Example of Effects of ICD-9 to ICD-10 Conversion on Research: Charlson/Klabunde Score Calculation

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Introduction

Approximately 13,000 ICD-9 diagnosis codes will be replaced with 68,000 ICD-10 codes in the near future. Specifically, the Department of Health and Human Services has mandated the transition to ICD-10 for reporting diagnoses and inpatient procedures effective October 1, 2013. Since many research tools use diagnosis (and procedure) codes, we wanted to examine one popular score based on ICD-9 diagnosis codes—the Charlson/Klabunde score—to see how the change would impact its derivation. Using information available from the CMS/Medicare website (https://www.cms.gov/ICD-10), we've looked at how replacing the ICD-9 codes with ICD-10 codes will proceed for the Charlson/Klabunde score. We first look at the mappings of ICD-9 and ICD-10 diagnoses codes and then discuss the Charlson/Klabunde score. We then analyze the switch-over.

Charlson/Klabunde Score

The inception of the Charlson score is discussed in "A new method of classifying prognostic comorbidity in longitudinal studies." *Development and Chronic Diseases*, 40 (1987), pp. 373–383. The score takes into account the number and seriousness of comorbid diseases. It was originally developed to predict risk of death from comorbid disease in a cohort of 685 patients with breast cancer between 1962 and 1969. The scoring uses a weighted index with weights of 1, 2, 3 and 6 for each of the existing comorbid diseases to derive a total score. The score is useful for adjusting the risk of subjects with comorbid conditions. The index can classify patients according to risk of death. The Charlson Index has been used in many research studies, with many patient populations. (From "Advanced Practice Nursing Data Collection Toolkit," http://apntoolkit.mcmaster.ca/index.php?option=com_content&view=article&id=139:-charlson-comorbidity-index&catid=40:general-health-status&Itemid=58.)

Later R.A. Deyo adapted the Charlson score to be based on ICD-9 codes from claims. (R.A Deyo, D.C Cherkin and M.A Ciol, "Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases." *Journal of Clinical Epidemiology*, 45 [1992], pp. 613–619.) Klabunde was a further modification of this approach to use physician claims and to take care of the problem that important comorbidities recorded on outpatient claims in administrative datasets may be missed in analyses when only inpatient care is considered. Using the comorbid conditions identified by Charlson and colleagues, Klabunde, et al developed a comorbidity index that incorporates the diagnostic and procedure data contained in Medicare physician (Part B) claims. (C.N. Klabunde, A.L. Potosky, J.M. Legler, J.L. Warren, "Development of a comorbidity index using physician claims data." *Journal of Clinical Epidemiology*, 53 [2000], pp. 1258-67.) SAS code (two macros) for the Klabunde version can be downloaded from http://healthservices.cancer.gov/seermedicare/program/comorbidity.html.

Summary

An examination of our analysis indicates that:
- Three (3) Klabunde fields are affected significantly:
  - Myocardial Infarction - Decrease of codes to ICD-10
  - Cerebrovascular - Increase of codes to ICD-10
  - Diabetes with Sequelae - Numerous combinations of ICD-9 to ICD-10
- Other affected fields are Dementia and Various Liver
- Only a few fields had a high number of Combinations (this indicates complex conversions)
- Many of the fields had a high proportion of Approximates (this indicates only an approximate, non-precise conversion)

In conclusion, research tools like the Charlson/Klabunde comorbidity index must be sufficiently analyzed for the effect of the transition to ICD-10 codes. It is not obvious if the transition will be smooth or not.

Overall Match

Number of ICD-10 Codes per ICD-9

Number of ICD-9 Codes per ICD-10

Data used for above frequencies and statistics on Klabunde macro obtained from CMS website: https://www.cms.gov/ICD-10/

TABLE 1. ICD-9-CM and ICD-10 Coding Algorithms for Charlson Comorbidities

Source:
- Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol.* 1992; 45: 613-9.
- Quan H, Sundararajan V, Halfon P, et al. Coding algorithms for defining Comorbidities in ICD-9-CM and ICD-10 administrative data. *Med Care.* 2005 Nov; 43(11): 1130-9.

Charlson/Klabunde Diagnoses Groups

Klabunde ICD9 Diagnoses Fields--Effects of Transition to ICD10 Codes

Klabunde ICD9 Diagnosis Field	Associated ICD9 Codes	Gross Number ICD10 Codes Used	Number Approximate	Number Combination	Unique Number ICD10 Codes Used	Number Unique ICD9 Codes Associated with ICD Codes
MYOCARDIAL INFARCTION	ICD9 Codes Beginning with 410	30	30	0	6	10
CHF	ICD9 Codes Beginning with 428	15	14	0	14	15
PERIPHERAL VASCULAR DISEASE	ICD9 Codes Beginning with 441, 4439, 7854, V434	15	3	0	15	15
CEREBROVASCULAR DISEASE	ICD9 Codes Beginning with 430-437 or equal to 438__	49	39	0	38	39
COPD	ICD9 Codes Beginning with 490-496, 500-505 or 5064	54	33	0	46	44
DEMENTIA	ICD9 Codes Beginning with 290	17	17	6	4	11
PARALYSIS	ICD9 Codes Beginning with 342 or 3441	21	21	0	16	13
DIABETES	ICD9 Codes Beginning with 2507, 2500-2503 or equal to '250 '	30	30	16	14	12
DIABETES WITH SEQUELAE	ICD9 Codes Beginning with 2404-2506 or 2508-2509	60	60	26	36	18
CHRONIC RENAL FAILURE	ICD9 Codes Beginning with 582, 583, 585, 586, 588	29	16	0	25	30
VARIOUS CIRRHODITES (LIVER)	ICD9 Codes Beginning with 5712, 5714, 5715, 5716	12	9	0	12	7
MODERATE SEVERE LIVER DISEASE	ICD9 Codes Beginning with 5722-5728, 4560-4561, or equal to 4562, 45620, 45621	9	3	0	9	8
ULCERS 1	ICD9 Codes Beginning with 5310-5313, 5320-5323, 5330-5333, 5340-5343, or equal to 531, 5319, 532, 5329, 533, 5339, 534, 5349	40	40	0	20	20
ULCERS 2	ICD9 Codes Beginning with 5314-5317, 5324-5327, 5334-5337, 5344-5347	32	32	0	16	16
RHEUMATOID	ICD9 Codes Beginning with 7140-7142 or equal to 71481, 725, 7100, 7101, 7104	6	6	0	6	4
AIDS	ICD9 Codes Beginning with 042-044	1	0	0	1	1

*Reduction in number of ICD-9 to ICD-10 for **Myocardial infarction***

ICD10	ICD10 Description	ICD9	ICD9 Description
I228	Subsequent ST elevation (STEMI) myocardial infarction of other sites	41081	Acute myocardial infarction of other specified sites, initial episode of care
		41051	Acute myocardial infarction of other lateral wall, initial episode of care
		41061	True posterior wall infarction, initial episode of care
I2129	ST elevation (STEMI) myocardial infarction involving other sites	41081	Acute myocardial infarction of other specified sites, initial episode of care
		41061	True posterior wall infarction, initial episode of care
		41051	Acute myocardial infarction of other lateral wall, initial episode of care

*Increase in number of ICD-10 from ICD-9. Each ICD-9 maps to each ICD-10 (1 = 13) for **Cerebrovascular***

ICD10	ICD10 Description	ICD9	ICD9 Description
I6601	Occlusion and stenosis of right middle cerebral artery	43400	Cerebral thrombosis without mention of cerebral infarction
I6602	Occlusion and stenosis of left middle cerebral artery	43410	Cerebral embolism without mention of cerebral infarction
I6603	Occlusion and stenosis of bilateral middle cerebral arteries	43490	Cerebral artery occlusion, unspecified without mention of cerebral infarction
I6609	Occlusion and stenosis of unspecified middle cerebral artery		
I6611	Occlusion and stenosis of right anterior cerebral artery		
I6612	Occlusion and stenosis of left anterior cerebral artery		
I6613	Occlusion and stenosis of bilateral anterior cerebral arteries		
I6619	Occlusion and stenosis of unspecified anterior cerebral artery		
I6621	Occlusion and stenosis of right posterior cerebral artery		
I6622	Occlusion and stenosis of left posterior cerebral artery		
I6623	Occlusion and stenosis of bilateral posterior cerebral arteries		
I6629	Occlusion and stenosis of unspecified posterior cerebral artery		
I663	Occlusion and stenosis of cerebellar arteries		

*Combination of ICD-9 codes to ICD-10 for **Diabetes with chronic complication** * repeated codes*

ICD10	ICD10 Description	ICD9	ICD9 Description
E1140	Type 2 diabetes mellitus with diabetic neuropathy, unspecified	25060	*Diabetes with neurological manifestations, type II or unspecified type, not stated as uncontrolled
E1141	Type 2 diabetes mellitus with diabetic mononeuropathy	3572	*Polyneuropathy in diabetes
		3559	Mononeuritis of unspecified site
E1142	Type 2 diabetes mellitus with diabetic polyneuropathy	25060	*
		3572	Polyneuropathy in diabetes
E1143	Type 2 diabetes mellitus with diabetic autonomic (poly)neuropathy	25060	*
		5363	Gastroparesis
E1144	Type 2 diabetes mellitus with diabetic amyotrophy	25060	*
		3535	Neuralgic amyotrophy
E1149	Type 2 diabetes mellitus with other diabetic neurological complication	34989	Other specified disorders of nervous system
		25060	*
E11610	Type 2 diabetes mellitus with diabetic neuropathic arthropathy	7135	Arthropathy associated with neurological disorders
		25060	*
E1340	Other specified diabetes mellitus with diabetic neuropathy, unspecified	25060	*
		3572	*
E1341	Other specified diabetes mellitus with diabetic mononeuropathy	25060	*
		3559	Mononeuritis of unspecified site
E1342	Other specified diabetes mellitus with diabetic polyneuropathy	25060	*
		3572	*
E1343	Other specified diabetes mellitus with diabetic autonomic (poly)neuropathy	25060	*
		5363	Gastroparesis
E1344	Other specified diabetes mellitus with diabetic amyotrophy	25060	*
		3535	*
E1349	Other specified diabetes mellitus with other diabetic neurological complication	34989	*
		25060	*
E13610	Other specified diabetes mellitus with diabetic neuropathic arthropathy	25060	*