ICD-10-CM
Is Sentinel ready?

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Disclosure

❑ My spouse is an employee and stockholder of Biogen

❑ My current research is funded by
- The U.S. Food and Drug Administration
- 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

ICD-10-CM Code Structure

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

ALHPA (NOT U)   NUMERIC

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

1st DIGIT   2nd DIGIT   3rd DIGIT   .   4th DIGIT   5th DIGIT   6th DIGIT   7th DIGIT

CATEGORY

ETIOLOGY, ANATOMICAL SITE, SEVERITY
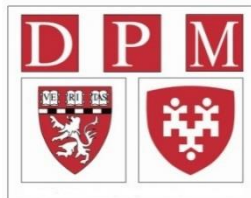
EXTENSION

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.

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

Sentinel

Lead – HPHC Institute

Data and scientific partners

Scientific partners

Sentinel Common Data Model

Administrative

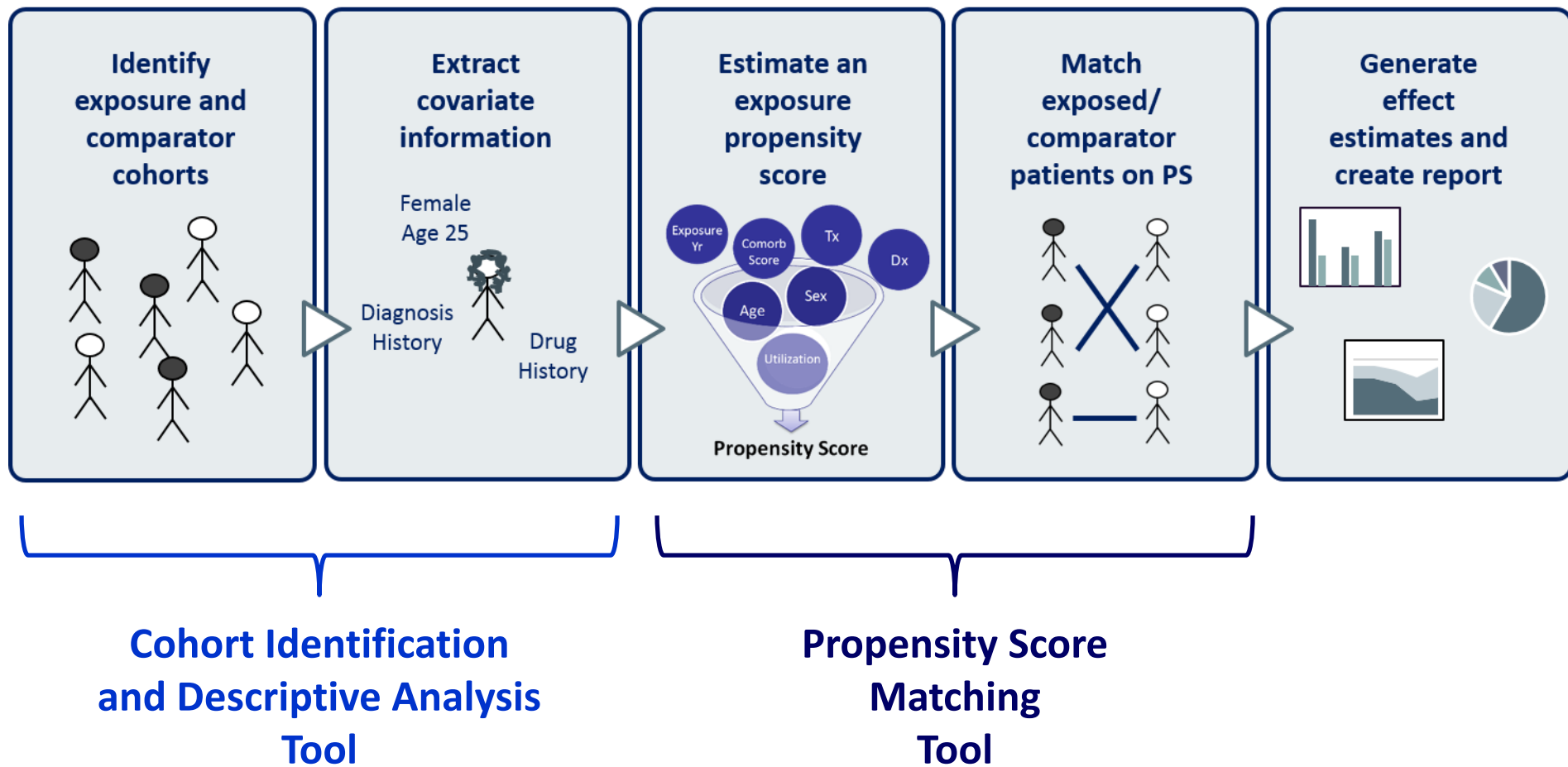| Enrollment	Demographic	Dispensing	Encounter	Diagnosis	Procedure
Person ID	**Person ID**	**Person ID**	**Person ID**	**Person ID**	**Person ID**
Enrollment start & end dates	Birth date	Dispensing date	Service date(s)	Service date(s)	Service date(s)
Drug coverage	Sex	National drug code (NDC)	Encounter ID	Encounter ID	Encounter ID
Medical coverage	ZIP code	Days supply	Encounter type & provider	Encounter type & provider	Encounter type & provider
Medical record availability	Etc.	Amount dispensed	Facility	Diagnosis code & type	Procedure code & type
			Etc.	Principal discharge diagnosis	Etc.

Clinical

Lab Result	Vital Signs
Person ID	**Person ID**
Result and specimen collection dates	Measurement date and time
Test type, immediacy & location	Height and weight
Logical Observation Identifiers Names and Codes (LOINC ®)	Diastolic & systolic BP
Test result & unit	Tobacco use & type
Etc.	Etc.

Registry

Death	Cause of Death	State Vaccine
Person ID	**Person ID**	**Person ID**
Death date	Cause of death	Vaccination date
Source	Source	Admission Type
Confidence	Confidence	Vaccine code & type
Etc.	Etc.	Provider
		Etc.

Sentinel analytic tools

Identify exposure and comparator cohorts

Extract covariate information

Female
Age 25

Diagnosis History

Drug History

Estimate an exposure propensity score

Exposure Yr

Comorb Score

Tx

Dx

Age

Sex

Utilization

Propensity Score

Match exposed/ comparator patients on PS

Generate effect estimates and create report

Cohort Identification and Descriptive Analysis Tool

Propensity Score Matching Tool

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

Not so good news

❑ 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?

ICD10 to ICD9

ICD10 Diagnosis Codes (Len vs. First Letters)

The FREQ Procedure

Table of Len by First_L																										
	First_L																									
Len	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**V**	**W**	**X**	**Y**	**Z**	**Total**
3	18	20	13	11	19	31	21	6	15	19	8	17	0	20	8	8	1	23	0	1	0	0	0	4	20	283
4	352	334	333	390	267	224	227	83	324	210	363	315	204	408	298	306	632	348	0	9	0	0	0	129	414	6170
5	333	176	736	281	361	295	271	765	262	143	311	98	1226	168	678	119	219	177	0	162	0	0	0	153	589	7523
6	0	2	146	63	275	448	138	2367	949	30	213	553	4180	61	1064	3	35	77	0	43	0	0	0	228	338	11213
7	0	0	0	0	0	0	0	547	0	0	0	0	1462	0	1855	0	0	75	31019	12628	3694	1155	485	1083	0	54003
Total	703	532	1228	745	922	998	657	3768	1550	402	895	983	7072	657	3903	436	887	700	31019	12843	3694	1155	485	1597	1361	79192

Chapter 19: Injury poisoning, and certain other consequences of external causes

How does GEMs work?

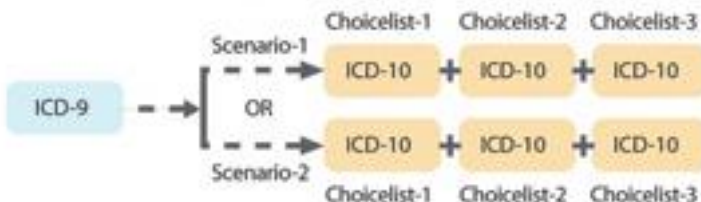1:1, Cluster, Combination, and Complex

1:1 Exact Map

ICD-9 → ICD-10

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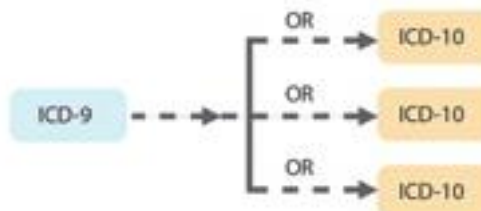
1:1 Approximate Map

ICD-9 ⇢ ICD-10

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

1: Many Combination ('ANDs')

ICD-9 →
Scenario-1: ICD-10 + ICD-10 + ICD-10
OR
Scenario-2: ICD-10 + ICD-10 + ICD-10
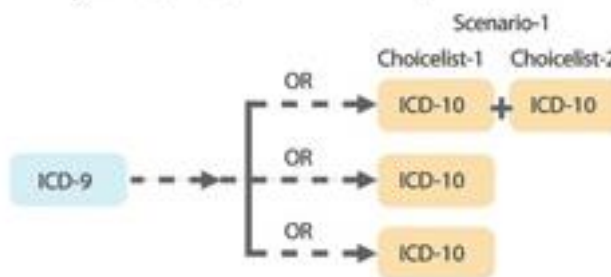Choicelist-1 Choicelist-2 Choicelist-3

The ICD-9/10 maps to a group of ICD-10/9 codes, which must be taken together in order to have a similar clinical meaning to the ICD-9/10 codes

1: Many Approximate Cluster ('ORs')

ICD-9 ⇢
OR → ICD-10
OR → ICD-10
OR → ICD-10

The ICD-9/10 maps to multiple ICD-10/9 codes. However, only one of these ICD codes will be required

1: Many Complex ('ANDs' and 'ORs')

Scenario-1
Choicelist-1 Choicelist-2
ICD-9 ⇢
OR → ICD-10 + ICD-10
OR → ICD-10
OR → ICD-10

The mapping consists of both combinations and alternative mappings

ICD-9-CM to ICD-10-CM transition*

Codes

	09	10
Pre	>15K	>10K
Post	<2K	>50K

Encounters

	09	10
Pre	>90M	<300K
Post	<40K	>90M

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

- Some use of ICD-10-CM in Aug and Sep 2015

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

- Low use of ICD-9-CM after Oct 2015

Top diagnoses 2-mo pre- & post-transition*

Code	Dx_type	description
4019	ICD-9-CM	Essential hypertension unspecified
2724	ICD-9-CM	Other and unspecified hyperlipidemia
7242	ICD-9-CM	Lumbago (low back pain)
25000	ICD-9-CM	Diabetes mellitus without mention of complication
V700	ICD-9-CM	General medical examination

Code	Dx_type	description
I10	ICD-10-CM	Essential (primary) hypertension
Z23	ICD-10-CM	Encounter for immunization
M545	ICD-10-CM	Low back pain
E785	ICD-10-CM	Hyperlipidemia, unspecified
Z0000	ICD-10-CM	Encounter for general adult medical examination without abnormal findings

ICD-10-CM preparedness in Sentinel

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

1	CCI variable	ICD-9	ICD-9 Reference	ICD-10	ICD-10 Reference	Mapping
16	Liver disease	ICD-9: 07032, 07033, 07054, 4560, 4561, 45620, 45621, 5710, 5712, 5713, 5714, 5715, 5716, 5718, 5719, 5723, 5728, V427	Gagne 2012 (CCI); used in Sentinel comorbcodes file	ICD-10: B180, B181, B182, I8500, I8501, I8510, I8511, K700, K7030, K709, K7210, K7290, K730, K732, K738, K739, K740, K741, K743, K744, K745, K7460, K7469, K754, K760, K766, K7689, K769, Z9710	Work group translation using GEMs	
17	Peripheral vascular disorder	ICD-9: 440, 4412, 4414, 4417, 4419, 4431, 4432, 4438, 4439, 4471, 5571, 5579, V434	Gagne 2012 (CCI); used in Sentinel comorbcodes file	ICD-10: I700, I701, I70209, I70219, I70229, I7025, I70269, I70299, I70399, I70499, I70599, I708, I7090, I7091, I7092, I712, I714, I716, I719, I731, I7381, I7389, I739, I771, I7771, I7772, I7773, I7774, I7779, I798, K551, K559, Z95828	Work group translation using GEMs	
18	Psychosis	ICD-9: 295, 29500, 29501, 29502, 29503, 29504, 29505, 296, 297, 298, 29910, 29911	Gagne 2012 (CCI); used in Sentinel comorbcodes file	ICD-10: F200, F201, F202, F205, F2081, F2089, F209, F22, F23, F24, F259, F28, F29, F3010, F3011, F3012, F3013, F302, F303, F304, F308, F3110, F3111, F3112, F3113, F312, F3130, F3131, F3132, F314, F315, F3160, F3161, F3162, F3163, F3164, F3173, F3174, F3175, F3176, F3177, F3178, F3181, F319, F320, F321, F322, F323, F324, F325, F328, F329, F330, F331, F332, F333, F3341, F3342, F339, F348, F39, F4489, F843	Work group translation using GEMs	
19	Pulmonary circulation disorders	ICD-9: 416, 4179	Gagne 2012 (CCI); used in Sentinel comorbcodes file	ICD-10: I270, I271, I2782, I2789, I279, I2781, I289, I272	Work group translation using GEMs	
20	HIV/AIDS	ICD-9: 042.x, 043.x, 044.x	Gagne 2012 (CCI), Deyo 1993 (CCI), Quan 2005 (CCI); used in Sentinel comorbcodes file	ICD-10: B20.x-B22.x, B24.x; B20	Work group translation using GEMs; also matches Quan (2005)	one-to-many
21	Hypertension	ICD-9: 4011, 4019, 40210, 40290, 40410, 40490, 40511, 40519, 40591, 40599	Gagne 2012 (CCI); used in Sentinel comorbcodes file	ICD-10: I10, I119, I1310, I150, I158,	Work group translation using GEMs	

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
- Gagne et al, Clin Pharmacol Ther 2016

❑ 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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