MILLIMAN REPORT

Chronic pain prevalence, cost, and connections to opioid use

Commissioned by Ethos Laboratories

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I. EXECUTIVE SUMMARY

Ethos Laboratories, a national laboratory specializing in pain diagnostics with a product portfolio designed to provide insight to support their customers in managing patient populations, engaged Milliman to explore healthcare costs for individuals with a recorded diagnosis of chronic and/or other pain conditions and opioid use based on prescription fills or opioid-related (use, dependence, abuse) diagnosis codes. Using administrative healthcare claims data, we estimate cost differences among cohorts with and without chronic and/or other pain conditions, stratified further by opioid use, for members insured under different sources of health benefits coverage—employer-sponsored commercial health insurance plans, Medicare Advantage (MA) plans, and Managed Medicaid (State of Illinois) plans.

We identified patients with chronic pain, as well as other common medical conditions that are usually characterized by persistent pain for which opioids may be used to manage. The most recent Centers for Disease Control and Prevention (CDC) Clinical Practice Guideline for Prescribing Opioids for Pain notes the following were used in the assessment for the categorization of the recommendations:[1]

- Multiple noninvasive nonpharmacologic interventions are not only not associated with serious harms but are also associated with improvements in pain that are comparable to those associated with opioid therapy and are sustained after completion of treatment (in comparison to medications for which benefits are not anticipated to continue after a patient stops taking them).
- There is limited evidence to suggest an association with improvements in pain and long-term opioid use; instead, most associations with long-term opioid therapy include increased risk for serious harm. Discontinuing opioid therapy after extended periods of continuous use is challenging and patients require effective support.
- There is no validated, nor reliable, method for predicting whether a patient will benefit from opioid therapy and/or whether a patient will experience serious harm from it.

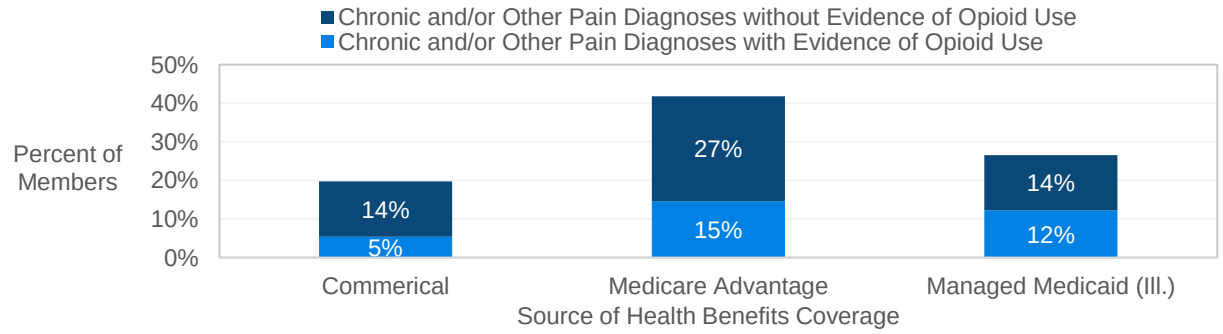
KEY FINDINGS

Prevalence of chronic and other pain diagnoses and evidence of opioid use

Figure 1 shows the percentage of members with a recorded diagnosis of chronic and/or other pain (defined as arthritis, headache and migraine, or low back pain) with and without evidence of opioid use based on prescription fills or opioid use, dependence, or abuse diagnosis codes, by source of health benefits coverage. Each cohort is unique so that if a member has both chronic pain and other pain, they are grouped into the chronic pain cohort.

We found one in five commercially insured adults have a recorded diagnosis of chronic and/or other pain and nearly one in three with a diagnosis of chronic and/or other pain have evidence of opioid use. More than four in 10 adult MA beneficiaries have a diagnosis of chronic and/or other pain, while more than one-third of MA beneficiaries with a diagnosis of chronic and/or other pain have evidence of opioid use. More than one in four Managed Medicaid (using State of Illinois) adult beneficiaries have a diagnosis of chronic and/or other pain. Nearly one-half of Managed Medicaid (State of Illinois) beneficiaries with a diagnosis of chronic and/or other pain have evidence of opioid use.

Figure 1:
Distributions of Members by Cohort and Source of Health Benefits Coverage, Calendar Year (CY) 2019



Note: See Methodology section for descriptions of cohort designation criteria.

[1] Dowell, D., Ragan, K.R., Jones, C.M., Baldwin, G.T., & Chou, R. (November 4, 2022). CDC Clinical Practice Guideline for Prescribing Opioids for Pain – United States, 2022. MMWR Recomm Rep;71 (No. RR-3):1–95. DOI: Retrieved 13 July 2023 from http://dx.doi.org/10.15585/mmwr.rr7103a1.

Healthcare costs for members with chronic and/or other pain diagnoses and evidence of opioid use

We adjusted the healthcare costs findings to account for certain population differences, such as age and certain comorbid conditions (e.g., rheumatoid arthritis, spinal injuries), using risk scores for each cohort. We did not account for differences in the prevalence of other health conditions not included in the risk adjustment model (e.g., migraines, spinal stenosis), the severity of health conditions regardless of whether or not they were included in the risk adjustment model (osteoarthritis, diabetes), or recent treatment of comorbid conditions (e.g., orthopedic surgery followed by opioid treatment for postsurgical pain).

After adjusting, commercially insured individuals with a recorded diagnosis of chronic and/or other pain have actual total allowed per member per month (PMPM) costs that are 1.2 times, or approximately 20%, higher than the cohort that does not have chronic and/or other pain (Figure 2). For the Managed Medicaid (State of Illinois) chronic and/or other pain cohort, costs are 1.1 times, or approximately 10%, higher than the cohort that does not have chronic and/or other pain. However, in the MA population, costs for the chronic and/or other pain cohort are lower than the cohort without chronic and/or other pain. Commercially insured, MA, and Managed Medicaid (State of Illinois) members in the chronic and/or other pain cohorts with evidence of opioid use have 60%, 30%, and 10% higher costs PMPM, respectively, than the chronic and/or other pain cohorts without evidence of opioid use (Figure 2).

Figure 2:
Actual to Expected Total Allowed Cost PMPMs
by Cohort and Source of Health Benefits Coverage, CY 2019

Cohort		Commercial	Medicare Advantage	Managed Medicaid (Ill.)
Chronic and/or Other Pain Diagnoses	Actual	$1,007	$967	$867
	Expected	$809	$1,077	$773
	Actual/Expected	**1.2**	**0.9**	**1.1**
Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	Actual	$1,895	$1,424	$1,166
	Expected	$1,215	$1,136	$1,096
	Actual/Expected	**1.6**	**1.3**	**1.1**

Note: See Methodology section for descriptions of cohort designation criteria. Actual to expected findings reflect certain population differences between cohorts within each line of business.

SUMMARY DISCUSSION AND AREAS FOR FURTHER RESEARCH

In the report that follows, we provide additional detail on our findings, presenting the methodology, healthcare cost results, and considerations for use of the summaries in estimating potential savings that might be associated with reductions in the prevalence of chronic and/or other pain with evidence of opioid use. The analysis presented herein indicates a likely association between the presence of a diagnosis of chronic and/or other pain with or without the evidence of opioid use, and increased costs for the commercial and Managed Medicaid (State of Illinois) populations. It should not be construed to mean that pain management, reduction in pain, and/or reduction in opioid use would necessarily eliminate any specific portion of excess costs illustrated in the table in Figure 2.

As we demonstrate, cost differences among the cohorts with and without a recorded diagnosis of chronic and/or other pain are not immaterial; instead, they are less in magnitude (except for Medicaid) when compared to differences in costs among the chronic and/or other pain cohort with and without evidence of opioid use. Furthermore, we find that these cost differences are not driven solely by costs for prescription drugs (to which opioids would be attributed); instead, we see that inpatient and outpatient facility costs appear to be the primary drivers of the higher amounts.

Finally, we observed the highest prevalence of members with a recorded diagnosis of chronic and/or other pain in the MA population, which aligns with published estimates that this diagnosis increases with older age.[2,3,4] On the other hand, the Managed Medicaid (State of Illinois) population has the highest proportion of members with a recorded diagnosis of chronic and/or other pain with evidence of opioid use. This may be due to the particular sample chosen, such as its geographic location (U.S. Midwest), or other factors currently unknown at this time.

[2] Dowell, D. (July 16, 2021). Draft Updated CDC Guideline for Prescribing Opioids: Background, Overview, and Progress. National Center for Injury Prevention and Control. Retrieved July 13, 2023, from https://www.cdc.gov/injury/pdfs/bsc/BSC_Background_Overview_Progress-GL-Update_6_28_cleared_final_D_Dowell-508-fx.pdf.

[3] Dahlhamer, J., Lucas, J., Zelaya, C. et al. (September 14, 2018). Prevalence of Chronic Pain and High-Impact Chronic Pain Among Adults – United States, 2016. MMWR;67:1001-6. Retrieved July 13, 2023, from http://dx.doi.org/10.15585/mmwr.mm6736a2.

[4] Zelaya, C.E., Dahlhamer, J.M., Lucas, J.W., & Connor, E.M. (November 2020). Chronic Pain and High-Impact Chronic Pain Among U.S. Adults, 2019. National Center for Health Statistics Data Brief No. 390. Retrieved July 13, 2023, from https://www.cdc.gov/nchs/products/databriefs/db390.htm.

LIMITATIONS

It is possible that the true burden of chronic and/or other pain is not fully ascertained using diagnosis coding from administrative claims data. Additionally, a different risk score model and/or risk adjustment methodology may result in larger or smaller amounts of adjusted cost differences among cohorts that are explained by differences in the risk profile of the populations being compared. Finally, the generalizability of our findings should be interpreted in the context of the study populations and their characteristics; it was not the intention of this analysis to provide a nationally representative summary of findings for Managed Medicaid populations, for example.

If this report is referenced, it should be made available in its entirety, to avoid information potentially being misinterpreted due to being out of context. This report has been funded by Ethos Laboratories.

II. INTRODUCTION

Chronic pain is typically defined as pain that lasts over three months, which can be caused by an underlying medical disease or condition, injury, medical treatment, inflammation, or an unknown cause.[5] Estimates of the prevalence of chronic pain in the United States have remained at approximately 20% since 2016.[6,7,8] According to the National Health Interview Survey 2019-2020 Longitudinal Cohort, the incidence rate of chronic pain is higher than that of diabetes and depression.[9] Chronic pain can lead to significantly more workdays missed and limitations around activities of daily living and associated activities. Opioids are a common treatment option for the management of chronic pain, and research has demonstrated a link to misuse or abuse of opioids among individuals with a diagnosis of chronic pain.[10]

Ethos Laboratories, a national laboratory specializing in pain diagnostics, with a product portfolio designed to provide insight to support its customers in managing patient populations, engaged Milliman to explore the costs of individuals with a recorded diagnosis for chronic and/or other pain conditions and opioid use, based on prescription fills and diagnosis codes for opioid use, dependence, and abuse. Using administrative healthcare claims data, we estimate cost differences among cohorts for members insured under different sources of health benefits coverage. We relied on Milliman's proprietary Consolidated Health Cost Guidelines™ Sources Database (CHSD) for the analysis, which includes detailed medical claims for employer-sponsored health insurance plans (commercial), Medicare Advantage (MA), and Managed Medicaid plans. This database does not necessarily represent the entire population for each source of health benefits coverage. We selected a single state for Managed Medicaid as the data source does not contain a nationally representative sample of Managed Medicaid claims from all states. The State of Illinois, in particular, offers the relative representativeness of the size of the state's Managed Medicaid business in the data source.

We identified patients with chronic pain, as well as other common medical conditions that are usually characterized by persistent pain for which opioids may be used to manage. The most recent CDC Clinical Practice Guideline for Prescribing Opioids for Pain notes that the following were used in the assessment for the categorization of the recommendations:[11]

- There are alternative nonpharmacologic and nonopioid medications associated with improvements in pain that are reportedly comparable to improvements associated with opioid therapy.
- Multiple noninvasive nonpharmacologic interventions are not only not associated with serious harms, but are also associated with improvements in pain that are sustained after completion of treatment (in comparison to medications for which benefits are not anticipated to continue after a patient stops taking them).
- There is limited evidence to suggest an association with improvements in pain and long-term opioid use. Instead, most association with long-term opioid therapy includes increased risk for serious harm.
- There is no validated, nor reliable, method for predicting whether a patient will benefit from opioid therapy and/or whether a patient will experience serious harm from it.
- Discontinuing opioid therapy after extended periods of continuous use is challenging and patients require effective support.

[5] Dowell, D. (July 16, 2021), op cit. .
[6] Dahlhamer, J., Lucas, J., op cit.
[7] Zelaya, C.E., Dahlhamer, J.M., op cit.
[8] Yong, R.J., Mullins, P.M., & Bhattacharyya, N. (February 1, 2022). Prevalence of chronic pain among adults in the United States. Pain;163(2):e328-32. Retrieved July 13, 2023, from https://pubmed.ncbi.nlm.nih.gov/33990113/.
[9] Nahin, R.L., Feinberg, T., Kapos, F.P., & Terman, G.W. (May 16, 2023). Estimated Rates of Incident and Persistent Chronic Pain Among U.S. Adults, 2019-2020. JAMA Netw Open;6(5):e2313563. Retrieved July 13, 2023, from https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2804995.
[10] Pacific Northwest Evidence-based Practice Center (September 2014). The Effectiveness and Risks of Long-Term Opioid Treatment of Chronic Pain. Agency for Healthcare Research and Quality Evidence Report/Technology Assessment;218. Retrieved July 13, 2023, from https://effectivehealthcare.ahrq.gov/sites/default/files/pdf/chronic-pain-opioid-treatment_research.pdf.
[11] Dowell, D. (July 16, 2021), op cit.

III. KEY FINDINGS

PREVALENCE OF CHRONIC AND OTHER PAIN DIAGNOSES AND EVIDENCE OF OPIOID USE

We grouped members who were over the age of 18 years and continuously enrolled in each of the payer populations during 2019 into the following cohorts: chronic pain with and without evidence of opioid use, other pain (headaches, back pain, and arthritis) with and without evidence of opioid use, and no chronic and/or other pain with and without evidence of opioid use. Assignment to each cohort defaults to the most severe status (if a member has both chronic pain and other pain, they are grouped into the chronic pain cohort). Descriptions of the cohort designation criteria can be found in the Methodology section below. The tables in Figures 3, 4, and 5 present the distribution of the defined cohorts.

We find that one in five commercially insured individuals with a recorded diagnosis of chronic and/or other pain, and one in four with a diagnosis of chronic and/or other pain have evidence of opioid use (Figure 3). More than four in 10 MA beneficiaries have a diagnosis of chronic and/or other pain, while more than one-third with a diagnosis of chronic and/or other pain have evidence of opioid use (Figure 4). More than one in four Managed Medicaid (State of Illinois) beneficiaries have a diagnosis of chronic and/or other pain, and nearly one-half with a diagnosis of chronic and/or other pain have evidence of opioid use (Figure 5). Across all three sources of coverage—commercial, MA, and Managed Medicaid (State of Illinois)—members with a diagnosis of chronic pain have the highest percentage of opioid use compared to the other cohorts, at 45%, 50%, and 59%, respectively.

Figure 3:
Distributions of Members by Cohort and Source of Health Benefits Coverage, Calendar Year (CY) 2019
Commercial

Total N (1,000s) = 23,804	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Evidence of…	**Chronic Pain Diagnoses**	**Other Pain Diagnoses**	**Chronic and/or Other Pain Diagnoses**	**No Chronic and/or Other Pain Diagnoses**	**Total**
(a) Opioid Use	1.4%	4.0%	5.4%	7.6%	**13.0%**
(b) No Opioid Use	1.7%	12.6%	14.3%	72.7%	**87.0%**
(c) = (a) + (b) Total	**3.2%**	**16.6%**	**19.7%**	**80.3%**	**100%**
(d) = (a) / (c) Opioid Users as % of Cohort	**45.4%**	**24.0%**	**27.5%**	**9.5%**	**13.0%**

Figure 4:
Medicare Advantage

Total N (1,000s) = 2,498					
Evidence of…	**Chronic Pain Diagnoses**	**Other Pain Diagnoses**	**Chronic and/or Other Pain Diagnoses**	**No Chronic and/or Other Pain Diagnoses**	**Total**
(a) Opioid Use	6.7%	8.0%	14.6%	6.2%	**20.8%**
(b) No Opioid Use	6.5%	20.7%	27.2%	52.0%	**79.2%**
(c) = (a) + (b) Total	**13.2%**	**28.7%**	**41.8%**	**58.2%**	**100%**
(d) = (a) / (c) Opioid Users as % of Cohort	**50.5%**	**27.8%**	**35.0%**	**10.6%**	**20.8%**

Figure 5:
Managed Medicaid (Ill.)

Total N (1,000s) = 53					
Evidence of…	**Chronic Pain Diagnoses**	**Other Pain Diagnoses**	**Chronic and/or Other Pain Diagnoses**	**No Chronic and/or Other Pain Diagnoses**	**Total**
(a) Opioid Use	6.3%	6.0%	12.3%	11.4%	**23.7%**
(b) No Opioid Use	4.4%	9.9%	14.3%	62.1%	**76.3%**
(c) = (a) + (b) Total	**10.7%**	**15.9%**	**26.6%**	**73.4%**	**100%**
(d) = (a) / (c) Opioid Users as % of Cohort	**58.7%**	**38.0%**	**46.3%**	**15.5%**	**23.7%**

Note: The percentages in Figures 3, 4, and 5 are out of all continuously eligible adults within each source of coverage.

HEALTHCARE COSTS FOR CHRONIC AND/OR OTHER PAIN DIAGNOSES AND EVIDENCE OF OPIOID USE

In Figure 3, we compare actual costs for members with chronic and/or other pain to "expected costs." Expected costs are calculated using a risk score ratio applied to the costs associated with the no chronic and/or other pain cohort. The risk scores used in the ratio are calculated using the U.S. Department of Health and Human Services Hierarchical Condition Categories (HHS-HCC) silver model risk score algorithm. This general method is illustrated below:

$$Expected\ Costs\ for\ Condition = \frac{Risk\ Score\ for\ Cohort\ with\ Condition}{Risk\ Score\ for\ Cohort\ without\ Condition} \times Actual\ Costs\ for\ Cohort\ without\ Condition$$

The purpose of this adjustment is to dampen some of the confounding effects in the two cohorts that are unrelated to the costs of chronic and/or other pain, thereby producing a more accurate estimate of the isolated costs. In the tables in Figures 7, 8, and 9, we follow a similar process when comparing the actual costs of members with chronic and/or other pain and opioid use to expected costs. In this case, however, we make modifications to the risk scores to ensure opioid costs are not normalized out of calculations but rather are appropriately captured.[12] Descriptions of allowed costs can be found in the Methodology section below. Actual costs are presented for transparency in the progression from actual to adjusted costs. Due to population differences, the actual costs should not be relied upon for purposes of understanding cost differences between cohorts unless otherwise indicated.

Please note that, while the risk scores adjust for population differences in the prevalence of certain underlying diseases, this adjustment does not account for disease severity, which may differ among the cohorts. In addition, the risk adjustment methodology does not account for differences in the prevalence of health conditions not included in the risk adjustment model (e.g., spinal stenosis, osteoarthritis) or for cohort differences in the rate of recent surgery. It is possible that differences in health condition prevalence, disease severity, and/or recent surgery among the cohorts contribute to the differences in expected versus actual cost differences.

Commercially insured individuals and Medicaid enrollees with a recorded diagnosis of chronic and/or other pain had actual total allowed per member per month costs that were 1.2 times (20%) and 1.1 times (10%) higher, respectively, than a cohort with no chronic and/or other pain diagnoses (Figures 2 above and 6). That is, the risk score did not explain the entirety of the observed difference in the actual cost for the chronic and/or other pain cohort.

For the MA population, those with a recorded diagnosis of chronic and/or other pain had actual total allowed per member per month costs that were 10% lower than a comparable cohort with no chronic and/or other pain diagnoses. In this case, the difference in risk score more than explains the difference in actual total allowed costs per member per month (PMPM) for the chronic and/or other pain cohort.

Figure 6:
Actual to Expected Total Allowed Costs PMPM
by Cohort and Source of Health Benefits Coverage, CY 2019

	Commercial	Medicare Advantage	Managed Medicaid (Ill.)
(a) Chronic and/or Other Pain Diagnoses Actual	$1,007	$967	$867
(b) No Chronic and/or Other Pain Diagnoses Actual	$333	$500	$303
(c) Ratio (a) / (b)	*3.0*	*2.0*	*2.9*
(d) Risk Score Ratio	2.4	2.2	2.5
(e) Chronic and/or Other Pain Diagnoses Expected = (b) x (d)	$809	$1,077	$773
(f) Chronic and/or Other Pain Diagnoses Actual / Expected (a) / (e)	**1.2**	**0.9**	**1.1**

Note: See Methodology section for descriptions of cohort designation criteria.

After adjusting for population differences, commercially insured, MA, and Managed Medicaid (State of Illinois) members in the chronic and/or other pain cohorts with evidence of opioid use have 60%, 30%, and 10% higher, respectively, total allowed costs PMPM than is otherwise explained by the differences in risk score when compared to the chronic and/or other pain cohort without evidence of opioid use (Figures 7, 8, and 9).

[12] This adjustment could only be made in the case of estimating opioid costs because the risk adjustment algorithm had specific codes related to opioid use that were consistent with our cohort definition for opioid use. No corresponding codes for chronic pain that were consistent with our cohort definition were available. See Methodology section for additional details.

Figure 7:
Actual to Expected Total Allowed Costs PMPM
by Cohort and Source of Health Benefits Coverage, CY 2019
Commercial

Evidence of…	(1) Chronic Pain Diagnoses	(2) Other Pain Diagnoses	(3) Chronic and/or Other Pain Diagnoses	(4) No Chronic and/or Other Pain Diagnoses	(5) Total
(a) Opioid Use Actual	$2,340	$1,735	$1,895	$1,012	**$1,380**
(b) No Opioid Use Actual	$887	$641	$670	$262	**$329**
(c) Ratio (a) / (b)	*2.6*	*2.7*	*2.8*	*3.9*	*4.2*
(d) Risk Differential	2.0	1.7	1.8	2.1	**2.4**
(e) Opioid Use Expected (b) x (d)	$1,736	$1,079	$1,215	$551	**$792**
(f) Opioid Use Actual / Expected (a) / (e)	**1.3**	**1.6**	**1.6**	**1.8**	**1.7**

Figure 8:
Medicare Advantage

Evidence of…	Chronic Pain Diagnoses	Other Pain Diagnoses	Chronic and/or Other Pain Diagnoses	No Chronic and/or Other Pain Diagnoses	Total
(a) Opioid Use Actual	$1,550	$1,319	$1,424	$984	**$1,293**
(b) No Opioid Use Actual	$804	$713	$735	$442	**$543**
(c) Ratio (a) / (b)	*1.9*	*1.8*	*1.9*	*2.2*	*2.4*
(d) Risk Differential	1.6	1.4	1.5	1.7	**1.8**
(e) Opioid Use Expected (b) x (d)	$1,276	$1,029	$1,136	$771	**$1,004**
(f) Opioid Use Actual / Expected (a) / (e)	**1.2**	**1.3**	**1.3**	**1.3**	**1.3**

Figure 9:
Managed Medicaid (Ill.)

Evidence of…	Chronic Pain Diagnoses	Other Pain Diagnoses	Chronic and/or Other Pain Diagnoses	No Chronic and/or Other Pain Diagnoses	Total
(a) Opioid Use Actual	$1,316	$1,009	$1,166	$640	**$913**
(b) No Opioid Use Actual	$672	$581	$609	$242	**$310**
(c) Ratio (a) / (b)	*2.0*	*1.7*	*1.9*	*2.6*	*2.9*
(d) Risk Differential	1.8	1.8	1.8	2.2	**2.6**
(e) Opioid Use Expected (b) x (d)	$1,235	$1,049	$1,096	$543	**$799**
(f) Opioid Use Actual / Expected (a) / (e)	**1.1**	**1.0**	**1.1**	**1.2**	**1.1**

Note: See Methodology section for descriptions of cohort designation criteria.

HEALTHCARE COSTS BY TYPE OF SERVICE

The tables in Figures 10, 11, and 12 show the actual to expected 2019 total medical and prescription drug allowed costs PMPM for the chronic and/or other pain diagnoses cohort for commercial, MA, and Managed Medicaid (State of Illinois) by setting (inpatient, outpatient facility, professional, and prescription drug).

For the commercial population, the primary driver of the 60% increase in total allowed costs PMPM observed for individuals with chronic and/or other pain and evidence of opioid use is from costs in the inpatient setting, which are 3.2 times higher than for those without evidence of opioid use (Figure 10). Outpatient facility total allowed costs PMPM are also elevated at nearly twice as high for those with evidence of opioid use as compared to without. Findings are similar for the MA population, with total allowed costs PMPM in the inpatient setting 1.8 times higher, and in the

outpatient facility setting 1.4 times higher, for beneficiaries with evidence of opioid use as compared to those without (Figure 11).

Most of the difference in overall total allowed costs PMPM for the Managed Medicaid (State of Illinois) population is driven by outpatient facility costs, which we found to be 1.3 times higher for beneficiaries with evidence of opioid use as compared to those without (Figure 12). Consistent with findings that the largest cost differences among cohorts result from inpatient hospitalizations and outpatient facility services, it is possible that individuals with chronic and/or other pain and evidence of opioid use have greater underlying disease severity, higher rates of other health conditions not included in the risk adjustment methodology, and/or higher rates of recent surgery compared to individuals with chronic and/or other pain and no evidence of opioid use.

Costs do not appear to be driven by prescription drug costs for the chronic and/or other pain diagnoses cohort with evidence of opioid use across any of the lines of business.

Figure 10:
Actual to Expected Total Allowed Cost PMPMs by Setting and Source of Health Benefits Coverage for Chronic and/or Other Pain Diagnoses, CY 2019
Commercial

	(1) Inpatient	(2) Outpatient Facility	(3) Professional	(4) Prescription Drug	(5) Total
(a) Opioid Use Actual	$415	$611	$524	$345	**$1,895**
(b) No Opioid Use Actual	$73	$176	$238	$183	**$670**
(c) Ratio (a) / (b)	*5.7*	*3.5*	*2.2*	*1.9*	*2.8*
(d) Risk Differential	1.8	1.8	1.8	1.8	**1.8**
(e) Any Opioid Use Expected	$132	$319	$432	$332	**$1,215**
(f) Opioid Use Actual / Expected (a) / (e)	**3.2**	**1.9**	**1.2**	**1.0**	**1.6**

Figure 11:
Medicare Advantage

	Inpatient	Outpatient Facility	Professional	Prescription Drug	Total
(a) Opioid Use Actual	$315	$316	$419	$373	**$1,424**
(b) No Opioid Use Actual	$113	$149	$260	$213	**$735**
(c) Ratio (a) / (b)	*2.8*	*2.1*	*1.6*	*1.8*	*1.9*
(d) Risk Differential	1.5	1.5	1.5	1.5	**1.5**
(e) Any Opioid Use Expected	$175	$231	$402	$329	**$1,136**
(f) Opioid Use Actual / Expected (a) / (e)	**1.8**	**1.4**	**1.0**	**1.1**	**1.3**

Figure 12:
Managed Medicaid (Ill.)

	Inpatient	Outpatient Facility	Professional	Prescription Drug	Total
(a) Opioid Use Actual	$273	$294	$342	$256	**$1,166**
(b) No Opioid Use Actual	$152	$128	$183	$147	**$609**
(c) Ratio (a) / (b)	*1.8*	*2.3*	*1.9*	*1.7*	*1.9*
(d) Risk Differential	1.8	1.8	1.8	1.8	**1.8**
(e) Any Opioid Use Expected	$273	$230	$329	$264	**$1,096**
(f) Opioid Use Actual / Expected (a) / (e)	**1.0**	**1.3**	**1.0**	**1.0**	**1.1**

Note: See Methodology section for descriptions of cohort designation criteria.

ESTIMATING COST SAVINGS

We demonstrate below examples of how the results of this analysis might be used, with caution per the Summary Discussion and Areas for Further Research section that follows, to estimate the potential cost savings that might be associated with chronic and/or other pain with opioid use by line of business (Figure 13). In the examples below, we assume that, through some intervention, 10% of the population that has been diagnosed with chronic and/or other pain and is using an opioid subsequently manages their pain through something other than the use of an opioid or never starts opioid use to begin with. We use 10% for illustrative purposes and ease of multiplication.

Figure 13:
Potential Annual Cost Savings per 100,000 Members With Chronic and/or Other Pain Diagnoses With Evidence of Opioid Use

Assumption = 10% reduction in members with diagnosis of chronic and/or other pain with evidence of opioid use	**Commercial**	**Medicare Advantage**	**Managed Medicaid (Ill.)**
(a) Members per 100,000 Population[i]	5,416	14,630	12,297
(b) 10% Reduction to (a)	542	1,463	1,230
(c) Actual PMPM Opioid Use, 2019[ii]	$1,895	$1,424	$1,166
(d) Expected PMPM Opioid Use, 2019[iii]	$1,215	$1,136	$1,096
(e) Savings (25% to 75%) 0.25 * ((b) * ((c) – (d)) * 12) - 0.75 * ((b) * ((c) – (d)) * 12)	**($1,105K to $3,316K)**	**($1,263K to $3,789K)**	**($257K to $772K)**
(f) Medical and Prescription Allowed (Total Spend), 2019 (a) x (c) x 12	**$123M**	**$250M**	**$172M**
(g) % Potential Savings to Total Spend (25% to 75%) (e) / (f)	**(1% to 3%) per year**	**(1% to 2%) per year**	**(0.1% to 0.4%) per year**
(h) Annual Cost Differential per Patient With Diagnosis of Chronic and/or Other Pain and Evidence of Opioid Use (c) – (d) x 12	**$8,160**	**$3,456**	**$840**

[i] From Figures 3, 4, 5,100,000 x column (3), row (a)
[ii] From Figures 7, 8, 9 column (3), row (a)
[iii] From Figures 7, 8, 9 column (3), row (e).

IV. SUMMARY DISCUSSION AND AREAS FOR FURTHER RESEARCH

The summary data presented from our analyses provide real-world healthcare experience for insured members with a recorded diagnosis of chronic and/or other pain with and without evidence of opioid use, demonstrating the prevalence and intersection of these conditions and behaviors using claims data that is not readily accessible to the public elsewhere.

COMPARISON OF RESULTS TO OTHER STUDIES

It is possible that the true burden of chronic and/or other pain is not fully ascertained using diagnosis coding from administrative claims data. The most recently updated published estimates we were able to find document the prevalence of chronic pain for adults in the United States at a rate of approximately 20%, or one in five individuals.[13,14,15] This is significantly higher than our findings of 4% for a recorded diagnosis of chronic pain but aligns with our findings of 22% for a recorded diagnosis of chronic and/or other pain, across all three payer populations. The difference, though, may be explained by different data sources that use different methodologies to identify chronic pain: while we use healthcare claims data, which reflect a provider-diagnosed case of chronic pain, the reference statistics use survey data from individuals. The difference in prevalence between the two methodologies indicates a gap between the prevalence of chronic pain reported by individuals and the rate of a formal diagnosis in claims data. It is also expected that symptoms may be inconsistent and/or attributed to other acute processes and/or coding practices may vary by provider or coder. We thus chose to use broad definitions for chronic and/or other pain for these reasons. It is also likely that the "no chronic and/or other pain diagnoses" cohort is not entirely pain-free but rather contains a certain number of individuals who might have pain of some kind but have not received a diagnosis from a provider that would qualify for our definitions. Future analyses may assess this assumption as it is possible these definitions may lessen observed differences if we have attributed a large subset of individuals without a diagnosis of chronic and/or other pain or opioid prescription use who truly have chronic and/or other pain to the "no chronic and/or other pain diagnoses" cohort.

USE OF RISK ADJUSTMENT

We applied only one risk score model to adjust for certain population differences among cohorts when calculating the total allowed costs PMPM for all three payer populations. The risk score we chose, the HHS-HCC silver model, is used to calculate payer risk transfer payments in the Patient Protection and Affordable Care Act (ACA) individual and small group markets.[16] The model's algorithm is publicly accessible and well-understood, and risk scores were readily available for our study populations at the time of analysis. Furthermore, this risk model accounts for total medical and pharmacy costs and is concurrent, which means it uses costs during the same period as the chronic and/or other pain diagnosis and evidence of opioid use. We removed the impact of opioid use, abuse, and/or misuse on the risk scores to avoid adjusting any differences due to this factor.

There are several limitations to our choice of risk score model. First, the HHS-HCC silver model is most appropriate for use in a commercially insured population and has not been calibrated for use in the MA or Managed Medicaid (State of Illinois) populations, nor for subgroups within a population, such as groups of members with a single condition (chronic and/or other pain) or a subset of that group with evidence of opioid use. A different risk score model and/or risk adjustment methodology may result in larger or smaller amounts of unadjusted cost differences among cohorts that are explained by differences in the risk profile of the populations being compared; this may comprise another assumption for future analyses to evaluate. Moreover, as shown in the table in Figure 6 above, the cost differential in MA for those with chronic pain and/or other pain is -10% relative to those without chronic and/or other pain. This unintuitive result could be driven by the choice of risk score model.

In addition, the risk adjustment model does not account for differences in the prevalence of certain health conditions relevant to chronic pain and opioid use, nor does it account for the disease severity of health conditions (regardless of whether or not they are included in the risk adjustment model) or the proximity of surgery relative to evidence of opioid use. For example, it is likely that the cohort with chronic and/or other pain and evidence of opioid use has a disproportionate share of individuals who recently had surgery, as opioids are typically prescribed for acute pain relief for brief periods of time after many surgeries. In some of those cases, eliminating opioid utilization would not necessarily

[13] Dowell, D. (July 16, 2021), op cit.
[14] Dahlhamer, J., Lucas, J., op cit.
[15] Zelaya, C.E., Dahlhamer, J.M., op cit.
[16] HHS (April 15, 2020). HHS-Developed Risk Adjustment Model Algorithm "Do It Yourself (DIY)" Software Instructions for the 2019 Benefit Year. Retrieved July 13, 2023, from https://www.cms.gov/CCIIO/Resources/Regulations-and-Guidance/Downloads/CY2019-DIY-instructions.04.15.2020.pdf.

change patients' overall healthcare costs. Accounting for the factors described above would likely reduce the observed adjusted cost differences among cohorts.

OTHER CONFOUNDING FACTORS

The analysis presented herein indicates a likely association between the presence of diagnosis of chronic and/or other pain with or without the evidence of opioid use, and increased costs in the commercial market and Managed Medicaid (State of Illinois) program. However, the risk adjustment methodology applied does not account for all confounders, or potential variables that might influence both the explanatory and outcome variables, among the cohorts that should be considered in an analysis of healthcare costs. For example, we observed that adjusted total allowed costs PMPM were 60% higher for commercially insured members with a diagnosis of chronic and/or other pain and evidence of opioid use as compared to members with a diagnosis of chronic and/or other pain and no evidence of opioid use. Although risk-adjusted to account for differences in certain health conditions between the two populations, for the reasons described previously, the difference of 60% may not be entirely attributable to the costs associated with opioid use alone because the risk model used does not fully account for other population differences relevant to the chronic pain and opioid use. Therefore, it should not be construed from this report that pain management, reduction in pain, and/or reduction in opioid use would necessarily avoid or eliminate any specific portion of the cost differences illustrated in the tables in Figures 2, 6 through 9, 10 through 12, and 13. Future analyses may consider alternative methods for controlling for confounders and other biases, such as matching and/or a self-controlled case series, to evaluate whether the findings presented can be replicated.

GENERALIZABILITY OF FINDINGS

The generalizability of our findings should be interpreted in the context of the study populations and their characteristics. We analyzed what is, to our knowledge, one of the largest analytical datasets comprised of a commercially insured population; however, we note potential limitations on the sample size for MA and Managed Medicaid (State of Illinois) as this database does not necessarily represent the entire population for each source of health benefits coverage. It was not the intention of this analysis to provide a nationally representative summary of findings for Managed Medicaid populations. Rather, the use of a single state in the Managed Medicaid population ensures a consistent reimbursement schedule and consistent covered services. A larger volume of membership and expansion to other states could yield different results.

V. METHODOLOGY

DATA SOURCE

We relied on healthcare claims data from Milliman's proprietary CHSD, which includes detailed medical claims for commercial health insurance (60 million lives), MA (5.5 million lives), and Managed Medicaid (3.7 million lives) plans. This database does not necessarily represent the entire population for each source of health benefits coverage. We selected a single state for Managed Medicaid as the data source does not contain a nationally representative sample of Managed Medicaid claims from all states and because the State of Illinois, in particular, offers the relative representativeness of the size of the state's Managed Medicaid business in the data source.

ELIGIBLE STUDY POPULATION

Members eligible for the study were required to have 12 months of continuous enrollment among the same payer type in 2019 and to be 18 years of age or older. Members were excluded with a diagnosis code on any claim in any position indicating the cancer (except for nonmelanoma malignant skin neoplasms) or sickle cell disease, members receiving hospice care based on revenue and Healthcare Common Procedure Coding System (HCPCS) codes, and members receiving palliative care services based on diagnosis codes and HCPCS codes in 2019 per the specified list in the table in Figure 14.

Figure 14:
Code Definitions

Variable	Code Type	Details
Cancer	ICD-10-CM diagnosis	Any that begins with "C" except C44 and C4A
Sickle Cell Disease	ICD-10-CM diagnosis	D570, D571, D572, D574, D578
Hospice Care	HCPCS	99377, 99378, G0051, G0182, G0299, G0300, G9473, G9474, G9475, G9476, G9477, G9478, G9479, G9524, G9687, G9718, G9720, G9857, G9858, G9860, G9861, G9996, M1022, M1025, M1026, Q5001, Q5002, Q5003, Q5004, Q5005, Q5006, Q5007, Q5008, Q5009, Q5010, S0271, S9126, T2042, T2043, T2044, T2045, T2046
	Revenue Codes	0650, 0651, 0652, 0655, 0656, 0657, 0658, 0659, 0653, 0654
Palliative Care	ICD-10-CM diagnosis	Z515
	HCPCS	D9110, G0031, G0034, G0048, G9054, G9394, G9433, G9667, G9668, G9747, G9749, G9781, G9924, G9988, G9992, G9994, G9995, G9996, M1017, M1059

Note: These exclusions represent medical conditions for which chronic and/or other pain is common, and clinical guidelines generally include opioid treatment.[17] These patient exclusions are intended to remove the potential for associated extreme healthcare experience (e.g., high costs) and opioid treatment.

COHORT CRITERIA

To be included in the chronic and/or other pain cohort, a member was required to have at least one non-laboratory, non-radiology claim in 2019 reporting a diagnosis code in any position from the following mutually exclusive Clinical Classifications Software Refined (CCSR) categories:[18]

- Chronic pain: CCSR NVS019, except ICD-10-CM diagnosis codes G891
- Other pain
  - Arthritis: CCSR MUS001, MUS003, MUS004, MUS006
  - Headache and migraine: CCSR NVS010
  - Low back pain: CCSR MUS038

We categorized opioid use using prescription drug and diagnosis claims information as follows: an opioid prescription drug fill(s) in 2019 with a Medi-Span Generic Product Identifier starting with 65 (which includes some drugs used solely for the treatment of opioid use disorder which are not used for pain), or at least one non-laboratory, non-radiology claim containing a diagnosis code in any position per CCSR MBD018 (opioid use, dependence, and abuse). Individuals identified via an opioid-related diagnosis code who did not have a prescription for an opioid accounted for 0.62% of

[17] Dowell, D. (July 16, 2021), op cit.
[18] HHS (December 2022). Clinical Classifications Software Refined (CCSR). Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality, Rockville, Md. Retrieved July 13, 2023, from https://hcup-us.ahrq.gov/toolssoftware/ccsr/ccs_refined.jsp.

commercial, 0.45% of MA, and 3.13% of the Managed Medicaid (State of Illinois) members with recorded diagnosis for chronic and/or other pain.

HEALTHCARE COSTS

Healthcare costs from administrative claims include the payer and member cost-sharing components and are reported as total medical and prescription drug allowed PMPM costs. PMPM costs among populations of similarly insured patients vary based on the presence of comorbid conditions, age, regional practice patterns, and contracted reimbursement rates. Unadjusted healthcare costs do not account for these differences among the payer populations included in our analysis. We apply the risk adjustment methodology to account for differences in age, sex, and certain comorbid conditions for members among cohorts within each payer population. The risk adjustment methodology does not account for differences in disease severity, health conditions not represented in the risk adjustment model, or differences in recent surgeries among populations.

RISK SCORES

We used 2019 HHS-HCC concurrent silver risk scores in our analysis for risk adjustment purposes.[19] The HHS-HCC model calculates concurrent risk scores, meaning it uses certain diagnosis codes within a period to measure healthcare utilization expectations in the same time period. HHS-HCC risk scores also consider member age, gender, and cost sharing. Though this risk score model does not consider geography, we observe similar regional distributions among the cohorts within each payer population (Figures 15, 16, and 17). The tables in Figures 15, 16, and 17 show the percentage of each population who were continuously enrolled, as well as the percentage in each cohort, by region, out of all continuously enrolled adults within each source of coverage.

Figure 15:
Distribution of Members by Region and Line of Business, Calendar Year 2019
Commercial

Region	Continuously Enrolled	Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	No Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	No Chronic and/or Other Pain Diagnoses
Midwest	27%	28%	29%	27%
Northeast	21%	17%	23%	21%
South	34%	40%	32%	34%
West	17%	16%	16%	18%

Figure 16:
Medicare Advantage

Region	Continuously Enrolled	Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	No Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	No Chronic and/or Other Pain Diagnoses
Midwest	32%	31%	32%	30%
Northeast	30%	20%	30%	31%
South	28%	35%	26%	28%
West	10%	14%	13%	11%

Figure 17:
Managed Medicaid (Ill.)

Region	Continuously Enrolled	Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	No Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	No Chronic and/or Other Pain Diagnoses
Midwest	100%	100%	100%	100%
Northeast	*0%*	*0%*	*0%*	*0%*
South	*0%*	*0%*	*0%*	*0%*
West	*0%*	*0%*	*0%*	*0%*

Note: The sum of the columns may not total to 100 due to rounding. See Methodology section for descriptions of cohort designation criteria.
Midwest states: Iowa, Ill., Ind., Kan., Mich., Minn., Mo., Neb., N.D., Ohio, S.D., Wis.
Northeast states: Conn., Mass., Maine, N.H., N.J., N.Y., Pa., R.I., Vt.
South states: Ala., Ark., D.C., Del., Fla., Ga., Ky., La., Md., Miss., N.C., Okla., S.C., Tenn., Texas, Va., W.V.
West states: Alaska, Ariz., Calif., Colo., Hawaii, Idaho, Mont., N.M., Nev., Ore., Utah, Wash., Wyo.

[19] Yong, R.J., Mullins, P.M., op cit.

We modified risk scores to remove the impact of opioid use as follows: we identified the proportion of the cohort subgroup with the presence of HCC 081 and/or 082, which measure Drug Psychosis and Drug Dependence, respectively, and are comprised of diagnosis codes that overlap with the definition of opioid use above; multiplied this by the weight (3.404) for the grouping variable (G09) for HCCs 081 and 082; subtracted this amount from the aggregate risk score for the cohort subgroup; and, finally, recalculated the risk score by dividing by the cohort subgroup size.

VI. CAVEATS AND LIMITATIONS

The American Academy of Actuaries requires members to acknowledge their qualifications in any actuarial communication. Fritz S. Busch, FSA, MAAA, principal and consulting actuary for Milliman, is a member of the American Academy of Actuaries and meets the qualification standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

It should not be construed from this report that pain management, reduction in pain, and/or reduction in opioid use would necessarily avoid or eliminate any specific portion of the cost differences shown throughout this report.

This report has been prepared for the specific purpose of summarizing the relationship of allowed costs for patient cohorts defined by recorded diagnosis code for chronic and/or other pain and/or diagnosis code or prescription drug claims for opioid use. This information may not be appropriate, and should not be used, for any other purpose. Milliman does not intend to endorse a product or organization. If this report is referenced, it should be made available in its entirety, to avoid information potentially being misinterpreted due to being out of context. Third parties are instructed to not place any reliance on this report and Milliman does not intend to benefit or create a legal duty to any third-party recipient of this work. This report has been funded by Ethos Laboratories. Our analysis was performed under a Consulting Services Agreement with Ethos Laboratories.

The results presented herein are estimates based on carefully constructed actuarial models, specifically risk adjustment algorithms. Differences between our estimates and actual amounts depend on the extent to which future experience conforms to the assumptions made for this analysis. It is certain that actual experience will not conform exactly to the assumptions used in this analysis. Actual amounts will differ from projected amounts to the extent that actual experience deviates from expected experience.

In performing this analysis, we relied on data provided by the Milliman Consolidated Health Cost Guidelines Sources Database (CHSD_2208) contributors, and Medi-Span. We have not audited or verified this data and other information but reviewed it for general reasonableness. If the underlying data or information is inaccurate or incomplete, the results of our analysis may likewise be inaccurate or incomplete.

APPENDIX A

Figure 18:
Age Group Distribution per 100,000 Continuously Enrolled Members, Calendar Year 2019
Commercial

Age Group (years)	Continuously Enrolled	Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	No Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	No Chronic and/or Other Pain Diagnoses
18 to 19	3,743	74	366	3,303
20 to 29	18,359	390	1,813	16,157
30 to 39	20,281	784	2,526	16,971
40 to 49	20,897	1,179	3,107	16,611
50 to 59	22,711	1,706	3,807	17,197
60 to 69	12,590	1,139	2,343	9,108
70 to 79	1,113	115	256	742
80 to 89	307	30	84	192

Figure 19:
Medicare Advantage

Age Group (years)	Continuously Enrolled	Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	No Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	No Chronic and/or Other Pain Diagnoses
18 to 19	0	0	0	0
20 to 29	137	11	22	105
30 to 39	489	93	98	298
40 to 49	1,231	357	276	598
50 to 59	3,646	1,229	881	1,536
60 to 69	27,805	4,422	6,775	16,609
70 to 79	45,857	5,926	12,581	27,349
80 to 89	20,835	2,593	6,581	11,660

Figure 20:
Managed Medicaid (Ill.)

Age Group (years)	Continuously Enrolled	Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	No Evidence of Opioid Use Among Chronic and/or Other Pain Diagnoses	No Chronic and/or Other Pain Diagnoses
18 to 19	6,896	124	712	6,060
20 to 29	23,711	1,564	2,907	19,240
30 to 39	24,357	2,547	3,200	18,609
40 to 49	17,698	2,841	2,503	12,353
50 to 59	16,959	3,455	2,965	10,540
60 to 69	8,477	1,445	1,592	5,440
70 to 79	1,307	241	256	810
80 to 89	595	81	134	381

Note: The sum of the diagnosis cohorts may not equal the continuously enrolled column due to rounding. See Methodology section for descriptions of cohort designation criteria.

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