MILLIMAN WHITE PAPER

Costs and comorbidities of opioid use disorder:

The impact of opioid use disorder for patients with chronic medical conditions

Stoddard Davenport
Alexandra Weaver, ASA, MAAA
Matt Caverly

Milliman

The enormous human costs of the opioid epidemic are accompanied by significant excess healthcare costs.

Payers, health systems, and at-risk providers that work to understand their risks related to opioid use disorder may find that investing in better care for these patients presents an opportunity to achieve the "Quadruple Aim" of healthcare—providing a better care experience for patients, lowering the cost of care, enhancing provider satisfaction, and improving the health of their populations.

Milliman has previously reported on the value opportunity of delivering effective behavioral healthcare (focusing on integration with physical healthcare), which was estimated to be $406 billion in potential healthcare cost savings in 2018.[1] We have found that, in the general population, medical costs for patients with chronic medical and comorbid mental health/substance use disorder (MH/SUD) conditions are two to three times higher on average compared to those who do not have comorbid MH/SUD conditions. This report builds on our earlier studies by focusing specifically on patients with opioid use disorder (OUD) and patients with high opioid usage who tend to have complex healthcare needs.

Last year, we studied prescription patterns for individuals with elevated opioid use but no diagnosed OUD and found that there may be many more individuals at risk for complications of high opioid usage than have been formally diagnosed with OUD (based on diagnosis codes in claim data). In 2015, over 1.5 million Americans were diagnosed with OUD. Opioid prescription patterns show that there are over five times as many patients without a diagnosed opioid use disorder who fill an extraordinary amount of opioid prescriptions in a year and qualify as "super-users."[2] Thus this study assesses the prevalence and costs associated with comorbid chronic medical conditions among individuals with diagnosed OUD, and opioid super-users without diagnosed OUD.

This analysis explores the prevalence of comorbid chronic medical conditions for these patients, as well as the impact of opioid use disorder on healthcare costs for patients with comorbid chronic medical conditions in the United States. A few of our key findings are highlighted below and are described in more detail throughout this report.

IN THIS REPORT . . .

- Opioid use disorder may have added **$10.8 billion** to the cost of treating commercially insured patients across the United States in 2016.
- Excess annual healthcare costs for patients with opioid use disorder averaged nearly **$23,000** for those with chronic medical conditions and over **$15,000** for those without chronic medical conditions.
- Patients with opioid use disorder have complex healthcare needs: nearly **60%** had at least one chronic medical condition.
- Patients with opioid use disorder and those with long-term opioid use made up **1.5%** of the commercially insured population in 2016, but accounted for **80%** of spending on prescription opioids.

[1] Melek, S., Norris, D., et al. (January 2018). Potential Economic Impact of Integrated Medical-Behavioral Healthcare: Updated Projections for 2017. Milliman Research Report. Retrieved December 4, 2018, from http://www.milliman.com/uploadedFiles/insight/2018/Potential-Economic-Impact-Integrated-Healthcare.pdf.

[2] Davenport, S., Weaver, A., & Caverly, M. (August 2018). Opioid Prescription Drug Patterns in Diagnosed and Non-Diagnosed Opioid Use Disorder Populations. Milliman White Paper. Retrieved December 4, 2018, from http://us.milliman.com/insight/2018/Opioid-prescription-drug-patterns-in-diagnosed-and-non-diagnosed-opioid-use-disorder-populations/.

Prevalence of chronic medical conditions for patients with OUD

In prior studies, we have found that most of the excess healthcare costs for patients with behavioral and chronic medical comorbidities results from increased medical treatment, rather than directly from higher utilization of behavioral services.[3] In other words, patients with comorbid medical and behavioral conditions have more medical needs than those without, beyond just the treatment of their behavioral conditions. In much the same way, research suggests that patients with diagnosed OUD have worse physical and mental quality of life than those without.[4] To expand on the complexities of health status for patients with diagnosed OUD and others with high opioid usage, we explored the prevalence of chronic medical conditions within these populations.

In our study of commercially insured members in 2016, we found that individuals with OUD and opioid super-users were more likely to have each of the studied chronic medical conditions than the general population. In this analysis, we defined opioid super-users as individuals without OUD who were covered by an opioid prescription for at least three-quarters of 2016 (measured as having a proportion of days covered, or PDC, of at least 75% for prescription opioids).[5] Detailed criteria used to identify eligible populations and conditions for this analysis can be found in the methodology section and appendix of this paper.

Approximately 60% of individuals with OUD and 85% of super-users had at least one of the studied chronic medical conditions, exhibiting prevalence rates 1.8 and 2.5 times higher than the general population, respectively. As those with chronic pain may be more likely to seek opioid pain relief, chronic pain, back pain, and headaches were the most prevalent among the OUD and super-user cohorts compared to the general population, showing nearly 20 to 50 times higher prevalence.

Figure 1 presents prevalence rates of chronic medical conditions in 2016 for three commercially insured population cohorts: individuals with OUD, opioid super-users, and all others (individuals without OUD and those with less than 75% PDC of opioids in 2016). The relative rates shown in Figure 1 display the ratio of prevalence rates for OUD patients and super-users compared to the general population.

FIGURE 1: PREVALENCE OF CHRONIC MEDICAL CONDITIONS BY OPIOID USE COHORT, 2016

	PREVALENCE RATES (%)			RELATIVE RATES		
CONDITION	OUD	SUPER-USER	OTHER	OUD	SUPER-USER	OTHER (REFERENCE)
Anemia	7.2	7.7	1.7	4.15	4.45	1.00
Arthritis	26.0	41.9	8.2	3.19	5.14	1.00
Asthma	11.7	14.5	5.8	2.02	2.50	1.00
Back Pain	8.9	16.8	0.2	49.25	93.35	1.00
Cancer	3.7	6.9	2.7	1.35	2.53	1.00
Chronic Kidney Disease	3.7	3.7	0.7	5.13	5.18	1.00
Chronic Obstructive Pulmonary Disease	6.8	8.5	1.3	5.15	6.42	1.00
Chronic Pain	1.9	7.9	0.3	5.66	23.60	1.00
Diabetes (with complications)	4.2	8.1	1.6	2.56	4.96	1.00
Diabetes (without complications)	5.0	9.7	4.0	1.27	2.46	1.00
Endocrine/Metabolic Disorders	26.8	32.7	10.5	2.54	3.10	1.00
Epilepsy	1.8	0.8	0.3	6.22	2.93	1.00
Headache	0.3	0.8	0.0	17.66	41.17	1.00
Heart Failure	5.5	10.2	1.9	2.86	5.28	1.00
HIV	0.3	0.3	0.2	1.84	1.72	1.00
Hypercholesterolemia (with complications)	4.5	8.6	1.7	2.67	5.08	1.00
Hypercholesterolemia (without complications)	11.4	22.8	8.9	1.28	2.57	1.00
Hypertension (with complications)	6.4	11.6	2.1	3.03	5.51	1.00
Hypertension (without complications)	19.4	32.3	10.5	1.84	3.06	1.00
Ischemic Heart Disease	3.7	5.9	1.2	3.01	4.76	1.00
Liver Disease	2.8	2.2	0.5	5.49	4.19	1.00
Osteoporosis	1.1	2.1	0.4	2.55	4.77	1.00
Other Heart Disease	6.5	6.7	1.9	3.41	3.49	1.00
Pulmonary Heart Disease	1.0	1.1	0.2	5.88	6.29	1.00
Stroke	1.4	1.8	0.4	3.68	4.63	1.00
None of the conditions above	**40.6**	**15.5**	**66.8**	**0.61**	**0.23**	**1.00**
Any of the conditions above	**59.4**	**84.5**	**33.2**	**1.79**	**2.55**	**1.00**

[3] Melek, S. et al. (January 2018), ibid.

[4] Griffin, M.L., Bennett, H.E., Fitzmaurice, G.M., Hill, K.P., Provost, S.E., & Weiss, R.D. (2015). Health-related quality of life among prescription opioid-dependent patients: Results from a multi-site study. *Am J Addict*.;24(4):308-314. doi: 10.1111/ajad.12188.

[5] PDC is a common medication adherence measure, calculated as the number of days in a period for which a person has a drug supply divided by the total number of days in a period for which the person is eligible for prescription drug coverage.

Super-users were particularly likely to have chronic medical conditions, with only 15% of the cohort being free from any of the chronic medical conditions studied. Super-users had higher prevalence rates than individuals with OUD for all of the conditions studied except for epilepsy, liver disease, and HIV. The relative rates of pain disorders were especially stark, with super-users being over 93 times as likely as the general population to have back pain, 41 times as likely to have headaches, and nearly 24 times as likely to have chronic pain. While the risks of adverse events and side effects may be significant for patients who use high quantities of opioids, these findings suggest that the healthcare needs for this cohort are quite complex. Any system-level efforts to reduce the volume of opioids prescribed should give special consideration to the unique healthcare needs of this population to ensure that patients are adequately supported.

The high prevalence of chronic medical conditions among those with opioid use disorder presents public health and cost challenges in the United States. Some studies suggest that 90% of the nation's annual health expenditures are used for treating chronic and mental health conditions,[6] so improving the health of these patients and reducing the associated excess healthcare costs is of national concern.

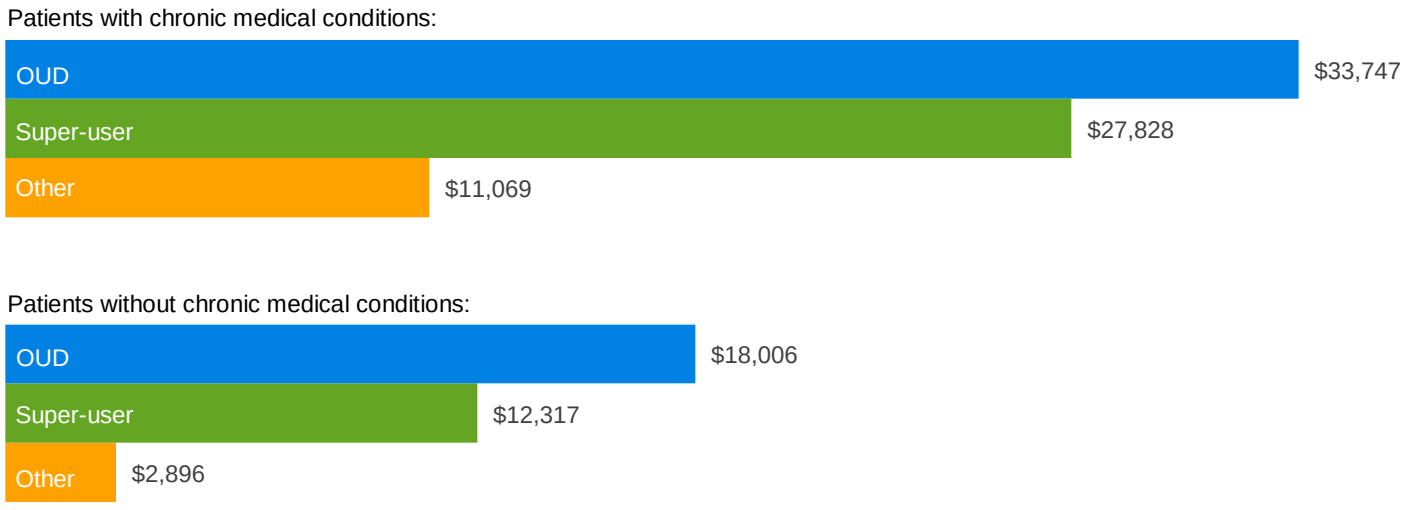
Excess healthcare costs of OUD

Healthcare expenditures for commercially insured individuals with opioid use disorder totaled $15.1 billion in the United States in 2016. On average, this translates to over $27,000 of annual healthcare costs per person with diagnosed OUD. Figure 2 highlights the cost difference by opioid use cohort.

Patients with OUD and any of the studied comorbid chronic medical conditions averaged $33,700 in annual healthcare costs, roughly three times the cost of treatment for individuals with any of the studied medical conditions but no diagnosed OUD. Patients with OUD but no comorbid chronic medical conditions averaged $18,000 in annual healthcare costs, over six times the cost of treatment for individuals without diagnosed OUD.

Opioid super-users with any of the studied chronic medical conditions averaged $27,800 in annual healthcare costs, roughly 2.5 times the cost of treatment for individuals with any of the studied medical conditions but with less significant or no opioid use. Opioid super-users without diagnosed chronic medical conditions averaged $12,300 in annual healthcare costs, over four times the cost of treatment for individuals with less significant or no opioid use, though it's possible that some of these patients have had undiagnosed medical conditions or conditions not captured by this analysis.

FIGURE 2: AVERAGE ANNUAL HEALTHCARE COSTS PER PATIENT BY OPIOID USE COHORT, 2016



[6] CDC. Health and Economic Costs of Chronic Diseases. Retrieved February 15, 2019, from https://www.cdc.gov/chronicdisease/about/costs/index.htm.

Figure 3 shows the total costs per member per month (PMPM) for each opioid use cohort by selected chronic medical condition in the United States in 2016, as well as the excess costs for the OUD and super-user cohorts compared to the general population. Excess costs were calculated as the difference in average costs between patients in the OUD and super-user cohorts and patients with the same chronic medical conditions but without OUD or high opioid use (the "Other" column in the table in Figure 3).

The final two rows show excess costs for individuals with OUD and none of the listed chronic medical conditions and for individuals with OUD and any of the listed chronic medical conditions, respectively. The "Any of the conditions above" row represents the total non-duplicated excess costs for those with OUD. Costs for specific conditions do not sum to the total costs for individuals having any condition because individuals are included in each row for which they have a chronic medical condition.

FIGURE 3: TOTAL AND EXCESS ALLOWED COSTS BY OPIOID USE COHORT, 2016 (PMPM)

	TOTAL COSTS (PMPM)			EXCESS COSTS (PMPM)	
CONDITION	**OUD**	**SUPER-USER**	**OTHER**	**OUD**	**SUPER-USER**
Anemia	$5,687	$4,655	$2,341	$3,346	$2,314
Arthritis	$3,297	$2,574	$1,161	$2,137	$1,414
Asthma	$3,494	$2,901	$926	$2,569	$1,976
Back Pain	$3,456	$2,765	$2,045	$1,411	$720
Cancer	$5,026	$4,957	$1,886	$3,139	$3,070
Chronic Kidney Disease	$6,243	$5,367	$3,657	$2,586	$1,711
Chronic Obstructive Pulmonary Disease	$4,135	$3,293	$1,707	$2,428	$1,585
Chronic Pain	$2,943	$2,493	$1,422	$1,521	$1,071
Diabetes (with complications)	$5,472	$3,817	$2,288	$3,184	$1,529
Diabetes (without complications)	$2,989	$2,335	$1,039	$1,950	$1,295
Endocrine/Metabolic Disorders	$3,593	$3,027	$1,242	$2,352	$1,786
Epilepsy	$5,842	$4,308	$2,155	$3,687	$2,153
Headache	$3,965	$3,212	$1,971	$1,994	$1,241
Heart Failure	$4,728	$3,532	$1,862	$2,866	$1,670
HIV	$6,235	$5,362	$3,125	$3,110	$2,237
Hypercholesterolemia (with complications)	$4,474	$3,450	$1,958	$2,516	$1,492
Hypercholesterolemia (without complications)	$2,479	$2,065	$885	$1,594	$1,180
Hypertension (with complications)	$4,800	$3,498	$2,036	$2,764	$1,462
Hypertension (without complications)	$2,576	$2,164	$930	$1,645	$1,233
Ischemic Heart Disease	$4,834	$3,605	$2,039	$2,795	$1,566
Liver Disease	$5,624	$4,837	$2,267	$3,358	$2,570
Osteoporosis	$5,437	$3,452	$1,465	$3,972	$1,987
Other Heart Disease	$5,069	$4,144	$2,048	$3,021	$2,096
Pulmonary Heart Disease	$7,882	$5,797	$3,517	$4,365	$2,280
Stroke	$4,817	$3,815	$2,163	$2,654	$1,653
None of the conditions above	**$1,500**	**$1,026**	**$241**	**$1,259**	**$785**
Any of the conditions above	**$2,812**	**$2,319**	**$922**	**$1,890**	**$1,397**

Healthcare costs for patients with OUD were 1.7 to 3.8 times higher than for the general population, and super-users were 1.4 to 3.1 times higher than the general population, for the chronic medical conditions studied. On a PMPM basis, patients with OUD and comorbid pulmonary heart disease, osteoporosis, or epilepsy show the highest excess costs compared to patients with comparable chronic medical conditions but no diagnosed OUD. Cancer, liver disease, and anemia are the highest excess-cost conditions among opioid super-users.

In total dollars, the excess costs for patients with OUD and comorbid chronic medical conditions are significant. Figure 4 displays the estimated number of commercially insured patients with diagnosed OUD and each chronic comorbid condition in 2016, as well as their total excess costs compared to the general population.[7] These results represent extrapolations to national totals based on our research database sample sizes and U.S. Census Bureau estimates for the number of individuals with commercial insurance coverage in the United States as of 2016.

[7] Total excess costs were calculated as the difference in PMPM costs for individuals with OUD and those without OUD and comparable medical conditions, multiplied by the number of member months for individuals with diagnosed OUD.

FIGURE 4: TOTAL EXCESS ALLOWED COST FOR COMMERCIALLY INSURED PATIENTS WITH OUD, 2016 (NATIONAL EXTRAPOLATIONS)

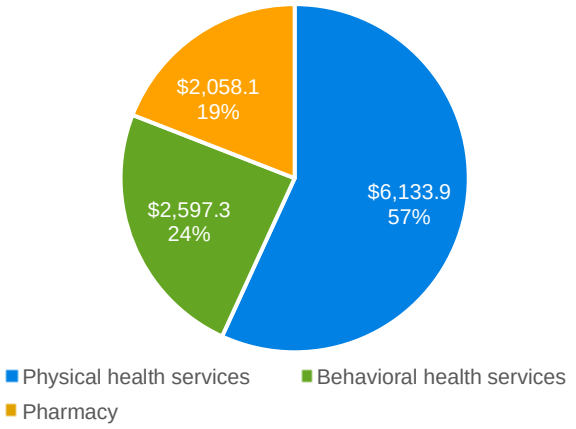
CONDITION	MEMBERS	EXCESS COSTS (IN MILLIONS)
Anemia	39,400	$1,583.3
Arthritis	143,000	$3,667.2
Asthma	64,400	$1,985.9
Back Pain	48,900	$828.0
Cancer	20,500	$770.4
Chronic Kidney Disease	20,300	$630.9
Chronic Obstructive Pulmonary Disease	37,300	$1,087.9
Chronic Pain	10,400	$189.5
Diabetes (with complications)	22,900	$876.0
Diabetes (without complications)	27,700	$648.8
Endocrine/Metabolic Disorders	147,500	$4,161.7
Epilepsy	9,600	$426.9
Headache	1,900	$45.5
Heart Failure	30,400	$1,045.5
HIV	1,700	$63.6
Hypercholesterolemia (with complications)	24,900	$751.8
Hypercholesterolemia (without complications)	62,700	$1,199.2
Hypertension (with complications)	35,100	$1,164.3
Hypertension (without complications)	106,800	$2,108.8
Ischemic Heart Disease	20,400	$684.4
Liver Disease	15,600	$627.3
Osteoporosis	6,200	$295.8
Other Heart Disease	35,800	$1,297.0
Pulmonary Heart Disease	5,700	$300.7
Stroke	7,800	$247.3
None of the conditions above	**223,200**	**$3,372.3**
Any of the conditions above	**327,100**	**$7,417.0**

In absolute terms, conditions with higher prevalence, including endocrine/metabolic disorders, arthritis, and hypertension, show the highest total excess costs for those with OUD. Total excess costs for individuals with OUD and comorbid chronic medical conditions totaled $7.4 billion in 2016, representing a significant value opportunity for costs that could potentially be reduced through targeted treatment strategies. Including individuals with and without any of the studied chronic medical conditions, the excess cost for patients with OUD totaled $10.8 billion for commercially insured patients in the United States in 2016.

Cost differences by type of service

Over 70% of total healthcare costs for individuals with OUD in 2016 were in excess of the costs for patients without OUD, and nearly half of those excess costs were for patients with comorbid chronic medical conditions. Figure 5 summarizes total excess costs for individuals with OUD by broad healthcare service category. Information about how healthcare service categories were identified can be found in the appendix.

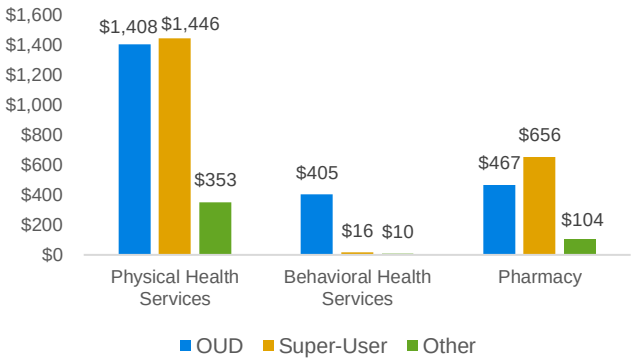
FIGURE 5: TOTAL EXCESS ALLOWED COST FOR PATIENTS WITH OUD BY BROAD SERVICE CATEGORY, 2016



As shown in Figure 5, over half of the excess costs for patients with OUD and comorbid chronic medical conditions are spent on physical healthcare services. This finding corroborates other research regarding behavioral and medical comorbidities, demonstrating that behavioral conditions complicate a person's overall health and contribute to excess costs beyond those that are directly for behavioral healthcare treatment.

Figure 6 further highlights healthcare spending differences among individuals with OUD, super-users, and the general population. Figure 6 shows 2016 healthcare costs PMPM by broad healthcare service category for each opioid use cohort.

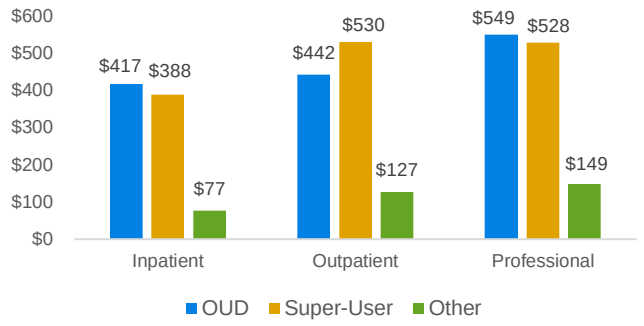
FIGURE 6: BROAD SERVICE CATEGORY COST BREAKDOWN BY OPIOID USE COHORT, 2016 (PMPM)



Individuals with OUD and opioid super-users showed similar spending for physical healthcare services but a remarkable difference in spending for behavioral and pharmacy services in 2016. Opioid super-users exhibited much higher pharmacy costs and lower costs for behavioral services than those with opioid use disorder. Figures 7 to 9 break down each broad healthcare service category into additional detail.

Figure 7 presents physical healthcare costs PMPM by type of service for each population cohort.

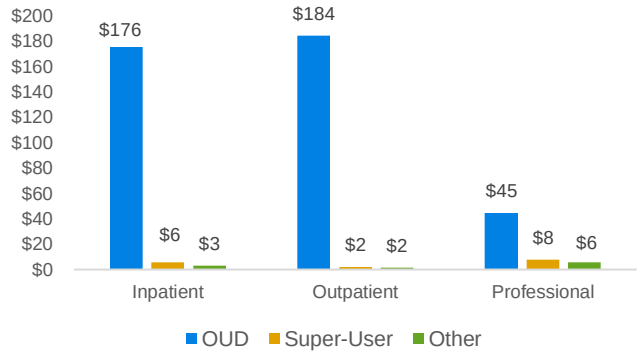
FIGURE 7: PHYSICAL COST BREAKDOWN BY OPIOID USE COHORT, 2016 (PMPM)



OUD patients have the highest inpatient physical healthcare costs of any opioid use cohort, despite having lower overall physical healthcare costs than opioid super-users. The high physical healthcare costs for super-users are driven primarily by elevated costs for outpatient facility services.

Figure 8 shows that opioid super-users spend similarly to the general population for behavioral services in inpatient, outpatient, and professional settings, while those with OUD spend significantly more for each type of behavioral service.

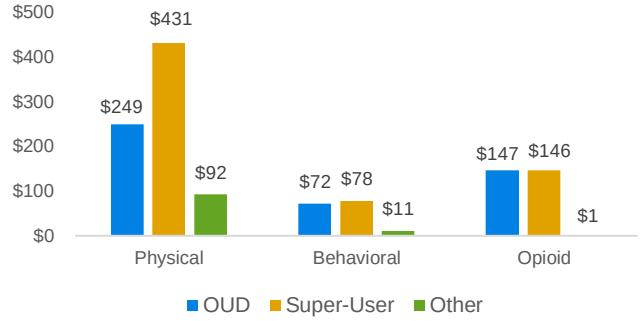
FIGURE 8: BEHAVIORAL COST BREAKDOWN BY OPIOID USE COHORT, 2016 (PMPM)



The difference in behavioral spending sharply contrasts the similarity of spending for physical services between super-users and OUD patients.

Pharmacy cost differences by opioid use cohort are shown in Figure 9. Behavioral pharmacy costs include antianxiety medications, central nervous system agents, antipsychotic medications, antidepressants, anorexiants, and memory enhancers.[8] It's possible that this category is capturing some medications used to manage pain in lieu of opioids. All other non-opioid prescriptions were included in the physical cost category.

FIGURE 9: PHARMACY COST BREAKDOWN BY OPIOID USE COHORT, 2016 (PMPM)



We found that super-users spend 73% more on prescriptions to treat physical conditions than patients with OUD. Part of this difference may be driven by higher prevalence rates of chronic medical conditions among super-users; however, the difference in physical drug spend is proportionally higher than the difference in total chronic condition prevalence between the super-user and OUD cohorts. Additionally, super-users spend a similar amount as the OUD cohort on prescriptions for behavioral disorders, despite showing lower costs for inpatient, outpatient, and professional behavioral treatment. Finally, super-users spend about as much on prescription opioids on a PMPM basis as do individuals with OUD.

Figure 10 shows a comparison of the proportion of opioid spend for each opioid use cohort alongside the percentage of the population that each cohort represents.

FIGURE 10: COMPARISON OF PRESCRIPTION OPIOID SPEND AND POPULATION SIZE BY COHORT, 2016

COHORT	PERCENT OF OPIOID SPEND	PERCENT OF POPULATION
OUD	17.4%	0.3%
Super-User	62.9%	1.2%
Other	19.6%	98.5%

[8] More details about prescription drug criteria used for this analysis can be found in the appendices.

Notably, the OUD and super-user populations, which make up 1.5% of the total population, account for over 80% of the total opioid spend among the commercially insured population in the United States. The remaining 98.5% of the population accounts for only 20% of prescription opioid expenditures.

Discussion

The economic burden of opioid use disorder in the United States is substantial. In addition to the direct costs of excess healthcare utilization reported for those with OUD, there are also high indirect costs associated with productivity loss, absenteeism, and mortality.[9] Estimates of the total economic burden of OUD vary (as do the methods used and factors included), but some estimates place the figure at $78.5 billion annually, over one-third of which is attributable to increased healthcare and substance abuse treatment costs.[10] Other estimates have pegged the cost much higher, including a study commissioned by the White House that estimated the total cost at over half of a trillion dollars in 2015.[11] Another recent analysis found that opioid overdoses alone contribute $11 billion to U.S. hospital costs annually.[12]

We estimate that opioid use disorder contributed $19,600 in excess healthcare costs per patient in 2016. Other studies have found similar results, estimating that opioid abuse, dependence, or poisoning contributes $10,000 to $20,000 in excess healthcare costs per patient each year.[13] In a Medicare population, excess costs of opioid abuse have been found to be even higher, at over $23,000 per patient.[14]

In addition to exhibiting higher costs, patients with OUD tend to be in worse physical and mental health than those without OUD.[15] Due to the complexity of health status for patients with OUD and elevated opioid use, there is no simple treatment solution that works for all patients. This paper aims to highlight the importance of providing comprehensive support for the complex healthcare needs of these patients, including effective management of chronic pain and other medical conditions, in addition to support for patients recovering from substance use disorders. As such, payers and at-risk providers may find that investments in enhanced care, including options such as medication-assisted treatment, behavioral healthcare integration, and effective chronic pain management may present opportunities to address and potentially reduce healthcare costs for patients suffering from both OUD and comorbid chronic medical conditions.

Next steps

Given the high costs and public health impacts of OUD and other chronic medical conditions, addressing the needs of these comorbid patients will be an important step in reducing the total excess healthcare costs of OUD in the United States. Targeted strategies to improve treatment for those with opioid use disorder may be a way to combat these excess costs. In a future paper, we will explore variation in the use of one such strategy, medication-assisted treatment, for patients with opioid use disorder.

Milliman's healthcare expertise and extensive research databases provide unique opportunities to explore pressing population and public health issues on both national and local scales. Those interested in understanding the healthcare costs and risks associated with opioid use disorder or other health concerns within their populations may find value in conducting custom and targeted data analyses or research.

[9] Reinhart, M., Scarpati, L., et al. (July 2018). The Economic Burden of Prescription Opioids: A Systematic Literature Review from 2012 to 2017. Applied Health Economics and Policy. Retrieved December 4, 2018, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6132448/.

[10] Florence, C., Luo F., et al. (October 2016). The Economic Burden of Prescription Opioid Overdose, Abuse and Dependence in the United States, 2013. Med Care. Retrieved December 4, 2018, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5975355/pdf/nihms966245.pdf.

[11] Council of Economic Advisers (November 2017). The Underestimated Cost of the Opioid Crisis, Retrieved February 15, 2019, from https://www.whitehouse.gov/sites/whitehouse.gov/files/images/The%20Underestimated%20Cost%20of%20the%20Opioid%20Crisis.pdf.

[12] Premier (January 3, 2019). Opioid overdoses costing U.S. hospitals an estimated $11 billion annually. News release. Retrieved February 15, 2019, from https://www.premierinc.com/newsroom/press-releases/opioid-overdoses-costing-u-s-hospitals-an-estimated-11-billion-annually.

[13] Kirson, Y., Scarpati, L., et al. (April 2017). The economic burden of opioid abuse: Updated findings. *Journal of Managed Care & Specialty Pharmacy*. Retrieved February 15, 2019, from https://www.jmcp.org/doi/full/10.18553/jmcp.2017.16265.

[14] Roland, C., Ye X., et al. (2019). The prevalence and cost of Medicare beneficiaries diagnosed and at risk for opioid abuse, dependence, and poisoning. *Journal of Managed Care & Specialty Pharmacy*. Retrieved February 15, 2019, from https://www.jmcp.org/doi/full/10.18553/jmcp.2019.25.1.018.

[15] Roland, C., Ye X., et al. ibid.

Data sources

This analysis is based on two large national research databases:

- 2015 and 2016 IBM Watson Health MarketScan Commercial Claims and Encounters Database®
- 2015 and 2016 Milliman Consolidated Health Cost Guidelines™ Sources Database

The IBM Watson Health MarketScan research database reflects the healthcare experience of employees and dependents covered by the health benefit programs of large employers, health plans, and government organizations. These claim data are collected from approximately 350 payers. The MarketScan Commercial Claims and Encounters Database includes data from active employees, early retirees, COBRA continues, and dependents insured by employer-sponsored plans.

The Milliman Consolidated Health Cost Guidelines Database contains healthcare experience primarily for large group commercial members, using data contributed from a number of payers with which Milliman has data purchase or trade agreements. Milliman collects this data from various health plans for use in product development, research, and client projects.

Methodology

The methodology used for this analysis is outlined below. The appendices provide detailed criteria used for identifying chronic conditions in this analysis.

SAMPLE SELECTION

Commercially insured members eligible for the study met the following criteria:

1. Must have at least three months of enrollment in 2015 to ensure minimum credible claim data to identify chronic conditions were present.
2. Must have 12 months of enrollment in 2016.
3. Must be eligible for pharmacy benefits in both 2015 and 2016 during the entire period of enrollment.

COHORT SELECTION AND DEFINITIONS

Eligible members were placed in one of the following mutually exclusive cohorts:

- Opioid use disorder (OUD): Members with any diagnosis code for opioid abuse, dependence, or poisoning in 2015. This includes ICD-9-CM codes beginning with 304.0, 304.7, 305.5, and 965.0, and ICD-10-CM codes beginning with F11, T40.0, T40.1, T40.2, and T40.3.
- Opioid super-users: Members who did not have any OUD diagnosis codes in 2015, but did have opioid prescriptions covering at least 75% of their eligibility in 2016 (PDC of at least 0.75).
- Other: All people who did not fall into either the OUD or super-user cohorts.

CONDITION SELECTION

Twenty-five chronic medical conditions were chosen for analysis, listed below. Diagnosis code and prescription drug criteria for identifying each condition can be found in Appendix A, and align with our previous studies of comorbid physical and behavioral health conditions.[16]

- Anemia
- Arthritis
- Asthma
- Back pain
- Cancer (malignant)
- Chronic kidney disease (CKD)
- Chronic obstructive pulmonary disease (COPD)
- Chronic pain
- Diabetes
  - With complications (IHD, HF, stroke, CKD)
  - Without complications
- Endocrine/metabolic disorders
- Epilepsy
- Headache
- Heart failure (HF)
- HIV
- Hypercholesterolemia
  - With complications (IHD, HF, or stroke)
  - Without complications
- Hypertension
  - With complications (IHD, HF, or stroke)
  - Without complications
- Ischemic heart disease (IHD)
- Liver disease
- Other heart disease
- Osteoporosis
- Pulmonary heart disease
- Stroke

[16] Melek, S. et al. (January 2018), op cit. The conditions and criteria used in this analysis were developed with the guidance of external expert opinion, provided by a psychiatrist and internal medicine physician.

Caveats and limitations

The results in this analysis reflect commercial large group employer-sponsored insurance and thus likely under-represent lower-income households that purchased individual coverage under the Patient Protection and Affordable Care Act (ACA). Publicly insured populations such as Medicare and Medicaid were not studied. Additionally, while sampling errors are quite small due to the large sample sizes available in each data set used for this analysis, sampling bias could be present to the extent that health plans and payers that contribute to the research databases differ systematically from non-contributors.

The diagnosis codes used to identify opioid use disorder include a range of severities, with some cases of uncomplicated use and some remission. Additionally, opioid overdose does not always happen within the context of an opioid use disorder, especially in the elderly or opioid-naïve. Due to lack of available data, we were not able to analyze chronic condition comorbidities for individuals who obtain opioids outside of a prescription.

This analysis is intended to highlight the impact of opioid use disorder on chronic medical conditions in the United States. Opioid therapy is a complicated medical practice, and we do not suggest or endorse any particular opioid prescribing strategy.

Milliman has not audited the research data set used for this analysis, but we have extensive experience working with this data and have found it to be reasonable. To the extent that there are errors or omissions in any of the data sources relied upon for this analysis, these results may also be in error. This report does not represent conclusive recommendations regarding treatment of opioid use disorder or legal advice.

Milliman does not intend to benefit or create a legal duty to any recipient of this work.

Additionally, this report explores the healthcare costs for people with both chronic medical conditions and various degrees of opioid use. Our analysis does not include a study of the causality of co-occurring medical and behavioral conditions, nor does it involve a detailed risk assessment of each patient.

Our national projections extrapolate the results from our database analyses to national population estimates for the commercially insured population cohort. To the extent that the national population healthcare costs and risk levels for any of these cohorts differ from that represented in the databases that we used, our national estimates may need adjustment. The databases we used represent the best available sources for our analysis.

The information in this study is designed to describe the prevalence and healthcare costs of insured members with certain chronic medical conditions, behavioral conditions, or both. It may not be appropriate and should not be used for other purposes.

Milliman did not receive any external funding for this analysis. Any opinions or views expressed in this report are those of the authors, not of Milliman.

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Milliman is among the world's largest providers of actuarial and related products and services. The firm has consulting practices in life insurance and financial services, property & casualty insurance, healthcare, and employee benefits. Founded in 1947, Milliman is an independent firm with offices in major cities around the globe.

milliman.com

CONTACT

Stoddard Davenport
Healthcare Management Consultant
stoddard.davenport@milliman.com

Alexandra Weaver
Associate Actuary
ally.weaver@milliman.com

Matt Caverly
Actuarial Analyst
matt.caverly@milliman.com

Appendix A: Chronic condition criteria

Conditions were identified using all available ICD-9 and ICD-10 diagnosis codes for 2015 claims for inpatient (IP), emergency room (ER), and outpatient (OP) healthcare services. For some conditions, pharmacy-based criteria were used as well. A member can have multiple chronic medical conditions; these members were analyzed once for each condition. The diagnosis code(s) and pharmacy criteria for identifying each of the conditions are described below.

For prescription-based criteria, when drugs were used to treat up to four conditions, we required presence of a diagnosis code within 30 days prior to the prescription to identify the condition. If a drug is used to treat a single condition, then we did not require the "diagnosis within 30 days" criteria. Certain conditions are treated with prescription medications that are also used for more than four other conditions. Because these drugs do not help uniquely identify the patient's condition, we have not included such drugs in the condition identification criteria below.[17]

For certain chronic conditions that are managed using drugs (such as COPD), we applied age-based criteria to reduce the possibility of identifying false positives in the pharmacy claim data. For example, for COPD, if only prescriptions for the condition but no diagnosis codes were available, we required that the member also be over the age of 50 to be assessed as having COPD.

Certain prescription-based criteria use therapeutic classes when the drugs within the class uniquely identify particular conditions.

Other prescription-based condition-identification criteria were obtained from Milliman Medical Underwriting Guidelines™ (MUGS™). The guidelines include uses not approved by the U.S. Food and Drug Administration (FDA) for some of the drugs. If a drug has three or more FDA-approved uses, then the non-FDA-approved conditions for that drug would not be listed. If the drug has fewer than three FDA-approved uses, then up to three "generally accepted" uses would be listed. If no such uses exist, then up to three "limited evidence uses" would be listed.

CRITERIA FOR DETERMINATION OF MEDICAL CONDITIONS

To ensure that we believe credible evidence exists of chronic medical and comorbid behavioral conditions, we applied the following criteria to determine presence of a condition:

For all conditions where drug-based identification criteria are not used, a member had to meet any one of the following criteria: one IP admission, one ER visit, or two OP visits with a diagnosis code identified below.

For all other conditions, the member had to meet any one of the following criteria: one IP admission, one ER visit, one OP visit and one Rx script (when the Rx is used to treat only one condition), one OP visit and one Rx within 30 days of an OP visit (when the Rx is used to treat more than one condition), or two OP visits or two Rx scripts related to the condition (that is, diagnosis code for the condition was present on the visit or the script met the therapeutic class and generic name criteria described above).

CHRONIC CONDITIONS: MEDICAL CLAIM CRITERIA

We identified chronic medical conditions by flagging any claim with a diagnosis code in the list below.

CONDITION	ICD-9 CRITERIA	ICD-10 CRITERIA
Anemia	280.XX-285.XX	D50.X-D53.X, D55.X-D64.X
Arthritis	710.XX-719.XX	M00.X-M02.2X, M02.8X-M02.9, M05.0X-M05.3X, M05.6X-M08.0X, M08.2X-M08.9X, M11.X-M19.X, M22.0X-M24.1X, M24.30-M25.53X, M25.55X-M25.67X, M25.8X-M25.9, M32.0, M32.10, M32.19-M33.00, M33.09-M33.10, M33.19-M33.20, M33.29, M33.90, M33.99-M34.2, M34.89-M35.01, M35.09-M35.1, M35.5, M35.8-M36.8, M43.3-M43.5X, M79.646, Q68.6, R26.2, R29.4
Asthma	493.XX	J45.X

[17] This criterion follows that used in Milliman's "Potential Economic Impact of Integrated Medical-Behavioral Healthcare" report published in January 2018. The criteria was developed with the guidance of external expert opinion, provided by a psychiatrist and internal medicine physician.

CONDITION	ICD-9 CRITERIA	ICD-10 CRITERIA
Back Pain	724.XX (for patients who had a proportion of days covered of 75% of their enrolled periods)	M43.2X, M43.8X (excluding M43.8X1, M43.8X2, M43.8X3), M48.0X (excluding M48.01-M48.03), M51.1X, M99.2X-M99.7X (excluding M99.20, M99.21, M99.30, M99.31, M99.40, M99.41, M99.50, M99.51, M99.60, M99.61, M99.70, M99.71), M53.X (excluding M53.0X, M53.1X, M53.81, M53.82, M53.83, M53.2X1, M53.2X2, M53.2X3), M54.X (excluding M54.2X, M54.01, M54.02, M54.11, M54.12, M54.13, M54.81), M62.830 (for patients who had a proportion of days covered of 75% of their enrolled periods)
Cancer (Malignant)	140.XX-209.3X, 209.7X, 230.XX-239.XX	CX (excluding C88.0, C96.5, C96.6), D0X, D4X (excluding D47.2, D47.Z2), D37X-D39X, Q850X
Chronic Kidney Disease (CKD)	580.XX-589.XX	M32.14, M32.15, M35.04, N0X, N14.X-N19.X (excluding N15.1), N25.X-N27.X (excluding N26.2)
Chronic Obstructive Pulmonary Disease (COPD)	490.XX-492.XX, 494.XX-496.XX, 500.XX-508.XX	J4X-J7X, excluding J45.X
Chronic Pain	338.2X (for patients who had a proportion of days covered of 75% of their enrolled periods)	G89.2X (for patients who had a proportion of days covered of 75% of their enrolled periods)
Diabetes With Complications	Member must also have had IHD, HF, stroke, kidney disease, retinopathy, or neuropathy. Retinopathy: 362.0X. Neuropathy: 365.0X, 356.8. All others identified as mentioned elsewhere in this appendix.	E08.32X-E08.35X (excluding E08.321, E08.329, E08.331, E08.339, E08.341, E08.349, E08.351, E08.359), E10.22-E10.35X, E10.40-E10.43, E11.22-E11.35X, E11.40-E11.43, G60.8X, H40.0X
Diabetes Without Complications	250.XX	E08.37X, E102.1, E10.1X, E10.36-E10.39, E10.44-E11.21, E11.36-E11.39, E11.44-E11.99
Endocrine/Metabolic Disorders	240.XX-279.XX (excluding 250.X, 272.0-272.4, 272.9)	C88.0, C96.5-C96.6, D47.2, D8X (excluding D86.X and D89.4X), E00.X-E07.X (excluding E07.81), E08.0X, E08.1X, E08.2X, E08.4X, E08.5X, E08.6X, E08.7X, E08.8X, E08.9X, E08.311, E08.319, E08.321, E08.329, E08.331, E08.339, E08.341, E08.349, E083.51, E08.359, E08.36, E08.39, E13.X-E35.X, E40-E74.X, E75.2X-E75.3 (excluding E75.23, E75.25, E75.29), E75.5, E76.0-E77.9, E78.79, E78.81, E78.89, E78.6, E79.1-E89.6 (excluding E83.2), H49.81, N98.1, M10.X, M83.X
Epilepsy	345.1X-345.9X	G40.X, excluding G40.AX
Headache	784.0X (for patients who had a proportion of days covered of 75% of their enrolled periods)	G44.1, R51 (for patients who had a proportion of days covered of 75% of their enrolled periods)
Heart Failure (HF)	402.01, 402.11, 402.91, 404.01, 404.11, or 428.XX	I11.0, I13.0, I50.X
HIV	042	B20.XX-B24.XX
Hypercholesterolemia With Complications	Member must also have had IHD, HF, or stroke (identified as mentioned elsewhere in this appendix).	
Hypercholesterolemia Without Complications	272.0-272.4, 272.9	E78.X (excluding E78.6, E78.71, E78.72, E78.79, E78.81, E78.89), E75.6

CONDITION	ICD-9 CRITERIA	ICD-10 CRITERIA
Hypertension With Complications	401.XX-405.XX (excluding 402.01, 402.11, 402.91, 404.01, 404.11)	I1X (excluding I11.0 and I13.0), N26.2
Hypertension Without Complications	Member must also have had IHD, HF, or stroke (identified as mentioned elsewhere in this appendix).	
Ischemic Heart Disease	410.XX-414.XX	I20.X-I25.X
Liver Disease	570.XX-573.XX	K7X
Osteoporosis	733.0X	M81X
Other Heart Disease	420.XX-427.XX, 429.XX	I3X, I4X, I23.X, I51.X, I52.X, I97.0, I97.1, R00.1, M32.11, M32.12
Pulmonary Heart Disease	415.XX-417.XX	I26.X-I28.X
Stroke	430.XX-434.XX	I60.X-I66.X

CHRONIC CONDITIONS: PHARMACY CLAIM CRITERIA

We identified chronic medical conditions by flagging any pharmacy claim with at least two prescription drug claims in the list below or at least one prescription drug claim in the list below within 30 days of diagnosis of the associated condition. Drugs that are predominantly used to treat a single condition are used to identify that condition if the patient had at least two claims for that drug, and drugs that are used to treat multiple conditions are used to identify a condition when prescribed within 30 days of a medical claim with a corroborating diagnosis code. Therapeutic classes (as defined by The IBM Micromedex® RED BOOK® database) are listed when every drug within the class is included in the identification criteria. Note that these criteria are not the only way to identify the associated conditions, and other criteria may produce differing results. There may be drugs listed below that are not always used for the associated conditions or drugs not listed below that are. Chronic conditions not listed in the table below were identified using medical claim criteria only.

CONDITION	AT LEAST TWO PRESCRIPTION DRUG CLAIMS	AT LEAST ONE PRESCRIPTION DRUG CLAIM WITHIN 30 DAYS OF DIAGNOSIS
Asthma	Any pharmacy drug with a National Drug Code (NDC) number identified as an asthma medication according to the National Committee for Quality Assurance (NCQA)	N/A
Chronic Obstructive Pulmonary Disease (COPD)	AIRET, ANORO ELLIPTA, ARALAST, ARCAPTA NEOHALER, COMBIVENT, DALIRESP, GLASSIA, INCRU.S.E ELLIPTA, PERFOROMIST, PROLASTIN, SPIRIVA, STIOLTO, STRIVERDI, TUDORZA, VOLMAX, ZEMAIRA **Members must also be age 50 or older*	ACCUNEB, ACETYLCYSTEINE, ADVAIR, AEROBID, AEROLATE, ALBUTEROL, AMINOPHYLLINE, BREO ELLIPTA, BRONDIL, BROVANA, CEDAX, CEFTIBUTEN, COPD, DG 200, DIFIL-G, DILEX-G, DILOR, DUONEB, DYFLEX-G, DY-G, DYLIX, DYPHYLLINE-GG, ELIXOPHYLLIN, FACTIVE, FLOVENT, FLOVENT DISKU.S., FORADIL AEROLIZER, JAY-PHYL, KETEK, LEVALBUTEROL, LUFYLLIN, MUCOMYST, PROAIR, PROVENTIL, PULMICORT, QUIBRON-T, QVAR, SYMBICORT, THEO-24, THEOCAP, THEOCHRON, THEOLAIR, THEOPHYLLINE, UNIPHYL, VENTOLIN HFA, VOSPIRE ER, XOPENEX
Diabetes (with or without complications)	Any pharmacy drug in the following therapeutic classes: “Diabetes Mell/Diab Supply NEC,” “Antidiabetic Ag, Sulfonylureas,” "Antidiabetic Agents, Insulins," or "Antidiabetic Agents, Misc”	N/A

CONDITION	AT LEAST TWO PRESCRIPTION DRUG CLAIMS	AT LEAST ONE PRESCRIPTION DRUG CLAIM WITHIN 30 DAYS OF DIAGNOSIS
Heart Failure (HF)	Any pharmacy drug in the following therapeutic classes: "Cardiac, Cardiac Glycosides," "Diuretics, Misc.," "Diuretics, Loop Diuretics," "Diuretics, Osmotic," "Diuretics, Potassium-Sparing," and "Diuretics, Carb Anhydrase Inhib."	N/A
Hypercholesterolemia (with or without complications)	ADVICOR, ANTARA, FENOFIBRATE, FENOFIBRIC ACID, FENOGLIDE, FIBRICOR, JUXTAPID, KYNAMRO, LIPOFEN, LIPTRUZET, LIVALO, LOFIBRA, LOVAZA, NIASPAN, SIMCOR, TRICOR, TRIGLIDE, TRILIPIX, VASCEPA, VYTORIN, ZETIA	ALTOPREV, AMLODIPINE BESYLATE/ATORVASTATIN CALCIUM, ATORVASTATIN CALCIUM, CADUET, CARDIOSTEROL, CHOLESTYRAMINE, COLESTID, COLESTIPOL, CRESTOR, FLUVASTATIN, GEMFIBROZIL, JUVISYNC, LESCOL, LIPITOR, LIPITOR (BRAND), LIPITOR (GENERIC), LOPID, LOVASTATIN, MEVACOR, MICRONIZED COLESTIPOL HCL, NEO-FRADIN, NIACIN, PANTOTHENIC ACID, POLICOSANOL, PREVALITE, QUESTRAN, SIMVASTATIN, VANADIUM, WELCHOL, ZOCOR, ZYNCOL
Hypertension (with or without complications)	ACCURETIC, ALDOCLOR, ALDORIL, AMLODIPINE BESYLATE/BENAXEPRIL HYDROCHLORIDE, AMLODIPINE/VALSARTAN, AMTURNIDE, AVALIDE, AZOR, BISOPROLOL FUMARATE/HYDROCHLOROTHIAZIDE, BYSTOLIC, CANDESARTAN CILEXETIL/HYDROCHLOROTHIAZIDE, CARTROL, CLEVIPREX, CLORPRES, CORLOPAM, CORZIDE, EDARBI, EDARBYCLOR, ENDURONYL, EPROSARTAN MESYLATE, EXFORGE, FENOLDOPAM MESYLATE, FOSINOPRIL SODIUM/HYDROCHLOROTHIAZIDE, GUANABENZ ACETATE, INDERIDE, INNOPRAN XL, KERLONE, LEVATOL, LOTREL, METHYCLOTHIAZIDE, METHYLDOPA/HYDROCHLOROTHIAZIDE, METHYLDOPATE HCL, MINIZIDE, MOEXIPRIL, NATURETIN, OLMESARTAN MEDOXOMIL, QUINARETIC, RAUWOLFIA/BENDROFLUMETHIAZIDE, TARKA, TEKAMLO, TEKTURNA, TEKTURNA HCT, TENORETIC, TEVETEN, TIMOLIDE, TRANDOLAPRIL/VERAPAMIL HCL, TRIBENZOR, TWYNSTA, UNIRETIC, UNIVASC, VALTURNA, ZIAC	ACCUPRIL, ACEON, ADALAT, AFEDITAB, ALDACTAZIDE, ALTACE, AMLODIPINE BESYLATE, AMLODIPINE BESYLATE/ATORVASTATIN CALCIUM, ATACAND, ATENOLOL, AVAPRO, BENAZEPRIL HCL, BENICAR, BETAXOLOL HCL, BISOPROLOL FUMARATE, BLOCADREN, BREVIBLOC, BUMETANIDE, CADUET, CANDESARTAN CILEXETIL, CAPOTEN, CAPOZIDE, CAPTOPRIL, CAPTOPRIL/HYDROCHLOROTHIAZIDE, CARDENE, CARDIZEM, CARDURA, CARTIA XT, CARVEDILOL, CATAPRES, CHLOROTHIAZIDE, CHLOROTHIAZIDE SODIUM, CHLORTHALIDONE, COREG, CORGARD, COVERA-HS, COZAAR, DEMADEX, DEMSER, DIBENZYLINE, DILACOR, DILTIA XT, DILT-XR, DILTZAC, DIOVAN, DIURIL, DOXAZOSIN MESYLATE, DYAZIDE, DYNACIRC, DYRENIUM, ENALAPRIL MALEATE, ENALAPRIL MALEATE/HYDROCHLOROTHIAZIDE, ENALAPRILAT, EPANED, EPLERENONE, ESMOLOL HCL, FELODIPINE, FOSINOPRIL SODIUM, FUROSEMIDE, GUANFACINE HCL, HYDRALAZINE, HYDROCHLOROTHIAZIDE, HYTRIN, HYZAAR, INDAPAMIDE, INSPRA, IRBESARTAN, ISOPTIN, ISRADIPINE, LABETALOL HCL, LASIX, LINSEED OIL, LISINOPRIL, LOSARTAN POTASSIUM, LOSARTAN POTASSIUM/HYDROCHLOROTHIAZIDE, LOTENSIN, LOZOL, LYTENSOPRIL, MAGNESIUM SULFATE, MATZIM LA, MAVIK, MAXZIDE, METHYLDOPA, METOLAZONE, METOPROLOL, MICROZIDE, MIDAMOR, MINIPRESS, MINOXIDIL, MONOPRIL, NADOLOL, NEXICLON XR, NICARDIPINE HCL, NIFEDIAC CC, NIFEDICAL XL, NIFEDIPINE, NISOLDIPINE, NITROGLYCERIN, NITRONAL, NITROPRESS, NORVASC, PERINDOPRIL ERBUMINE, PINDOLOL, PLENDIL, PRAZOSIN HCL, PRINIVIL, PRINZIDE, PROCARDIA, QUINAPRIL, RAMIPRIL, RENESE, RESERPINE, SODIUM DIURIL, SODIUM EDECRIN, SULAR, TAZTIA XT, TENEX, TENORMIN, TERAZOSIN HCL, THALITONE, TIAZAC, TOPROL XL, TORSEMIDE, TRANDATE, TRANDOLAPRIL, TRIAMTERENE/HYDROCHLOROTHIAZIDE, VALSARTAN, VALSARTAN/HYDROCHLOROTHIAZIDE, VASERETIC, VASOTEC, VECAMYL, VERELAN, ZAROXOLYN, ZEBETA, ZESTORETIC, ZESTRIL

CONDITION	AT LEAST TWO PRESCRIPTION DRUG CLAIMS	AT LEAST ONE PRESCRIPTION DRUG CLAIM WITHIN 30 DAYS OF DIAGNOSIS
HIV	APTIVUS, ATRIPLA, COMPLERA, EDURANT, EGRIFTA, EPZICOM, EVOTAZ, FORTOVASE, INTELENCE, ISENTRESS, MEGACE, MEGACE ES, PREZCOBIX, PREZISTA, REYATAZ, SELZENTRY, STRIBILD, TIVICAY, TRIUMEQ, TRIZIVIR, ABACAVIR SULFATE, LAMIVUDINE AND ZIDOVUDINE, TRUVADA, TYBOST, VITEKTA	ABACAVIR, AGENERASE, COMBIVIR, CRIXIVAN, DAUNORUBICIN HCL, DAUNORUBICIN HCL NOVAPLU.S., DIDANOSINE, DIDANOSINE DR, DOXIL, EMTRIVA, EPIVIR, EPIVIR A/F, EPIVIR HBV, EPOGEN, FULYZAQ, FUZEON, HIVID, INVIRASE, KALETRA, LAMIVUDINE, LAMIVUDINE HBV, LAMIVUDINE-ZIDOVUDINE, LEUKINE, LEXIVA, LIPODOX, LIPODOX 50, NEUTREXIN, NEVIRAPINE, NORVIR, PROCRIT, RESCRIPTOR, RETROVIR, STAVUDINE, SU.S.TIVA, VIDEX, VIDEX EC, VIDEX PEDIATRIC, VIRACEPT, VIRAMUNE, VIRAMUNE O/S, VIRAMUNE XR, VIREAD, ZERIT, ZIAGEN, ZIDOVUDINE
Osteoporosis	ACTIMMUNE, ATELVIA, CALCITONIN-SALMON, DUAVEE, FORTEO, FORTICAL, FOSTEUM **Members must also be age 50 or older*	ACTIVELLA, ACTONEL, ALENDRONATE SODIUM, ALORA, BINOSTO, BONIVA, CALAFOL, CALCIUM ACETATE, CAVAREST, CAVIRINSE, CITRU.S. CALCIUM + D, CLINPRO, CONTROLRX, DENTA 5000 PLU.S., DENTAGEL, DENTALL 1100 PLU.S., ESTRADERM, ESTROPIPATE, EVISTA, FEMHRT, FLORICAL, FLUORIDE MOUTHWASH, FLUORIDEX DAILY DEFENSE, FLUORIGARD, FOSAMAX, GYNODIOL, IBANDRONATE SODIUM, JEVANTIQUE, JINTELI, KARIGEL, LISTERINE TOOTH DEFENSE, LISTERMINT, LOPREEZA, MENOSTAR, MIACALCIN, MIMVEY, MINIVELLE, NAFRINSE, NEUTRAGARD ADVANCED, NEUTRAL SODIUM FLUORIDE, NITROBID, NORETHINDRONE ACETATE, OGEN, ORTHO-EST, PHOS-FLUR, PHOS-FLUR OTC, PREFEST, PREMPHASE, PREMPRO, PREVIDENT, PROLIA, RALOXIFENE, RECLAST, REMBRANDT, RISEDRONATE, SODIUM FLUORIDE, THERA-FLUR-N, VIVELLE
Stroke	AGGRENOX	ACTIVASEALTACE, ATORVASTATIN CALCIUM, CLOPIDOGREL, COZAAR, ELIQUIS, HYZAAR, JUVISYNC, LIPITOR, LIPITOR (BRAND), LIPITOR (GENERIC), LOSARTAN POTASSIUM, LOSARTAN POTASSIUM/HYDROCHLOROTHIAZIDE, NIMODIPINE, NIMOTOP, NYMALIZE, PLAVIX, PRADAXA, RAMIPRIL, REOPRO, SIMVASTATIN, TICLID, TICLOPIDINE HCL, ZOCOR

Appendix B: Claim service categories

We grouped claims into inpatient, outpatient, and professional categories for physical and behavioral healthcare services. Service categories were determined using Milliman's proprietary Health Cost Guidelines™ Grouper (HCG Grouper) software.[18]

The software uses a variety of claim-level detail, including revenue codes, Current Procedural Terminology (CPT) codes, Diagnosis-Related Group (DRG) codes, place of service codes, and diagnosis codes, in order to produce service category classifications.

We relied on therapeutic class and specific drug usage in order to identify behavioral prescription drugs. The logic used to classify service categories within the pharmacy data is listed below.

Prescription drugs: Opioids

Opioids were identified in prescription drug data using a list of National Drug Code (NDC) codes published by the Centers for Disease Control and Prevention (CDC).[19]

Prescription drugs: Behavioral

Any claims identified by the following criteria (and not already classified as an opioid) were allocated to these categories.

- Antianxiety drugs: Therapeutic classes of "ASH, Benzodiazepines," "Anticonvulsant, Benzodiazepine," and "Anxiolytic/Sedative/Hypnot NEC"; generic drugs "Clonazepam" and "Buspirone Hydrochloride."
- Central nervous system (CNS) agents: Therapeutic classes of "Anticonvulsants, Misc," and "CNS Agents, Misc."
- Antipsychotics: Therapeutic classes of "Antimanic Agents, NEC" and "Psychother,Tranq/Antipsychotic"; generic drug "Valproic Acid."
- Antidepressants: Therapeutic class of "Psychother, Antidepressants."
- Anorexiants: Therapeutic class of "Stimulant, Amphetamine Type."
- Memory enhancers: The dementia medication "Reminyl."

Prescription drugs: Physical

Any prescription drug claim not categorized as a behavioral drug above is tagged under this category.

[18] More information about Milliman's HCG Grouper can be found here: http://www.milliman.com/Solutions/Products/Resources/Health-Cost-Guidelines/Health-Cost-Guidelines---Grouper/.

[19] CDC (September 29, 2017). Analyzing Prescription Data and Morphine Milligram Equivalents (MME). Opioid Overdose: Data Resources. Retrieved August 9, 2018, from https://www.cdc.gov/drugoverdose/resources/data.html.