

# Characteristics of High-Cost Patients Diagnosed with Opioid Abuse

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## ABSTRACT

**BACKGROUND:** Prescription opioid abuse is associated with substantial economic burden, with estimates of incremental annual per-patient health care costs of diagnosed opioid abuse exceeding \$10,000 in prior literature. A subset of patients diagnosed with opioid abuse has disproportionately high health care costs, but little is known about the characteristics of these patients.

**OBJECTIVE:** To describe the characteristics of a subset of patients diagnosed with opioid abuse with disproportionately high health care costs to assist physicians and managed care organizations in targeting interventions at the costliest patients.

**METHODS:** This retrospective claims data analysis identified patients aged 12 to 64 years diagnosed with opioid abuse/dependence in the OptumHealth Reporting and Insights medical and pharmacy claims database, Quarter 1 (Q1) 1999-Q1 2012. Inclusion criteria required that patients had a diagnosis of opioid abuse during or after Q1 2006, no prior diagnoses of opioid abuse, and continuous non-HMO coverage over an 18-month study period. The study period comprised a 12-month observation period centered on the date of the first opioid abuse diagnosis (index date) and a 6-month baseline period immediately preceding the observation period. Patients in the top 20% of total health care costs in the observation period were classified as "high-cost patients," and the remaining patients were classified as "lower-cost patients." Patient characteristics, comorbidities, health care resource use, and health care costs were compared between high-cost patients and lower-cost patients using chi-square tests for dichotomous variables and Wilcoxon rank-sum tests for continuous variables. In addition, multivariate regression was used to assess the relationship between patient characteristics in the baseline period and total health care costs in the observation period among all patients diagnosed with opioid abuse.

**RESULTS:** 9,291 patients diagnosed with opioid abuse met the inclusion criteria. The 20% of patients classified as high-cost patients accounted for approximately two thirds of the total health care costs of patients diagnosed with opioid abuse. Compared with lower-cost patients, high-cost patients were older (42.5 vs. 36.1;  $P < 0.001$ ) and more likely to be female (55.9% vs. 42.9%;  $P < 0.001$ ). They had a higher comorbidity burden at baseline, as reflected in the Charlson Comorbidity Index (0.8 vs. 0.2;  $P < 0.001$ ), and rates of conditions such as chronic pulmonary disease (12.9% vs. 5.6%;  $P < 0.001$ ) and mild/moderate diabetes (8.4% vs. 3.4%;  $P < 0.001$ ). High-cost patients also had higher rates of nonopioid substance abuse diagnoses (12.4% vs. 8.9%;  $P < 0.001$ ) and psychotic disorders (26.5% vs. 13.6%;  $P < 0.001$ ). In the observation period, high-cost patients continued to have higher rates of nonopioid substance abuse diagnoses (53.0% vs. 47.2%;  $P < 0.001$ ) and psychotic disorders (67.1% vs. 47.5%;  $P < 0.001$ ). In addition, they had greater medical resource use across all places of service (i.e., inpatient, emergency department, outpatient, drug/alcohol rehabilitation facility, and other) compared with lower-cost patients. The mean observation period health care costs of high-cost patients was

\$89,177 compared with \$11,653 for lower-cost patients ( $P < 0.001$ ). High-cost patients had higher medical costs linked to claims with an opioid abuse diagnosis in absolute terms, but the share of total medical costs attributed to such claims was lower among high-cost patients than among lower-cost patients. While many baseline characteristics were found to have a statistically significant ( $P < 0.05$ ) association with observation period health care costs, only 27.3% of the variation in observation period health care costs was explained by patient characteristics in the baseline period.

**CONCLUSIONS:** This study found that the costliest patients diagnosed with opioid abuse had high rates of preexisting and concurrent chronic comorbidities and mental health conditions, suggesting potential indicators for targeted intervention and a need for greater awareness and screening of comorbid conditions. Opioid abuse may exacerbate existing conditions and make it difficult for patients to adhere to treatment plans for those underlying conditions. Baseline patient characteristics explained only a small share of the variation in observation period health care costs, however. Future research should explore the degree to which other factors not captured in administrative claims data (e.g., severity of abuse) can explain the wide variation in health care costs among opioid abusers.

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## What is already known about this subject

- Prescription opioid abuse is associated with substantial health and economic burden in the United States.
- The prevalence of diagnosed opioid abuse increased from 6.7 per 10,000 in 2006 to 18.6 per 10,000 in 2011 in a commercially insured population.
- Existing evidence suggests that patients diagnosed with opioid abuse incur higher health care resource use and costs than patients not diagnosed with opioid abuse.

## What this study adds

- The 20% of patients with the highest costs accounted for approximately two thirds of the total health care costs of patients diagnosed with opioid abuse.
- High-cost patients had higher rates of chronic comorbidities and mental health conditions than did lower-cost patients, highlighting the need to consider the complete medical and psychosocial history of a patient when managing underlying conditions that contribute to higher health care costs.
- Much of the variation in health care costs cannot be attributed to comorbidities, however.

The abuse of prescription opioids is a major public health problem in the United States. The 2012 National Survey on Drug Use and Health (NSDUH) reported that an estimated 2.1 million Americans aged 12 years and older (or 0.8% of that population) had prescription pain reliever dependence or abuse.<sup>1</sup> Rates of diagnosed opioid abuse/dependence (known hereafter as “opioid abuse”) have grown over time. In a recent study using commercial claims data, Rice et al. (2014) reported that the prevalence of diagnosed opioid abuse increased from 6.7 per 10,000 in 2006 to 18.6 per 10,000 in 2011.<sup>2</sup> Other studies using administrative claims data have found increasing rates of diagnosed opioid abuse among commercially insured populations as well as among publicly insured populations such as those covered by Medicaid, Medicare, and the Veteran’s Health Administration.<sup>3-5</sup>

While a recent study using Researched Abuse, Diversion, and Addiction-Related Surveillance (RADARS) data from drug-diversion investigators, poison centers, substance abuse treatment centers, and college students reported declining rates of diversion and abuse among individuals in 5 RADARS programs starting around 2011,<sup>6</sup> it remains to be seen whether this change in trend has also occurred in broader patient populations or whether it is specific to the types of patients who entered these RADARS programs during this time period. Nevertheless, the public health burden of opioid abuse remains substantial. The Drug Abuse Warning Network reported that there were approximately 366,000 emergency department (ED) visits in 2011 associated with nonmedical use of narcotic pain relievers, out of over 5 million ED visits that were drug related.<sup>7</sup>

In addition, prior research has identified substantial opioid abuse-related costs to payers and society. Rice et al. matched commercially insured diagnosed opioid abusers to controls (i.e., patients not diagnosed with opioid abuse) based on baseline demographics, comorbidities, and health care resource use and estimated excess annual per-patient health care costs of diagnosed opioid abuse of \$10,627 (\$20,343 for opioid abusers vs. \$9,716 for matched controls;  $P < 0.01$ ).<sup>2</sup> A follow-up study by Rice et al. (2014) using a different and larger commercial claims database yielded similar results; excess annual per-patient health care costs of diagnosed opioid abuse were estimated to be \$11,376 (\$22,301 for opioid abusers vs. \$10,925 for matched controls;  $P < 0.01$ ).<sup>8</sup> In a recent study of the excess medical costs of diagnosed opioid abusers based on administrative claims data during 2009-2012, Rossiter et al. (2014) estimated excess medical costs of diagnosed opioid abusers of \$9,456 for commercially insured continuous users of extended-release/long-acting opioids.<sup>9</sup> White et al. (2011), using a demographically matched sample of opioid abusers and nonabusers, estimated excess annual health care costs of diagnosed opioid abuse of \$20,546 per commercially insured patient.<sup>3</sup> At a societal level, Birnbaum

et al. (2011) estimated that the total societal costs of prescription opioid abuse, including direct costs and indirect costs (i.e., workplace and criminal justice costs) were \$55.7 billion in 2007.<sup>10</sup>

Many of these findings reflect average excess health care costs among patients diagnosed with opioid abuse and do not capture considerable variation in the costs of opioid abuse. Health care spending in general (i.e., across all conditions) is quite concentrated, with patients in the top 20% in terms of health care spending accounting for over three quarters of total health care spending in 2009.<sup>11</sup> An Agency for Healthcare Research and Quality study of the U.S. civilian noninstitutionalized population found that, in 2002, 5% of the population accounted for 49% of total medical expenditures, and half the population accounted for only 3% of total medical expenditures in 2002.<sup>12</sup> As we discuss later, health care costs among patients diagnosed with opioid abuse are concentrated as well, with the top 20% of patients in terms of health care costs accounting for a disproportionate share of total health care costs. Little is known, however, about the characteristics of these diagnosed opioid abusers with extremely high health care costs. An improved understanding of these costly patients is relevant for physicians, managed care organizations, and other stakeholders who have an interest in addressing opioid abuse and reducing the associated health care costs. To this end, the primary objective of this study was to describe the characteristics of the subset of patients with total health care costs in the top 20% of total health care costs among patients diagnosed with opioid abuse (known hereafter as “high-cost patients”).

## Methods

### Data Source

Patients with commercial health insurance coverage were selected from the OptumHealth Reporting and Insights (OptumHealth) medical and pharmacy claims database. The OptumHealth database currently contains approximately 18.5 million commercially insured beneficiaries (employees, spouses, children, and retirees) of 84 large self-insured companies with locations across the United States and representing a variety of industries and job types. The data include medical claims (dates of service, *International Classification of Diseases, Ninth Revision, Clinical Modification* [ICD-9-CM] diagnosis codes, procedures performed, places of service, and payment amounts); pharmacy claims (fill dates, National Drug Code numbers, and payment amounts); and eligibility information (patient demographics and enrollment history). The data were de-identified by the data vendor in order to be compliant with the Health Insurance Portability and Accountability Act of 1996. Therefore, institutional review board approval was not necessary for this study. Data for services provided covering the period of Quarter 1 (Q1) 1999 through Q1 2012 were used in the analyses that follow.

### Study Design

A retrospective analysis of administrative claims data was conducted to examine the characteristics of high-cost patients diagnosed with opioid abuse. Patients with opioid abuse were identified as those with any medical claims with at least 1 of the following ICD-9-CM diagnosis codes for opioid abuse or dependence: 304.0x, 304.7x, 305.5x, 965.00, 965.02, or 965.09 (Appendix A, available in online article). The use of opioid abuse and dependence ICD-9-CM diagnosis codes is consistent with the combination of prescription pain reliever abuse and dependence in the NSDUH.<sup>13</sup> It is also consistent with the *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition, which combines substance abuse and substance dependence into a single disorder.<sup>14</sup> Several other studies on opioid abuse have also used opioid abuse and dependence ICD-9-CM diagnosis codes.<sup>3,4,9,10,15-17</sup> Therefore, this study uses ICD-9-CM diagnosis codes for opioid abuse and dependence.

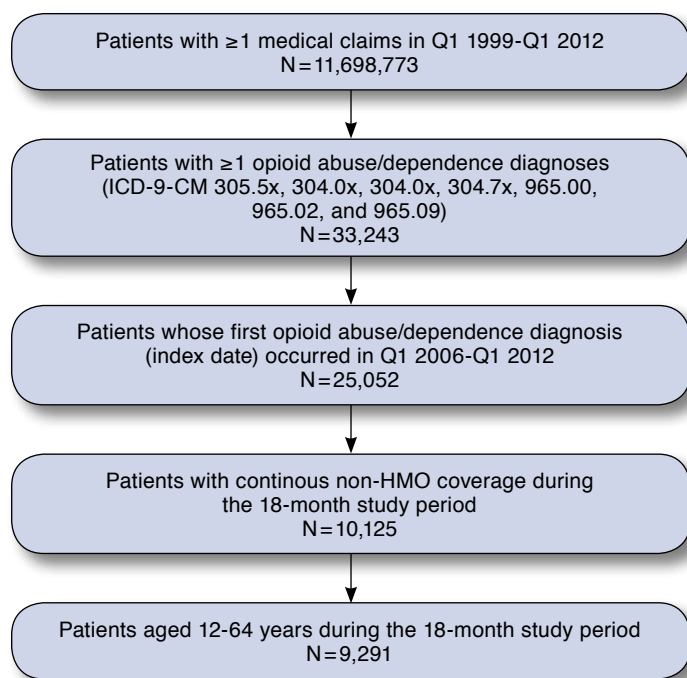
### Patient Selection

Patients from the OptumHealth database were included in the study if they had at least 1 medical claim linked to an ICD-9-CM diagnosis code for opioid abuse, with the earliest such claim occurring during the period Q1 2006-Q1 2012 (Figure 1). Patients with an opioid abuse diagnosis prior to Q1 2006 were excluded in order to focus on more recent data. The study index date was defined as the date of the first medical claim with an opioid abuse diagnosis. Each individual was observed over an 18-month study period consisting of a 12-month observation period, which was centered on the index date, and a 6-month baseline period, which immediately preceded the observation period.

Patients were required to be aged 12-64 years and to have continuous non-HMO (health maintenance organization) coverage throughout the 18-month study period (i.e., 6-month baseline period and the 12-month observation period) to ensure that all relevant medical and pharmacy claims were captured for the final sample of patients. Patients as young as aged 12 years were included because opioid abuse is a concern among youth aged 12-17 years, and they have been included in prior studies on opioid abuse.<sup>1,2,9</sup> Patients aged 65 years and older were excluded from our study, since their Medicare eligibility would possibly have limited the ability to observe all relevant medical and pharmacy claims.

Among all patients diagnosed with opioid abuse included in the study cohort, “high-cost patients” were defined as patients with total health care costs in the top quintile (i.e., top 20%) of total health care costs among the study cohort during the 12-month observation period (Figure 2). The remaining patients were classified as “lower-cost patients.” The decision to group patients into quintiles based on total health care costs during the 12-month observation period and to compare patients in the top quintile with the rest of the patients was

**FIGURE 1** Sample Selection



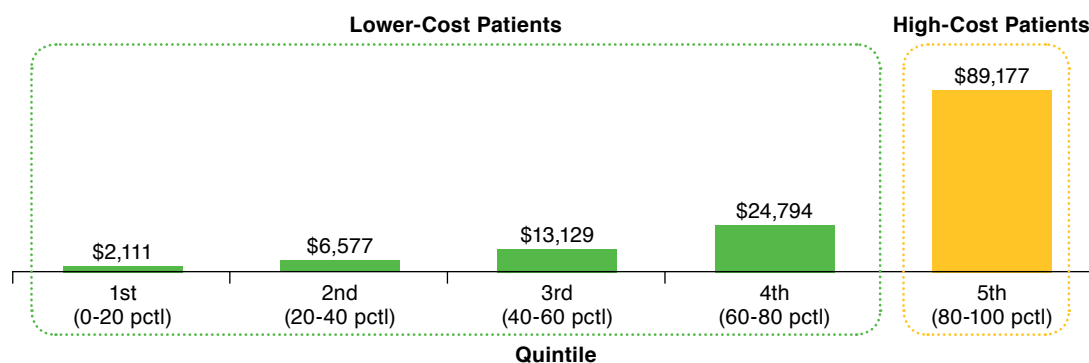
HMO=health maintenance organization; ICD-9-CM=International Classification of Diseases, Ninth Revision, Clinical Modification; Q1=Quarter 1.

made a priori as a way to examine the characteristics of a subset of patients with high costs.

### Baseline Patient Characteristics

Baseline patient characteristics were examined during the 6-month baseline period. Characteristics included demographics (age, gender, and region) and the year of the index date (i.e., date of opioid abuse diagnosis). In addition, baseline comorbidities were assessed. The Charlson Comorbidity Index was derived based on the Romano adaptation.<sup>18</sup> The Charlson Comorbidity Index is a method of categorizing patient comorbidities based on ICD-9-CM diagnosis codes, and each comorbidity category is assigned a weight from 1 to 6 based on the adjusted risk of mortality. The sum of all the weights results in a single score for each patient, and a higher risk of mortality corresponds with a higher score. Individual categories of the Charlson Comorbidity Index, such as chronic pulmonary disease, diabetes, and rheumatologic disease, were also tabulated. In addition, given their relevance to patients diagnosed with opioid abuse, rates of nonopioid substance abuse diagnoses, psychotic disorders, and other mental disorders were calculated as well. Comorbidities were identified using ICD-9-CM diagnosis codes (Appendix A, available in online article).

**FIGURE 2** Mean Per-Patient Health Care Costs During the 12-Month Observation Period Among Patients Diagnosed with Opioid Abuse, by Quintiles



pctl = percentile.

### Outcome Measures

The previously mentioned comorbidities were also examined during the 12-month observation period. In addition, health care resource use and health care costs were examined. Health care resource use included the rate of any health care resource use and the intensity of such use (e.g., number of visits or length of stay), and the measures were medical resource use by places of service and prescription drug use. Medical claims were classified into places of service (i.e., ED, inpatient, drug/alcohol rehabilitation facility, and outpatient) using codes for place of service, provider specialty, provider type, and type of service codes (available upon request). Claims not classified in 1 of these 4 categories were classified as “other facility.”

Health care costs were calculated as the total amount paid to service providers by the insurer for all covered services, regardless of diagnosis, as reflected on the claims. Out-of-pocket payments by patients (e.g., copay and deductibles) were not included. Measures included total health care costs, total medical costs, medical costs by places of service, and prescription drug costs. Health care costs were inflated to 2012 U.S. dollars using the medical care component of the Consumer Price Index.

The share of medical resource use directly attributed to opioid abuse (vs. other causes) was also examined. “Abuse-related medical resource use” was defined as medical resource use linked to claims with opioid abuse diagnoses. Note that this likely reflects a lower-bound estimate of opioid abuse-related medical resource use, since some medical care triggered by opioid abuse may not be coded as related to opioid abuse for insurance claims purposes. Medical resource use not linked to claims with opioid abuse diagnoses was defined as “other medical resource use.” “Abuse-related medical costs” and “other medical costs” were similarly defined.

### Statistical Analysis

Dichotomous variables were summarized using frequencies and percentages. Continuous variables were summarized using means and standard deviations. Comparisons between high-cost patients and lower-cost patients diagnosed with opioid abuse were conducted using chi-square tests for dichotomous variables and Wilcoxon rank-sum tests for continuous variables.

In addition, a multivariate regression analysis was conducted to examine the relationship between patient characteristics in the baseline period and health care costs in the observation period among all patients diagnosed with opioid abuse. Specifically, we estimated an ordinary least squares (OLS) regression model in which 12-month observation period health care costs (log-transformed) was the dependent variable. Health care costs were log-transformed to account for their skewed distribution; log-transformed costs were approximately normally distributed (Appendix B, available in online article). Independent variables included age; gender; geographic region; indicator variables for baseline period comorbidities (components of the Charlson Comorbidity Index, as well as nonopioid substance abuse diagnoses [e.g., abuse of hallucinogenics], psychotic disorders, and other mental disorders); log-transformed baseline health care costs; and baseline health care resource use. Data on race and socioeconomic status were not available in the OptumHealth database. All analyses were conducted using SAS software for Windows version 9.3 (SAS Institute, Cary, NC). Results were considered statistically significant at  $P < 0.05$ .

### Results

The patient selection criteria resulted in a sample of 9,291 patients diagnosed with opioid abuse (Figure 1). There were 1,859 patients classified as high-cost patients, and the remaining 7,432 patients were classified as lower-cost patients.

### Comparing Baseline Characteristics

Relative to lower-cost patients, high-cost patients were older (42.5 vs. 36.1;  $P < 0.001$ ) and more likely to be female (55.9% vs. 42.9%;  $P < 0.001$ ; Table 1). In addition, high-cost patients had increased rates of baseline comorbidities, as reflected by the Charlson Comorbidity Index (0.8 vs. 0.2;  $P < 0.001$ ), as well as specific conditions such as chronic pulmonary disease (12.9% vs. 5.6%;  $P < 0.001$ ), mild/moderate diabetes (8.4% vs. 3.4%;  $P < 0.001$ ), rheumatologic disease (5.1% vs. 1.3%;  $P < 0.001$ ), congestive heart failure (5.1% vs. 1.0%;  $P < 0.001$ ), and malignancies (3.4% vs. 1.2%;  $P < 0.001$ ). High-cost patients also had increased rates of nonopioid substance abuse diagnoses (12.4% vs. 8.9%;  $P < 0.001$ ), psychotic disorders (26.5% vs. 13.6%;  $P < 0.001$ ), and other mental disorders (36.1% vs. 25.6%;  $P < 0.001$ ).

### Comparing Observation Period Characteristics

In the observation period, high-cost patients continued to have increased rates of comorbidities, as reflected by the Charlson Comorbidity Index (1.6 vs. 0.4;  $P < 0.001$ ), as well as specific conditions such as chronic pulmonary disease (24.0% vs. 10.5%;  $P < 0.001$ ), mild/moderate diabetes (10.8% vs. 5.2%;  $P < 0.001$ ), rheumatologic disease (8.3% vs. 2.4%;  $P < 0.001$ ), congestive heart failure (12.2% vs. 2.2%;  $P < 0.001$ ), and malignancies (7.4% vs. 2.4%;  $P < 0.001$ ; Table 2). In fact, high-cost patients had higher rates of all components of the Charlson Comorbidity Index, and the ratios of rates of comorbidities among high-cost patients to those among lower-cost patients increased for nearly all conditions in the follow-up period. High-cost patients also had increased rates of nonopioid substance abuse diagnoses (53.0% vs. 47.2%;  $P < 0.001$ ), psychotic disorders (67.1% vs. 47.5%;  $P < 0.001$ ), and other mental disorders (70.2% vs. 57.5%;  $P < 0.001$ ).

Compared with lower-cost patients, high-cost patients had a greater likelihood of utilizing medical resources across all places of service and did so with greater intensity. For example, high-cost patients were more likely to have at least 1 inpatient visit (82.2% vs. 36.4%;  $P < 0.001$ ) and at least 1 ED visit (88.2% vs. 60.9%;  $P < 0.001$ ). They also had longer inpatient stays (16.1 days vs. 2.9;  $P < 0.001$ ) and spent more days in the ED (8.9 days vs. 1.9;  $P < 0.001$ ). High-cost patients were more likely to have any prescription drug fill (96.9% vs. 92.5%;  $P < 0.001$ ), and they filled more prescriptions (71.4 vs. 32.6;  $P < 0.001$ ) and more unique prescriptions as measured by different National Drug Code numbers (29.0 vs. 12.9;  $P < 0.001$ ) compared with lower-cost patients.

High-cost patients also had a greater intensity of opioid abuse-related medical resource use in the inpatient setting (4.7 days vs. 1.6;  $P < 0.001$ ), ED (1.3 days vs. 0.5;  $P < 0.001$ ), and drug/alcohol rehabilitation facility (4.6 days vs. 4.3;  $P < 0.001$ ). However, the share of overall all-cause medical resource use that was related to opioid abuse was lower among high-cost patients than among lower-cost patients across all places of service. For

example, opioid abuse-related inpatient days accounted for 29% of inpatient days for high-cost patients but accounted for 56% of inpatient days for lower-cost patients. Abuse-related ED days accounted for 15% of ED days for high-cost patients but accounted for 25% of ED days for lower-cost patients.

The mean observation period health care costs of high-cost patients was \$89,177 (vs. \$11,653 for lower-cost patients;  $P < 0.001$ ), of which 38.8% (\$34,600) was attributed to inpatient costs, 21.9% (\$19,513) to outpatient costs, 18.6% (\$16,597) to ED costs, 4.9% (\$4,393) to drug/alcohol rehabilitation facility costs, 4.8% (\$4,283) to other facility costs, and 11.0% (\$9,791) to prescription drugs. In total, high-cost patients accounted for approximately two thirds of the total health care costs of patients diagnosed with opioid abuse (Figure 3).

High-cost patients had overall all-cause medical costs that were nearly 9 times higher (\$79,386 vs. \$8,986;  $P < 0.001$ ) and opioid abuse-related medical costs that were 4.5 times higher (\$15,706 vs. \$3,429;  $P < 0.001$ ) than lower-cost patients. Although high-cost patients had higher health care costs across all places of service, the largest differential was due to inpatient stays (\$34,600 vs. \$1,577;  $P < 0.001$ ). In addition, high-cost patients had higher prescription drug costs compared with lower-cost patients (\$9,791 vs. \$2,667;  $P < 0.001$ ).

However, mirroring the resource use findings, the share of medical costs directly attributable to claims with opioid abuse diagnoses was lower among high-cost patients than among lower-cost patients. For example, opioid abuse-related inpatient costs accounted for 23% of inpatient costs for high-cost patients but 58% of inpatient costs for lower-cost patients. Opioid abuse-related drug/alcohol rehabilitation facility costs accounted for 53% of drug/alcohol rehabilitation facility costs for high-cost patients but 74% of opioid abuse-related drug/alcohol rehabilitation facility costs for lower-cost patients.

A sensitivity analysis was conducted in order to examine whether the results were sensitive to the definition of the study period. The results using a 6-month post-index period (i.e., the second half of the 12-month observation period) were consistent with those using the full 12-month observation period (results available upon request).

### Multivariate Regression Results

Several baseline characteristics had a statistically significant ( $P < 0.05$ ) relationship with observation period health care costs when considered jointly in a multivariate regression framework (Table 3). Eight of the 17 components of the Charlson Comorbidity Index had a positive and statistically significant association with observation period health care costs. Log-transformed baseline medical costs and prescription drug costs also had a positive and statistically significant association with observation period health care costs, as did health care resource use (i.e., number of visits/days by different places of service).

## Characteristics of High-Cost Patients Diagnosed with Opioid Abuse

**TABLE 1** Patient Characteristics and Comorbidities in the Baseline Period

Baseline Characteristics <sup>a</sup>	High-Cost Patients <sup>b</sup> (n = 1,859)		Lower-Cost Patients <sup>b</sup> (n = 7,432)		P Value <sup>c</sup>
	N or Mean	% or SD	N or Mean	% or SD	
<b>Patient characteristics</b>					
Age at index date	42.5	13.9	36.1	14.4	<0.001
Female	819	55.9%	4,244	42.9%	<0.001
<b>U.S. Census division<sup>d</sup></b>					
East North Central	368	19.8%	1,427	19.2%	0.561
Middle Atlantic	291	15.7%	1,415	19.0%	<0.001
South Atlantic	332	17.9%	1,307	17.6%	0.782
West South Central	230	12.4%	736	9.9%	0.002
Mountain	188	10.1%	699	9.4%	0.353
Pacific	188	10.1%	575	7.7%	<0.001
East South Central	89	4.8%	596	8.0%	<0.001
West North Central	106	5.7%	344	4.6%	0.054
New England	66	3.6%	324	4.4%	0.120
Unknown	1	0.1%	9	0.1%	0.698
<b>Year of index date</b>					
2006	228	12.3%	860	11.6%	0.406
2007	301	16.2%	1,074	14.5%	0.059
2008	262	14.1%	1,145	15.4%	0.158
2009	344	18.5%	1,269	17.1%	0.145
2010	413	22.2%	1,669	22.5%	0.824
2011	311	16.7%	1,415	19.0%	0.022
<b>Comorbidities</b>					
Charlson Comorbidity Index	0.8	1.4	0.2	0.7	<0.001
<b>Components of Charlson Comorbidity Index</b>					
Chronic pulmonary disease	240	12.9%	417	5.6%	<0.001
Mild-to-moderate diabetes	157	8.4%	254	3.4%	<0.001
Rheumatologic disease	94	5.1%	93	1.3%	<0.001
Congestive heart failure	95	5.1%	72	1.0%	<0.001
Any malignancy including leukemia and lymphoma	64	3.4%	92	1.2%	<0.001
Cerebrovascular disease	77	4.1%	78	1.0%	<0.001
Diabetes with chronic complications	62	3.3%	65	0.9%	<0.001
Peripheral vascular disease	54	2.9%	68	0.9%	<0.001
Mild liver disease	42	2.3%	49	0.7%	<0.001
Renal disease	50	2.7%	32	0.4%	<0.001
Peptic ulcer disease	26	1.4%	26	0.3%	<0.001
Myocardial infarction	21	1.1%	17	0.2%	<0.001
Hemiplegia or paraplegia	20	1.1%	16	0.2%	<0.001
Metastatic solid tumor	21	1.1%	8	0.1%	<0.001
HIV/AIDS	13	0.7%	14	0.2%	<0.001
Moderate or severe liver disease	8	0.4%	5	0.1%	0.001
Dementia	0	0.0%	3	0.0%	1.000
<b>Other selected comorbidities</b>					
Nonopioid substance abuse diagnoses	231	12.4%	662	8.9%	<0.001
Psychotic disorders	493	26.5%	1,008	13.6%	<0.001
Other mental disorders	672	36.1%	1,900	25.6%	<0.001

<sup>a</sup>The baseline period was defined as the 6-month period prior to the 12-month observation period (which was centered on the index date).

<sup>b</sup>High-cost patients were defined as patients with health care costs in the top 20% of health care costs among all patients in the study cohort during the observation period.

<sup>c</sup>P values were calculated using chi-square tests for dichotomous variables and Wilcoxon rank-sum tests for continuous variables. Results were considered statistically significant at P<0.05.

<sup>d</sup>U.S. Census Bureau divisions were classified as follows: East North Central (IL, IN, MI, OH, WI); Middle Atlantic (NJ, NY, PA); South Atlantic (DC, DE, FL, GA, MD, NC, VA, SC, WV); West South Central (AR, LA, OK, TX); Mountain (AZ, CO, ID, MT, NM, NV, UT, WY); Pacific (AK, CA, HI, OR, WA); East South Central (AL, KY, MS, TN); West North Central (IA, KS, ND, MN, MO, NE, SD); and New England (CT, NH, MA, ME, RI, VT).

AIDS=acquired immune deficiency syndrome; HIV=human immunodeficiency virus; SD=standard deviation.

## Characteristics of High-Cost Patients Diagnosed with Opioid Abuse

**TABLE 2** Comorbidities, Health Care Resource Use, and Health Care Costs in the Observation Period

Characteristics <sup>a</sup>	High-Cost Patients <sup>b</sup> (n = 1,859)		Lower-Cost Patients <sup>b</sup> (n = 7,432)		P Value <sup>c</sup>
	N or Mean	% or SD	N or Mean	% or SD	
<b>Comorbidities</b>					
Charlson Comorbidity Index	1.60	2.29	0.42	1.05	<0.001
<b>Components of Charlson Comorbidity Index</b>					
Chronic pulmonary disease	447	24.0%	784	10.5%	<0.001
Mild-to-moderate diabetes	200	10.8%	387	5.2%	<0.001
Rheumatologic disease	154	8.3%	176	2.4%	<0.001
Congestive heart failure	226	12.2%	161	2.2%	<0.001
Any malignancy including leukemia and lymphoma	138	7.4%	180	2.4%	<0.001
Cerebrovascular disease	214	11.5%	197	2.7%	<0.001
Diabetes with chronic complications	120	6.5%	126	1.7%	<0.001
Peripheral vascular disease	123	6.6%	105	1.4%	<0.001
Mild liver disease	92	4.9%	95	1.3%	<0.001
Renal disease	144	7.7%	70	0.9%	<0.001
Peptic ulcer disease	65	3.5%	52	0.7%	<0.001
Myocardial infarction	73	3.9%	43	0.6%	<0.001
Hemiplegia or paraplegia	49	2.6%	40	0.5%	<0.001
Metastatic solid tumor	44	2.4%	16	0.2%	<0.001
HIV/AIDS	19	1.0%	25	0.3%	<0.001
Moderate or severe liver disease	32	1.7%	16	0.2%	<0.001
Dementia	13	0.7%	14	0.2%	<0.001
<b>Other selected comorbidities</b>					
Nonopioid substance abuse diagnoses	984	53.0%	3,351	47.2%	<0.001
Psychotic disorders	1,244	67.1%	3,374	47.5%	<0.001
Other mental disorders	1,302	70.2%	4,081	57.5%	<0.001
<b>Annual Health Care Resource Use</b>					
<b>Medical resource use</b>					
<b>Any visit</b>					
Inpatient	1,529	82.2%	2,702	36.4%	<0.001
Emergency department	1,640	88.2%	4,528	60.9%	<0.001
Outpatient	1,855	99.8%	7,274	97.9%	<0.001
Drug/alcohol rehabilitation facility	559	30.1%	1,632	22.0%	<0.001
Other	1,487	80.0%	4,005	53.9%	<0.001
<b>Number of visits/days</b>					
Inpatient days	16.1	23.9	2.9	7.2	<0.001
Emergency department days	8.9	13.6	1.9	3.2	<0.001
Outpatient visits	38.2	24.6	18.7	15.9	<0.001
Drug/alcohol rehabilitation facility days	9.5	22.3	5.6	18.0	<0.001
Other visits	8.2	13.7	2.6	5.3	<0.001
<b>Abuse-related medical resource use</b>					
Inpatient days	4.7	10.7	1.6	4.7	<0.001
Emergency department days	1.3	3.0	0.5	1.1	<0.001
Outpatient visits	2.5	7.5	3.4	7.0	<0.001
Drug/alcohol rehabilitation facility days	4.6	14.9	4.3	16.4	<0.001
Other visits	0.6	2.6	0.7	2.6	<0.001
<b>Abuse-related share of total medical resource use</b>					
Inpatient days	29%	-	56%	-	-
Emergency department days	15%	-	25%	-	-
Outpatient visits	7%	-	18%	-	-
Drug/alcohol rehabilitation facility days	49%	-	76%	-	-
Other visits	8%	-	27%	-	-
<b>Prescription drug use</b>					
Any prescription drug fill	1,802	96.9%	6,871	92.5%	<0.001
Number of prescriptions filled	71.4	50	32.6	32	<0.001
Number of unique NDC numbers filled	29.0	20	12.9	11	<0.001

## Characteristics of High-Cost Patients Diagnosed with Opioid Abuse

**TABLE 2** Comorbidities, Health Care Resource Use, and Health Care Costs in the Observation Period (continued)

Characteristics <sup>a</sup>	High-Cost Patients <sup>b</sup> (n = 1,859)		Lower-Cost Patients <sup>b</sup> (n = 7,432)		P Value <sup>c</sup>
	N or Mean	% or SD	N or Mean	% or SD	
<b>Annual Health Care Costs</b>	\$89,177	\$87,211	\$11,653	\$9,031	<0.001
<b>Medical costs</b>	\$79,386	\$86,986	\$8,986	\$8,075	<0.001
Inpatient	\$34,600	\$68,531	\$1,577	\$3,752	<0.001
Emergency department	\$16,597	\$35,913	\$1,630	\$3,102	<0.001
Outpatient	\$19,513	\$25,233	\$3,696	\$4,474	<0.001
Drug/alcohol rehabilitation facility	\$4,393	\$11,696	\$1,263	\$3,666	<0.001
Other	\$4,283	\$10,949	\$821	\$2,178	<0.001
<b>Abuse-related medical costs</b>	\$15,706	\$31,980	\$3,429	\$4,978	<0.001
Inpatient	\$8,089	\$29,449	\$909	\$2,774	<0.001
Emergency department	\$3,320	\$10,675	\$559	\$1,774	<0.001
Outpatient	\$1,231	\$5,336	\$617	\$1,473	0.029
Drug/alcohol rehabilitation facility	\$2,336	\$7,924	\$940	\$3,106	<0.001
Other	\$730	\$3,271	\$405	\$1,537	<0.001
<b>Abuse-related share of total medical costs</b>	20%	-	38%	-	-
Inpatient	23%	-	58%	-	-
Emergency department	20%	-	34%	-	-
Outpatient	6%	-	17%	-	-
Drug/alcohol rehabilitation facility	53%	-	74%	-	-
Other	17%	-	49%	-	-
<b>Prescription drug costs</b>	\$9,791	\$16,811	\$2,667	\$3,864	<0.001

<sup>a</sup>The observation period was defined as the 12-month period centered on the index date.

<sup>b</sup>High-cost patients were defined as patients with health care costs in the top 20% of health care costs among all patients in the study cohort during the observation period.

<sup>c</sup>P values were calculated using chi-square tests for dichotomous variables and Wilcoxon rank-sum tests for continuous variables. Results were considered statistically significant at P<0.05.

AIDS = acquired immune deficiency syndrome; HIV = human immunodeficiency virus; NDC = National Drug Code; SD = standard deviation.

The R-squared value of our OLS regression on log-transformed health care costs was 0.273, suggesting that a relatively small share of the variation in health care costs in the observation period was explained by observable baseline characteristics.

### Discussion

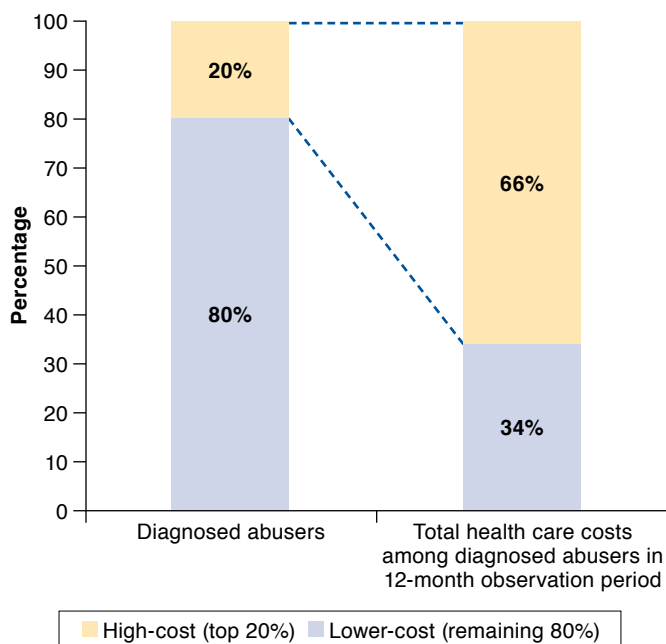
This study provides insights into the challenges physicians and managed care organizations face in managing patients diagnosed with opioid abuse. Compared with lower-cost patients, the costliest patients diagnosed with opioid abuse were found to have higher rates of preexisting and concurrent chronic comorbidities and mental health conditions. While we focused on identifying differences within the population of diagnosed opioid abusers, these findings are consistent with prior research on opioid abuse comparing opioid abusers to nonabusers. White et al. (2005) reported that opioid abusers have higher rates of certain comorbidities than do nonabusers.<sup>19</sup> For example, opioid abusers were 11.2 times more likely to have had at least 1 mental health outpatient visit and 12.2 times more likely to have had at least 1 hospital inpatient stay than nonabusers (P<0.01). In addition, nonopioid poisoning and psychiatric illnesses were 78.0 and 8.5 times more prevalent

among opioid abusers than among nonabusers, respectively (P<0.01). Becker et al. (2008) also found that mental health conditions (e.g., panic and social phobic/agoraphobic symptoms, misuse of another class of prescription medication) were prevalent among opioid abusers than among nonabusers.<sup>20</sup> Furthermore, 2 review articles also had similar observations. Jan (2010) noted that psychiatric disorders are common among patients with opioid dependence.<sup>21</sup> Strassels (2009) noted that patients who abuse opioids may be at risk for certain conditions such as hepatitis or human immunodeficiency virus, as they may be at higher risk for hazardous routes of administration such as intravenous use.<sup>22</sup>

Reducing costs and improving quality and outcomes are important functions of managed care organizations. With nearly two thirds of the health care costs associated with patients diagnosed with opioid abuse concentrated in just one fifth of patients, being able to target the subset of patients that accounts for a disproportionate share of the economic burden of opioid use is an important step towards achieving these goals. High-cost patients had greater all-cause and opioid abuse-related medical resource use and costs in absolute terms, so addressing opioid abuse in this population could reduce



**FIGURE 3** Relative Contributions of High-Cost Patients and Lower-Cost Patients to Total Health Care Costs in the Observation Period



**TABLE 3** Multivariate Regression Results

Parameter	Co-efficient	Standard Error	P Value
<b>Intercept</b>	8.08	0.07	<0.001
<b>Patient characteristics</b>			
Age	0.00	0.00	0.078
Male	-0.15	0.03	<0.001
U.S. Census Division: Unknown	0.19	0.40	0.636
U.S. Census Division 1: New England	-0.10	0.07	0.157
U.S. Census Division 2: Middle Atlantic	-0.01	0.04	0.807
U.S. Census Division 4: West North Central	0.09	0.07	0.189
U.S. Census Division 5: South Atlantic	0.09	0.04	0.034
U.S. Census Division 6: East South Central	-0.16	0.06	0.005
U.S. Census Division 7: West South Central	0.12	0.05	0.015
U.S. Census Division 8: Mountain	0.11	0.05	0.043
U.S. Census Division 9: Pacific	0.23	0.06	<0.001
Year of index date: 2007	-0.01	0.05	0.901
Year of index date: 2008	0.07	0.05	0.159
Year of index date: 2009	0.01	0.05	0.866
Year of index date: 2010	-0.03	0.05	0.468
Year of index date: 2011	-0.07	0.05	0.170
<b>Comorbidities</b>			
<b>Components of Charlson Comorbidity Index</b>			
Chronic pulmonary disease	0.14	0.05	0.011
Mild-to-moderate diabetes	0.16	0.07	0.014
Rheumatologic disease	0.25	0.09	0.008
Congestive heart failure	0.16	0.11	0.137
Any malignancy including leukemia and lymphoma	0.16	0.10	0.123
Cerebrovascular disease	0.18	0.11	0.092
Diabetes with chronic complications	0.34	0.12	0.004
Peripheral vascular disease	0.11	0.12	0.337
Mild liver disease	0.21	0.13	0.121
Renal disease	0.44	0.14	0.002
Peptic ulcer disease	0.15	0.18	0.393
Myocardial infarction	0.10	0.21	0.640
Hemiplegia or paraplegia	0.59	0.21	0.005
Metastatic solid tumor	0.63	0.24	0.008
HIV/AIDS	0.46	0.24	0.061
Moderate or severe liver disease	0.85	0.35	0.015
Dementia	-0.17	0.73	0.815
<b>Other selected comorbidities</b>			
Nonopioid substance abuse diagnoses	0.01	0.05	0.814
Psychotic disorders	0.07	0.04	0.092
Other mental disorders	0.00	0.03	0.898
<b>Baseline health care costs (log-transformed)</b>			
Medical costs	0.09	0.01	<0.001
Prescription drug costs	0.10	0.10	<0.001
<b>Baseline health care resource use (number of visits/days)</b>			
Inpatient days	0.01	0.00	<0.001
Emergency department days	0.02	0.00	<0.001
Outpatient visits	0.01	0.00	<0.001
Drug/alcohol rehabilitation facility days	0.01	0.00	0.050
Other visits	0.01	0.00	0.014

Note: An ordinary least squares (OLS) regression was performed on log-transformed health care costs. N=9,291; R-squared value=0.273. Results were considered statistically significant at P<0.05.

AIDS=acquired immune deficiency syndrome; HIV=human immunodeficiency virus.

the overall economic burden of opioid abuse by reducing the medical costs of the costliest opioid abuse patients. However, the finding that the share of overall all-cause medical resource use and costs that was directly related to opioid abuse was lower among high-cost patients than among lower-cost patients suggests that high-cost patients would likely continue to have high medical resource use and costs due to other conditions. High-cost patients have higher rates of nonopioid abuse-related comorbidities, so the share of total health care costs attributed to opioid abuse specifically is lower than that among lower-cost patients who have lower rates of nonopioid abuse-related comorbidities. In addition, differences in rates of comorbidities between high-cost patients and lower-cost patients widened in the observation period, suggesting that disease progression for nonopioid abuse-related comorbidities may have been more pronounced or accelerated among high-cost patients. Better understanding of the characteristics of high-cost patients diagnosed with opioid abuse could help physicians and managed care organizations target their efforts to address opioid abuse and to reduce health care costs.

This study found that high-cost patients were complicated patients with higher rates of baseline comorbidities. Opioid abuse may interact with these baseline comorbidities and make

it difficult for patients to adhere to treatment plans for underlying conditions, thereby resulting in greater health care resource use and costs. This suggests that there is a need for greater awareness and screening of comorbid conditions when patients are first diagnosed with opioid abuse. Baseline comorbidities, combined with baseline health care costs and resource use, explained a relatively small share of the variation in observation period health care costs, however.

Using administrative claims data, it would be difficult to predict which opioid abusers will be the costliest patients based on characteristics prior to the first opioid abuse diagnosis. Therefore, future research should explore other reasons for the disproportionately higher health care costs among high-cost patients, such as differences in the severity of opioid abuse, which cannot be observed in administrative claims data but could potentially be observed in electronic medical records or survey data, for example. A multifaceted approach may be necessary to address opioid abuse at the societal level. In addition to treatment for patients diagnosed with opioid abuse, other efforts may include education of physicians, risk stratification tools to identify patients at higher risk of opioid abuse, prescription drug monitoring programs, and new drug formulations intended to deter opioid abuse.<sup>23</sup>

### Limitations

This study has a number of limitations. First, the study did not assess the causal relationship between patient characteristics and health care costs among diagnosed opioid abusers. Moreover, no causal relationship was established between opioid abuse severity and costs, since data were not available regarding opioid abuse severity. Because much of the variation in observation period health care costs cannot be explained by observable patient characteristics, further research is necessary to understand the extent to which treating or preventing opioid abuse among the higher cost patients would reduce health care costs. Second, as with any claims-based study, this study relied on the accuracy of claims data, and any miscoding in the underlying data could affect our results. For example, opioid abusers were identified using ICD-9-CM diagnosis codes for opioid abuse, but a substantial share of opioid abusers may be undiagnosed. In addition, opioid abuse may be coded as another condition, such as depression, for reimbursement purposes. These undiagnosed opioid abusers would not be captured in this analysis. In addition, our analysis of opioid abuse-related medical resource use and opioid abuse-related medical costs relied on medical claims associated with ICD-9-CM diagnosis codes for opioid abuse. As previously noted, these claims likely reflect a lower-bound estimate of opioid abuse-related resource use and costs, since some medical care resulting from opioid abuse (e.g., repeat visits, treatment of complications) may not be coded as opioid abuse-related for insurance claims purposes. Third, the rates of comorbidities estimated in this study are likely underestimates due to the

relatively short duration of the baseline period (i.e., 6 months). A longer baseline period would have allowed for the observation of more comorbidities. In addition, only the primary and secondary diagnosis codes are included in the OptumHealth claims data, so any additional diagnoses would not be captured in our analysis. Fourth, the OptumHealth claims data do not include race or socioeconomic status, which may affect opioid abuse and the costs associated with opioid abuse. Finally, this study used the OptumHealth commercial claims database. Future research should examine the characteristics of high-cost patients diagnosed with opioid abuse in Medicaid, Medicare, and uninsured populations.

### Conclusions

Addressing a problem as complicated as prescription opioid abuse requires a nuanced understanding of opioid abusers. Such an understanding could help physicians and managed care organizations identify opportunities for intervention and target their efforts to address prescription opioid abuse and reduce the associated costs. This study found that high-cost patients accounted for a disproportionately large share of the total health care costs of patients diagnosed with opioid abuse. The costliest patients diagnosed with opioid abuse had high rates of preexisting and concurrent chronic comorbidities and mental health conditions. These results highlight the need to consider the complete medical and psychosocial patient history to better manage the underlying conditions contributing to high health care costs. Abuse may also exacerbate existing conditions and make it difficult for patients to adhere to treatment plans. In addition to targeting the subset of patients that accounts for a disproportionate share of the economic burden of opioid abuse, other multifaceted efforts, such as provider education, coordinated programs that address medical and social needs, prescription drug monitoring programs, and new drug formulations intended to deter opioid abuse, may be necessary to address prescription opioid abuse at the societal level.

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### DISCLOSURES

This study was funded by Purdue Pharma. Holly is an employee of Purdue Pharma, and Ben-Joseph was employed by Purdue Pharma at the time of this study. Kirson, Rice, Shei, Enloe, and Birnbaum are employees of Analysis Group, a consulting company that received funding for this research from Purdue Pharma. Bodnar was an employee of Analysis Group at the time of this study.

All authors contributed to the concept and design for this study. Data analysis was done primarily by Bodnar and Enloe, with assistance from Kirson, Rice, and Shei. All authors contributed to data interpretation, as well as to writing and revising the manuscript.

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## Characteristics of High-Cost Patients Diagnosed with Opioid Abuse

### APPENDIX A Diagnosis Codes

Comorbidity	ICD-9-CM Diagnosis Codes
<b>Opioid abuse and dependence</b>	
Opioid type dependence	304.0x
Combinations of opioid type drug with any other drug dependence	304.7x
Nondependent opioid abuse	305.5x
Poisoning by opiates and related narcotics	965.0x (excluding 965.01 for poisoning by heroin)
<b>Components of the Charlson Comorbidity Index</b>	
Myocardial infarction	410.xx, 412.xx
Congestive heart failure	402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 425.xx, 428.xx, 429.3x
Peripheral vascular disease	440.xx-442.xx, 443.1x-443.9x, 447.1x, 785.4x
Cerebrovascular disease	362.34, 430.xx-436.xx, 437.0x-437.1x, 437.9x, 438.xx, 781.4x, 784.3x, 997.0x
Dementia	290.xx, 331.0x-331.2x
Chronic pulmonary disease	415.0x, 416.8x, 416.9x, 491.xx-494.xx, 496.xx
Rheumatologic disease	710.xx, 714.xx
Peptic ulcer disease	531.xx-534.xx
Mild liver disease	571.2x, 571.5x, 571.6x, 571.8x, 571.9x
Diabetes	250.0x-250.3x
Diabetes with chronic complications	250.4x-250.9x
Hemiplegia or paraplegia	342.xx, 344.xx
Renal disease	585.xx-586.xx, V42.0x, V45.1x, V56.xx
Any malignancy including leukemia and lymphoma	140.xx-171.xx, 174.xx-195.xx, 200.xx-208.xx, 273.0x, 273.3x, V10.46
Moderate or severe liver disease	572.2x-572.4x, 456.0x-456.2x
Metastatic solid tumor	196.xx-199.xx
AIDS	042.xx-044.xx
<b>Other selected comorbidities</b>	
Nonopioid substance abuse diagnoses	303.xx, 304.1x-304.6x, 304.8x-304.9x, 305.0x-305.4x, 305.6x-305.9x, V11.3
Psychotic disorders	290.xx-299.xx, V11.0-V11.1
Other mental disorders	300.xx-302.xx, 306.xx-319.xx, V11.2, V11.8-V11.9

AIDS = acquired immune deficiency syndrome; ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification.

APPENDIX B Distribution of Log-Transformed Total Health Care Costs

