Accuracy of administrative health data for conducting traumatic brain injury surveillance: a Bayesian latent class analysis

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Poster ID: 41855
Disclosures

• None
Introduction and Objectives

• Traumatic brain injury (TBI):
  • Costly injury burden across the globe

• Surveillance efforts tend to underestimate the true injury burden, which is a problem for:
  • Decision-makers
  • Stakeholders
  • Prevention efforts

• Administrative health data (AHD) are a widely-accessible and resource-friendly tool for conducting TBI surveillance, but they pose challenges:
  • Underestimate true injury burden
  • Measurement error

• Previous studies have attempted to assess the accuracy of TBI case definitions in AHD but have provided biased estimates because:
  • They relied on the clinical diagnosis of TBI as a “perfect” reference standard which it is not

• Objectives of present study: Estimate TBI incidence and accuracy of TBI case definitions in administrative health data across the full injury spectrum without relying on a gold standard TBI definition
Methods

- 25% random sample of Montreal residents
- Publically insured population from 2000-2014
- Linked administrative health databases
- ICD coding system: ICD-9 and ICD-10
- All analyses stratified in 3 age groups (children, adults, elderly)
- Overlapping case definitions for TBI (observed data):
  - 4 widely-used ICD-based case definitions (Centers for Disease Control definition)
  - 1 based on imaging of the head claims
- Hierarchical Bayesian Latent Class Models were used to:
  - Assess sensitivity and specificity of each case definition
  - Assess incidence of TBI while correcting for measurement error
  - Each of these parameters was assessed for each year of the analysis and pooled parameters across all years of the analysis were also estimated
- No perfect reference standard is required when using latent class models

Heuristic diagram for the latent class model: the observed variables are the 5 case definitions we used for TBI in administrative health data across different care settings and data sources. The latent class approach allows us to model the severity of injuries of patients based on the case definitions they are positive for.
Results – adjusted incidence by age and sex
Comparison of overall incidence with and without measurement error error adjustment

Incidence per 100,000

587

853

Traditional ICD-Based

Measurement error correction
<table>
<thead>
<tr>
<th></th>
<th>Sensitivity (pooled) (95% CrI)</th>
<th>Specificity (pooled x10^2) (95% CrI)</th>
<th>Positive predictive value (pooled) (95% CrI)</th>
<th>Negative predictive value (pooled) (95% CrI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Children (&lt;18 years)</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Outpatient claim</td>
<td>0.14 (0.10 , 0.19)</td>
<td>9.988 (9.986, 9.990)</td>
<td>0.62 (0.54 , 0.70)</td>
<td>0.988 (0.985 , 0.992)</td>
</tr>
<tr>
<td>ER claim</td>
<td>0.45 (0.39 , 0.52)</td>
<td>9.982 (9.969, 9.995)</td>
<td>0.78 (0.63 , 0.95)</td>
<td>0.993 (0.990 , 0.995)</td>
</tr>
<tr>
<td>Inpatient claim</td>
<td>0.02 (0.02 , 0.03)</td>
<td>9.999 (9.999, 9.999)</td>
<td>0.92 (0.89 , 0.94)</td>
<td>0.987 (0.984 , 0.990)</td>
</tr>
<tr>
<td>Discharge abstract database</td>
<td>0.04 (0.03 , 0.05)</td>
<td>9.999 (9.999, 9.999)</td>
<td>0.90 (0.85 , 0.94)</td>
<td>0.987 (0.984 , 0.990)</td>
</tr>
<tr>
<td>Radiological examination of head</td>
<td>0.14 (0.11 , 0.17)</td>
<td>9.999 (9.999, 9.999)</td>
<td>0.94 (0.89 , 1.00)</td>
<td>0.988 (0.985 , 0.992)</td>
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<tr>
<td><strong>Adults (18-64 years)</strong></td>
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<tr>
<td>Outpatient claim</td>
<td>0.13 (0.10 , 0.17)</td>
<td>9.995 (9.993, 9.995)</td>
<td>0.54 (0.44 , 0.66)</td>
<td>0.996 (0.995 , 0.997)</td>
</tr>
<tr>
<td>ER claim</td>
<td>0.34 (0.29 , 0.37)</td>
<td>9.993 (9.991, 9.994)</td>
<td>0.70 (0.64 , 0.76)</td>
<td>0.997 (0.996 , 0.997)</td>
</tr>
<tr>
<td>Inpatient claim</td>
<td>0.04 (0.04 , 0.05)</td>
<td>9.999 (9.999, 9.999)</td>
<td>0.81 (0.78 , 0.84)</td>
<td>0.995 (0.995 , 0.996)</td>
</tr>
<tr>
<td>Discharge abstract database</td>
<td>0.05 (0.05 , 0.06)</td>
<td>9.999 (9.999, 9.999)</td>
<td>0.70 (0.62 , 0.77)</td>
<td>0.995 (0.995 , 0.996)</td>
</tr>
<tr>
<td>Radiological examination of head</td>
<td>0.48 (0.42 , 0.54)</td>
<td>9.996 (9.994, 9.999)</td>
<td>0.87 (0.79 , 0.97)</td>
<td>0.998 (0.997 , 0.998)</td>
</tr>
<tr>
<td><strong>Elderly (&gt;64 years)</strong></td>
<td></td>
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<tr>
<td>Outpatient claim</td>
<td>0.03 (0.02 , 0.04)</td>
<td>9.994 (9.992, 9.996)</td>
<td>0.45 (0.26 , 0.62)</td>
<td>0.985 (0.983 , 0.987)</td>
</tr>
<tr>
<td>ER claim</td>
<td>0.21 (0.19 , 0.23)</td>
<td>9.992 (9.990, 9.994)</td>
<td>0.80 (0.75 , 0.86)</td>
<td>0.988 (0.986 , 0.990)</td>
</tr>
<tr>
<td>Inpatient claim</td>
<td>0.05 (0.05 , 0.06)</td>
<td>9.998 (9.997, 9.999)</td>
<td>0.84 (0.77 , 0.91)</td>
<td>0.985 (0.983 , 0.987)</td>
</tr>
<tr>
<td>Discharge abstract database</td>
<td>0.06 (0.05 , 0.08)</td>
<td>9.995 (9.993, 9.997)</td>
<td>0.68 (0.59 , 0.77)</td>
<td>0.986 (0.984 , 0.987)</td>
</tr>
<tr>
<td>Radiological examination of head</td>
<td>0.66 (0.54 , 0.79)</td>
<td>9.999 (9.996, 9.999)</td>
<td>0.99 (0.96 , 0.99)</td>
<td>0.995 (0.992 , 0.997)</td>
</tr>
</tbody>
</table>
Secular trends – variation of accuracy over time
Discussion

• TBI burden is larger than previously described
• Administrative health data are a useful data source to conduct TBI surveillance

• Accuracy varies over time
  • Stakeholders should be aware of this variation
  • Policy changes are likely responsible for these observations

• Epidemiological research using administrative health data is prone to false inferences
  • Low positive predictive value of ICD-based algorithms
  • Measurement error adjustment necessary
Summary of findings

• Administrative health data remain an accurate and resource-friendly approach to conducting TBI surveillance if measurement error is adjusted for

• Without adjusting for measurement error, the TBI burden is underestimated in administrative health data

• Secular trends in the accuracy of TBI case definitions in administrative health data vary over time and should be accounted for

• Similarly to surveillance studies, future epidemiological research using administrative health data should correct for this measurement error so that appropriate inferences on interventions to prevent TBI can be obtained