

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

Authors: Balch, Steven; Keudell, Edward

Affiliation: Group Health Research Institute



## 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](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. Pototsky, 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.htm>.

## 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 Code				Number of ICD-9 Codes per ICD-10 Code			
Code	Frequency	Percent	Cumulative Percent	Code	Frequency	Percent	Cumulative Percent
1	11224	76.3%	11.0%	1	42229	89.1%	42.2%
2	1710	12.0%	23.0%	2	4294	9.0%	52.0%
3	583	4.2%	27.2%	3	2271	4.8%	56.8%
4	477	3.4%	30.6%	4	1012	2.1%	58.9%
5	417	3.0%	33.6%	5	511	1.1%	60.0%
6	344	2.5%	36.1%	6	271	0.6%	60.6%
7	304	2.2%	38.3%	7	151	0.3%	60.9%
8	267	1.9%	40.2%	8	81	0.2%	61.1%
9	230	1.7%	42.0%	9	41	0.1%	61.2%
10	193	1.4%	43.4%	10	21	0.0%	61.3%
11	156	1.1%	44.5%	11	11	0.0%	61.4%
12	119	0.9%	45.4%	12	6	0.0%	61.4%
13	82	0.6%	46.0%	13	3	0.0%	61.4%
14	45	0.3%	46.3%	14	2	0.0%	61.4%
15	31	0.2%	46.5%	15	1	0.0%	61.4%
16	17	0.1%	46.6%	16	1	0.0%	61.4%
17	10	0.1%	46.7%	17	1	0.0%	61.4%
18	7	0.1%	46.8%	18	1	0.0%	61.4%
19	5	0.0%	46.8%	19	1	0.0%	61.4%
20	3	0.0%	46.9%	20	1	0.0%	61.4%
21	2	0.0%	46.9%	21	1	0.0%	61.4%
22	1	0.0%	46.9%	22	1	0.0%	61.4%
23	1	0.0%	46.9%	23	1	0.0%	61.4%
24	1	0.0%	46.9%	24	1	0.0%	61.4%
25	1	0.0%	46.9%	25	1	0.0%	61.4%
26	1	0.0%	46.9%	26	1	0.0%	61.4%
27	1	0.0%	46.9%	27	1	0.0%	61.4%
28	1	0.0%	46.9%	28	1	0.0%	61.4%
29	1	0.0%	46.9%	29	1	0.0%	61.4%
30	1	0.0%	46.9%	30	1	0.0%	61.4%

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

## Charlson/Klabunde Diagnoses Groups

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

Klabunde ICD9 Diagnosis Field	Associated ICD9 Codes	Gross Number of ICD9 Codes Used	Number Approximate	Number Combination	Number Unique ICD9 Codes Associated with ICD Codes	
						ICD10
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, 443.9, 785.4, V44	35	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 506	54	33	0	46	44
DEMENZA	ICD9 Codes Beginning with 290	17	17	6	4	11
PARALYSIS	ICD9 Codes Beginning with 342 or 344	21	21	0	16	13
DIABETES	ICD9 Codes Beginning with 2507, 2508-2509 or equal to 250	30	30	16	14	12
DIABETES WITH SEQUELAE	ICD9 Codes Beginning with 240A-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 CIRRHOSITIS (LIVER)	ICD9 Codes Beginning with 571.2, 571.4, 571.5, 571.6	12	9	0	12	7
MODERATE SEVERE LIVER DISEASE	ICD9 Codes Beginning with 572-572.8, 573-573.1, 573.2, 573.3, 573.4, 573.5, 573.6, 573.7, 573.8, 573.9, 574, 574.1, 574.2, 574.3, 574.4, 574.5, 574.6, 574.7, 574.8, 574.9, 575, 575.1, 575.2, 575.3, 575.4, 575.5, 575.6, 575.7, 575.8, 575.9, 576, 576.1, 576.2, 576.3, 576.4, 576.5, 576.6, 576.7, 576.8, 576.9, 577, 577.1, 577.2, 577.3, 577.4, 577.5, 577.6, 577.7, 577.8, 577.9, 578, 578.1, 578.2, 578.3, 578.4, 578.5, 578.6, 578.7, 578.8, 578.9, 579, 579.1, 579.2, 579.3, 579.4, 579.5, 579.6, 579.7, 579.8, 579.9, 580, 580.1, 580.2, 580.3, 580.4, 580.5, 580.6, 580.7, 580.8, 580.9, 581, 581.1, 581.2, 581.3, 581.4, 581.5, 581.6, 581.7, 581.8, 581.9, 582, 582.1, 582.2, 582.3, 582.4, 582.5, 582.6, 582.7, 582.8, 582.9, 583, 583.1, 583.2, 583.3, 583.4, 583.5, 583.6, 583.7, 583.8, 583.9, 584, 584.1, 584.2, 584.3, 584.4, 584.5, 584.6, 584.7, 584.8, 584.9, 585, 585.1, 585.2, 585.3, 585.4, 585.5, 585.6, 585.7, 585.8, 585.9, 586, 586.1, 586.2, 586.3, 586.4, 586.5, 586.6, 586.7, 586.8, 586.9, 587, 587.1, 587.2, 587.3, 587.4, 587.5, 587.6, 587.7, 587.8, 587.9, 588, 588.1, 588.2, 588.3, 588.4, 588.5, 588.6, 588.7, 588.8, 588.9, 589, 589.1, 589.2, 589.3, 589.4, 589.5, 589.6, 589.7, 589.8, 589.9, 590, 590.1, 590.2, 590.3, 590.4, 590.5, 590.6, 590.7, 590.8, 590.9, 591, 591.1, 591.2, 591.3, 591.4, 591.5, 591.6, 591.7, 591.8, 591.9, 592, 592.1, 592.2, 592.3, 592.4, 592.5, 592.6, 592.7, 592.8, 592.9, 593, 593.1, 593.2, 593.3, 593.4, 593.5, 593.6, 593.7, 593.8, 593.9, 594, 594.1, 594.2, 594.3, 594.4, 594.5, 594.6, 594.7, 594.8, 594.9, 595, 595.1, 595.2, 595.3, 595.4, 595.5, 595.6, 595.7, 595.8, 595.9, 596, 596.1, 596.2, 596.3, 596.4, 596.5, 596.6, 596.7, 596.8, 596.9, 597, 597.1, 597.2, 597.3, 597.4, 597.5, 597.6, 597.7, 597.8, 597.9, 598, 598.1, 598.2, 598.3, 598.4, 598.5, 598.6, 598.7, 598.8, 598.9, 599, 599.1, 599.2, 599.3, 599.4, 599.5, 599.6, 599.7, 599.8, 599.9, 600, 600.1, 600.2, 600.3, 600.4, 600.5, 600.6, 600.7, 600.8, 600.9, 601, 601.1, 601.2, 601.3, 601.4, 601.5, 601.6, 601.7, 601.8, 601.9, 602, 602.1, 602.2, 602.3, 602.4, 602.5, 602.6, 602.7, 602.8, 602.9, 603, 603.1, 603.2, 603.3, 603.4, 603.5, 603.6, 603.7, 603.8, 603.9, 604, 604.1, 604.2, 604.3, 604.4, 604.5, 604.6, 604.7, 604.8, 604.9, 605, 605.1, 605.2, 605.3, 605.4, 605.5, 605.6, 605.7, 605.8, 605.9, 606, 606.1, 606.2, 606.3, 606.4, 606.5, 606.6, 606.7, 606.8, 606.9, 607, 607.1, 607.2, 607.3, 607.4, 607.5, 607.6, 607.7, 607.8, 607.9, 608, 608.1, 608.2, 608.3, 608.4, 608.5, 608.6, 608.7, 608.8, 608.9, 609, 609.1, 609.2, 609.3, 609.4, 609.5, 609.6, 609.7, 609.8, 609.9, 610, 610.1, 610.2, 610.3, 610.4, 610.5, 610.6, 610.7, 610.8, 610.9, 611, 611.1, 611.2, 611.3, 611.4, 611.5, 611.6, 611.7, 611.8, 611.9, 612, 612.1, 612.2, 612.3, 612.4, 612.5, 612.6, 612.7, 612.8, 612.9, 613, 613.1, 613.2, 613.3, 613.4, 613.5, 613.6, 613.7, 613.8, 613.9, 614, 614.1, 614.2, 614.3, 614.4, 614.5, 614.6, 614.7, 614.8, 614.9, 615, 615.1, 615.2, 615.3, 615.4, 615.5, 615.6, 615.7, 615.8, 615.9, 616, 616.1, 616.2, 616.3, 616.4, 616.5, 616.6, 616.7, 616.8, 616.9, 617, 617.1, 617.2, 617.3, 617.4, 617.5, 617.6, 617.7, 617.8, 617.9, 618, 618.1, 618.2, 618.3, 618.4, 618.5, 618.6, 618.7, 618.8, 618.9, 619, 619.1, 619.2, 619.3, 619.4, 619.5, 619.6, 619.7, 619.8, 619.9, 620, 620.1, 620.2, 620.3, 620.4, 620.5, 620.6, 620.7, 620.8, 620.9, 621, 621.1, 621.2, 621.3, 621.4, 621.5, 621.6, 621.7, 621.8, 621.9, 622, 622.1, 622.2, 622.3, 622.4, 622.5, 622.6, 622.7, 622.8, 622.9, 623, 623.1, 623.2, 623.3, 623.4, 623.5, 623.6, 623.7, 623.8, 623.9, 624, 624.1, 624.2, 624.3, 624.4, 624.5, 624.6, 624.7, 624.8, 624.9, 625, 625.1, 625.2, 625.3, 625.4, 625.5, 625.6, 625.7, 625.8, 625.9, 626, 626.1, 626.2, 626.3, 626.4, 626.5, 626.6, 626.7, 626.8, 626.9, 627, 627.1, 627.2, 627.3, 627.4, 627.5, 627.6, 627.7, 627.8, 627.9, 628, 628.1, 628.2, 628.3, 628.4, 628.5, 628.6, 628.7, 628.8, 628.9, 629, 629.1, 629.2, 629.3, 629.4, 629.5, 629.6, 629.7, 629.8, 629.9, 630, 630.1, 630.2, 630.3, 630.4, 630.5, 630.6, 630.7, 630.8, 630.9, 631, 631.1, 631.2, 631.3, 631.4, 631.5, 631.6, 631.7, 631.8, 631.9, 632, 632.1, 632.2, 632.3, 632.4, 632.5, 632.6, 632.7, 632.8, 632.9, 633, 633.1, 633.2, 633.3, 633.4, 633.5, 633.6, 633.7, 633.8, 633.9, 634, 634.1, 634.2, 634.3, 634.4, 634.5, 634.6, 634.7, 634.8, 634.9, 635, 635.1, 635.2, 635.3, 635.4, 635.5, 635.6, 635.7, 635.8, 635.9, 636, 636.1, 636.2, 636.3, 636.4, 636.5, 636.6, 636.7, 636.8, 636.9, 637, 637.1, 637.2, 637.3, 637.4, 637.5, 637.6, 637.7, 637.8, 637.9, 638, 638.1, 638.2, 638.3, 638.4, 638.5, 638.6, 638.7, 638.8, 638.9, 639, 639.1, 639.2, 639.3, 639.4, 639.5, 639.6, 639.7, 639.8, 639.9, 640, 640.1, 640.2, 640.3, 640.4, 640.5, 640.6, 640.7, 640.8, 640.9, 641, 641.1, 641.2, 641.3, 641.4, 641.5, 641.6, 641.7, 641.8, 641.9, 642, 642.1, 642.2, 642.3, 642.4, 642.5, 642.6, 642.7, 642.8, 642.9, 643, 643.1, 643.2, 643.3, 643.4, 643.5, 643.6, 643.7, 643.8, 643.9, 644, 644.1, 644.2, 644.3, 644.4, 644.5, 644.6, 644.7, 644.8, 644.9, 645, 645.1, 645.2, 645.3, 645.4, 645.5, 645.6, 645.7, 645.8, 645.9, 646, 646.1, 646.2, 646.3, 646.4, 646.5, 646.6, 646.7, 646.8, 646.9, 647, 647.1, 647.2, 647.3, 647.4, 647.5, 647.6, 647.7, 647.8, 647.9, 648, 648.1, 648.2, 648.3, 648.4, 648.5, 648.6, 648.7, 648.8, 648.9, 649, 649.1, 649.2, 649.3, 649.4, 649.5, 649.6, 649.7, 649.8, 649.9, 650, 650.1, 650.2, 650.3, 650.4, 650.5, 650.6, 650.7, 650.8, 650.9, 651, 651.1, 651.2, 651.3, 651.4, 651.5, 651.6, 651.7, 651.8, 651.9, 652, 652.1, 652.2, 652.3, 652.4, 652.5, 652.6, 652.7, 652.8, 652.9, 653, 653.1, 653.2, 653.3, 653.4, 653.5, 653.6, 653.7, 653.8, 653.9, 654, 654.1, 654.2, 654.3, 654.4, 654.5, 654.6, 654.7, 654.8, 654.9, 655, 655.1, 655.2, 655.3, 655.4, 655.5, 655.6, 655.7, 655.8, 655.9, 656, 656.1, 656.2, 656.3, 656.4, 656.5, 656.6, 656.7, 656.8, 656.9, 657, 657.1, 657.2, 657.3, 657.4, 657.5, 657.6, 657.7, 657.8, 657.9, 658, 658.1, 658.2, 658.3, 658.4, 658.5, 658.6, 658.7, 658.8, 658.9, 659, 659.1, 659.2, 659.3, 659.4, 659.5, 659.6, 659.7, 659.8, 659.9, 660, 660.1, 660.2, 660.3, 660.4, 660.5, 660.6, 660.7, 660.8, 660.9, 661, 661.1, 661.2, 661.3, 661.4, 661.5, 661.6, 661.7, 661.8, 661.9, 662, 662.1, 662.2, 662.3, 662.4, 662.5, 662.6, 662.7, 662.8, 662.9, 663, 663.1, 663.2, 663.3, 663.4, 663.5, 663.6, 663.7, 663.8, 663.9, 664, 664.1, 664.2, 664.3, 664.4, 664.5, 664.6, 664.7, 664.8, 664.9, 665, 665.1, 665.2, 665.3, 665.4, 665.5, 665.6, 665.7, 665.8, 665.9, 666, 666.1, 666.2, 666.3, 666.4, 666.5, 666.6, 666.7, 666.8, 666.9, 667, 667.1, 667.2, 667.3, 667.4, 667.5, 667.6, 667.7, 667.8, 667.9, 668, 668.1, 668.2, 668.3, 668.4, 668.5, 668.6, 668.7, 668.8, 668.9, 669, 669.1, 669.2, 669.3, 669.4, 669.5, 669.6, 669.7, 669.8, 669.9, 670, 670.1, 670.2, 670.3, 670.4, 670.5, 670.6, 670.7, 670.8, 670.9, 671, 671.1, 671.2, 671.3, 671.4, 671.5, 671.6, 671.7, 671.8, 671.9, 672, 672.1, 672.2, 672.3, 672.4, 672.5, 672.6, 672.7, 672.8, 672.9, 673, 673.1, 673.2, 673.3, 673.4, 673.5, 673.6, 673.7, 673.8, 673.9, 674, 674.1, 674.2, 674.3, 674.4, 674.5, 674.6, 674.7, 674.8, 674.9, 675, 675.1, 675.2, 675.3, 675.4, 675.5, 675.6, 675.7, 675.8, 675.9, 676, 676.1, 676.2, 676.3, 676.4, 676.5, 676.6, 676.7, 676.8, 676.9, 677, 677.1, 677.2, 677.3, 677.4, 677.5, 677.6, 677.7, 677.8, 677.9, 678, 678.1, 678.2, 678.3, 678.4, 678.5, 678.6, 678.7, 678.8, 678.9					