Calculation of the ICD-10 Based Injury Severity Scores



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Background

- Desire to develop internationally comparable indicators of injury morbidity using administrative datasets
- Decision to hospitalize can vary over time and from country to country
- A standard method to identify patients of similar injury severity level is needed
  - Consensus derived *vs* empirically derived
  - AIS; ISS *vs* DSP, “SRR”; ICISS

Background

Diagnosis-specific Survival Probability (DSP; "SRR")

- Determined for each individual ICD diagnosis code
- $\frac{\text{Number of patients with a given injury code who survived}}{\text{Total number of patients with that injury code}}$
- Values range from 0-1

ICD-based Injury Severity Score (ICISS)

- The product of the DSPs for each injury
- ICISS = DSP_{inj1} x DSP_{inj2} x DSP_{inj3}, etc.
- ICISS used in logistic regression models to predict probability of death

Background

- For a more accurate estimate of the DSP, a large number of observations is needed
- At the 2008 Boston ICE meeting, researchers from several countries agreed to pool data to generate the international DSPs (ICE-DSPs)

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Objectives of the Study

- To develop DSPs from pooled data (ICE-DSPs)
- To compare the performance in predicting inpatient mortality of ICISS based on ICE-DSPs to ICISS based on country-specific DSPs

Methods

Seven countries provided data for creating the ICE-DSPs

- Australia
- Argentina
- Austria
- Canada
- Denmark*
- New Zealand*
- Sweden*

*Provided record level data

Methods

- The pooled data included nearly 4 million injury diagnoses
  - 1168 dx had at least 1 observation in the pooled data
  - 88% had at least 20 observations to calculate DSP
  - 66% had at least 100 observations to calculate DSP

Methods

- Four methods were used to calculate ICE-DSPs using the pooled data
  - Summation
  - Arithmetic means
  - Trimmed means
  - Combined approach
- Summation method is recommended (simplest)

Methods

- For the 3 countries that provided record level data, the performance of a logistic regression model using ICE-DSP-derived ICISS to predict mortality was compared to that of a model using ICISS calculated using the country-specific DSPs
  - Discrimination: c-statistic
  - Calibration: Nagelkerke's R^2

Results

- Variability among country-specific DSPs
  - Range = the difference between the highest and lowest country-specific DSPs for an injury diagnosis

Diagnoses with the least variability in DSPs between countries

ICD-10 code	Diagnosis	Range in DSPs	Mean of DSPs
S807	Multiple superficial injuries of lower leg	0.033	0.974
S799	Unspecified injury of hip and thigh	0.035	0.979
S211	Open wound of front wall of thorax	0.040	0.963
T141	Open wound of unspecified body region	0.041	0.976
S122	Fracture of other specified cervical vertebra	0.044	0.954
S829	Fracture of lower leg, part unspecified	0.049	0.970
T149	Injury, unspecified	0.050	0.968
T589	Toxic effect of carbon monoxide	0.052	0.970
S212	Open wound of back wall of thorax	0.056	0.976
S141	Other/unspecified injuries of cervical spinal cord	0.064	0.917

Diagnoses with the most variability in DSPs between countries

ICD-10 code	Diagnosis	Range in DSPs	Mean of DSPs
S271	Traumatic haemothorax	0.263	0.940
S368	Injury of other intra-abdominal organs	0.264	0.925
S027	Multiple fractures involving skull and facial bones	0.294	0.893
T689	Hypothermia	0.294	0.852
S066	Traumatic subarachnoid haemorrhage	0.379	0.816
S361	Injury of liver or gall bladder	0.386	0.932
S064	Epidural haemorrhage	0.391	0.920
T175	Foreign body in bronchus	0.408	0.971
S272	Traumatic haemopneumothorax	0.411	0.944
S065	Traumatic subdural haemorrhage	0.539	0.826

Performance of model using ICE-DSP-derived ICISS: Data from New Zealand

N= 264,348 Inpatient Mortality Rate = 1.2%

Factors in the model	C-statistic (Discrimination)	Nagelkerke's R^2 (Calibration)
ICISS from NZ DSPs	0.876	0.2263
ICISS from ICE-DSPs	0.868	0.2088

Performance of model using ICE-DSP-derived ICISS: Data from Sweden

N=707,968 Inpatient Mortality Rate = 1.6%

Factors in the model	C-statistic (Discrimination)	Nagelkerke's R^2 (Calibration)
ICISS from Swedish DSPs	0.829	0.1678
ICISS from ICE-DSPs	0.815	0.1489
Age + Sex + ICISS from Swedish DSPs	0.877	0.2385
Age + Sex + ICISS from ICE-DSPs	0.871	0.2232

Performance of model using ICE-DSP-derived ICISS: Data from Denmark (one hospital)

N=23,449 Inpatient Mortality Rate = 10.8%

Factors in the model	C-statistic (Discrimination)	Nagelkerke's R^2 (Calibration)
ICISS from Danish DSPs	0.725	0.1311
ICISS from ICE-DSPs	0.681	0.0756
Age + Sex + ICISS from Danish DSPs	0.822	0.2613
Age + Sex + ICISS from ICE-DSPs	0.816	0.2490

Next Steps: International DSPs

- Are the ICE-DSPs ready for use or do they need to be further refined or tested?
  - Include out of hospital deaths?
  - Include data from more countries?
  - Create ICE-DSPs for different age groups (pediatric *vs* adult vs older adult)
  - Create ICE-DSPs for comorbidities?
  - Test discrimination/calibration using data from less resourced countries?

Next Steps: International DSPs

- Do we need to generate standard methods for how to use the ICE-DSPs?
  - Post the international DSPs to the web?
  - Create a toolkit on how to use?
    - Multiplicative model *vs* single worst injury
    - Include ICE-DSPs for comorbidities when calculating ICISS?

Next Steps: Other Considerations

- Do we continue on the path of international DSPs or do we consider other methods?
  - Excess Mortality Ratio-adjusted ISS, Kim et al, 2009
  - Trauma Mortality Prediction Model, Osler, et al, 2007
  - ICD-10 to AIS crosswalk, Haas, Nathans, et al, 2012

Questions and Discussion

Thank you!

Next Steps: International DSPs

- Should we use the ICE-DSPs to define broader injury severity categories for international comparisons (ordinal scale)?

- Should we use the ICE-DSPs to identify a “basket of injuries” that could be used when ICD-10 coded data are not available (threshold)?

Next Steps: International DSPs

- Should the ICE-DSPs be updated, and if so, how often?
  - Include the same countries each time?