

Supplementary Material

Multimorbidity in Medicare beneficiaries: Performance of an ICD-coded multimorbidity-weighted index

Melissa Y. Wei, MD, MPH, MS^{1,2}, David Ratz, MS³, Kenneth J. Mukamal, MD, MPH, MA⁴

¹ Division of General Medicine, University of Michigan, 2800 Plymouth Rd, Building 16, Room 430W, Ann Arbor, Michigan 48109, USA

² Institute for Healthcare Policy and Innovation, University of Michigan, 2800 Plymouth Rd, Building 16, Room 430W, Ann Arbor, Michigan 48109, USA

³ Center for Clinical Management Research, VA Ann Arbor Healthcare System, Ann Arbor, MI, USA

⁴ Division of General Medicine, Beth Israel Deaconess Medical Center and Harvard Medical School, 1309 Beacon St., 2nd floor, Brookline, Massachusetts 02446, USA

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Supplementary Appendix S1. How to calculate the ICD-coded multimorbidity-weighted index (MWI-ICD).

1. Assess for the presence of physician-diagnosed chronic diseases and conditions. Locate the corresponding ICD-9-CM codes for each condition using Supplementary Table S1.
2. Look up the multimorbidity-weighted index weightings for each chronic disease or condition using Supplementary Table S1. For chronic diseases and conditions not specifically listed, use the weighting “other diagnosis” in the first row.
3. Add up all the weighted chronic diseases and conditions to create the ICD-coded multimorbidity-weighted index.

Example:

1. Participant A has chronic conditions X_1 , X_2 and X_3 identified through their respective ICD-9 codes.
2. Using Supplemental Table 1, the MWI disease weightings for the ICD-9 codes corresponding to conditions X_1 , X_2 and X_3 are β_{X_1} , β_{X_2} , and β_{X_3} , respectively.
3. Person A has an ICD-coded multimorbidity-weighted index = $\beta_{X_1} + \beta_{X_2} + \beta_{X_3}$.

Reference on the development and internal validation of the multimorbidity-weighted index:

Wei MY, Kawachi I, Okereke OI, Mukamal KJ. Diverse cumulative impact of chronic diseases on physical health-related quality of life: implications for a measure of multimorbidity. *American Journal of Epidemiology*. 2016;184(5):357-365.

Reference on the development and construct validity of the ICD-coded multimorbidity-weighted index:

Wei MY, Ratz D, Mukamal KJ. Multimorbidity in Medicare beneficiaries: Performance of an ICD-coded multimorbidity-weighted index. *Journal of the American Geriatrics Society*.

Supplementary Table S1. Multimorbidity-weighted index weightings and ICD-9-CM codes for chronic diseases and conditions.

Chronic disease or condition	Multimorbidity-weighted index weighting	ICD-9-CM codes	Chronic disease or condition	Multimorbidity-weighted index weighting	ICD-9-CM codes
Cardiovascular			Valvular heart disease	-0.416	394.0X, 394.2X, 396.XX, 397.0X, 424.1X- 424.3X, 429.71, 746.3X- 746.6X, V42.2X, V43.3X
Angina	-2.20	413.XX			
Aneurysm/dissection of chest area	-1.96	441.XX			
Atrial fibrillation	-1.33	427.31			
Automated Implantable Cardioverter Defibrillator (AICD)	-1.57	37.94- 37.98, V45.02, V53.32, 996.04			
Congestive heart failure ¹	-4.77	425.11- 425.9X, 428.XX, 398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93	Endocrine		
			Diabetes mellitus	-2.67	249.XX, 250.XX, V58.67, V53.91, E93.23
			Elevated cholesterol Hyperlipidemia	-0.343	272.0X, 272.2X, 272.4X, 272.6X, 272.7X
			Hyperthyroidism ²	-0.149	242.01, 242.11, 242.21, 242.31, 242.41, 242.81, 242.91
Coronary artery bypass graft surgery	-0.724	036.1X	Hypertriglyceridemia	-0.692	272.1X, 272.3X
High blood pressure ¹	-1.53	401.XX, 402.00, 402.10, 402.90, 403.10- 403.91, 405.XX	Hypothyroidism	-0.808	243.XX, 244.XX
Mitral valve prolapse	-0.033	394.9X, 424.0X	Thyroid nodule/goiter ²	0	240.XX- 242.41, 246.1X
Myocardial infarction	-1.73	410.XX, 411.0X, 411.1X, 412.XX, 429.79	Gastrointestinal		
			Barrett's esophagus	-0.284	530.85
Peripheral artery disease/atherosclerosis of extremities	-3.25	443.81- 443.9X, 447.1X, V43.4X, 440.1X- 440.9X			

Chronic disease or condition	Multimorbidity-weighted index weighting	ICD-9-CM codes	Chronic disease or condition	Multimorbidity-weighted index weighting	ICD-9-CM codes
Chronic hepatitis Hepatocellular disease ¹	-0.293	070.22, 070.23, 070.31- 070.33, 070.44, 070.54, 571.0X, 571.3X, 571.4X, 571.8X, 571.9X, 572.XX- 573.0X, 130.5X	Deep vein thrombosis/pulmonary embolism	-1.98	415.XX, 416.2X, 452.XX- 453.3X, 453.50- 453.7X, 453.9X
			Immunologic		
			Acquired Immune Deficiency Syndrome (AIDS)	-2.91	042.XX, 079.53
			Integumentary		
			Solar actinic keratosis	0	702.0X
			Musculoskeletal		
			Connective tissue disease	-3.02	695.4X, 710.XX
			Sjogren's disease Dermatomyositis Polymyositis Systemic lupus erythematosus		
			Gout	-1.34	274.XX
			Herniated disc	-3.27	722.XX
Gallstones	-0.929	574.XX, 997.41	Hip fracture	-3.56	733.14, 733.15, 733.96, 808.0X, 808.1X, 820.XX
			Hip replacement surgery	-3.55	81.51- 81.53, V43.64, 00.70- 00.73
Hepatitis not specified as chronic	-0.147	070.0X- 070.21, 070.30, 070.41- 070.43, 070.49- 070.53, 070.59- 070.9X, 571.1X, 573.1X- 573.4X	Knee replacement surgery	-9.11	81.54, 81.55, 00.80- 00.84, V43.65
			Osteoarthritis	-3.52	715.XX
Inflammatory bowel disease Crohn's disease Ulcerative colitis	-1.07	555.XX, 556.XX, 558.XX	Osteoporosis	-0.997	733.0X
			Rheumatoid arthritis	-3.79	714.XX
Pancreatitis	-0.675	577.0X- 577.2X	Vertebral fracture	-2.07	733.13, 805.XX, 806.XX
Ulcer, peptic	-1.08	531.XX- 534.XX	Wrist fracture	0	814.XX
Hematologic			Nervous		
Pernicious anemia	-1.82	281.0X	Amyotrophic lateral sclerosis (ALS)	-7.45	335.2X

Chronic disease or condition	Multimorbidity-weighted index weighting	ICD-9-CM codes	Chronic disease or condition	Multimorbidity-weighted index weighting	ICD-9-CM codes
Dementia Alzheimer disease	-6.10	290.XX, 294.1X- 294.2X, 331.0X- 331.2X, 331.7X, 331.5X, 331.82	Ophthalmologic Cataract	-0.288	366.XX, 379.26, 379.31, 379.39, 743.30- 743.34, 743.39, V43.1X, V45.61
Migraine headache	-0.614	346.XX	Glaucoma	-0.427	362.85, 365.XX, 377.14
Multiple sclerosis	-10.6	340.XX			
Parkinson disease	-8.82	332.XX			
Restless legs syndrome	-2.23	333.94			
Seizure disorder Epilepsy	-0.841	345.XX	Macular degeneration	-0.564	362.5X
Cerebrovascular disease and stroke	-3.79	430.XX- 434.XX, 437.XX, 438.XX, 443.21, 997.02, 852.0X- 852.39, 853.0X, 854.1X	Oral Periodontal disease	-0.164	523.1X- 523.32, 523.4X- 523.5X, 523.8X, 523.9X
Transient ischemic attack	-1.24	435.XX	Psychiatric Alcohol abuse	-1.37	291.XX, 303.XX, 305.0X, V11.3X
Oncologic Basal cell carcinoma	0	173.X1	Depression	-1.29	296.20- 296.36, 296.82, 298.0X, 300.4X, 309.0X, 309.1X, 311.XX
Bladder cancer	-0.99	188.XX	Pulmonary Asthma Chronic obstructive pulmonary disease (COPD) Chronic bronchitis Emphysema	-1.62 -4.32	493.XX 490.XX- 492.8X, 494.0X, 494.1X, 496.XX, 518.1X, 518.2X, 770.2X, 958.7X, 998.81
Breast cancer	-0.886	174.XX- 175.XX, 233.0X			
Cervical cancer	-0.723	180.XX			
Colon cancer	-1.18	153.XX			
Leukemia	-1.32	200.XX- 208.XX, 238.6X, 273.3X			
Lung cancer	-6.25	162.XX			
Melanoma	0	172.XX			
Other cancer Neoplasms of unspecified nature	-1.76	239.XX			
Ovarian cancer	-1.87	183.XX			
Prostate cancer	-0.402	185.0X			
Squamous cell carcinoma	0	173.X2			
Uterine cancer	-0.753	182.1X, 182.8X, 179.0X			

Chronic disease or condition	Multimorbidity-weighted index weighting	ICD-9-CM codes	Chronic disease or condition	Multimorbidity-weighted index weighting	ICD-9-CM codes
Renal			Reproductive		
Chronic kidney disease ¹	-3.98	283.11, 403.XX, 404.XX, 572.4X, 580.XX-583.9X, 585.XX, 587.XX-589.XX	Benign breast disease	0	217.XX
			Benign prostatic hyperplasia (BPH)	0	600.XX
			Ectopic pregnancy	0	633.XX
			Endometriosis	-0.142	617.XX
			Erectile dysfunction	-1.22	302.72, 607.84
			Polycystic ovary syndrome	-0.640	256.4X
Interstitial and other chronic cystitis	-0.879	595.1X-595.9X	Premenstrual syndrome	-0.412	625.4X
Calculus of kidney and ureter	-0.291	592.XX	Prostate surgery for benign prostatic hyperplasia	0	60.21, 60.29, 60.95, 60.96, 60.97
Reproductive			Uterine fibroid	-0.029	218.XX
Benign breast disease	0	217.XX			

¹Intentional overlap in the codes for high blood pressure and chronic kidney disease (403.01-403.91), congestive heart failure and chronic kidney disease (404.01, 404.03, 404.11, 404.13, 404.91, 404.93), and chronic hepatitis/hepatocellular disease and chronic kidney disease (572.4X) is due to mentioned codes encompassing both conditions.

²Intentional overlap in codes for hyperthyroidism and thyroid nodule/goiter is due to codes 242.01, 242.11, 242.21, 242.31, and 242.41 that apply to both conditions.

Supplementary Table S2. Prevalence of chronic conditions based on self-report versus ICD-coded conditions at baseline in 2006.

Condition	N=10,488* (based on self-report)	Self-Report	ICD-Coded
Dementia	7964	289 (3.6%)	588 (5.9%)
Stroke	8283	902 (10.9%)	1281 (12.9%)
Angina	8041	721 (9.0%)	533 (5.4%)
Congestive heart failure	8040	473 (5.9%)	1460 (14.7%)
Heart surgery	8054	247 (3.1%)	135 (1.4%)
Hypertension	8274	5492 (66.4%)	7071 (71.3%)
Myocardial infarction/Heart attack	8043	231 (2.9%)	660 (6.7%)
Other heart condition	8292	1531 (18.5%)	2452 (24.7%)
Lung disease	8280	1049 (12.7%)	1727 (17.4%)
Diabetes	8283	1971 (23.8%)	2944 (29.7%)
Cancer	8281	1551 (18.7%)	1328 (13.4%)
Arthritis	8278	5857 (70.8%)	2875 (29.0%)
Hip replacement	8292	62 (0.8%)	166 (1.7%)
Knee replacement	8292	211 (2.5%)	286 (2.9%)
Glaucoma	8266	308 (3.7%)	1391 (14.0%)

* N in Supplementary Table S2 did not exclude Medicare beneficiaries without continuous enrollment in Medicare Parts A and B in 2006.

Supplementary Table S3. Hazard ratios for mortality after 10-year follow-up, 2006-2016, N=9,923.

		N=9,923		
Deaths	N=4465			
Model	HR (95% CI)	P Value	AIC	C-statistic (SE)
MWI-ICD, continuous, standardized	1.60 (1.56, 1.64)	<0.001	78651.71	0.642 (0.004)
MWI-ICD, quartiles				
Q4	3.28 (3.01, 3.57)	<0.001	78763.31	0.632 (0.004)
Q3	1.80 (1.64, 1.97)	<0.001		
Q2	1.10 (1.00, 1.22)	0.05		
Q1 (reference)	1.0			
	<i>P</i> trend <0.001			
MWI-ICD, continuous, standardized, adjusted for sex	1.60 (1.56, 1.64)	<0.001	78617.49	0.645 (0.004)
MWI-ICD, quartiles, adjusted for sex				
Q4	3.31 (3.04, 3.61)	<0.001	78729.16	0.639 (0.004)
Q3	1.82 (1.66, 1.99)	<0.001		
Q2	1.11 (1.01, 1.22)	0.04		
Q1 (reference)	1			
	<i>P</i> trend <0.001			
MWI-ICD, linear	1.74 (1.67, 1.81)	<0.001		
MWI-ICD, quadratic	0.96 (0.94, 0.97)	<0.001	78625.85	0.642 (0.004)
MWI-ICD, linear	1.73 (1.66, 1.80)	<0.001		
MWI-ICD, quadratic	1.00 (0.96, 1.04)	0.99		
MWI-ICD, cubic	0.99 (0.98, 1.00)	0.03	78623.08	0.642 (0.004)
Simple Disease Count, continuous, standardized	1.44 (1.40, 1.48)	<0.001	79152.34	0.602 (0.004)
Simple Disease Count, quartiles				
Q4	2.22 (2.04, 2.42)	<0.001	79255.97	0.592 (0.004)
Q3	1.33 (1.21, 1.46)	<0.001		
Q2	1.02 (0.93, 1.12)	0.68		
Q1 (reference)	1.0			
	<i>P</i> trend <0.001			
Simple Disease Count, linear	1.43 (1.37, 1.48)	<0.001		
Simple Disease Count, quadratic	1.01 (0.99, 1.02)	0.32	79153.39	0.602 (0.004)
Simple Disease Count, linear	1.45 (1.40, 1.51)	<0.001		
Simple Disease Count, quadratic	1.10 (1.07, 1.14)	<0.001		
Simple Disease Count, cubic	0.97 (0.97, 0.98)	<0.001	79119.12	0.602 (0.004)
Charlson Index, continuous, standardized	1.54 (1.50, 1.57)	<0.001	78743.11	0.643 (0.004)
Charlson Index, quartiles				
Q4	3.23 (2.99, 3.49)	<0.001	78789.17	0.634 (0.004)
Q3	2.13 (1.94, 2.34)	<0.001		
Q2	1.47 (1.34, 1.61)	<0.001		
Q1 (reference)	1.0			
	<i>P</i> trend <0.001			

Charlson Index, linear	1.83 (1.75, 1.90)	<0.001		
Charlson Index, quadratic	0.94 (0.92, 0.95)	<0.001	78647.00	0.643 (0.004)
Charlson Index, linear	1.90 (1.82, 1.99)	<0.001		
Charlson Index, quadratic	0.87 (0.84, 0.90)	<0.001		
Charlson Index, cubic	1.01 (1.01, 1.02)	<0.001	78631.64	0.643 (0.004)
NJ Medicare Charlson, continuous, standardized	1.65 (1.61, 1.68)	<0.001	78433.98	0.656 (0.004)
NJ Medicare Charlson, quartiles				
Q4	3.82 (3.54, 4.13)	<0.001	78508.51	0.647 (0.004)
Q3	2.14 (1.93, 2.37)	<0.001		
Q2	1.48 (1.36, 1.61)	<0.001		
Q1 (reference)	1.0			
	P trend <0.001			
Elixhauser Score, continuous, standardized	1.62 (1.58, 1.66)	<0.001	78597.46	0.642 (0.004)
Elixhauser Score, quartiles				
Q4	2.90 (2.61, 3.23)	<0.001	78849.09	0.624 (0.004)
Q3	1.48 (1.30, 1.67)	<0.001		
Q2	1.11 (0.99, 1.24)	0.09		
Q1 (reference)	1.0			
	P trend <0.001			
Elixhauser Score, linear	1.74 (1.67, 1.81)	<0.001		
Elixhauser Score, quadratic	0.97 (0.95, 0.98)	<0.001	78579.03	0.642 (0.004)
Elixhauser Score, linear	1.72 (1.65, 1.80)	<0.001		
Elixhauser Score, quadratic	1.02 (0.98, 1.06)	0.41		
Elixhauser Score, cubic	0.99 (0.98, 1.00)	0.01	78573.03	0.642 (0.004)
van Walraven Elixhauser Score, continuous, standardized	1.62 (1.58, 1.66)	<0.001	78518.36	0.648 (0.004)
van Walraven Elixhauser Score, quartiles				
Q4	2.79 (2.46, 3.17)	<0.001	78664.66	0.636 (0.004)
Q3	1.35 (1.18, 1.54)	<0.001		
Q2	0.85 (0.74, 0.96)	0.01		
Q1 (reference)	1.0			
	P trend <0.001			
HRQOL-Comorbidity Index, continuous, standardized	1.48 (1.45, 1.53)	<0.001	79035.36	0.614 (0.004)
HRQOL-Comorbidity Index, quartiles				
Q4	2.49 (2.28, 2.72)	<0.001	79169.68	0.602 (0.004)
Q3	1.49 (1.35, 1.64)	<0.001		
Q2	1.11 (1.00, 1.22)	0.04		
Q1 (reference)	1.0			
	P trend <0.001			

Abbreviations: MWI-ICD, Multimorbidity-Weighted Index-ICD coded conditions; AIC, Akaike Information Criterion; C, concordance; HR, hazard ratio; Q, quartile; ICD, International Classification of Diseases; SE, standard error; HRQOL, health-related quality of life

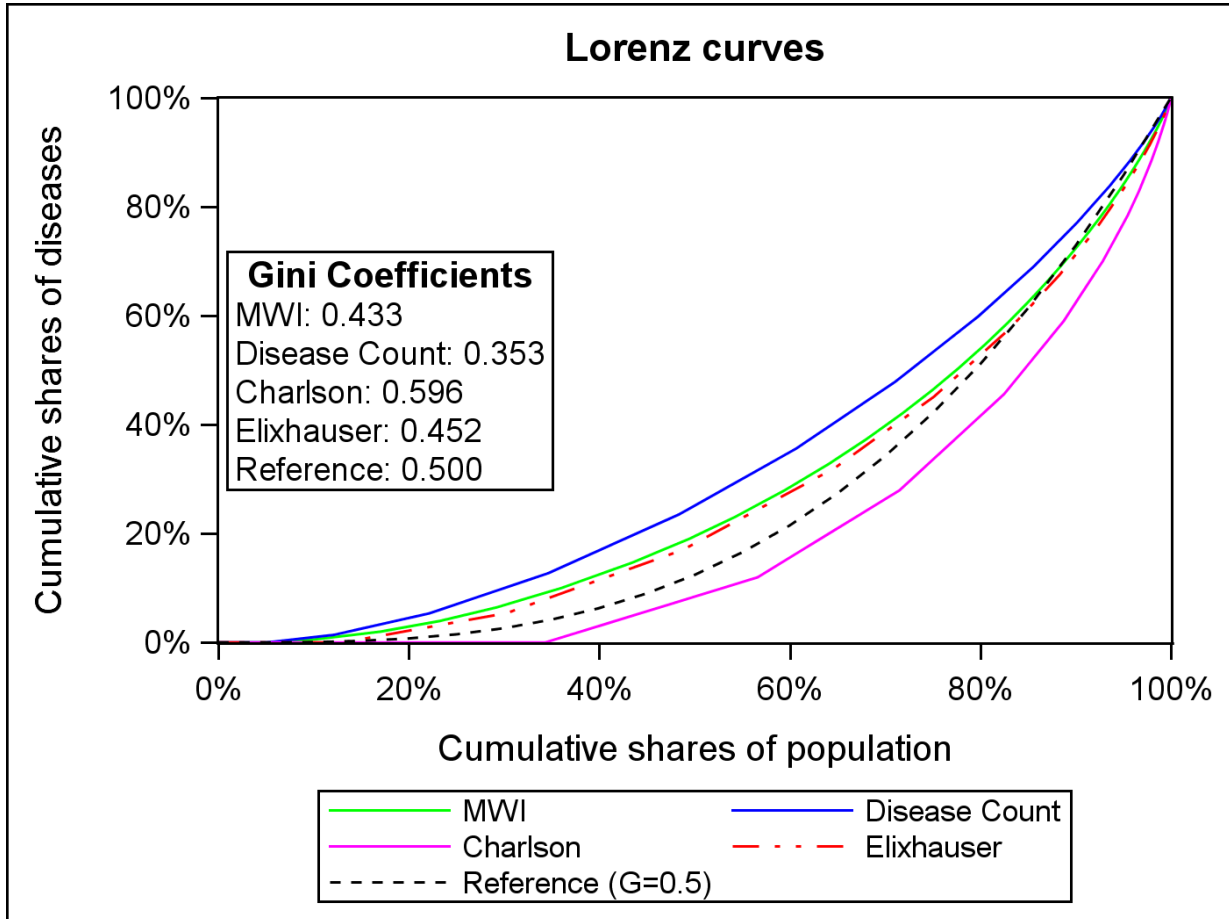
Supplementary Table S4. Short Form-36 physical functioning by standardized metrics after 8-years of follow-up from baseline, 2006-2014. N=4,950, physical functioning mean 48.6±31.8.

Model	β coefficient (95% CI)	P Value	T Value	R ²
MWI-ICD, continuous, standardized	-12.50 (-13.54, -11.47)	<0.001	-23.66	0.11
MWI-ICD, quartiles				
Q4	-28.51 (-31.11, -25.92)	<0.001	-21.52	0.10
Q3	-18.20 (-20.50, -15.90)	<0.001	-15.51	
Q2	-6.79 (-8.96, -4.61)	<0.001	-6.13	
Q1 (reference)	0			
MWI-ICD, continuous, adjusted for sex	-12.21 (-13.23, -11.19)	<0.001	-23.46	0.13
MWI-ICD, quartiles, adjusted for sex				
Q4	-27.99 (-30.54, -25.43)	<0.001	-21.47	0.13
Q3	-17.60 (-19.86, -15.33)	<0.001	-15.23	
Q2	-6.62 (-8.75, -4.48)	<0.001	-6.07	
Q1 (reference)	0			
MWI-ICD, linear	-14.22 (-15.40, -13.03)	<0.001		
MWI-ICD, quadratic	2.29 (1.50, 3.07)	<0.001	5.73	0.11
MWI-ICD, linear	-13.84 (-15.24, -12.44)	<0.001		
MWI-ICD, quadratic	2.90 (1.44, 4.37)	<0.001		
MWI-ICD, cubic	-0.27 (-0.80, 0.26)	0.33	-0.98	0.11
Simple Disease Count, continuous, standardized	-9.54 (-10.51, -8.56)	<0.001	-19.13	0.07
Simple Disease Count				
Q4	-21.91 (-24.42, -19.39)	<0.001	-17.07	0.06
Q3	-12.57 (-15.02, -10.11)	<0.001	-10.02	
Q2	-4.61 (-6.93, -2.28)	0.001	-3.88	
Q1 (reference)	0			
Simple Disease Count, linear	-9.64 (-10.66, -8.61)	<0.001		
Simple Disease Count, quadratic	0.23 (-0.50, 0.95)	0.54	0.61	0.07
Simple Disease Count, linear	-10.37 (-11.79, -8.95)	<0.001		
Simple Disease Count, quadratic	-0.34 (-1.39, 0.70)	0.52		
Simple Disease Count, cubic	0.34 (-0.12, 0.80)	0.14	14.6	0.07
Charlson Index, continuous, standardized	-9.42 (-10.52, -8.32)	<0.001	-16.77	0.05
Charlson Index				
Q4	-20.47 (-22.83, -18.14)	<0.001	-17.03	0.06
Q3	-12.19 (-14.83, -9.55)	<0.001	-9.07	
Q2	-7.41 (-9.61, -5.22)	<0.001	-6.63	
Q1 (reference)	0			
Charlson Index, linear	-11.95 (-13.34, -10.57)	<0.001		
Charlson Index, quadratic	2.10 (1.40, 2.80)	<0.001	5.86	0.06
Charlson Index, linear	-11.88 (-13.27, -10.50)	<0.001		
Charlson Index, quadratic	3.28 (1.65, 4.90)	<0.001		
Charlson Index, cubic	-0.31 (-0.70, 0.08)	0.12	-1.57	0.06

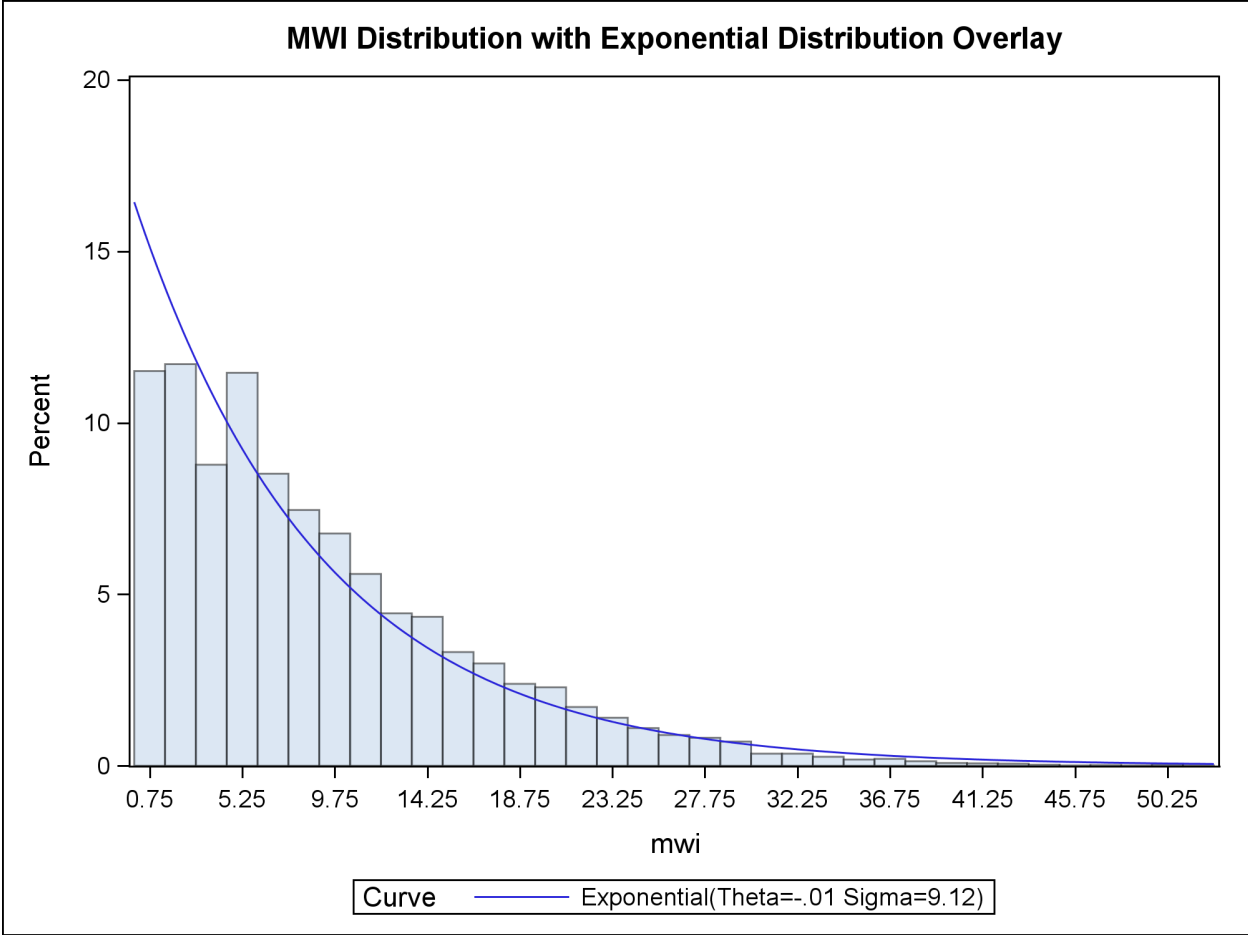
Elixhauser Score, continuous, standardized	-11.20 (-12.28, -10.13)	<0.001	-20.48	0.08
Elixhauser Score				
Q4	-25.47 (-28.22, -22.73)	<0.001	-18.22	0.08
Q3	-14.64 (-17.61, -11.67)	<0.001	-9.67	
Q2	-8.07 (-10.59, -5.55)	<0.001	-6.27	
Q1 (reference)	0			
Elixhauser Score, linear	-12.22 (-13.41, -11.04)	<0.001		
Elixhauser Score, quadratic	1.56 (0.78, 2.34)	<0.001	3.93	0.08
Elixhauser Score, linear	-12.00 (-13.35, -10.64)	<0.001		
Elixhauser Score, quadratic	1.93 (0.61, 3.25)	0.004		
Elixhauser Score, cubic	-0.15 (-0.58, 0.28)	0.50	-0.68	0.08
HRQOL-Comorbidity Index, continuous, standardized	-11.62 (-12.58, -10.67)	<0.001	-23.85	0.10
HRQOL-Comorbidity Index, quartiles				
Q4	-26.34 (-28.87, -23.81)	<0.001	-20.39	0.09
Q3	-16.74 (-19.22, -14.26)	<0.001	-13.24	
Q2	-6.48 (-8.78, -4.18)	<0.001	-5.52	
Q1 (reference)	0			

Abbreviations: CI, confidence interval; HRQOL, health-related quality of life; ICD, International Classification of Diseases; MWI-ICD, Multimorbidity-Weighted Index-ICD coded conditions; Q, Quartile; R², coefficient of determination.

Supplementary Figure S1. Lorenz curves for Gini index values for measures of multimorbidity at baseline, 2006.



Supplementary Figure S2. The distribution of the ICD-coded multimorbidity weighted index (MWI-ICD) most closely follows an exponential function.



Supplementary Appendix S1. SAS macro for ICD-coded multimorbidity-weighted index (MWI-ICD)

/* Multimorbidity-Weighted Index, ICD-9 Coded MACRO DEVELOPMENT

By Joshua Petrie, University of Michigan

REQUIRED DATA INPUT (indata): A SAS dataset with 2 variables named "id" and "icd9code".
"id" contains unique subject identifiers. "icd9code" is a character variable containing ICD-9 diagnosis codes in a format that includes the decimal point (e.g. XXX.XX). The dataset should be in long format i.e. 1 row per ICD-9 code, more than 1 row per subject.

DATA OUTPUT (indata): A SAS dataset with 2 variables named "id" and "mwi". "id" contains unique subject identifiers. "mwi" contains the calculated multimorbidity weighted index score. The dataset will include 1 row per subject. */

```
%macro MWI(indata,outdata);
  PROC SORT DATA=&indata NODUPKEY;
    BY id icd9code;
  RUN;

  DATA &indata;
    SET &indata;
    IF prxmatch("/^413/",icd9code) THEN DO;
      diseaseid=1;*2.2 - angina;
      weight=2.2;
    END;
    ELSE IF prxmatch("/^441/", icd9code) THEN DO;
      diseaseid=2;*aortic aneurysm;
      weight=1.96;
    END;
    ELSE IF prxmatch("/^427\.31/",icd9code) THEN DO;
      diseaseid=3;*1.33 - atrial fibrillation;
      weight=1.33;
    END;
    ELSE IF prxmatch("m/^37\.9[4-8]|\^V45\.02|\^V53\.32|\^996\.04/i",icd9code)
  THEN DO;*37.X are procedure codes i.e. NOT 037.X;
      diseaseid=4;*1.57 - automated implantable cardioverter
  defibrillator (AICD);
      weight=1.57;
    END;
    ELSE IF prxmatch("/^425\.1[1-9]|\^425\.2[2-
  9]|\^428|\^398\.91|\^402\.[0,1,9]1|\^404\.[0,1,9][1,3]/",icd9code) THEN DO;*Codes 404.01,
  404.03, 404.11, 404.13, 404.91, and 404.93 overlap with chronic kidney disease below.
  Weight as congestive heart failure, but retain to facilitate individual condition
  flagging.;
      diseaseid=5;*4.77 - congestive heart failure;
      weight=4.77;
    END;
    ELSE IF prxmatch("/^36\.1/",icd9code) THEN DO;*36.X are procedure codes
  i.e. NOT 036.X;
      diseaseid=6;*coronary artery bypass graft surgery;
      weight=0.724;
    END;
    ELSE IF
  prxmatch("/^070\.2[2,3]|\^070\.3[2,3]|\^070\.[4,5]4|\^571\.[0,3,4,8,9]|\^572|\^573\.0|\^130\
  .5/", icd9code) THEN DO;*Codes 572.4X overlap with chronic kidney disease below.
  Weight as chronic hepatitis, but retain to facilitate individual condition flagging.;
      diseaseid=19;*chronic hepatitis, hepatocellular disease;
      weight=0.293;
    END;
  END;
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ELSE IF prxmatch("/^283\.11|^40[3,4]^572\.4|^58[0-3,5-9]^591/",
icd9code) THEN DO;*Codes 403.10-403.91 overlap with high blood pressure below. Weight
as chronic kidney disease, but retain to facilitate individual condition flagging.;
diseaseid=73;*chronic kidney disease;
weight=3.98;
END;
ELSE IF prxmatch("/^401|^402\.[0,1,9]0|^403\.[1-
8]|^403\.9[0,1]^405/",icd9code) THEN DO;
diseaseid=7;*high blood pressure;
weight=1.53;
END;
ELSE IF prxmatch("/^394\.9|^424\.0/",icd9code) THEN DO;
diseaseid=8;*mitral valve prolapse;
weight=0.033;
END;
ELSE IF prxmatch("/^410|^411\.[0,1]|^412|^429\.79/",icd9code) THEN DO;
diseaseid=9;*myocardial infarction;
weight=1.73;
END;
ELSE IF prxmatch("m/^443\.8[1-
9]|^443\.9|^447\.1|^785\.4|^V43\.4|^38\.48|^440\.[1-9]/i",icd9code) THEN DO;*38.48 is
a procedure code i.e. NOT 038.48;
diseaseid=10;*peripheral artery disease/atherosclerosis of
extremities;
weight=3.25;
END;
ELSE IF prxmatch("m/^394\.[0,2]|^396|^397\.0|^424\.[1-
3]|^429\.71|^746\.[3-6]|^V42\.2|^V43\.3/i", icd9code) THEN DO;
diseaseid=11;*valvular heart Disease;
weight=0.416;
END;
ELSE IF prxmatch("m/^249|^250|^V58\.67|^V53\.91|^E93\.23/i",icd9code)
THEN DO;
diseaseid=12;*diabetes;
weight=2.67;
END;
ELSE IF prxmatch("/^272\.[0,2,4,6,7]/", icd9code) THEN DO;
diseaseid=13;*elevated cholesterol;
weight=0.343;
END;
ELSE IF prxmatch("/^242\.[0-4,8,9]1/", icd9code) THEN DO;
diseaseid=14;*hyper-thyroidism;
weight=0.149;
END;
ELSE IF prxmatch("/^272\.[1,3]/", icd9code) THEN DO;
diseaseid=15;*hypertriglyceridemia;
weight=0.692;
END;
ELSE IF prxmatch("/^24[3-4]/", icd9code) THEN DO;
diseaseid=16;*hypothyroidism;
weight=0.808;
END;
ELSE IF prxmatch("/^242\.[0-3]|^242\.4[0,1]/", icd9code) THEN DO;
diseaseid=17;*thyroid nodule;
weight=0;
END;
ELSE IF prxmatch("/^530\.85/", icd9code) THEN DO;
diseaseid=18;*barretts esophagus;
weight=0.284;
END;
ELSE IF prxmatch("m/^571\.[2,5,6]|^V42\.7|^50\.5[1,9]/i", icd9code) THEN
DO;*50.5X are procedure codes i.e. NOT 050.5X;
diseaseid=20;*cirrhosis, liver transplant;

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        weight=4.3;
    END;
ELSE IF prxmatch("/^211\[3]/", icd9code) THEN DO;
    diseaseid=21;*colon polyp;
    weight=0.01;
    END;
ELSE IF prxmatch("/^562/", icd9code) THEN DO;
    diseaseid=22;*diverticulosis, diverticulitis;
    weight=0.624;
    END;
ELSE IF prxmatch("/^574|^997\.41/", icd9code) THEN DO;
    diseaseid=23;*gallstones;
    weight=0.929;
    END;
ELSE IF prxmatch("/^070\[0,1,6-9]|^070\.2[0,1]|^070\.3[0,1]|^070\.4[1-3,9]|^070\.5[0-3,9]|^571\.1|^573\[1-4]/", icd9code) THEN DO;
    diseaseid=24;*hepatitis not specified as chronic;
    weight=0.147;
    END;
ELSE IF prxmatch("/^55[5,6,8]/", icd9code) THEN DO;
    diseaseid=25;*inflammatory bowel disease;
    weight=1.07;
    END;
ELSE IF prxmatch("/^577\[0,1,2]/", icd9code) THEN DO;
    diseaseid=26;*Pancreatitis;
    weight=0.675;
    END;
ELSE IF prxmatch("/^53[1-4]/", icd9code) THEN DO;
    diseaseid=27;*ulcer, peptic;
    weight=1.08;
    END;
ELSE IF prxmatch("/^281\.0/", icd9code) THEN DO;
    diseaseid=28;*pernicious anemia;
    weight=1.82;
    END;
ELSE IF prxmatch("/^415|^416\.2|^452|^453\[3,5-7,9]/", icd9code) THEN
DO;
    diseaseid=29;*venous thrombo-embolism (pulmonary embolus,
deep venous thrombosis);
    weight=1.98;
    END;
ELSE IF prxmatch("/^042|^079\.53/", icd9code) THEN DO;
    diseaseid=30;*acquired immune deficiency syndrome (AIDS);
    weight=2.91;
    END;
ELSE IF prxmatch("/^702\.0/", icd9code) THEN DO;
    diseaseid=31;*solar actinic keratosis;
    weight=0;
    END;
ELSE IF prxmatch("/^695\.4|^710/", icd9code) THEN DO;
    diseaseid=32;*connective tissue disease;
    weight=3.02;
    END;
ELSE IF prxmatch("/^274/", icd9code) THEN DO;
    diseaseid=33;*gout;
    weight=1.34;
    END;
ELSE IF prxmatch("/^722/", icd9code) THEN DO;
    diseaseid=34;*herniated disc;
    weight=3.27;
    END;
ELSE IF prxmatch("/^733\.1[4,5]|^733\.96|^808\[0,1]|^820/", icd9code)
THEN DO;

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        diseaseid=35;*hip fracture;
        weight=3.56;
    END;
    ELSE IF prxmatch("m/^81\.5[1-3]|^V43\.64|^00\.7[0-3]/i", icd9code) THEN
DO;*81.5X and 00.7X are procedure codes i.e. NOT 081.5X or 000.7X;
        diseaseid=36;*hip replacement surgery;
        weight=3.55;
    END;
    ELSE IF prxmatch("m/^81\.5[4,5]|^00\.8[0-4]|^V43\.65/i", icd9code) THEN
DO;*81.X and 00.X are procedure codes i.e. NOT 081.X or 000.X;
        diseaseid=37;*knee replacement surgery;
        weight=9.11;
    END;
    ELSE IF prxmatch("/^715/", icd9code) THEN DO;
        diseaseid=38;*osteo-arthritis;
        weight=3.52;
    END;
    ELSE IF prxmatch("/^733\[0]/", icd9code) THEN DO;
        diseaseid=39;*osteoporosis;
        weight=0.997;
    END;
    ELSE IF prxmatch("/^714/", icd9code) THEN DO;
        diseaseid=40;*rheumatoid arthritis;
        weight=3.79;
    END;
    ELSE IF prxmatch("/^733\.13|^80[5,6]/", icd9code) THEN DO;
        diseaseid=41;*vertebral fracture;
        weight=2.07;
    END;
    ELSE IF prxmatch("/^814/", icd9code) THEN DO;
        diseaseid=42;*wrist fracture;
        weight=0;
    END;
    ELSE IF prxmatch("/^335\.2/", icd9code) THEN DO;
        diseaseid=43;*Amyotrophic lateral sclerosis (ALS);
        weight=7.45;
    END;
    ELSE IF prxmatch("/^290|^294\[1-2]|^331\[0-2,5,7]|^331\.82/",
icd9code) THEN DO;
        diseaseid=44;*dementia including alzheimer disease;
        weight=6.1;
    END;
    ELSE IF prxmatch("/^346/", icd9code) THEN DO;
        diseaseid=45;*migraine;
        weight=0.614;
    END;
    ELSE IF prxmatch("/^340/", icd9code) THEN DO;
        diseaseid=46;*multiple sclerosis;
        weight=10.6;
    END;
    ELSE IF prxmatch("/^332/", icd9code) THEN DO;
        diseaseid=47;*parkinson disease;
        weight=8.82;
    END;
    ELSE IF prxmatch("/^333\.94/", icd9code) THEN DO;
        diseaseid=48;*restless legs syndrome;
        weight=2.23;
    END;
    ELSE IF prxmatch("/^345/", icd9code) THEN DO;
        diseaseid=49;*seizure disorder and epilepsy;
        weight=0.841;
    END;
END;

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ELSE IF prxmatch("/^43[0-4,7,8]|^443\.21|^997\.02|^852\.[0-3]|^853\.0|^854\.1/", icd9code) THEN DO;
    diseaseid=50;*stroke;
    weight=3.79;
END;
ELSE IF prxmatch("/^435/", icd9code) THEN DO;
    diseaseid=51;*transient ischemic attack;
    weight=1.24;
END;
ELSE IF prxmatch("/^173\[0-9]1/", icd9code) THEN DO;
    diseaseid=52;*basal cell carcinoma;
    weight=0;
END;
ELSE IF prxmatch("/^188/", icd9code) THEN DO;
    diseaseid=53;*bladder cancer;
    weight=0.99;
END;
ELSE IF prxmatch("/^17[4-5]|^233\.0/", icd9code) THEN DO;
    diseaseid=54;*breast cancer;
    weight=0.886;
END;
ELSE IF prxmatch("/^180/", icd9code) THEN DO;
    diseaseid=55;*cervical cancer;
    weight=0.723;
END;
ELSE IF prxmatch("/^153/", icd9code) THEN DO;
    diseaseid=56;*colon cancer;
    weight=1.18;
END;
ELSE IF prxmatch("/^20[0-8]|^238\.6|^273\.3/", icd9code) THEN DO;
    diseaseid=57;*leukemia,lymphoma;
    weight=1.32;
END;
ELSE IF prxmatch("/^162/", icd9code) THEN DO;
    diseaseid=58;*lung cancer;
    weight=6.25;
END;
ELSE IF prxmatch("/^172/", icd9code) THEN DO;
    diseaseid=59;*melanoma;
    weight=0;
END;
ELSE IF prxmatch("/^239/", icd9code) THEN DO;
    diseaseid=60;*other cancer;
    weight=1.76;
END;
ELSE IF prxmatch("/^183/", icd9code) THEN DO;
    diseaseid=61;*ovarian cancer;
    weight=1.87;
END;
ELSE IF prxmatch("/^185/", icd9code) THEN DO;
    diseaseid=62;*prostate cancer;
    weight=0.402;
END;
ELSE IF prxmatch("/^173\[0-9]2/", icd9code) THEN DO;
    diseaseid=63;*squamous cell carcinoma;
    weight=0;
END;
ELSE IF prxmatch("/^182\[1,8]|^179/", icd9code) THEN DO;
    diseaseid=64;*uterine cancer;
    weight=0.753;
END;
ELSE IF prxmatch("m/^366|^379\.26|^379\.3[1,9]|^743\.3[0-4,9]|^v43\.1|^v45\.61/i", icd9code) THEN DO;

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        diseaseid=65;*cataract;
        weight=0.288;
    END;
ELSE IF prxmatch("/^362\.85|^365|^377\.14/", icd9code) THEN DO;
    diseaseid=66;*glaucoma;
    weight=0.427;
    END;
ELSE IF prxmatch("/^362\.5/", icd9code) THEN DO;
    diseaseid=67;*macular degeneration;
    weight=0.564;
    END;
ELSE IF prxmatch("/^523\[1,2,4,5,8,9]^523\.3[0-2]/", icd9code) THEN DO;
    diseaseid=68;*periodontal disease;
    weight=0.164;
    END;
ELSE IF prxmatch("m/^291|^303|^305\.0|^V11\.3/i", icd9code) THEN DO;
    diseaseid=69;*alcohol abuse;
    weight=1.37;
    END;
ELSE IF prxmatch("/^296\.2|^296\.3[0-6]^296\.82|^298\.0|^300\.4|^309\[0,1]^311/", icd9code) THEN DO;
    diseaseid=70;*depression;
    weight=1.29;
    END;
ELSE IF prxmatch("/^493/", icd9code) THEN DO;
    diseaseid=71;*asthma;
    weight=1.62;
    END;
ELSE IF prxmatch("/^49[0,1]^492\[0-8]^494\[0,1]^496|^518\[1-2]^770\.2|^958\.7|^998\.81/", icd9code) THEN DO;
    diseaseid=72;*Chronic obstructive pulmonary disease (COPD) (chronic bronchitis and emphysema);
    weight=4.32;
    END;
ELSE IF prxmatch("/^595\[1-9]/", icd9code) THEN DO;
    diseaseid=74;*interstitial cystitis;
    weight=0.879;
    END;
ELSE IF prxmatch("/^592/", icd9code) THEN DO;
    diseaseid=75;*calculus of kidney and ureter;
    weight=0.291;
    END;
ELSE IF prxmatch("/^217/", icd9code) THEN DO;
    diseaseid=76;*benign breast disease;
    weight=0;
    END;
ELSE IF prxmatch("/^600/", icd9code) THEN DO;
    diseaseid=77;*benign prostatic hyperplasia (BPH);
    weight=0;
    END;
ELSE IF prxmatch("/^633/", icd9code) THEN DO;
    diseaseid=78;*ectopic pregnancy;
    weight=0;
    END;
ELSE IF prxmatch("/^617/", icd9code) THEN DO;
    diseaseid=79;*endometriosis;
    weight=0.142;
    END;
ELSE IF prxmatch("/^302\.72|^607\.84/", icd9code) THEN DO;*CHECKED;
    diseaseid=80;*erectile dysfunction;
    weight=1.22;
    END;
ELSE IF prxmatch("/^256\.4/", icd9code) THEN DO;

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        diseaseid=81;*polycystic ovary syndrome;
        weight=0.64;
    END;
ELSE IF prxmatch("/^625\.4/", icd9code) THEN DO;
    diseaseid=82;*premenstrual syndrome;
    weight=0.412;
    END;
ELSE IF prxmatch("/^60\.2[1,9]|^60\.9[5,6,7]/", icd9code) THEN DO;
    diseaseid=83;*prostate surgery for benign prostatic
hyperplasia;
    weight=0;
    END;
ELSE IF prxmatch("/^218/", icd9code) THEN DO;
    diseaseid=84;*uterine fibroid;
    weight=0.029;
    END;
ELSE DO;
    diseaseid=85;*other non-mwi diagnosis;
    weight=0;
    END;
RUN;

PROC SORT DATA=&indata NODUPKEY;
    BY id diseaseid;
RUN;

DATA &indata;
    SET &indata;
    BY id;
    IF FIRST.id THEN num=0;
    num+1;
RUN;

PROC TRANSPOSE DATA=&indata OUT=&indata;
    BY id;
    ID num;
    VAR weight;
RUN;

DATA &outdata;
    SET &indata (RENAME=( _NAME_ =name));
    mwi=sum(of _:);
    KEEP id mwi;
RUN;

%mend;

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