ICD-10-CM
Is Sentinel ready?

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Disclosure

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- My current research is funded by
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  - The Patient-Centered Outcomes Research Institute

- The views expressed in this presentation are mine and do not necessarily represent the views of the FDA, PCORI, or the U.S. government
ICD-10-CM Code Structure

ICD-10 diagnosis codes have between 3 and 7 characters:

1st DIGIT

2nd DIGIT

3rd DIGIT

4th DIGIT

5th DIGIT

6th DIGIT

7th DIGIT

ALPHA (NOT U)

NUMERIC

CATEGORY

CHARACTERS 3 – 7 CAN BE ANY COMBINATION OF ALPHA OR NUMERIC

ETIOLOGY, ANATOMICAL SITE, SEVERITY

EXTENSION
### ICD-10-CM vs. ICD-9-CM

The Differences will make a Difference

It is important to understand the major improvements and changes between ICD-9 and ICD-10 diagnosis codes.

<table>
<thead>
<tr>
<th>ICD-9-CM Diagnosis Codes</th>
<th>ICD-10-CM Diagnosis Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Laterality</td>
<td>Laterality – Right or Left account for &gt;40% of codes</td>
</tr>
<tr>
<td>3-5 digits</td>
<td>7 digits</td>
</tr>
<tr>
<td>• First digit is alpha (E or V) or numeric</td>
<td>• Digit 1 is alpha; Digit 2 is numeric</td>
</tr>
<tr>
<td>• Digits 2-5 are numeric</td>
<td>• Digits 3-7 are alpha or numeric</td>
</tr>
<tr>
<td>• Decimal is placed after the third character</td>
<td>• Decimal is placed after the third character</td>
</tr>
<tr>
<td>No placeholder characters</td>
<td>“X” placeholders</td>
</tr>
<tr>
<td>14,000 codes</td>
<td>69,000 codes to better capture specificity</td>
</tr>
<tr>
<td>Limited Severity Parameters</td>
<td>Extensive Severity Parameters</td>
</tr>
<tr>
<td>Limited Combination Codes</td>
<td>Extensive Combination Codes to better capture complexity</td>
</tr>
<tr>
<td>1 type of Excludes Notes</td>
<td>2 types of Excludes Notes</td>
</tr>
</tbody>
</table>
Sentinel Common Data Model

**Administrative**

**Enrollment**
- Person ID
- Enrollment start & end dates
- Drug coverage
- Medical coverage
- Medical record availability

**Demographic**
- Person ID
- Birth date
- Sex
- ZIP code
- Etc.

**Dispensing**
- Person ID
- Dispensing date
- National drug code (NDC)
- Days supply
- Amount dispensed

**Encounter**
- Person ID
- Service date(s)
- Encounter ID
- Encounter type & provider
- Facility
- Etc.

**Diagnosis**
- Person ID
- Service date(s)
- Encounter ID
- Encounter type & provider
- Diagnosis code & type
- Principal discharge diagnosis
- Etc.

**Procedure**
- Person ID
- Service date(s)
- Encounter ID
- Encounter type & provider
- Procedure code & type
- Etc.

**Clinical**

**Lab Result**
- Person ID
  - Result and specimen collection dates
  - Test type, immediacy & location
  - Logical Observation Identifiers Names and Codes (LOINC ®)
  - Test result & unit
  - Etc.

**Vital Signs**
- Person ID
  - Measurement date and time
  - Height and weight
  - Diastolic & systolic BP
  - Tobacco use & type
  - Etc.

**Registry**

**Death**
- Person ID
  - Death date
  - Source
  - Confidence
  - Etc.

**Cause of Death**
- Person ID
  - Cause of death
  - Source
  - Confidence
  - Etc.

**State Vaccine**
- Person ID
  - Vaccination date
  - Admission Type
  - Vaccine code & type
  - Provider
  - Etc.
Sentinel analytic tools

Cohort Identification and Descriptive Analysis Tool

Identify exposure and comparator cohorts
- Female
- Age 25
- Diagnosis History
- Drug History

Extract covariate information

Propensity Score Matching Tool

Estimate an exposure propensity score

Match exposed/comparator patients on PS

Generate effect estimates and create report
Good news

- Sentinel Common Data Model is agnostic to code type
  - Can readily accommodate ICD-9-CM & ICD-10-CM

- Most Sentinel analytic tools are agnostic to code type
  - Can readily accommodate ICD-9-CM & ICD-10-CM
Some tools or toolkits are code type dependent
  - Combined Charlson/Elixhauser comorbidity scores
  - An algorithm that identifies livebirth pregnancies

Health outcomes of interest and covariate algorithms will need to be developed and possibly validated.
ICD-10-CM preparedness in Sentinel

- Combined Charlson/Elixhauser comorbidity scores
  - GEMs mapping tool
  - Literature review

- An algorithm that identifies livebirth pregnancies
  - GEMs mapping tool
  - Literature review
ICD-10-CM preparedness in Sentinel

- Health outcomes of interest (HOIs) algorithms
  - GEMs mapping tool
  - Literature review
  - Validation studies with chart review

- Covariate algorithms
  - GEMs mapping tool
  - Literature review
Generalized Equivalence Mappings (GEMs)

- Developed by
  - Centers for Medicare and Medicaid Services
  - Centers for Disease Control and Prevention

- A tool for ICD-9-CM ↔ ICD-10-CM/PCS

What is in GEMs?

Chapter 19: Injury poisoning, and certain other consequences of external causes
How does GEMs work?

1:1, Cluster, Combination, and Complex

1:1 Exact Map
- ICD-9
  - The ICD-9/10 maps to a single ICD-10/9 and both codes have the exact clinical meaning
- ICD-10

1:1 Approximate Map
- ICD-9
  - The ICD-9/10 maps to a single ICD-10/9, and the two codes have similar meanings although the underlying clinical contexts are not the same
- ICD-10

1: Many Approximate Cluster (‘ORs’)
- OR
  - ICD-9
  - OR
  - ICD-10
  - OR
  - ICD-10

1: Many Combination (‘ANDs’)
- Scenario-1
  - Choicelist-1 → ICD-10
  - OR → ICD-10
  - Choicelist-2 → ICD-10
  - OR → ICD-10
  - Choicelist-3 → ICD-10
  - OR → ICD-10
- Scenario-2
  - Choicelist-1 → ICD-10
  - OR
  - Choicelist-2 → ICD-10
  - OR
  - Choicelist-3 → ICD-10
  - OR

1: Many Complex (‘ANDs’ and ‘ORs’)
- Scenario-1
  - Choicelist-1 → ICD-10
  - OR
  - Choicelist-2 → ICD-10
  - OR

The mapping consists of both combinations and alternative mappings.

http://bok.ahima.org/doc?oid=106975#.V6kvbvkrLDc
ICD-9-CM to ICD-10-CM transition*

The number of codes used in a 2-month pre-period doubled in a 2-month post-period.


Dramatic switch over to use of ICD-10-CM based on encounters.


* Preliminary quality assurance work initiated by one Sentinel data partner
# Top diagnoses 2-mo pre- & post-transition*

<table>
<thead>
<tr>
<th>Code</th>
<th>Dx_type</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4019</td>
<td>ICD-9-CM</td>
<td>Essential hypertension unspecified</td>
</tr>
<tr>
<td>2724</td>
<td>ICD-9-CM</td>
<td>Other and unspecified hyperlipidemia</td>
</tr>
<tr>
<td>7242</td>
<td>ICD-9-CM</td>
<td>Lumbago (low back pain)</td>
</tr>
<tr>
<td>25000</td>
<td>ICD-9-CM</td>
<td>Diabetes mellitus without mention of complication</td>
</tr>
<tr>
<td>V700</td>
<td>ICD-9-CM</td>
<td>General medical examination</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Dx_type</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I10</td>
<td>ICD-10-CM</td>
<td>Essential (primary) hypertension</td>
</tr>
<tr>
<td>Z23</td>
<td>ICD-10-CM</td>
<td>Encounter for immunization</td>
</tr>
<tr>
<td>M545</td>
<td>ICD-10-CM</td>
<td>Low back pain</td>
</tr>
<tr>
<td>E785</td>
<td>ICD-10-CM</td>
<td>Hyperlipidemia, unspecified</td>
</tr>
<tr>
<td>Z0000</td>
<td>ICD-10-CM</td>
<td>Encounter for general adult medical examination</td>
</tr>
</tbody>
</table>

* Preliminary quality assurance work initiated by one Sentinel data partner
# ICD-10-CM preparedness in Sentinel

## ICD-9-CM to ICD-10-CM conversion of the combined comorbidity score

<table>
<thead>
<tr>
<th>CCI variable</th>
<th>ICD-9</th>
<th>ICD-9 Reference</th>
<th>ICD-10</th>
<th>ICD-10 Reference</th>
<th>Mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 HIV/AIDS</td>
<td>ICD-9: D42 x, D45 x, D44 x</td>
<td>Gagne 2012 (CCI), Deyo 1993 (CCI), Quan 2005 (CCI); used in Sentinel comorbidity codes file</td>
<td>ICD-10: B20 x-B22 x, B24 x- B20</td>
<td>Work group translation using GEMs; also matches Quan (2005) one-to-many</td>
<td></td>
</tr>
<tr>
<td>21 Hypertension</td>
<td>ICD-9: 4011, 4015, 40210, 40290, 40410, 40490, 40511, 40519, 40591, 40599</td>
<td>Gagne 2012 (CCI); used in Sentinel comorbidity codes file</td>
<td>ICD-10: I10, I116, I13310, I150, I158</td>
<td>Work group translation using GEMs</td>
<td></td>
</tr>
</tbody>
</table>
Next steps (selected)

- Repeat some of the previously completed analyses using ICD-10-CM data
  - e.g., ACEI-angioedema
  - Toh et al, Arch Intern Med 2012

- Design and implement a series of validation studies
Conclusion

- Sentinel is starting to get ICD-10-CM data
- Sentinel CDM readily accommodates ICD-10-CM
- Some Sentinel tools readily handle ICD-10-CM
- Other tools require modifications or enhancement
- HOI and covariate algorithms will need to be updated
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