Online Supplement
Pulmonary Rehabilitation and Readmission Rates for Medicare Beneficiaries with Acute Exacerbation of
Chronic Obstructive Pulmonary Disease

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Table of Contents

eTable 1. Chronic obstructive pulmonary disease definition based on International Classification of Diseases, Ninth Revision, Clinical Modification

Either
1) Primary diagnosis of chronic obstructive pulmonary disease: 491.21, 491.22, 491.8, 491.8, 491.9, 492.8, 493.20, 493.21, 493.22, 496
Or
1) Primary diagnosis of respiratory failure: 518.81, 518.82, 518.84, 799.1 And 2) Secondary diagnosis of chronic obstructive pulmonary disease: 491.21, 491.22, 493.21, 493.22

eTable 2. Codes used to identify pulmonary rehabilitation

Healthcare Common Procedure Coding System
G0424
G0237
G0238
G0239
G0152
97001-97002
97112-97113
97116
97003-97004

eTable 3. Center for Medicare and Medicaid Services' Condition Categories for risk adjustment from the Chronic Obstructive Pulmonary Disease Readmission Methodology Report

Condition	Codes
History of Mechanical Ventilation	ICD-9 procedure codes: 93.90, 96.70, 96.71, 96.72
Sleep Apnea	ICD-9 diagnosis codes: 327.20, 327.21, 327.23, 327.27, 327.29, 780.51, 780.53, 780.57
Congestive Heart Failure	Condition Categories 80
Acute Coronary Syndrome	Condition Categories 81-82
Chronic Atherosclerosis	Condition Categories 83-84
Arrhythmias	Condition Categories 92-93
Other and Unspecified Heart Disease	Condition Categories 94
Vascular or Circulatory Disease	Condition Categories 104-106
Fibrosis of Lung and Other Chronic Lung Disorder	Condition Categories 109
Pneumonia	Condition Categories 111-113
History of Infection	Condition Categories 1, 3-6
Metastatic Cancer and Acute Leukemia	Condition Categories 7
Lung, Upper Digestive Tract, and Other Severe Cancers	Condition Categories 8
Lymphatic, Head and Neck, Brain, and Other Major Cancers; Breast, Colorectal and other Cancers and Tumors; Other Respiratory and Heart Neoplasms	Condition Categories 9-11
Other Digestive and Urinary Neoplasms	Condition Categories 12
Diabetes and DM Complications	Condition Categories 15-20, 119-120
Protein-Calorie Malnutrition	Condition Categories 21
Disorders of Fluid/Electrolyte/Acid-Base	Condition Categories 22-23
Other Endocrine/Metabolic/Nutritional Disorders	Condition Categories 24
Pancreatic Disease	Condition Categories 32
Peptic Ulcer, Hemorrhage, Other Specified Gastrointestinal Disorders	Condition Categories 34
Other Gastrointestinal Disorders	Condition Categories 36
Severe Hematological Disorders	Condition Categories 44
Iron Deficiency and Other/Unspecified Anemia and Blood Disease	Condition Categories 47
Dementia or Senility	Condition Categories 49-50

Drug/Alcohol Induced Dependence/Psychosis	Condition Categories 51-52
Major Psychiatric Disorders	Condition Categories 54-56
Depression	Condition Categories 58
Anxiety Disorders	Condition Categories 59
Other Psychiatric Disorders	Condition Categories 60
Quadriplegia, Paraplegia, Paralysis, Functional Disability	Condition Categories 67-69, 100-102, 177-178
Polyneuropathy	Condition Categories 71
Hypertensive Heart and Renal Disease or Encephalopathy	Condition Categories 89
Stroke	Condition Categories 95-96
Renal Failure	Condition Categories 131
Decubitus Ulcer or Chronic Skin Ulcer	Condition Categories 148-149
Cellulitis, Local Skin Infection	Condition Categories 152
Vertebral Fractures	Condition Categories 157

Abbreviations: ICD-9, International Classification of Diseases, Ninth Revision

eTable 4. Healthcare Financing Administration Common Procedure Coding System codes used to identify oxygen users
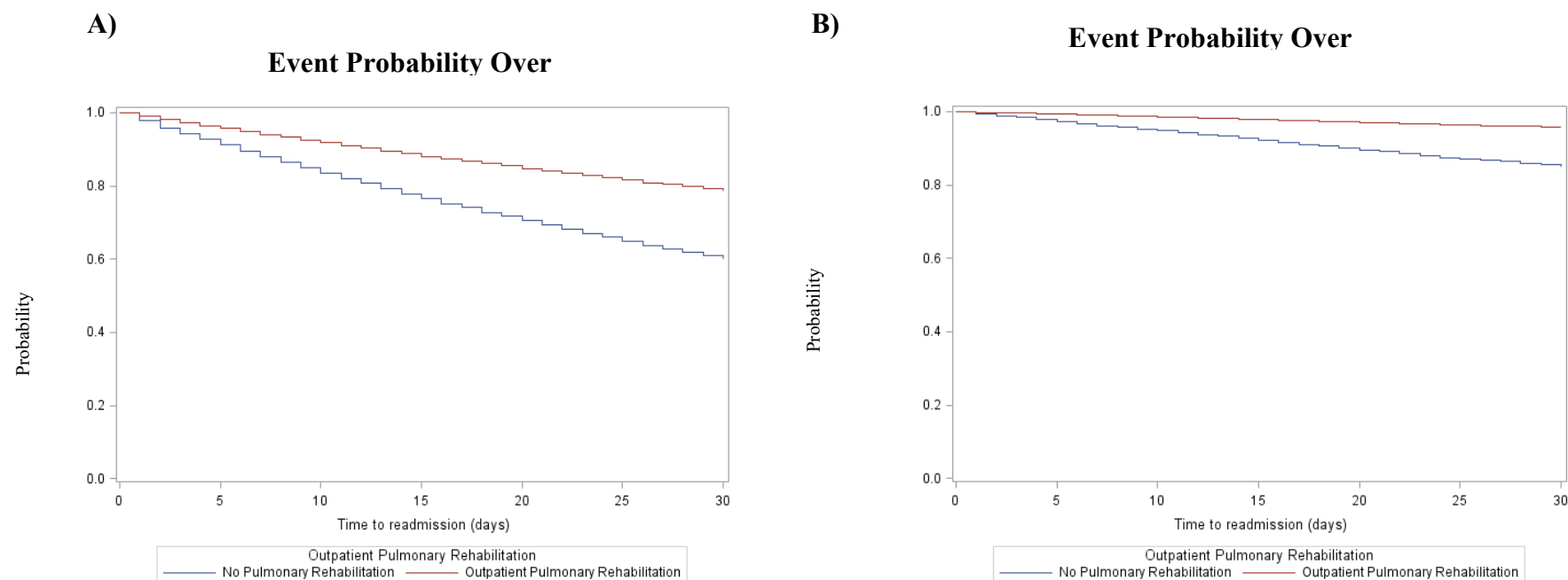
Oxygen concentrators	Oxygen gas	Oxygen liquid
E1377	E0400	E0410
E1378	E0405	E0415
E1379	E0416	E0434
E1380	E0424	E0435
E1381	Q0042	E0439
E1382	E0425	E0440
E1383	E0430	E0442
E1384	E0431	E0444
E1385	Q0038	Q0039
E1388	E0443	Q0041
E1389	Q0040	Q0043
E1390		Q0046
E1391		
E1392		
E1393		
E1394		
E1395		
E1396		
E1400		
E1401		
E1402		
E1403		
E1404		

eTable 5. Selected claim-based codes to create composite score for frailty

Type	Codes	Description of Claims-Based Variables
HCPCS	E0250-E0373	Hospital beds and associated supplies
HCPCS	K0001-K0462, K0669	Wheelchairs, components, and accessories
ICD-9 Diagnosis	290–294	Organic psychotic conditions
ICD-9 Diagnosis	330–338	Hereditary and degenerative diseases of the central nervous system
HCPCS	E0100-E0159	Walking aids and attachments
HCPCS	E1353-E1406	Accessories for oxygen delivery devices
HCPCS	A4244-A4290	Other supplies including diabetes supplies and contraceptives
HCPCS	A5500-A5513	Diabetic footwear
ICD-9 Diagnosis	295–299	Other psychoses
ICD-9 Diagnosis	420–429	Other forms of heart disease
ICD-9 Diagnosis	890–897	Open wound of lower limb
ICD-9 Diagnosis	410–414	Ischemic heart disease
ICD-9 Diagnosis	401–405	Hypertensive disease
ICD-9 Diagnosis	430–438	Cerebrovascular disease
ICD-9 Diagnosis	300–316	Neurotic disorders, personality disorders, and other nonpsychotic mental disorders
ICD-9 Diagnosis	710–719	Arthropathies and related disorders
CPT-4	99308	Nursing facility care—subsequent
ICD-9 Diagnosis	490–496	Chronic obstructive pulmonary disease and allied conditions
ICD-9 Diagnosis	030-041	Other bacterial diseases
ICD-9 Diagnosis	451–459	Diseases of veins and lymphatics, and other diseases of circulatory system
ICD-9 Diagnosis	480–487	Pneumonia and influenza
ICD-9 Diagnosis	250–259	Diseases of other endocrine glands
ICD-9 Diagnosis	590–599	Other diseases of urinary system
ICD-9 Diagnosis	797–799	Ill-defined and unknown causes of morbidity and mortality
ICD-9 Diagnosis	920–924	Contusion with intact skin surface
ICD-9 Diagnosis	580–589	Nephritis, nephrotic syndrome, and nephrosis
HCPCS	A0021-A0999	Transportation services including ambulance

Abbreviations: HCPCS, Healthcare Common Procedure Coding System; ICD-9, International Classification of Disease, Ninth Revision; CPT-4, Current Procedural Terminology, Fourth Revision
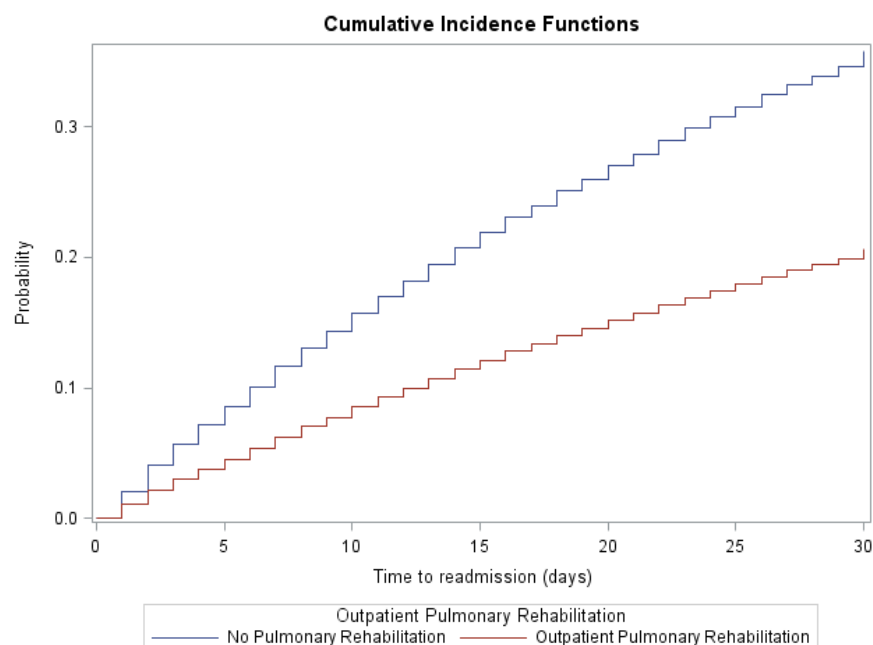
eFigure 1: Event probability over time for unweighted 30-day readmission competing risk model for A) all-cause and B) chronic obstructive pulmonary disease-related readmissions
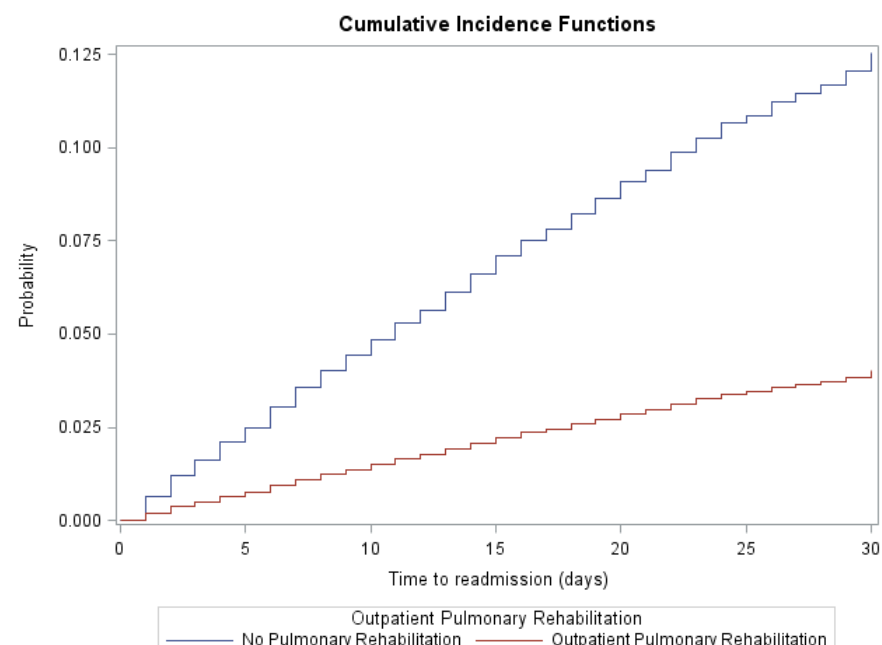

The P-value for the comparison between pulmonary rehabilitation group vs control was <0.001 for all-cause readmission and 0.001 for chronic obstructive pulmonary disease related-readmission.

eFigure 2: Cumulative incidence curve for 30-day readmission Fine-Gray competing risk model for A) all-cause and B) chronic obstructive pulmonary disease-related readmissions

A)

B)
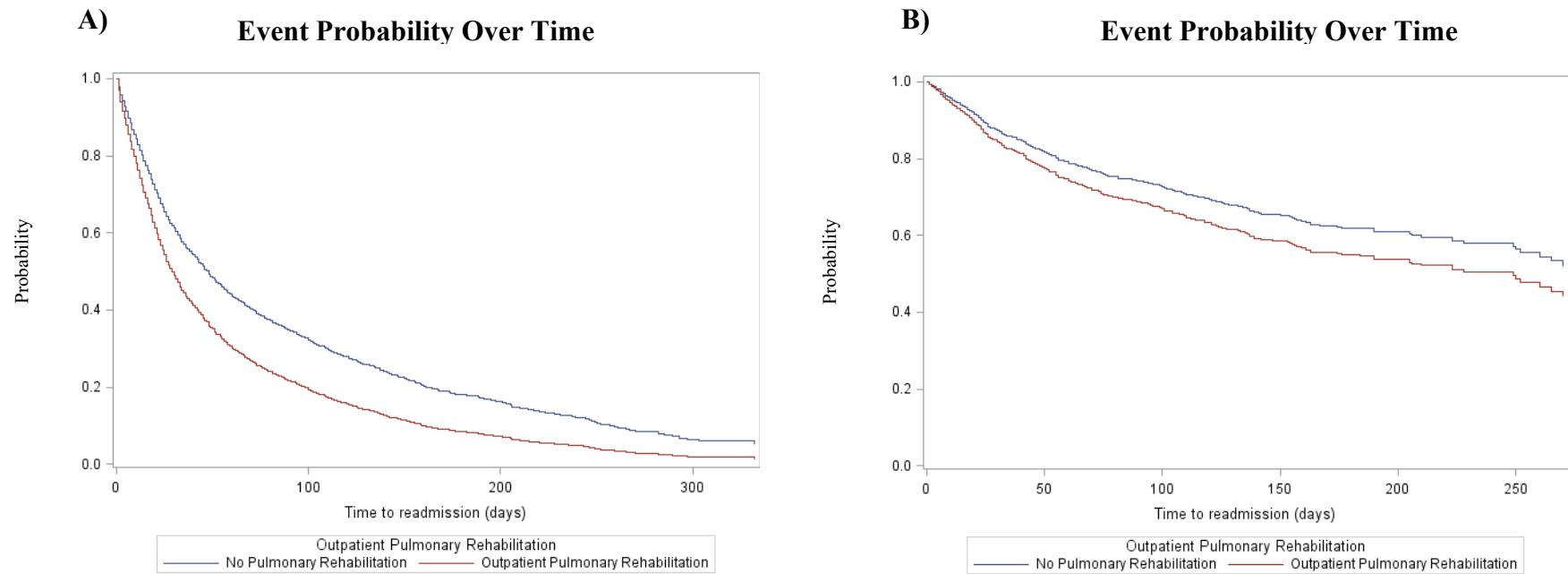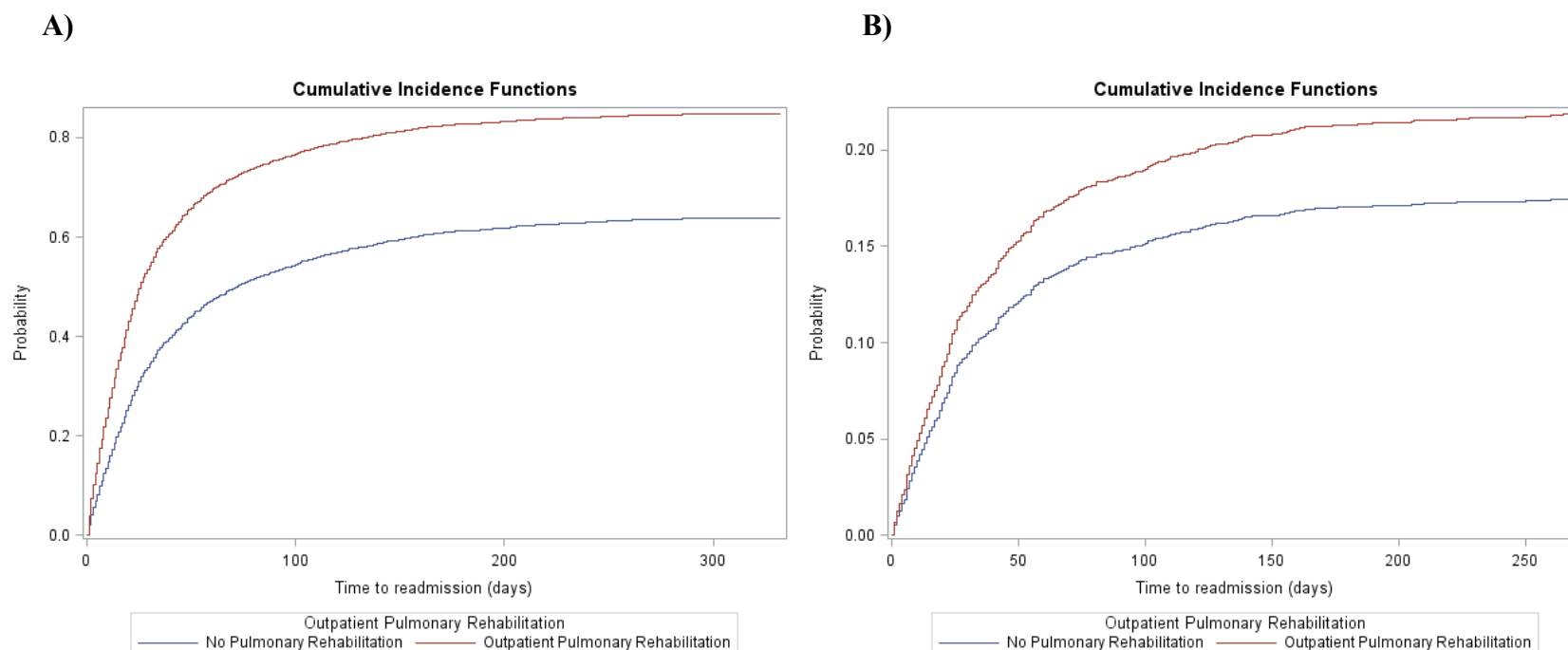

The P-value for the comparison between pulmonary rehabilitation group vs control was <0.001 for both all-cause readmission and chronic obstructive pulmonary disease related-readmission.

eFigure 3: Event probability over time for unweighted 1-year readmission competing risk model for A) all-cause and B) chronic obstructive pulmonary disease-related readmissions

A)

Event Probability Over Time

B)

Event Probability Over Time

The P-value for the comparison between pulmonary rehabilitation group vs control was <0.001 for all-cause readmission and 0.07 for chronic obstructive pulmonary disease related-readmission.

eFigure 4: Cumulative incidence curve for 1-year readmission Fine-Gray competing risk model for A) all-cause and B) chronic obstructive pulmonary disease-related readmissions

A)

B)

The P-value for the comparison between pulmonary rehabilitation group vs control was <0.001 for all-cause readmission and 0.35 for chronic obstructive pulmonary disease related-readmission.