

CBE 1463: Standardized Hospitalization Ratio for Dialysis Facilities (SHR)

5.4.4 Risk/Case-Mix Adjustment Modeling and/or Stratification Results

5.4.4 [If risk/case-mix factors are addressed by any method (5.4.1)] Risk/Case-Mix Adjustment Modeling and/or Stratification Results*

Describe the statistical results of the analyses used to test and select risk/case-mix factors for inclusion in or exclusion from the adjusted model and/or stratification, as applicable. Clearly indicate the risk/case-mix factors included in the final adjusted model and/or used in the final stratification approach.

Please see section 5.4.6 for a list of the final set of risk factors used in the model.

Final Risk Model

Covariate	Coefficient	P-value	Hazard Ratio
Medicare Advantage (MA) coverage	-0.088	<.0001	0.92
Age, Centered at 65 years	-0.000	0.0364	N/A*
Age (Centered at 65 years), Squared	0.000	<.0001	N/A*
Diabetes	-0.027	<.0001	N/A*
Cause of ESRD Missing	-0.020	0.7588	0.98
Female	0.100	<.0001	N/A*
Patient in a Nursing Home <90 days in last 365 days	0.248	<.0001	1.28
Patient in a Nursing Home 90 days or more in last 365 days	0.066	<.0001	1.07
BMI: Underweight	0.136	<.0001	1.15
BMI: Normal	0.087	<.0001	1.09
BMI: Overweight	0.050	<.0001	1.05
Female*Diabetes	-0.032	<.0001	N/A*
Age*Diabetes	-0.003	<.0001	N/A*
Age*Female	-0.002	<.0001	N/A*
Age Squared*Diabetes	0.000	<.0001	N/A*
Age Squared*Female	0.000	<.0001	N/A*
Incident Comorbidity: Atherosclerotic heart disease	0.031	<.0001	1.03
Incident Comorbidity: Other cardiac disease	0.016	<.0001	1.02
Incident Comorbidity: Congestive heart failure	0.025	<.0001	1.03
Incident Comorbidity: Inability to ambulate	0.037	<.0001	1.04

Covariate	Coefficient	P-value	Hazard Ratio
Incident Comorbidity: Chronic obstructive pulmonary disease	0.025	<.0001	1.03
Incident Comorbidity: Inability to transfer	0.004	0.7414	1.00
Incident Comorbidity: Malignant neoplasm, cancer	0.023	0.0005	1.03
Incident Comorbidity: Diabetes that is not cause of ESRD (all types)	-0.050	<.0001	0.10
Incident Comorbidity: Peripheral vascular disease	0.039	<.0001	1.04
Incident Comorbidity: Cerebrovascular disease, CVA, TIA	0.014	0.0067	1.02
Incident Comorbidity: Tobacco use (current smoker)	0.136	<.0001	1.15
Incident Comorbidity: Alcohol dependence	0.009	0.4646	1.01
Incident Comorbidity: Drug dependence	0.217	<.0001	1.24
Incident Comorbidity: At least one of the incident comorbidities listed	0.044	<.0001	1.05
Incident Comorbidity: No Medical Evidence (CMS-2728) Form	-0.035	0.6066	0.97
Prevalent Comorbidity: CCS Group 1: Candidal esophagitis	0.159	<.0001	1.17
Prevalent Comorbidity: CCS Group 2: Sarcoidosis	0.075	<.0001	1.08
Prevalent Comorbidity: CCS Group 3: Cancer of Liver	0.186	<.0001	1.20
Prevalent Comorbidity: CCS Group 4: Cancer of Lung	0.188	<.0001	1.21
Prevalent Comorbidity: CCS Group 5: Cancer of Prostate	-0.023	0.0253	0.98
Prevalent Comorbidity: CCS Group 6: Cancer of Bladder	0.111	<.0001	1.12
Prevalent Comorbidity: CCS Group 7: Cancer of Kidney	0.038	0.0006	1.04
Prevalent Comorbidity: CCS Group 8: Cancer of Bone	0.277	<.0001	1.32
Prevalent Comorbidity: CCS Group 9: Other Neoplasm	0.054	0.0024	1.06
Prevalent Comorbidity: CCS Group 10: Non-Hodgkins Lymphoma	0.106	<.0001	1.11

Covariate	Coefficient	P-value	Hazard Ratio
Prevalent Comorbidity: CCS Group 11: Multiple Myeloma	0.090	<.0001	1.09
Prevalent Comorbidity: CCS Group 12: Chronic lymphoid leukemia	0.058	0.0597	1.06
Prevalent Comorbidity: CCS Group 13: Myelodysplastic Syndrome	0.138	<.0001	1.15
Prevalent Comorbidity: CCS Group 14: Essential Thrombocytopenia	0.018	0.5409	1.02
Prevalent Comorbidity: CCS Group 15: Diabetes without complications	0.047	<.0001	1.05
Prevalent Comorbidity: CCS Group 16: Diabetes with complications	0.107	<.0001	1.11
Prevalent Comorbidity: CCS Group 17: Glucocorticoid deficiency	0.115	<.0001	1.12
Prevalent Comorbidity: CCS Group 18: Malnutrition / Cachexia	0.075	<.0001	1.01
Prevalent Comorbidity: CCS Group 19: Cerebral edema	0.240	<.0001	1.27
Prevalent Comorbidity: CCS Group 20: Disorders of urea cycle metabolism	0.033	0.0982	1.03
Prevalent Comorbidity: CCS Group 21: Other amyloidosis	0.161	<.0001	1.17
Prevalent Comorbidity: CCS Group 22: Other specified disorders of metabolism	-0.014	0.0014	0.99
Prevalent Comorbidity: CCS Group 23: Morbid Obesity	0.470	<.0001	1.60
Prevalent Comorbidity: CCS Group 24: Solid Organ Transplant	0.171	<.0001	1.19
Prevalent Comorbidity: CCS Group 25: Sickle-cell Anemia	0.076	<.0001	1.08
Prevalent Comorbidity: CCS Group 26: Pancytopenia	0.014	0.2014	1.02
Prevalent Comorbidity: CCS Group 27: Neutropenia	0.042	<.0001	1.04
Prevalent Comorbidity: CCS Group 28: Primary hypercoagulable state	0.148	<.0001	1.16
Prevalent Comorbidity: CCS Group 29: Dementia	0.007	0.8285	1.01
Prevalent Comorbidity: CCS Group 30: Substance Related Disorders	0.196	<.0001	1.22
Prevalent Comorbidity: CCS Group 31: Infection due to urinary catheter	0.098	<.0001	1.10

Covariate	Coefficient	P-value	Hazard Ratio
Prevalent Comorbidity: CCS Group 32: HIV	0.077	<.0001	1.08
Prevalent Comorbidity: CCS Group 33: Gastrostomy status	-0.130	0.0001	0.88
Prevalent Comorbidity: CCS Group 34: Long-term (current) use of insulin	0.034	0.0069	1.04
Prevalent Comorbidity: CCS Group 35: Miscellaneous Mental Health	0.148	<.0001	1.16
Prevalent Comorbidity: CCS Group 36: Opioid Dependence	0.180	<.0001	1.20
Prevalent Comorbidity: CCS Group 37: Schizophrenia	0.201	<.0001	1.22
Prevalent Comorbidity: CCS Group 38: Cerebral degeneration, unspecified	0.113	<.0001	1.12
Prevalent Comorbidity: CCS Group 39: Peripheral autonomic neuropathy in disorders classified elsewhere	0.138	<.0001	1.15
Prevalent Comorbidity: CCS Group 40: Unspecified hereditary and idiopathic peripheral neuropathy	0.093	<.0001	1.10
Prevalent Comorbidity: CCS Group 41: Epilepsy	0.078	<.0001	1.08
Prevalent Comorbidity: CCS Group 42: Bipolar Disorder	-0.155	<.0001	0.86
Prevalent Comorbidity: CCS Group 43: Major depressive affective disorder	0.076	<.0001	1.08
Prevalent Comorbidity: CCS Group 44: Mood Disorders	0.185	<.0001	1.20
Prevalent Comorbidity: CCS Group 45: Alcohol Related Disorders	0.142	<.0001	1.15
Prevalent Comorbidity: CCS Group 46: Coma	0.101	<.0001	1.11
Prevalent Comorbidity: CCS Group 47: Hip and Femur Fracture	-0.057	0.0005	0.94
Prevalent Comorbidity: CCS Group 48: Critical illness myopathy	0.095	<.0001	1.10
Prevalent Comorbidity: CCS Group 49: hypertensive heart disease with heart failure	0.090	<.0001	1.09
Prevalent Comorbidity: CCS Group 50: Myocardial Infarction	0.003	0.7749	1.00

Covariate	Coefficient	P-value	Hazard Ratio
Prevalent Comorbidity: CCS Group 51: Coronary Atherosclerosis	0.056	<.0001	1.06
Prevalent Comorbidity: CCS Group 52: pulmonary embolism and infarction	0.128	<.0001	1.13
Prevalent Comorbidity: CCS Group 53: Primary pulmonary hypertension	0.026	0.0001	1.03
Prevalent Comorbidity: CCS Group 54: Pulmonary Heart Disease	0.042	<.0001	1.04
Prevalent Comorbidity: CCS Group 55: Cardiomyopathy	0.061	<.0001	1.06
Prevalent Comorbidity: CCS Group 56: Atrioventricular block, complete	0.092	<.0001	1.10
Prevalent Comorbidity: CCS Group 57: Paroxysmal Tachycardia	0.144	<.0001	1.16
Prevalent Comorbidity: CCS Group 58: Atrial fibrillation	0.104	<.0001	1.11
Prevalent Comorbidity: CCS Group 59: Atrial flutter	0.197	<.0001	1.22
Prevalent Comorbidity: CCS Group 60: Sinoatrial node dysfunction	0.134	<.0001	1.14
Prevalent Comorbidity: CCS Group 61: Acute Cerebrovascular Disease	0.097	<.0001	1.10
Prevalent Comorbidity: CCS Group 62: Peripheral and Visceral Atherosclerosis	0.047	<.0001	1.05
Prevalent Comorbidity: CCS Group 63: Aortic and Peripheral Artery Aneurysm	0.037	<.0001	1.04
Prevalent Comorbidity: CCS Group 64: Venous Thromboembolism	0.249	<.0001	1.28
Prevalent Comorbidity: CCS Group 65: Esophageal varices	0.052	0.0005	1.05
Prevalent Comorbidity: CCS Group 66: Chronic Obstructive Pulmonary Disease	0.108	<.0001	1.12
Prevalent Comorbidity: CCS Group 67: Asthma	0.182	<.0001	1.20
Prevalent Comorbidity: CCS Group 68: Aspiration Pneumonitis	0.179	<.0001	1.20
Prevalent Comorbidity: CCS Group 69: Other Lower Respiratory Diseases	0.281	<.0001	1.33
Prevalent Comorbidity: CCS Group 70: Respiratory Failure	0.118	<.0001	1.13
Prevalent Comorbidity: CCS Group 71: Enteritis and Ulcerative Colitis	0.071	<.0001	1.07

Covariate	Coefficient	P-value	Hazard Ratio
Prevalent Comorbidity: CCS Group 72: Ileus and Intestinal Obstruction	0.029	<.0001	1.03
Prevalent Comorbidity: CCS Group 73: Cirrhosis of Liver	0.078	<.0001	1.08
Prevalent Comorbidity: CCS Group 74: Other Liver Disease	0.119	<.0001	1.13
Prevalent Comorbidity: CCS Group 75: Pancreatitis	0.143	<.0001	1.15
Prevalent Comorbidity: CCS Group 76: Chronic Skin Ulcer	-0.021	0.0426	0.98
Prevalent Comorbidity: CCS Group 77: Systemic lupus erythematosus and connective tissue disorders	0.056	<.0001	1.06
Prevalent Comorbidity: CCS Group 78: Infective arthritis and osteomyelitis	0.195	<.0001	1.22
Prevalent Comorbidity: CCS Group 79: Aseptic Necrosis	0.170	<.0001	1.19
Prevalent Comorbidity: CCS Group 80: Rheumatoid Arthritis	0.068	<.0001	1.07
Prevalent Comorbidity: CCS Group 81: Pathologic Fracture	-0.021	0.09	0.98
Prevalent Comorbidity: CCS Group 82: Gangrene	0.126	<.0001	1.14
Prevalent Comorbidity: CCS Group 83: Other toe(s) amputation status	0.198	<.0001	1.22
Prevalent Comorbidity: CCS Group 84: Below knee amputation status	-0.117	<.0001	0.89
Prevalent Comorbidity: CCS Group 85: Ileostomy / Colostomy Status	0.042	<.0001	1.04
Prevalent Comorbidity: CCS Group 86: Above knee amputation status	-0.001	0.9182	1.00
Prevalent Comorbidity: CCS Group 87: Other artificial opening of urinary tract status	0.015	0.181	1.02
Prevalent Comorbidity: CCS Group 88: Dependence on respirator, status	0.124	<.0001	1.13
Prevalent Comorbidity: CCS Group 89: Cancer of Rectum	0.182	<.0001	1.20
Prevalent Comorbidity: CCS Group 90: Inflammatory polyarthropathy	-0.020	0.4517	0.98
Prevalent Comorbidity: CCS Group 91: Sacroiliitis	0.081	<.0001	1.08

Covariate	Coefficient	P-value	Hazard Ratio
Prevalent Comorbidity: Insufficient Medicare claims to determine prevalent comorbidities	0.576	<.0001	1.78
*Hazard ratios are not calculated for interaction terms or main effects of variables that have interaction terms.			

Hazard ratios are not shown for interaction terms or main effects of variables that are also included as interaction terms because caution is needed in interpreting these terms. For example, the coefficient for Female cannot be interpreted simply as the difference in hospitalization risk of females compared to males. It is, instead, the difference in risk for non-diabetic females and non-diabetic males aged 65. The difference in risk for diabetic females vs diabetic males aged 65 is smaller as indicated by the negative coefficient for the diabetes by female interaction term.

The table below shows the parameter estimates for patient and area level SDS/SES variables tested based on a model that included these variables along with the original covariates.

Table SDS/SES 2023

Covariate	Estimates	P-value	Hazard Ratio
Race: Black	-0.087	<.0001	0.92
Race: AAPI	-0.186	<.0001	0.83
Race: Native American	-0.040	0.0028	0.96
Race: Other	-0.067	0.0278	0.94
Hispanic Ethnicity	-0.084	<.0001	0.92
Dual Eligibility	0.454	<.0001	N/A*
Dual Eligibility*Female	-0.011	0.1001	N/A*
ADI National Rank of Patient's ZIP Code of Residence	0.001	<.0001	1.00

*Hazard ratios are not shown for interaction terms or main effects of variables that have interaction terms. See below for interpretation.

The Dual Eligibility (DE) main effect can be interpreted as the effect of DE for males. The HR=1.57 meaning that males with dual eligibility have 57% higher risk of hospitalization than those without dual eligibility, all else being equal. The interaction between Dual Eligibility and Female is negative but not statistically significant. This means that the difference in hospitalization risk for DE females compared to non-DE females is not quite as large as the difference for DE males compared to non-DE males, but the difference is not significant. To calculate the HR for DE females compared to non-DE females, we sum the dual eligibility and dual eligibility by female interaction terms before exponentiating to get a HR ratio of 1.56.

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5.4.4a Attach Risk/Case-mix Adjustment Modeling and/or Stratification Specifications

The risk adjustment is based on a Cox or relative risk model. The adjustment is made for the following variables:

- Patient age: Age (continuous); Age squared
- Sex
- Medicare Advantage coverage
- Diabetes as cause of ESRD
- Nursing home status in previous 365 days:
 - None (0 days) (reference)
 - Short term (0-89 days)
 - Long term (≥ 90 days)
- BMI at ESRD incidence
 - BMI < 18.5
 - $18.5 \leq \text{BMI} < 24.9$
 - $25 \leq \text{BMI} < 29.9$
 - BMI ≥ 30 (reference)
- Comorbidities at ESRD incidence
 - Atherosclerotic heart disease
 - Other cardiac disease
 - Diabetes that is not cause of ESRD (all types including diabetic retinopathy)
 - Congestive heart failure
 - Inability to ambulate
 - Chronic obstructive pulmonary disease
 - Inability to transfer
 - Malignant neoplasm, cancer
 - Peripheral vascular disease
 - Cerebrovascular disease, CVA, TIA
 - Tobacco use (current smoker)
 - Alcohol dependence
 - Drug dependence
 - No Medical Evidence (CMS-2728) Form
 - At least one of the comorbidities listed
- A set of prevalent comorbidities based on Medicare claims (individual comorbidities categorized into 91 groups – see below)
 - Includes an adjustment for less than 6 months of Medicare covered months in prior calendar year
- Beside main effects, two-way interaction terms between age, sex, and cause of ESRD are also included:
 - Diabetes as cause of ESRD*Sex
 - Diabetes as cause of ESRD*Age
 - Age*Sex