PRHI Readmission Brief

Chronic Obstructive Pulmonary Disease

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By Keith T. Kanel, MD;
Susan Elster PhD;
Colleen Vrbin

Centre City Tower
650 Smithfield Street
Suite 2400
Pittsburgh, PA 15222
Ph: 412-586-6700
Fax: 412-586-6701
www.prhi.org

Introduction

Chronic obstructive pulmonary disease (COPD) is the fourth leading cause of death in the U.S., behind heart disease, cancer, and stroke.[1] Leading healthcare professionals believe that COPD is also currently under-diagnosed and under-treated.[2] Despite this, COPD admissions increased by 8% between 1997 and 2007.[3] Patients with COPD made an estimated 8 million physician-office and outpatient visits, 1.5 emergency department visits, accounted for 726,000 hospitalizations in 2000.[4] Moreover, annual healthcare spending for COPD was an estimated $32 billion according to a 2004 report.[5] As public education campaigns yield greater awareness of COPD, the ranks of those diagnosed could swell from the 10 million currently diagnosed, to include some of the additional 14 million Americans with evidence of impaired lung function[6] with significant implications for health care spending.

Widely applying best practice to improve the care for patients with COPD is warranted to reduce its clinical and economic burden. However, despite the availability of comprehensive care guidelines,[7,8] significant gaps remain in the evidence base for common recommendations. Clinical trial data, which draws on selected patient pools, provide limited guidance,[9,10,11] especially for clinicians managing the care of high utilizers who are often excluded from clinical trials. This is unfortunate on multiple levels because there is evidence that only a small proportion of complex COPD patients account for most healthcare spending on COPD care.[12]

Prior analysis (see Table 1) by the Pittsburgh Regional Health Initiative (PRHI) revealed that COPD represented the second-highest volume of 30-day hospital readmissions for chronic medical conditions in southwestern Pennsylvania (SWPA).[13] Further, Pennsylvania's overall COPD hospitalization rate was 25% higher than the U.S. average and increased by 20% between 2007 and 2008.[14]

Using retrospective, all-payer hospital discharge data to examine patterns of admission and readmission, this observational study aims to expand the knowledge base needed to develop guidelines that are relevant to the management of complex COPD patients in real-world settings. It is part of a larger effort at PRHI to develop clinically practical algorithms to proactively identify hospitalized patients at highest risk for readmission.

Table 1: Overview of Targeted Chronic Disease Admissions and 30-day Readmissions in SWPA

Targeted Condition	Index Admission				30-Day Readmissions	
	Number of Admissions	Percent of all MS-DRGs	Percent of Medical MS-DRGs	Ranking Among Medical MS-DRGs*	Readmit Rate	Ranking Among Medical MS-DRGs**
Heart Failure	13,503	3%	5%	3	26%	1
COPD	12,137	3%	4%	4	23%	3
AMI	4,728	1%	2%	11	23%	7
Depression	3,477	1%	1%	18	18%	14
Asthma	3,392	1%	1%	19	10%	32
Diabetes	3,029	1%	1%	21	21%	16
Total	**40,266**	**10%**	**14%**	**-**	**22%**	-

*The top 10 medical diagnoses in the PHC4 data set are, in ranked order (MS-DRG in parentheses): psychoses (885), normal childbirth (775), heart failure (291, 292, 293), COPD (190, 191, 192), digestive disorders (392), rehabilitation (945), septicemia (871), cellulitis (603), pneumonia (194), and chest pain (313).

**The top 10 medical diagnoses on 30-day readmissions in the PHC4 data set are, in ranked order (MS-DRG in parentheses): heart failure (291, 292, 293), psychoses (885), COPD (190, 191, 192), digestive disorders (392), septicemia (871), rehabilitation (945), AMI (280, 281, 282, 283, 284, 285), respiratory failure (189), pneumonia (194), and nutritional disorders (641).

Methods

This observational study utilizes hospital discharge data drawn from claims data as reported to the Pennsylvania Health Care Cost Containment Council (PHC4), an independent agency mandated by the Pennsylvania Legislature in 1986 to collect a wide range of all-payer, inpatient data. It includes all admissions for patients 19 years and older who were hospitalized at least once with COPD (MS-DRG[15] 190-192) in any of the 44 acute care facilities in the 11-county region of southwestern Pennsylvania[16] between October 1, 2007 and September 30, 2008. Patients 18 years of age or younger were excluded from analysis. Readmission rates were calculated after excluding patients who died in the hospital from the denominator.

Analyses were performed on the overall dataset of 408,924 all-cause admissions as well as two subgroups specific to patients with COPD, as described in Table 2.

Table 2: Overview of COPD datasets

	Group One: COPD Admissions	Group Two: Patients with COPD
Description	All admissions with: - MS-DRG 190: COPD with major complications and/or comorbidities (MCC) - MS-DRG 191: COPD with complications and/or comorbities (CC) - MS-DRG 192: COPD without CC/MCC	All-cause admissions for patients who had at least one COPD admission in 12 months.
Number	12,137 COPD admissions	9,116 patients with 19,157 all-cause admissions
Exclusions	Admissions missing any of the following: • patient age, • MS-DRG, • principal ICD-9 diagnosis, and • discharge status. Transfers to another facility were excluded from 30-day readmission rate calculations	None

Characteristics of admissions (Group One) enabled analyses of common characteristics of patients hospitalized with a COPD exacerbation. Analyses of Group Two enabled an evaluation of 12 months of patient hospitalization history, including non-COPD admissions. Patients in Group Two had between one and 29 admissions in the 12 months of data. To highlight the characteristics of patients with multiple admissions, patients were grouped as follows: (a) those with a single COPD admission in 12 months; (b) those with two to five admissions in 12 months – at least one of which was COPD; and (c) those with six or more admissions in 12 months – at least one of which was COPD. While the groupings are somewhat arbitrary, from a patient perspective, being hospitalized on average every other month seemed an intuitive classification for patient considered to be a "high utilizer." There is compelling evidence that quality of life declines with multiple exacerbations.[17,18]

Characteristics of admissions and patients were explored along the following dimensions:

- Length of Stay (LOS): In order to quantify inpatient burden from the patient's perspective, total cumulative LOS (over all 12-month admissions) was calculated for each patient.
- Hospital Charges: Payer burden was calculated by adding the total hospital charges for each admission per patient (Group2). It is important to note that total charges reflect the charges that were applied, and not the total cost for each admission.
- Comorbidities: In addition to assigning an MS-DRG to an admission, each admission also includes an ICD-9 code for the principal diagnosis and up to 8 secondary diagnoses. The prevalence and kinds of comorbidities were explored using these ICD-9 codes. A large study of both inpatients and outpatients receiving pulmonary rehabilitation found that

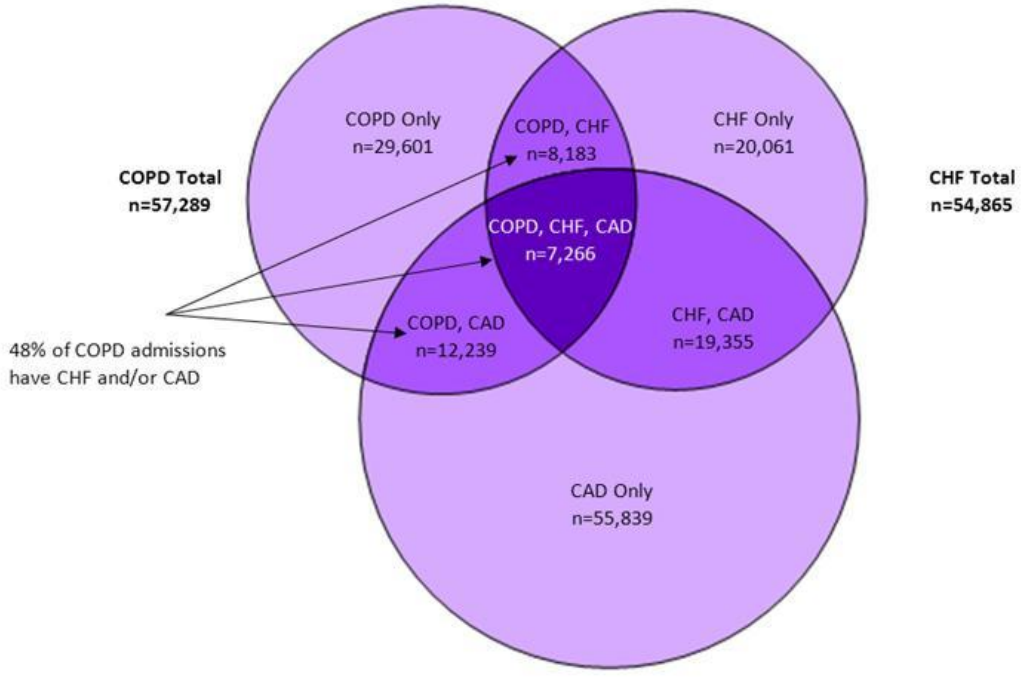
51% had at least one other disease, with congestive heart failure (at 61%) and coronary artery disease (at 24%) being the most prevalent.[19] The ICD-9 codes used to classify these comorbidities may be found in Appendix A.

Characteristics of Admissions (Group One)

Significance of Cardiovascular Comorbidities

Taking the broadest look at patients with COPD to include those who were hospitalized for other conditions during which a principal or secondary diagnosis of COPD was recorded, we note the striking intertwining of COPD with cardiovascular conditions [see Appendix A for coding]. Evaluating all 408,924 admissions in the 12 months of data, there were 19,157 for which COPD was documented as either a principal or secondary diagnosis. Figure 1 shows that the patients in nearly 50% of these admissions also had comorbid heart disease.

Figure 1: Admissions with Comorbid ICD-9 Coded COPD, CHF and/or CAD
(ICD-9 code present in principal diagnosis or any of the up to 8 secondary diagnoses)



PHC4-provided hospital discharges for 11 county SWPA region between October 1, 2007-September 30, 2008 (n=408,924)

Looking specifically at admissions with MS-DRG of COPD admissions, Table 3 shows the most common comorbities. Among the top ten most prevalent principal or secondary diagnoses (using ICD-9 code group), 66% were for cardiovascular conditions (*other forms of chronic ischemic heart disease, heart failure,* and *cardiac dysrhythmias*). Diabetes was a documented comorbidity on 26% of COPD admissions.

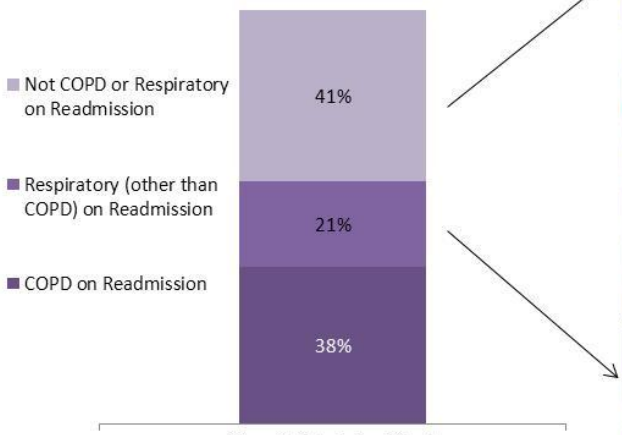
Table 3. Most Prevalent Principal or Secondary Diagnoses (by ICD-9 code groups)*

Most Common Principal and Secondary Diagnoses (ICD-9 Code Group)	Number of Admissions	Prevalence of Comorbidity
1. Essential hypertension (401)	5,521	45%
2. Other forms of chronic ischemic heart disease (414)	3,403	28%
3. Diabetes mellitus (250)	3,189	26%
4. Disorders of lipoid metabolism (272)	2,982	25%
5. Asthma (493)	2,725	22%
6. Nondependent abuse of drugs (305)	2,724	22%
7. Diseases of esophagus (530)	2,640	22%
8. Heart failure (428)	2,434	20%
9. Cardiac dysrhythmias (427)	2,196	18%
10. Disorders of fluid electrolyte and acid-base balance (276)	1,997	16%
TOTAL (all admissions)	**12,137**	

* Note: patients may have one or more of these conditions on a given admission.

While the overall 30-day readmission rate for COPD admissions was 23% (see Table 1 above), approximately 50% of COPD admissions were followed by a readmission within the 12 month dataset, just 38% of which were for COPD (see Figure 2). Breaking out the most common reasons for all non-respiratory readmissions, cardiovascular-related diagnoses again figure prominently.

Figure 2: Reason for Readmission



Most Common Diagnoses for Non-Respiratory Readmission	% of Non-COPD or Non-Respiratory-Related
Heart Failure and Shock	11%
Septicemia without Mechanical Ventilation 96+ Hours	5%
Esophagitis, Gastroenteritis and Miscellaneous Digestive Disorders	4%
Cardiac Arrhythmia and Conduction Disorders	3%
GI Hemorrhage	3%
Psychoses	3%
Cellulitis	3%
Acute Myocardial Infarction, Discharged Alive	3%
Renal Failure	3%
Major Gastrointestinal Disorders and Peritoneal Infections	3%

Readmission is Respiratory-Related (Not COPD)	% of Respiratory-Related (Not COPD)
Pulmonary Edema and Respiratory Failure	25%
Simple Pneumonia and Pleurisy	25%
Respiratory Infections and Inflammations	12%

Source: PRHI analysis of PHC4-provided discharges between Oct. 1, 2007-Sept. 30, 2008

Readmissions

Beyond their prevalence, cardiovascular comorbidities also appear to be important drivers of hospital readmissions. Controlled for the presence or absence of the top ten comorbidities (see Table 4), 30-day readmission rates are statistically higher among individuals with chronic

ischemic heart disease, heart failure, cardiac dysrhythmias, and diabetes. The presence of some of the other conditions is associated with a statistically significantly lower 30-day readmission rate (essential hypertension, disorders of lipoid metabolism, asthma, nondependent abuse of drugs). Further research is warranted to investigate why some of the comorbidities are associated with lower 30-day readmission rates.

Table 4: Readmissions With and Without Prevalent Principal or Secondary Diagnoses

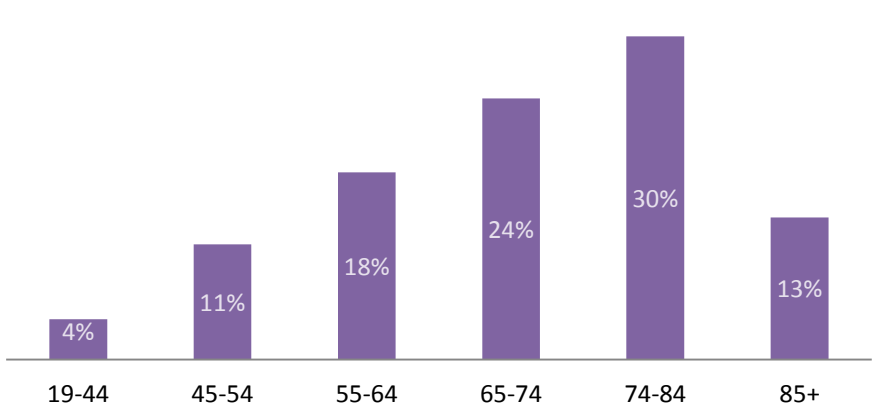
Most Common Principal and Secondary Diagnoses (ICD-9 Code Group)	30-day Readmit Rate WITHOUT Comorbidity	30-day Readmit Rate WITH Comorbidity	Comparison of Readmit Rates with and without each Comorbidity
1. Essential hypertension (401)	23%	21%	Readmit rate lower with comorbidity (p=0.008)
2. ***Other forms of chronic ischemic heart disease (414)***	**21%**	**26%**	**Readmit rate higher with comorbidity (p< 0.001)**
3. ***Diabetes mellitus (250)***	**22%**	**25%**	**Readmit rate higher with comorbidity (p=0.001)**
4. Disorders of lipoid metabolism (272)	23%	20%	Readmit rate lower with comorbidity (p< 0.001)
5. Asthma (493)	24%	18%	Readmit rate lower with comorbidity (p< 0.001)
6. Nondependent abuse of drugs (305)	23%	19%	Readmit rate lower with comorbidity (p< 0.001)
7. Diseases of esophagus (530)	22%	24%	No significant difference (p=0.150)
8. ***Heart failure (428)***	**21%**	**30%**	**Readmit rate higher with comorbidity (p< 0.001)**
9. ***Cardiac dysrhythmias (427)***	**22%**	**27%**	**Readmit rate higher with comorbidity (p< 0.001)**
10. Disorders of fluid electrolyte and acid-base balance (276)	23%	23%	No significant difference (p=0.803)

Characteristics of Patients (Group2)

Gender, Age and Payer

In concert with national trends, 59% of the 9,116 unique patients were female, and reflecting the region's racial composition, 85% were Caucasian, and 8% African American. Those 65 years or older represented 67% of patients (Figure 3).

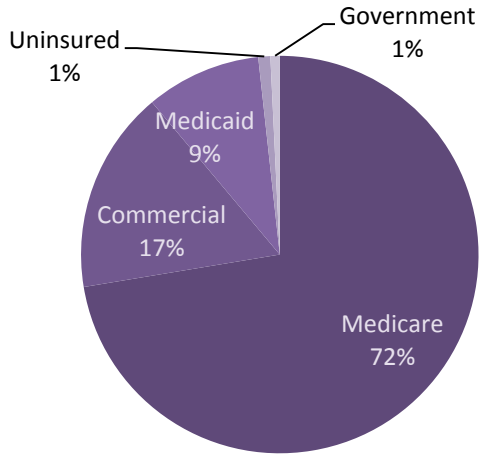
Figure 3: COPD Patients by Age Group



Source: PRHI analysis of PHC4-provided discharges between Oct. 1, 2007-Sept. 30, 2008

Medicare was the primary payer in 72% of the initial COPD admissions (Figure 4). Overall, 82% of patients were insured through state or federal health programs. While Figure 4 shows the primary payer, up to three payers were provided for each admission. "Dual eligible" individuals – receiving coincident coverage from both Medicare and Medicaid – comprised 13% of the patient data set.

Figure 4: Primary Payer on COPD Patient's Index Admission



Source: PRHI analysis of PHC4-provided discharges between Oct. 1, 2007-Sept. 30, 2008

Readmissions and Hospital Charges

Readmission rates were calculated for each patient group (Table 5). While the highest utilizers (those with six or more admissions) accounted for only 5% of patients, they generated 19% of total admissions and 24% of total cumulative hospital charges. Overall, patients with two or more admissions amounted to 83% of cumulative hospital charges, reinforcing the economic case for targeted readmission reduction efforts.

Table 5. Overview of COPD Patients Segregated by Total Number of Admissions

	With 1 Admission	With 2-5 Admissions	With 6+ Admissions
Patients*	53%	42%	5%
Cumulative Admissions*	25%	56%	19%
Cumulative Hospital Charges*	16%	59%	24%
65 and Older**	65%	72%	65%
Have 7 or More Secondary Diagnoses**	55%	66%	75%
Dual Eligible Patients (Receiving both Medicare and Medicaid)**	11%	15%	20%

*percent of all patients (n=9,116)

**percent of each utilizer category (n for 1 admit=4,792; n for 2-5 admits=3,853; n for 6+ admits=471)

The 47% of patients who had more than one admission during the 12 months and were more likely to be 65 or older (71% compared to 65% for patients with only one admission), and to have at least seven secondary diagnoses (eight being the maximum coded) (67% compared to 55% for patients with one admission).

The prevalence of cardiovascular diseases, including diabetes, in the readmissions patterns of high utilizers may be seen in Table 6. Compared to patients who had a single admission in 12 months, those who were hospitalized two-five times were 27% more likely to have had comorbid chronic ischemic heart disease; and, those with six or more admissions were 51% more likely to have had comorbid chronic ischemic heart disease. The data are even more striking for heart failure. Those who go on to have six or more admissions were twice as likely to have had comorbid heart failure on their index COPD admission than those with a single admission.

Table 6. Key Comorbidities on Index COPD Admission, Among Patients Who Go on to Have Subsequent Admissions

	Number of Admissions						Percent difference between 1 and 2-5 admits	Percent difference between 1 and 6+ admits*
	1		2-5		6+			
	n	% of 1 admits	n	% of 2-5 admits	n	% of 6+ admits		
Other forms of chronic ischemic heart disease	1,152	24%	1,173	30%	171	36%	27% increase (p<0.001)	51% increase (p<0.001)
Diabetes mellitus	1,105	23%	1,042	27%	168	36%	17% increase (p<0.001)	55% increase (p<0.001)
Heart failure	720	15%	880	23%	142	30%	52% increase (p<0.001)	101% increase (p<0.001)
Cardiac dysrhythmias	757	16%	808	21%	93	20%	33% increase (p<0.001)	25% increase (p=0.026)

Length of Stay and Total Charges

In addition, our analysis indicated that the inpatient burden was high. Table 7 shows that 32% of patients spent a cumulative total of more than 14 days in the hospital over the year.

Table 7: Cumulative Length of Stay

Cumulative Length of Stay	Number of Patients	Percent of Patients
0-1 days	243	3%
2-4 days	2,257	25%
5-7 days	1,651	18%
8-14 days	2,027	22%
15-21 days	1,084	12%
22+ days	1,854	20%

Cumulative hospital charges reached $405 million in these 12 months. Table 8 shows a breakdown of charges by patient. Ten percent of patients had a total of $100,000 or more in cumulative hospital charges over the time period. Total charges for just the COPD admissions in the 12 months totaled $184 million.

Table 8: Cumulative Total Charge

Cumulative Total Charge	Number of Patients	Percent of Patients
less than $10,000	2,167	24%
$10,000-$24,999	3,093	34%
$25,000-$49,999	1,771	19%
$50,000-$74,999	810	9%
$75,000-$99,999	385	4%
$100,000-$499,999	839	9%
$500,000 or more	51	1%

Discussion

The picture of COPD that emerges from this analysis is one of a highly complicated disease, and that addressing the pulmonary issues alone is insufficient to create effective treatment strategies to reduce avoidable hospital admissions. This study has shown that:

- Half of COPD discharges have coincident CHF and/or CAD, and that the presence of those specific comorbidities actually increased an already concerning 30-day readmission rate.
- Over 60% of readmissions were not for COPD exacerbations, but rather for pulmonary edema, pneumonia, decompensated heart failure, or another acute problem (Figure 2). Since the physiological interdependence of these conditions appears to be high, it is perhaps pertinent to ask:
    - Are care providers similarly interdependent? In healthcare settings where complex patients are co-managed by separate teams of specialists, is the care being conducted using a central, agreed-upon treatment plan? Do the pulmonologist, cardiologist, and primary care physician collaborate and communicate effectively?
    - Are intravenous fluids and salt-retaining glucocorticoid medications, given routinely during COPD exacerbations, predisposing patients to decompensated heart failure following discharge? Are beta-blockers being earnestly withdrawn to improve lung function during a COPD exacerbation, yet may unintentionally lead to cardiac decompensation?
    - Are physicians adhering to evidence-based treatment guidelines, and are those guidelines adequately addressing the nuances of the complex patient with a preponderance of comorbidities?

- High utilizers (those with 6 or more admissions within 12 months) accounted for only 5% of patients, but generated one-fifth of total admissions and one-quarter of total cumulative hospital charges. Moreover, they were more likely to be dually-eligible for both Medicare and Medicaid, to have seven or more secondary diagnoses generally, and cardiovascular comorbidities specifically. These findings reinforce the importance of targeted readmission reduction efforts.

Conclusion

Despite disadvantages associated with using administrative (claims) data, there are benefits including the data's large denominator, all payer information, and standardized input. This study has shown that probing large-denominator databases may reveal opportunities for quality improvement in COPD care. COPD patients with comorbid congestive heart failure, ischemic heart disease, arrhythmias, and diabetes were at statistically higher risk for hospital readmission within one month. Further, this study confirms the economic impact of a small group of high utilizers on hospital admissions and readmissions and suggests that the presence of cardiovascular comorbidities may enable prospective identification of potential high utilizers. Our findings underscore the importance of comprehensive patient-centered care and accountable collaboration of medical specialty support, as well as the importance of tackling competing treatment priorities and therapeutic contraindications in the development of urgently-needed clinical practice guidelines that address the needs of complex chronic disease patients.

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PHC4 has provided data to PRHI in an effort to further PHC4's mission of educating the public and containing healthcare costs in Pennsylvania. PHC4, its agents, and staff, have made no representation, guarantee, or warranty, express or implied, that the data – financial, patient, payer, and physician specific information – provided to this entity, are error free, or that the use of the data will avoid differences of opinion or interpretation.

Appendix A.

ICD-9-coded COPD: ICD-9 code groups 491 (chronic bronchitis), 492 (emphysema), and 496 (chronic airway obstruction, not elsewhere classified).

Coronary artery disease (CAD): ICD-9 code group 410 (acute myocardial infarction), 411 (other acute and subacute forms of ischemic heart disease), 412 (old myocardial infarction), 413 (angina pectoris), and 414 (other forms of chronic ischemic heart disease).

Congestive heart failure (CHF): ICD-9 code group 428 (heart failure); ICD-9 codes 398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404

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