

Comorbidity index used for mortality analyses for dialysis patients

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Introduction

- Comorbidity indices have been widely used for describing a patient's comorbidity burden, predicting outcomes, and for adjusting as a confounder in analyses involving end-stage renal disease (ESRD) patients.
- Comorbidity indices in use, however, were developed for general populations or on small samples.
- These indices were not formally validated or were validated based only on predictive ability or significance as a predictor.
- Validation of an index should be goal-driven and in terms of goals, compared with the individual comorbid conditions the index represents.
- This study developed and validated a new comorbidity index as a comorbidity burden indicator, predictor, and adjuster for mortality analyses of dialysis patients.

Data

- The 2000 US incident dialysis cohort was used as the training population.
- The 1999 and 2001 incident and 2000 prevalent cohorts were used as testing populations, separately.

Methods

- The baseline period was defined from month 4 to month 9 of dialysis for incident patients, and from January to June for prevalent patients.
- The follow-up period was from the 1st day after the baseline period to death, transplant, loss-to-follow-up, change of primary payer, or the end of 2005.
- Comorbidities were defined using the ESRD Medical Evidence form and medical claims in the baseline period.
- A Cox proportional hazard model was used for the index development and validation.
- Age, race, gender, and primary ESRD cause were included in the model.
- The index score for each comorbidity was defined based on the coefficient estimates, and the index score of each patient was the sum of the coefficients of the comorbidities of each patient.
- Model fit statistics: Akaike's Information Criteria (AIC), Schwartz Bayesian Criteria (SBC), and -2* log Likelihood; model predictive statistics: Kent-O' Quigley R-square and c-statistic; parameter estimates and standard errors of the estimates were compared between the model with the individual comorbidities and the one with the new index.

Results

- 102,134 incident and 142,517 prevalent patients were included (Table 1).
- Mean follow-up time was 2.3 years for the incident cohort and 2.5 years for the prevalent cohort.
- Patient comorbidity increased over years (Table 2).
- Prevalent patients were younger, had a smaller proportion of whites, and less comorbidities (Tables 1,2).
- Comorbidity score was assigned: 0 if coeff.<0.05, 1 for 0.05-0.15, 2 for 0.15-0.25, and 3 for >=0.25 (Table 2)

Table 1. Patient characteristics, by cohort.

Characteristics	1999 Incident n = 33,166	2000 Incident n = 33,277	2001 Incident n = 35,891	2000 Prevalent n = 142,517
Mean Age	65.6	65.2	65.7	62.8
Median Age	69	68	69	63
ID	14.7	15	14.7	15.6
Diagnosis				
0 to 19	0.31	0.4	0.38	0.41
20 to 29	1.87	2.08	1.88	2.59
30 to 39	4.57	4.6	4.38	7.51
40 to 49	8.4	9	8.18	15.67
50 to 59	13.59	13.66	13.51	18.15
60 to 64	8.3	8.85	8.87	10.66
65 to 69	15.36	14.49	15.04	12.67
70 to 79	33	32.14	32.14	24.86
> 80	14.61	14.78	15.62	9.79
Race				
White	64.04	64.08	65.44	52.86
Black	30.34	30.78	29.77	41.67
Native American	1.57	1.56	1.64	1.64
Asian	2.83	2.66	2.35	3.1
Other	0.81	0.91	0.81	0.79
Gender				
Female	48.29	48.11	48	48.29
Male	51.71	51.89	52	51.71
ESRD primary cause				
Diabetes	40.89	47.23	46.26	38.06
Hypertension	29.8	29.72	29.41	29.9
CH/Cyclic Kidney Disease	10.36	9.6	9.15	17.44
Other	12.94	13.15	13.07	14.1

Table 2. Patient baseline comorbidities, coefficient estimates, and comorbidity score.

Comorbidity	Cohort				Parameter Estimates From Cox Model			
	1999 Incident n = 33,166	2000 Incident n = 33,277	2001 Incident n = 35,891	2000 Prevalent n = 142,517	Estimate	Error	p-value	Score
Comorbidity								
ASHD	51.53	52.16	53.8	41.2	0.0634	0.0165	<.0001	1
CHF	34.63	35.01	35.48	44.32	0.2044	0.0164	<.0001	3
CVA/TIA	24.16	25.05	25.58	18.42	0.1867	0.0159	<.0001	2
PVD	44.37	44.53	45.59	38.04	0.2002	0.0149	<.0001	2
Other cardiac	35.28	34.88	36.87	33.88	0.157	0.0174	<.0001	2
COPD	20.63	21.17	22.17	16.09	0.232	0.0167	<.0001	2
GI	10.78	10.72	10.68	9.94	0.1858	0.0215	<.0001	2
Liver disease	21.49	12.7	12.33	13.42	0.0426	0.0211	0.0431	0
Cystitis/UTI	30.63	31.67	32.29	26.18	0.2089	0.0188	<.0001	2
Cancer	12.16	12.18	12.85	9.43	0.2024	0.0205	<.0001	2
Diabetes	63.61	65.32	67.21	53.39	0.125	0.0205	<.0001	1

1 includes pericarditis, endocarditis, myocarditis, other complications of heart disease, heart transplant, heart valve replacement, and cardiac devices.

Table 3. Model fit statistics, and coefficient estimates for the other variables not in the comorbidity index.

Model fit statistics	1999 Incident		2001 Incident		2000 Prevalent	
	Individual Comorbidities	Score % Change	Individual Comorbidities	Score % Change	Individual Comorbidities	Score % Change
AIC	438,211	438,261	0.01	362,887	362,911	0.01
SBC	438,428	438,398	-0.01	363,098	363,044	-0.01
Model predictive ability	0.6693	0.6687	-0.09	0.6735	0.6732	-0.05
c-statistic						
Predictive ability of comorbid conditions						
Partial R square	0.0339	0.0322	-0.11	0.065	0.0647	-0.11
Other estimates						
ESRD cause						
Diabetes	0.2358	0.3021	19.02	0.2475	0.2507	1.35
Hypertension	0.174	0.1817	4.44	0.1823	0.1786	-2.03
Other	0.2377	0.2412	1.49	0.3143	0.3177	1.1
Race						
Asian/Pacific Islander	-0.3568	-0.3579	0.32	-0.26	-0.2955	-11.5
African American	-0.2414	-0.2433	1.61	-0.2389	-0.2359	-1.26
Native American	-0.1423	-0.1428	0.37	-0.1866	-0.1912	2.46
Other	0.1187	0.116	-2.36	-0.046	-0.0571	24.1
Female gender	0.0004	-0.0007	-270.22	0.0239	0.0261	9.66
Age, years						
0 to 19	-1.5108	-1.5265	0.7	-1.7086	-1.7462	-6.19
20 to 29	-1.6204	-1.6481	8.84	-1.45	-1.4374	-8.87
30 to 39	-1.2533	-1.2539	0.04	-1.1724	-1.1585	-1.27
40 to 49	-1.1096	-1.1024	-0.65	-1.0802	-0.9954	-1.27
50 to 59	-0.9061	-0.8908	-1.47	-0.8228	-0.8232	-1.39
60 to 64	-0.7372	-0.7239	-1.8	-0.671	-0.6654	-1.14
65 to 69	-0.6004	-0.593	-1.25	-0.5579	-0.5499	-1.43
70 to 79	-0.3881	-0.375	-1.12	-0.3839	-0.3794	-1.2

- CHF had the highest score, 3 and liver disease had the lowest score, 0 (Table 2).
- The comorbidity score worked almost the same as the individual comorbidities in terms of model fit, prediction, and effect on inference (table 3).
- Standard errors for the estimates from the two models were almost the same.
- The new score was also compared with the Charlson comorbidity Index (CCI); it outperforms the CCI.

Conclusions

- The new comorbidity score system works well for mortality analysis among dialysis patients.
- This score system is designed for analyses using administrative data.
- Diabetes has a lower score than expected because diabetes as a primary cause of ESRD was also in the model when the score system was developed; they are highly correlated. It is necessary to include diabetes as ESRD primary cause in the model when using this score.
- For similar reasons, age should also be included in the analysis when this score system is used.
- The score depends on how the comorbidities are defined in the claims data.
- The liver disease definition will be modified and the analysis will be re-run based on the new definition.