Challenges and Remediation for Patient Safety indicators (PSI) in the transition to ICD-10-CM

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Contrast the limitations and advantages of two methods of translation of ICD–9 codes to those of ICD–10:
  ◦ (i) "naive translation" method
  ◦ (ii) “science of networks" method

Analyze the potential patient miscategorization arising from a "naive translation" during the transition to ICD–10–CM with specific examples

Analyze the potential implications of the transition to ICD–10–CM for over- or under-reporting adverse events using Patient Safety Indicators
Plan

- Intro & problem statement
- Methods
- Results
- Conclusion & take home points
Patient Safety Indicator (PSI)

- set of measures to evaluate hospital complications and adverse events
  - Calculated using ICD–9–CM diagnoses codes

- hospital’s rating
  - @ Centers for Medicaid and Medicare Services
  - e.g. CMS web portals
  - US News and World Reports’ Best Hospitals
  - Agency for Healthcare Research and Quality (AHRQ)
World’s experience with ICD–10

- WHO ICD–10 is only ~14,000 codes
  - ICD–9–CM is the same size for diagnosis
- Switzerland\(^4\)
  - 5 years experience with ICD–10
  - Improved sensitivity from 37% to 45%
    - Comparison of ICD–10 code to detailed nurse chart abstraction
- Canada created ICD–10–CA compared to ICD–9–CM\(^5\)
  - 7 diagnosis categories had worse sensitivity in ICD–10–CA
- Public Health transition from WHO ICD–9 to WHO ICD–10\(^6\)
  - Substantial impact on relative risk of disease
  - 20% increase in septicemia
  - 60% decrease in bronchitis
Possible over or under reporting of safety indicators due to missing, new, ambiguous or redundant coding representation

US healthcare system will transition from ICD–9–CM to ICD–10–CM
  ◦ Oct. 1, 2015

How difficult will the transition be?
  ◦ New coding scheme
  ◦ Reorganization of Clinical Classes

CMS provides General Equivalent Mappings (GEM)
  ◦ Mappings from ICD–9–CM to ICD–10–CM and back
Sickle Cell disease with mention of crisis (282.64)
Accounts for 1.1% of all costs 0.3% of encounters
Science of network applied to the transition to ICD–10–CM
(prior study)

<table>
<thead>
<tr>
<th>Mapping Category</th>
<th>ICD-9-CM Mapp.</th>
<th>ICD-10-CM Mapp.</th>
<th>% of ICD-9-CM</th>
<th>Mapping Motif</th>
</tr>
</thead>
<tbody>
<tr>
<td>identity</td>
<td></td>
<td></td>
<td>28%</td>
<td>Malignant neoplasm of penis part unspecified (187.4) ↔ Malignant neoplasm of penis, unspecified (C50.9)</td>
</tr>
<tr>
<td>class-to-subclass</td>
<td></td>
<td></td>
<td>22%</td>
<td>Dietary folate deficiency anemia (D52.0) → Drug-induced folate deficiency anemia (D52.1) → Other folate deficiency anemias (D52.8) → Folate deficiency anemia, unspecified (D52.9)</td>
</tr>
<tr>
<td>subclass-to-class</td>
<td></td>
<td></td>
<td>12%</td>
<td>Depress psychosis-unspec (296.20) ↔ Major depressive disorder, single episode, unspecified (F32.9)</td>
</tr>
<tr>
<td>convoluted</td>
<td></td>
<td></td>
<td>36%</td>
<td>Breast dis preg NEC-unsp. (676.30) ↔ Unspecified disorder of breast associated w/ pregnancy and the puerperium (O92.20) → Breast dis NEC-del w p/p. (676.32) → Breast dis NEC-postpart. (676.34) → Other disorders of breast associated w/ pregnancy and the puerperium (O92.29)</td>
</tr>
<tr>
<td>no mapping</td>
<td></td>
<td></td>
<td>1%</td>
<td>Accidental poisoning by unspecified drug (E858.9)</td>
</tr>
</tbody>
</table>
Mitigating Tools for ICD–10–CM Transition Through Convolution and Entanglement

## ICD–10–CM to ICD–9–CM categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Count (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>identity</td>
<td>4123 (5.9%)</td>
</tr>
<tr>
<td>class-to-subclass</td>
<td>867 (1.2%)</td>
</tr>
<tr>
<td>subclass-to-class</td>
<td>7494 (10.7%)</td>
</tr>
<tr>
<td>convoluted</td>
<td>56,681 (81.2%)</td>
</tr>
<tr>
<td>no mapping</td>
<td>669 (1.0%)</td>
</tr>
</tbody>
</table>
network methodology

REF: “The discriminatory cost of ICD–10–CM transition between clinical specialties: metrics, case study, and mitigating tools”  
J Am Med Inform Assoc doi:10.1136/amiajnl-2012-001358
Case Study 1 – IL Medicaid data

- Illinois Medicaid data
  - All reimbursed payments for primary care patients of University of Illinois
  - 38,644 patients
  - 1,446,581 patient encounters
  - $382 million in payments
  - 299 institutions included
  - All payments related to ICD–9–CM codes, no DRG’s
Statewide percentages

Visit %
- 24%
- 36%
- 13%
- 25%
- 2%

Cost %
- 30%
- 26%
- 21%
- 22%
- 2%

- identity
- class-to-subclass
- subclass-to-class
- convoluted
- no mapping

The University of Arizona
Overview of Methodology

27 Patient Safety Indicators (PSIs)

\[ \downarrow \]

Remove 4 PSIs
(lack of ICD-9-CM in numerator)

23 PSIs
(Dataset I)

\[ \downarrow \]

Map all Numerator ICD-9-CM to ICD-10-CM via General Equivalent Mappings (GEMs)

\[ \downarrow \]

Categorization of ICD-9-CM code for translation (Dataset II)

Example of PSI Complexity

**Figure 2.** PSI Complexity

ICD-9-CM  ICD-10-CM

**Figure 3.** Detail of ICD-9-CM Diagnosis Codes in the Numerator of "PSI 15 Accidental Puncture of Vascular Catheter"

Impact of Complexity
(Dataset III)

**Figure 4.** Percentage of Error for PSI (Under and Over Reporting)

Comparison to AHRQ published PSI for ICD-10-CM (Dataset IV)
<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dataset</td>
<td>23 PSI metrics</td>
<td>Categorization of ICD-9-CM to ICD-10-CM</td>
<td>Illinois Medicaid patient cohort</td>
<td>ICD-10-CM diagnosis codes for PSI reports</td>
</tr>
<tr>
<td>Description</td>
<td>23 diagnosis-related PSI metrics published by AHRQ</td>
<td>The categorization of ICD-9-CM to ICD-10-CM ‘translation complexity’ that we reported (‘no coding’ vs ‘straightforward’ vs ‘convoluted’) by Centers for Medicaid and Medicare Services’ General Equivalency Mappings (GEMs)</td>
<td>A previously identified Illinois Medicaid patient cohort (IL-cohort; 38 644 patients, 1 446 581 visits, 399 hospitals)</td>
<td>The newly published ICD-10-CM diagnosis codes for the new PSI reports</td>
</tr>
<tr>
<td>Rationale</td>
<td>Standard definition of PSIs (4 were procedure codes and N/A with analysis)</td>
<td>Our prior work derived from official CMS translation tables determining which relationships are straightforward vs convoluted</td>
<td>Our clinical validation cohort</td>
<td>The newly published ICD-10-CM diagnosis codes for the new PSI reports</td>
</tr>
<tr>
<td>References</td>
<td>Authors: Miller MR et al</td>
<td>Boyd AD et al</td>
<td>Boyd AD et al</td>
<td>AHRQ</td>
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<tr>
<td></td>
<td>Source: Health Serv Res</td>
<td>J Am Med Inform Assoc</td>
<td>J Am Med Inform Assoc</td>
<td>NA</td>
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</tbody>
</table>

Detail of ICD-9-CM Diagnosis Codes in the NUMERATOR of “PSI 15 Accidental Puncture”

ICD-9-CM

998.2
Accidental puncture or laceration during a procedure

998.13
Seroma complicating a procedure

999.9
Other and unspecified complications of medical care, NEC

ICD-10-CM

T88.8XXA
Other specified complications of surgical and medical care, NEC, initial encounter

Legend: Complexity of ICD-9-CM to ICD-10-CM translation mappings

- ICD-9-CM in PSI
- ICD-9-CM not in PSI
- ICD-10-CM
- CMS GEMs Translations
<table>
<thead>
<tr>
<th>PSI</th>
<th>Description</th>
<th>Reporting Change</th>
<th>-100% -80%</th>
<th>-60%</th>
<th>-40%</th>
<th>-20%</th>
<th>0%</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXP1</td>
<td>Rate of Complications of Anesthesia</td>
<td>-100</td>
<td></td>
<td></td>
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<tr>
<td>PSI16</td>
<td>Transfusion Reaction Volume</td>
<td>-100</td>
<td></td>
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<tr>
<td>PSI26</td>
<td>Transfusion Reaction Rate</td>
<td>-100</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>PSI3</td>
<td>Pressure Ulcer Rate</td>
<td>-26</td>
<td></td>
<td></td>
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<tr>
<td>PSI10</td>
<td>Postoperative Physiologic and Metabolic Derangement Rate</td>
<td>+18</td>
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<td>PSI15</td>
<td>Accidental Puncture or Laceration Rate</td>
<td>-5</td>
<td></td>
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<tr>
<td>PSI25</td>
<td>Accidental Puncture or Laceration Rate</td>
<td>-5</td>
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<tr>
<td>PSI22</td>
<td>Iatrogenic Pneumothorax Rate</td>
<td>+4</td>
<td></td>
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</tr>
<tr>
<td>PSI7</td>
<td>Central Venous Catheter-Related Blood Stream Infection Rate</td>
<td>+2</td>
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<tr>
<td>PSI23</td>
<td>Central Venous Catheter-Related Blood Stream Infection Rate</td>
<td>+2</td>
<td></td>
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<tr>
<td>PSI13</td>
<td>Postoperative Sepsis Rate</td>
<td>-1</td>
<td></td>
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<tr>
<td>Patient Safety Indicators</td>
<td>Explanation in PSI algorithm in ICD-10-CM</td>
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<tr>
<td>PSI-03, PSI-07, PSI-12, PSI-22: Pressure ulcer, Central venous catheter, Postoperative pulmonary embolism or deep vein thrombosis,iatrogenic pneumothorax</td>
<td>Four-digit ICD-9-CM codes frequently used in billing practice are included in PSI calculations; however official CMS guidelines require five-digit ICD-9-CM codes. GEMs are only provided for official reimbursable codes. Concepts map forward to ICD-10-CM with additional detail</td>
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<tr>
<td>EXP-1: Rate of complications of anesthesia</td>
<td>EXP-1 has become discontinued in ICD-10-CM</td>
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<tr>
<td>PSI-16 and PSI-26: Transfusion</td>
<td>PSI-16 and PSI-26 cause of no translation was due to a wide spread use of parent codes</td>
<td></td>
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<tr>
<td>PSI-5 and PSI 21: Complications of foreign body during procedure</td>
<td>All 10 ICD-9-CM codes with no GEM mapping to ICD-10-CM. In ICD-10-CM, 219 new codes related to foreign body left in procedure. Complete restructure of concept focused on complications: unspecified, adhesions, obstruction, perforation, other complications, and acute reaction (see figure 4). Only initial encounter is included in PSI ICD-10-CM 10 ICD-9-CM codes with no official mapping to ICD-10-CM. In ICD-10-CM, 98 codes related to puncture, laceration. Complete restructure of concept focuses on injured organ first instead of procedure</td>
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<tr>
<td>PSI-15 and PSI-25: Accidental puncture or laceration rate</td>
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<tr>
<td>EXP-1: Rate of complications of anesthesia</td>
<td>EXP-1 has become discontinued in ICD-10-CM</td>
</tr>
<tr>
<td>PSI-13: Postoperative sepsis rate</td>
<td>All ICD-9-CM codes have a direct mapping to ICD-10-CM codes; however, the ICD-10-CM codes have a one way mapping back to a general ICD-9-CM code, Sepsis, causing convolution</td>
</tr>
<tr>
<td>PSI-9 and PSI-27: Postoperative hemorrhage or hematoma</td>
<td>The concept of Hematoma and Hemorrhage were merged in ICD-10-CM and the revised specificity focuses on organ system damaged. Convolution predicted entanglement of concepts. New ICD-10-CM codes focus on procedure during injury</td>
</tr>
<tr>
<td>PSI-11: Postoperative respiratory failure</td>
<td>The two ICD-9-CM codes map forward and reverse to the two codes listed in the ICD-10-CM. However, this is convoluted due to the forward and reverse mapping to J96.00 and J96.20, both regarding respiratory failure but neither of which specify association with procedures and are not included in the PSI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PSI 5 Complication of Foreign Body</th>
<th>ICD-9-CM</th>
<th>PSI Inclusion</th>
<th>ICD-10-CM</th>
<th>PSI Inclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute reaction to foreign substance accidentally left during a procedure initial visit (998.7)</td>
<td>✔</td>
<td>Oth acute reaction to foreign subst accident left during a proc, initial enct (T81.69XA)</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Acute reaction to foreign substance accidentally left during a procedure second visit (998.7)</td>
<td>✔</td>
<td>Oth acute reaction to foreign subst accident left during a proc, subsequent enct (T81.69XD)</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Foreign body accidentally left during a procedure initial visit (998.4)</td>
<td>✔</td>
<td>Adhesions due to foreign body accident left in body unspecified procedure, initial enct (T81.519A)</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Foreign body accidentally left during a procedure second visit (998.4)</td>
<td>✔</td>
<td>Adhesions due to foreign body accident left in body unspecified procedure, subsequent enct (T81.519D)</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Total Reported Events</td>
<td>4</td>
<td></td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
ICD–10–CM translations proposed by CMS pose impending risk for
- Comparing safety incidents across institutions
- Inflating or underreporting the number of PSI as compared to ICD–9–CM coding
  - (depending of the indicator)
- Increasing the inter–institutional variability of calculations

Responsible organizations should
- Proactively plan unambiguous and consistent mappings to ICD–10–CM among alternate solutions.
- Mitigate apparent inflation in reported incidents attributable to coding changes rather than safety changes.
  - E.g. analyzing PSIs in both coding schemes
- Proactively avoid complacency in apparent reduction of safety indicators attributable to to coding
How about my institution’s codes?

- Free portal service
- www.lussierlab.org/transition-to-ICD10CM
## Additional tools

<table>
<thead>
<tr>
<th>Resource sharing work product</th>
<th>Use case or targeted audience</th>
<th>Description or content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tables of mapping motifs and categories (.xls format)</td>
<td>Rapid reuse in software developed by health information technologists and informaticians.</td>
<td><a href="http://lussierlab.org/transition-to-ICD10CM/ICD-9-10-Transl-Cat.xlsx">http://lussierlab.org/transition-to-ICD10CM/ICD-9-10-Transl-Cat.xlsx</a>, 326643 rows, eight columns headers</td>
</tr>
<tr>
<td>SQL database of mapping motifs and categories</td>
<td>Lookup of SQL queries and specific results by health system analysts strategically to improve health system operations and plan transition to ICD–10–CM.</td>
<td><a href="http://lussierlab.org/publication/Motif_table_SQLcode/DB">http://lussierlab.org/publication/Motif_table_SQLcode/DB</a> name, 38 distinct queries, one table, 324913 rows, five columns</td>
</tr>
</tbody>
</table>
Collaborators and Funding

- Jianrong “John” Li
- Mike D. Burton
- Michael Jonen
- Vincent Gardeux
- Ikbel Achour
- Roger Q. Luo
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- Office of the Vice–President for Health Affairs of the University of Illinois Hospital and Health Science System

- Department of Biomedical and Health Information Sciences
Questions?

Thank You!

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