ICD-10 With A New Lens: How Medical Coding Can Affect Everything from Safety Reporting to Population Health Matters

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- The views expressed in this publication are strictly those of the presenter(s) and do not necessarily represent official positions of the American Hospital Association.
Faculty

Moderator
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Speaker
Andrew Boyd, Assistant Professor, Biomedical and Health Information Sciences, College of Applied Health Sciences, University of Illinois at Chicago

“Housekeeping” Instructions

Download Slides and CEU Information
Ask Question
Learning Objectives

- Quality Measurement
- Public Health
- Health Policy Planning
- Clinical Research

Disclaimer, this presentation is not about the proper coding rules to assign a code, but the challenges in running reports and queries across the transition between ICD-9-CM and ICD-10-CM

World’s experience with ICD-10

- WHO ICD-10 is only ~14,000 codes
  - ICD-9-CM is the same size for diagnosis
- Switzerland¹
  - 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-CM²
  - 7 diagnosis categories had worse sensitivity in ICD-10-CA
- U.S. Public Health transition from WHO ICD-9 to WHO ICD-10³
  - Substantial impact on relative risk of disease
  - 20% increase in sepsis
  - 60% decrease in bronchitis
U.S. experience with ICD-10-CM

- Transition went smoothly
  - CMS stated Oct 2015, only 10% of claims denied and .09 invalid ICD-10-CM codes

- Some roadbumps
  - Published reports of 30-40% of decrease in productivity of professional coders one month into coding in ICD-10-CM.

- Some projected concerns
  - Peer review presentations showed even after a year of coding in ICD-10-CM (from dual coding hospitals), same cases can take 50% longer to code in ICD-10-CM than in ICD-9-CM

- Medicaid in California, Louisiana, Maryland, and Montana, are not ready for ICD-10-CM, and will map all ICD-10-CM submitted claims to ICD-9-CM for approval based on ICD-9-CM billing rules

Transition to ICD-10-CM

- US healthcare system has transitioned from ICD-9-CM to ICD-10-CM
  - Oct. 1, 2015

- Projected costs?
  - AMA cites between $83,000 to $2.7 million dollars per practice for implementation costs
  - ~68,000 diagnosis codes
  - New coding scheme
  - Reorganization of Clinical Classes

- One year delay cost billions

- CMS provides General Equivalent Mappings (GEM)
  - Mappings from ICD-9-CM to ICD-10-CM and back

<table>
<thead>
<tr>
<th>Mapping Categories</th>
<th>10 to 9</th>
<th>9 to 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Match</td>
<td>1.20%</td>
<td>3.00%</td>
</tr>
<tr>
<td>1-to-1 Exact Match</td>
<td>5.00%</td>
<td>24.20%</td>
</tr>
<tr>
<td>1-to-1 Approximate Match with 1 Choice</td>
<td>82.60%</td>
<td>49.10%</td>
</tr>
<tr>
<td>1-to-1 Approximate Match with Multiple Choices</td>
<td>4.30%</td>
<td>18.70%</td>
</tr>
<tr>
<td>1-to-Many Match with 1 Scenario</td>
<td>6.60%</td>
<td>2.10%</td>
</tr>
<tr>
<td>1-to-Many Match with Multiple Scenarios</td>
<td>0.20%</td>
<td>2.90%</td>
</tr>
</tbody>
</table>
Simple transition using GEM

- Some researchers proposed one way directional GEM mapping
- GEM is not a substitute for appropriately coding in the native ICD-10-CM
- GEM from ICD-9-CM to ICD-10-CM
  - Begins with 14,567 ICD-9-CM codes
  - Includes only 16,604 ICD-10-CM codes
  - No mapping to at least 53,229 ICD-10-CM codes (76%)
- GEM from ICD-10-CM to ICD-9-CM
  - Begins with 69,833 ICD-10-CM codes
  - Includes only 11,603 ICD-9-CM codes
  - No mapping to at least 5,001 ICD-9-CM codes (34%)

How do you simplify comprehensive transition ICD-10-CM?
Center for Medicaid/Medicare Services (CMS)
General Equivalent Mappings (GEMS)

- ICD-9  ICD-10  Flag
- 0010  A000  00000
- 0011  A001  00000
- 0019  A009  00000
- 0020  A0100  10000
- 0021  A011  00000
- 0022  A012  00000
- 0023  A013  00000
- 0029  A014  00000
- 0030  A020  00000
- 0031  A021  10000
- 00320  A0220  00000

- Data provided by a .txt file
- Two separate files
  - I9 to I10
  - I10 to I9

Migrating to the science of networks

- Blue ICD-9-CM codes
  - 456.4 Scrotal Varices
  - 378.20 Intermittent heterotropia, unspecified
  - 327.39 Other circadian rhythm sleep disorder
  - 296.62 Bipolar affective disorder, mixed, moderate degree

- Purple ICD-10-CM codes
  - Same meaning in these examples

- Network derived from GEMS files
  - Direction of arrow is from the specific GEM file
Networks increase in complexity

- ICD-9-CM
  - 527.7 Disturbance of salivary secretion

- ICD-10-CM
  - K11.7 Disturbances of salivary secretion
  - R68.2 Dry mouth, unspecified

Networks continue to increase in complexity

- ICD-9-CM
  - 653.91 Unspecified disproportion, delivered
  - 653.93 Unspecified disproportion, antepartum
  - 653.90 Unspecified disproportion, unspecified as to episode of care

- ICD-10-CM
  - O33.9 Maternal care for disproportion, unspecified
Further simplification of ICD-9-CM to ICD-10-CM categories

<table>
<thead>
<tr>
<th>Mapping Category</th>
<th>ICD-9-CM</th>
<th>Mapped</th>
<th>ICD-10-CM</th>
<th>Mapped</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identity</td>
<td></td>
<td>28 %</td>
<td>Malignant melanoma of skin, not unspecified (187.9)</td>
<td></td>
</tr>
<tr>
<td>class-to-subclass</td>
<td>22 %</td>
<td>dental caries (17.9)</td>
<td>Dental caries (E06.3)</td>
<td></td>
</tr>
<tr>
<td>subclass-to-class</td>
<td>12 %</td>
<td>depression, not elsewhere classified (311)</td>
<td>Major depressive disorder, single episode, unspecified (311.8)</td>
<td></td>
</tr>
<tr>
<td>convoluted</td>
<td>56 %</td>
<td>Breast ddx (563.9)</td>
<td>Breast ddx (563.9)</td>
<td></td>
</tr>
<tr>
<td>no mapping</td>
<td>1 %</td>
<td>Accidental poisoning by unspecified drug (E850.1)</td>
<td>Accidental poisoning by unspecified drug (E850.1)</td>
<td></td>
</tr>
</tbody>
</table>
Journal Articles with further details

- “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

- “Challenges and remediation for Patient Safety Indicators in the transition to ICD-10-CM.”
  *J Am Med Inform Assoc* doi:10.1136/amiajnl-2013-002491

- “Metrics and tools for consistent cohort discovery and financial analyses post-transition to ICD-10-CM.”
  *J Am Med Inform Assoc* Feb 13, 2015, DOI:10.1093/jamia/ocu003

Entanglement

- Entanglement between mapping motifs occurs when either mapping motifs are unbounded and point into other motifs or when other mapping motifs point (E929.2 convoluted) into a bounded mapping motif
  - Not present in simplification method

![Diagram showing entanglement between mapping motifs](image.png)
## Entanglement table

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Identity (4123)</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Class-to-subclass (3260)</td>
<td>N/A</td>
<td>6% (184)</td>
<td></td>
</tr>
<tr>
<td>Subclass-to-class (1757)</td>
<td>39% (694)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Convoluted (5280)</td>
<td>100% (5280)</td>
<td>Not calculated</td>
<td></td>
</tr>
<tr>
<td>No mapping (147)</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Motifs TOTALS (14567)</td>
<td></td>
<td></td>
<td>42% (6158)</td>
</tr>
</tbody>
</table>

## All codes are not equal

- **789.09 (Abdominal Pain)** is frequently encountered
- **E845.0 (Accident involving spacecraft injuring occupant of spacecraft)** infrequently used
- Does the convolution impact all medical subspecialties equally?
Discrimination by clinical class

ICD-10-CM to ICD-9-CM categories

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

27 Patient Safety Indicators (PSIs)

Remove 4 PSIs (bulk of ICD-9-CM in numerators)

23 PSIs (Dataset II)

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

Categorization of ICD-10-CM codes for translation (Dataset II)

Example of PSI Complexity

Impact of Complexity (Dataset II)

Figure 2. PSI Complexity

Figure 3. Detail of ICD-9-CM Codes in the Numerator of PSI 15 Accidental Puncture

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

Comparison to AHRQ published PSI for ICD-10-CM (Dataset IV)
Table 1: Dataset description

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Description</th>
<th>Rationale</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>23 PSI metrics</td>
<td>The categorization of ICD-9-CM to ICD-10-CM &quot;translation complexity&quot; that we reported (no coding versus straightforward versus convoluted) by Centers for Medicare and Medicaid Services' General Equivalence Mappings (GEMs).</td>
<td>Miller et al, Boyd AD et al, Boyd KD et al, AHRQ</td>
</tr>
<tr>
<td>II</td>
<td>Categorization of ICD-9-CM to ICD-10-CM</td>
<td>A previously identified Illinois Medicaid patient cohort (644 patients, 1446 561 visits, 399 hospitals)</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Illinois Medicaid patient cohort</td>
<td></td>
<td>Boyd KD et al, AHRQ</td>
</tr>
<tr>
<td>IV</td>
<td>ICD-10-CM diagnosis codes for PSI reports</td>
<td>The newly published ICD-10-CM diagnosis codes for the new PSI reports</td>
<td></td>
</tr>
</tbody>
</table>


**PSI Complexity**

<table>
<thead>
<tr>
<th>PSI</th>
<th>Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSI 16</td>
<td>Intravenous Pneumothorax Rate</td>
</tr>
<tr>
<td>PSI 17</td>
<td>Infant Death Rate</td>
</tr>
<tr>
<td>PSI 18</td>
<td>Obstetric Trauma Rate-Vaginal Delivery</td>
</tr>
<tr>
<td>PSI 19</td>
<td>Obstetric Trauma Rate-Vaginal Delivery Without Instrument</td>
</tr>
<tr>
<td>PSI 20</td>
<td>Obstetric Trauma Rate-Cesarean Delivery</td>
</tr>
<tr>
<td>PSI 21</td>
<td>Central Venous Catheter-Related Bloodstream Infection Rate</td>
</tr>
<tr>
<td>PSI 22</td>
<td>Postoperative Hemorrhage or Hematoma Rate</td>
</tr>
<tr>
<td>PSI 23</td>
<td>Postoperative Pneumonia Rate</td>
</tr>
<tr>
<td>PSI 24</td>
<td>Postoperative Wound Complications Rate</td>
</tr>
<tr>
<td>PSI 25</td>
<td>Postoperative Urinary Tract Infection Rate</td>
</tr>
<tr>
<td>PSI 26</td>
<td>Postoperative Respiratory Failure Rate</td>
</tr>
<tr>
<td>PSI 27</td>
<td>Postoperative Sepsis Rate</td>
</tr>
<tr>
<td>PSI 28</td>
<td>Postoperative Venous Thromboembolism Rate</td>
</tr>
</tbody>
</table>

**Legend:** ICD-10-CM Mapping Complexity Categories

- PSI code % with no mapping
- PSI code % with convoluted mapping
- PSI code % with simple mapping

Category Percentage of ICD-9-CM codes in Numerator

0% 25% 50% 75% 100%
### Table 2: Patient Safety Indicators with ICD-9-CM codes with no mapping to ICD-10-CM

<table>
<thead>
<tr>
<th>Patient Safety Indicators</th>
<th>Explanation in PSI algorithm in ICD-10-CM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSI-01, PSI-07, PSI-12, PSI-32: 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>
</tr>
<tr>
<td>EXP1: Rate of complications of anesthesia</td>
<td>EXP-1 has been discontinued in ICD-10-CM.</td>
</tr>
<tr>
<td>PSI-16 and PSI-36: Transfusion</td>
<td>PSI-16 and PSI-36 cause of no translation was due to a widespread use of parent codes.</td>
</tr>
<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 restructuring 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.</td>
</tr>
<tr>
<td>PSI-15 and PSI-19: Accidental puncture or laceration rate</td>
<td>10 ICD-9-CM codes with no official mapping to ICD-10-CM. In ICD-10-CM, 38 codes related to puncture, laceration. Complete restructuring of concept focuses on injured organ first instead of procedure.</td>
</tr>
</tbody>
</table>

Not all 3 and 4 digits codes were mapped to ICD-10-CM via GEMs.
Inappropriate use of XXX.XXID could make hospitals look safer.
Case Study 2- 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 %

<table>
<thead>
<tr>
<th>Identity</th>
<th>Class-to-subclass</th>
<th>Subclass-to-class</th>
<th>Convoluted</th>
<th>No mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>24%</td>
<td>36%</td>
<td>13%</td>
<td>25%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Cost %

<table>
<thead>
<tr>
<th>Identity</th>
<th>Class-to-subclass</th>
<th>Subclass-to-class</th>
<th>Convoluted</th>
<th>No mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>26%</td>
<td>21%</td>
<td>22%</td>
<td>2%</td>
</tr>
</tbody>
</table>
Convolution and Planning

- From the raw data convoluted codes and visit count or cost can be calculated to prioritize training
- Sickle Cell disease with mention of crisis (282.64)
  - Accounts for 1.1% of all costs
  - 0.3% of encounters
- Transition Mapping
Limitations of simple mapping

- 250.02 type II diabetes mellitus [non-insulin dependent type] [NIDDM type] [adult-onset type] or unspecified type, uncontrolled, without mention of complication
- No ICD-10-CM code maps back to 250.02 in 2012 GEM or 2014 GEM file
- If you only map backwards using the ICD10 GEM file no ICD-10-CM code will be associated with this frequently used code

Case Study 3 – Pediatrics

- Statewide Medicaid dataset filter for Pediatric Providers
  - 174,500 patient encounter
  - 2,708 diagnosis
  - $12,298,520 total payment to providers

<table>
<thead>
<tr>
<th>Category</th>
<th>% of Peds ICD-9-CM</th>
</tr>
</thead>
<tbody>
<tr>
<td>identity</td>
<td>33%</td>
</tr>
<tr>
<td>class-to-subclass</td>
<td>29%</td>
</tr>
<tr>
<td>subclass-to-class</td>
<td>12%</td>
</tr>
<tr>
<td>convoluted</td>
<td>26%</td>
</tr>
<tr>
<td>no mapping</td>
<td>0.08%</td>
</tr>
</tbody>
</table>
Pediatric Percentages

Quality of mapping could affect results
**Discussion**

- Specific diagnosis and disease will have a difficult time applying analytics across with codes that are convoluted.
- Training of personnel and management should focus on the frequently used and complex mapping motifs
- Tools provided for free
  - [www.lussierlab.net/transition-to-ICD10CM](http://www.lussierlab.net/transition-to-ICD10CM)
  - [www.lussierlab.net/transition-to-ICD9CM](http://www.lussierlab.net/transition-to-ICD9CM)

**Take home points**

- Accurately coded data is critical for the functioning of the hospitals and health care systems
- ICD-10-CM translations proposed by CMS pose impending risk for
  - Comparing safety incidents across institutions
  - Increasing the inter-institutional variability of calculations
- Responsible organizations should
  - Proactively manage unambiguous and consistent mappings to ICD-10-CM among alternate solutions.
  - Proactively avoid complacency in apparent reduction of safety indicators attributable to to coding
Collaborators Names only listed once

- **Methodology**
  - Yves A. Lussier (Univ. of Arizona)
  - Jianrong “John” Li (Univ. of Arizona)
  - Mike D. Burton
  - Michael Jonen (Univ. of Arizona)
  - Vincent Gardeux (Univ. of Arizona)
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- **Pediatrics**
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  - Jeffery Zaman
  - Hannah Nam

- **Patient Safety**
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  - Colleen Kenost (Univ. of Arizona)
  - Brian Becker

- **ICD-10-CM to ICD-9-CM**
  - Binoy Josese
  - Olympia Kalagidis
  - Don Saner (Univ. of Arizona)

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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
Literature Cited

1. Januel JM, Luthi JC, Quan H, et al. Improved accuracy of co-morbidity coding over time after the introduction of ICD-10 administrative data. BMC Health Serv Res 2011;11:194
Survey

www.surveymonkey.com/r/04_28_16Webinar

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Retain this verification in your personal file for audit purposes.

Thank you for your interest and participation.

Chabre Ross
Program Chairperson
American Hospital Association
ICD 10 with a new lens: How Medical Coding can affect everything from safety reporting to population health (Live or On-Demand)

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