

The epidemiology of outpatient pain treatment in pediatrics

Stacy Baldrige
Laura Wallace
Aditi Kadakia

Purdue Pharma L.P., Stamford, CT,
USA

Background: There is limited real-world, population-level data on the prevalence and treatment of pain in children. An understanding of pediatric pain conditions and its management can help inform provider education, treatment guidelines, and design of pediatric pain studies. Therefore, in this study, we aimed to describe the prevalence of conditions associated with acute and chronic pain in pediatric patients and to characterize pediatric pain treatment with nonsteroidal anti-inflammatory drugs, cyclooxygenase-2 (COX-2) inhibitors, opioids (immediate release or extended release), antidepressants, topical analgesics, anticonvulsants, and other therapies based on a large, real-world sample.

Materials and methods: In this cohort study, we used administrative claims data from the Truven Health MarketScan® Research Databases, which contain data regarding demography, prescription, diagnosis, and procedure performed. Descriptive statistics were used to assess the prevalence of various conditions associated with pediatric pain and to estimate the proportion of patients who received various analgesic and nonanalgesic treatments. All analyses were stratified according to demographics.

Results: This study included data on more than 30 million pediatric patients from throughout the US. Overall, among patients with commercial insurance, surgery was the most common pain-related diagnosis, followed by orthopedic conditions, malignancies, trauma, and genetic conditions. For patients with Medicaid, surgery was also the most common diagnosis, followed by traumatic injury, orthopedic conditions, malignancies, and genetic conditions. These diagnoses varied by age, with most showing higher prevalence in older children. Treatment varied substantially by condition, and many children (more than 50% for most of the conditions evaluated) did not receive any prescription pain treatments. For patients with either commercial insurance or Medicaid who were using prescription opioids, immediate-release opioids were the most commonly used analgesic treatment for pain. Overall, prescription pain treatments were more common in the Medicaid population. Extended-release opioids were rarely used.

Conclusion: The types of pain treatments varied substantially by condition and age of the patient, with the highest prevalence of use in older children.

Keywords: analgesia, pain conditions, pediatric, pain treatment, prevalence

Introduction

Real-world, population-level data on the prevalence of conditions associated with acute and chronic pain in pediatric patients and literature regarding the methods of pain treatment are scarce. Previous research that described the prevalence of pain in children demonstrated varying results.¹⁻⁶ Historically, studies describing prevalence of pediatric pain report survey data, estimations of prevalence based on questionnaires

Correspondence: Stacy Baldrige
Purdue Pharma L.P., 201 Tresser
Boulevard, Stamford, CT 06901, USA
Tel +1 203 588 7276
Email stacy.baldrige@pharma.com

or interviews, or characterizations of inpatients.^{1–6} In a 2014 study of inpatients in a large pediatric institution, 86% of them reported pain, with patients hospitalized for surgical procedures reporting pain more frequently than those with medical conditions.¹ Another study that described the inpatient characteristics of pediatric patients with chronic pain used a database with information from 43 hospitals to define incidence of pain, demographics, and treatment provided.² Pediatric inpatients with diagnoses of chronic pain and associated diagnoses such as psychogenic pain, reflex sympathetic dystrophy, or complex regional pain syndrome accounted for 0.16% of the overall population (3,752 children 0–18 years).² Patients with diagnoses related to underlying conditions known to cause recurrent pain (cancer, sickle cell disease, burns, and others) were excluded from the study.² The authors concluded that the prevalence of 0.16% significantly underestimated the number of children affected by chronic pain, since many children are not assigned with a specific diagnosis of chronic pain during hospitalization; however, chronic pain in children is increasingly common due to hospitalization.²

Although findings of inpatient studies are important in understanding children's experience with pain and pain treatment, evaluating pain in children in an outpatient setting is necessary to provide a comprehensive description of this problem. A 2011 systematic review presented a comprehensive examination of pediatric pain epidemiology in follow-up to Goodman and McGrath's seminal publication in 1991.^{3,7} This review of 32 publications provided prevalence estimates for various painful conditions, including headache (8%–83%), abdominal pain (4%–53%), back pain (14%–24%), musculoskeletal pain (4%–40%), combined pains (4%–49%), and other pains (5%–88%).³ Prevalence estimates included in the review were based on patients reporting either in their interview or through questionnaire, and they obtained cumulative sample sizes ranging from 3,619 for studies of back pain to 30,843 for studies of combined pain. Although the review included a sizable number of studies, cumulative sample sizes were relatively small. Moreover, the authors noted that most studies were of low quality, and the variation across studies was due to the wide range in prevalence estimates.

Studies describing treatment patterns of painful conditions in pediatric outpatients are also limited, with most studies focusing on the use of opioids for specific conditions such as cancer, burns, or sickle cell disease.^{1,4,6} Furthermore, existing studies have not used information from large databases that reflect real-world conditions. Undertreatment of pain in children is an ongoing issue. Hospitalized children

experience insufficient pain management after surgery, while admissions for chronic pain are increasing.^{2,5} In a survey of US pediatricians, the most common treatments for chronic, severe pain were acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs), with fewer prescribers using intermittent opiates, and even fewer prescribing around-the-clock opiates.⁸ While this finding may reflect the severity of pain encountered by general pediatricians, it may also highlight the lack of understanding of the complex pain conditions or treatment options for pediatric patients.⁸ When pain cannot be controlled in the outpatient setting, many patients are admitted for additional diagnostic evaluation and pain management, which further increases health care costs, as well as costs associated with missed school days for children and missed work for parents.² The financial impact of the undertreatment of pain in children can be significant, with inpatient admissions contributing to increasing costs and resource utilization.² It is also unclear whether there are differences in the patterns of pain treatment based on insurance type (ie, commercial insurance versus Medicaid). Medicaid is the primary source of health care coverage for Americans with low incomes or disabilities, providing coverage to many who do not have access to, or cannot afford, commercial insurance. In 2016, approximately 30 million children were covered by Medicaid.⁹ Prior research has shown that medical care and prescription-drug utilization may vary based on insurance coverage. Children enrolled in Medicaid were shown to have lower rates for clinical quality indicators compared to children with commercial insurance.¹⁰ A US pediatrician survey showed that physicians with higher percentages of Medicaid-insured patients were less likely to prescribe opioids.⁸ The cost of medications is a significant contributor to overall cost for pediatric Medicaid recipients, including many children with chronic conditions and medical complexity.⁹ Understanding the frequency and duration of conditions associated with pain in children, the characteristics of these patients, and the methods of pain management can help to inform provider education, policy and treatment guidelines, and design of pediatric pain studies.

The limitations of recently published studies, particularly the use of inpatient populations, patient/family reports, and relatively small sample sizes, make it difficult to present a comprehensive picture of the epidemiology of pain-causing conditions in pediatric patients and the methods by which they are being treated in real-world clinical practice. In this study, we attempted a unique approach to evaluate the prevalence of painful conditions and disorders to describe the pediatric population based on data from real-world health

care claims and to evaluate and to evaluate a broad range of pain treatments, including pharmaceutical products labeled as analgesics and pharmaceutical products not labeled as analgesics but those used in the treatment of pain.

The objectives of this study were to: 1) estimate the prevalence of conditions associated with acute and chronic pain in pediatric patients; 2) describe the demographic and clinical characteristics of these patients; 3) characterize the use of various pharmacological treatments, including both analgesics (NSAIDs, cyclooxygenase-2 [COX-2] inhibitors, and opioids) and nonanalgesics (eg, anticonvulsants and antidepressants), for conditions associated with pain; and 4) provide data on the prevalence and treatment of conditions associated with pain in pediatric patients with commercial or Medicaid insurance.

Material and methods

Study population

This is a retrospective cohort study that was conducted by using 2 Truven Health MarketScan® Research Databases—the Commercial Database and the Multi-State Medicaid Database for 2009–2012. These large health care claims databases contain data related to demography, diagnosis, procedure performed, and prescription on more than 30 million pediatric patients (about 26 million insured through commercial plans and about 5 million insured through the Medicaid program). All database records were de-identified and accessed with protocols compliant with US patient confidentiality requirements, including the Health Insurance Portability and Accountability Act (HIPAA) of 1996, and thus, this study was exempt from institutional review board approval.

Patient cohorts and study measures

Patients in the age group of 0–16 years were included in the study and were categorized according to their primary insurance type (commercial or Medicaid). Conditions associated with pain were identified using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes and assigned to 1 of the following 6 clinically meaningful categories. Some of the individual conditions associated with these cohorts are as follows:

1. Orthopedic conditions (eg, fracture, dislocation, spondylolysis, scoliosis, and kyphosis)
2. Malignancies and related conditions (eg, leukemia, lymphoma, and bone marrow transplant)
3. Surgeries (eg, bone resection, transplant, spinal fusion, osteotomy, and pectus excavatum repair)
4. Trauma (eg, burn, gunshot wound, and amputation)
5. Genetic conditions associated with pain (eg, Ehlers-Danlos syndrome, Fabry disease, muscular dystrophy, thalassemia, and sickle cell disease)
6. Other painful conditions (eg, arthritis, abdominal pain, migraine, neuropathy, fibromyalgia, and osteonecrosis).

A complete list of the conditions associated with each category, including the relevant ICD-9-CM codes is available by request.

Evidence of treatment, defined as at least 1 prescription claim for a medication of interest at any point during the study period, was identified on the basis of a prescription for an analgesic or nonanalgesic medication. Analgesic products included NSAIDs (eg, aspirin, ibuprofen, and naproxen), COX-2 inhibitors (eg, celecoxib), and opioids (eg, morphine, hydrocodone, oxycodone, and oxymorphone). Opioids were stratified according to whether they were extended release (ER), immediate release (IR), or both (IR + ER). Nonanalgesic products included benzodiazepines (eg, alprazolam, clonazepam, diazepam, and lorazepam), muscle relaxants (eg, cyclobenzaprine and methocarbamol), glucocorticoids (eg, dexamethasone, hydrocortisone, and prednisone), topical treatments (eg, lidocaine), and other treatments sometimes used in the treatment of pain, including antidepressants, anticonvulsants, and *N*-methyl-D-aspartate receptor agonists. Duration of use, as measured by total days' supply and dose was captured. The presence of medication use following an inpatient stay was also measured.

Analyses

All analyses were conducted using SAS Version 9.2. Descriptive statistics, including frequencies, percentages, and means/medians with standard deviations, were used to assess the prevalence of each of the conditions over 1 year, patient medical and demographic characteristics, and the proportion of patients who received various treatments. Treatment-utilization characteristics such as duration of use, dose, and use of treatment after inpatient stays were also evaluated. All analyses were stratified by the age group of patient (0 to <6 years, 6 to <12 years, or 12 to 16 years) and insurance type (commercial or Medicaid).

Results

Demographics

This study included data on more than 30 million pediatric patients from throughout the US who had commercial (about 26 million) or Medicaid (about 5 million) insurance. There

were differences in the age distribution of patients depending on the insurance type, with Medicaid patients being much younger than commercially insured patients. Among the 26 million commercially insured patients, 38.8% were in the age group of 0 to <6 years, 32.4% were in the age group of 6 to <12 years, and 28.8% were in the age group of 12 to 16 years. In contrast, among the 5 million Medicaid patients, 53.9% were in the age group of 0 to <6 years, 26.8% were in the age group of 6 to <12 years, and 19.3% were in the age group of 12 to 16 years. The distribution of sex did not differ across age groups or by insurance type, with approximately 51% of the patients being male and 49% being female (data not shown).

Conditions

The prevalence of most conditions of interest was low. Among total Medicaid-insured patients, surgery was most prevalent (9.7%), followed by other pain (8.6%), trauma (2.0%), orthopedic conditions (1.9%), malignancies (1.7%), and genetic conditions (0.6%). Prevalence among total commercially insured patients was similarly low, with several conditions present in less than 3% of the population (orthopedic conditions [2.7%], malignancies [2.1%], trauma [1.6%], and genetic conditions [0.7%]). The most commonly occurring conditions were surgery (5.6%) and other pain (8.9%), which was the most prevalent condition (Figure 1).

Estimates of conditions by prevalence among both commercially insured and Medicaid-insured patients varied by

age (Figure 1). Among both commercially insured and Medicaid-insured patients, orthopedic conditions, malignancies, and especially other pain tended to be more common in older age groups (4.4% in the age group of 0 to <6 years, 8.9% in the age group of 6 to <12 years, and 15.0% in the age group of 12 to 16 years for commercially insured patients with other pain), whereas surgery tended to be more common in younger age groups (8.3% in the age group of 0 to <6 years, 3.6% in the age group of 6 to <12 years, and 4.2% in the age group of 12 to 16 years for commercially insured patients). The corresponding prevalence of other pain in Medicaid-insured patients was 5.2% in the age group of 0 to <6 years, 9.9% in the age group of 6 to <12 years, and 16.3% in the age group of 12 to 16 years, and the prevalence of surgery was around 13.5%, 5.1%, and 5.6%, respectively. In both commercially insured and Medicaid-insured patients, trauma and genetic conditions had less variation across all the age groups.

Treatments

Overall, higher proportions of Medicaid-insured patients than that of commercially insured patients with conditions of interest received one or more of the analgesic and nonanalgesic treatments under study. Treatments varied substantially according to the condition, age, and insurance type (Figure 2, Tables 1 and 2). For example, in pediatric patients with diagnoses related to traumatic injury (amputation, burn, penetrating injury), opioids were prescribed for approximately 29% of

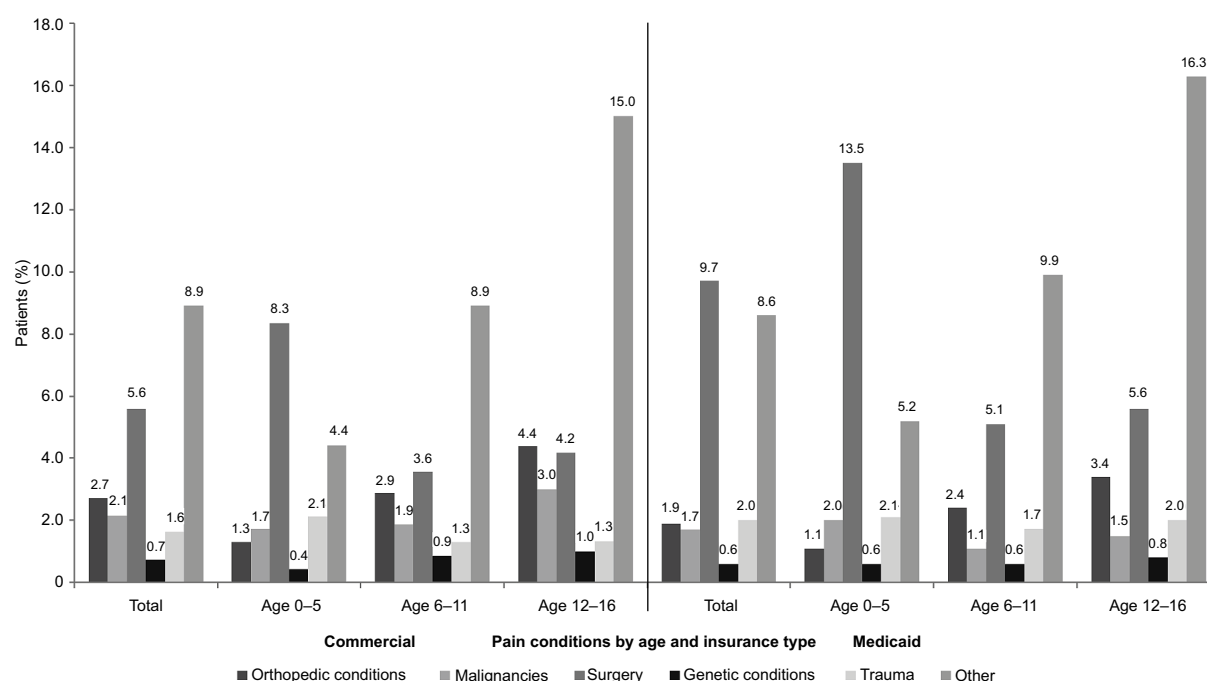


Figure 1 Prevalence of categories of conditions associated with pain in commercial and Medicaid pediatric patients by age.

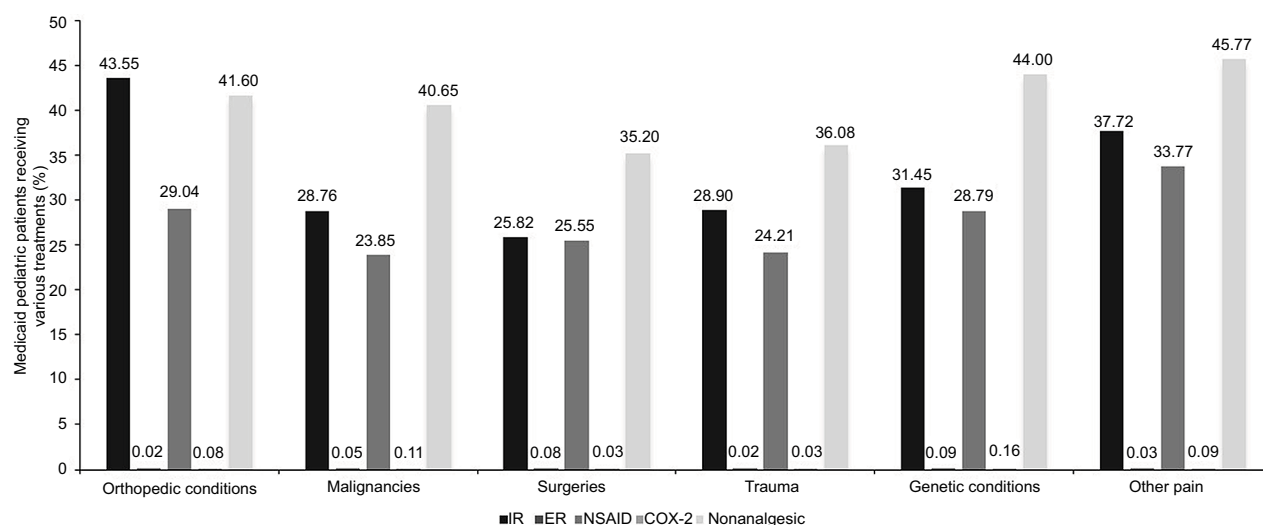


Figure 2 Proportion of Medicaid pediatric patients receiving various treatments by category.

Abbreviations: COX-2, cyclooxygenase-2; ER, extended release; IR, immediate release; NSAID, nonsteroidal anti-inflammatory drug.

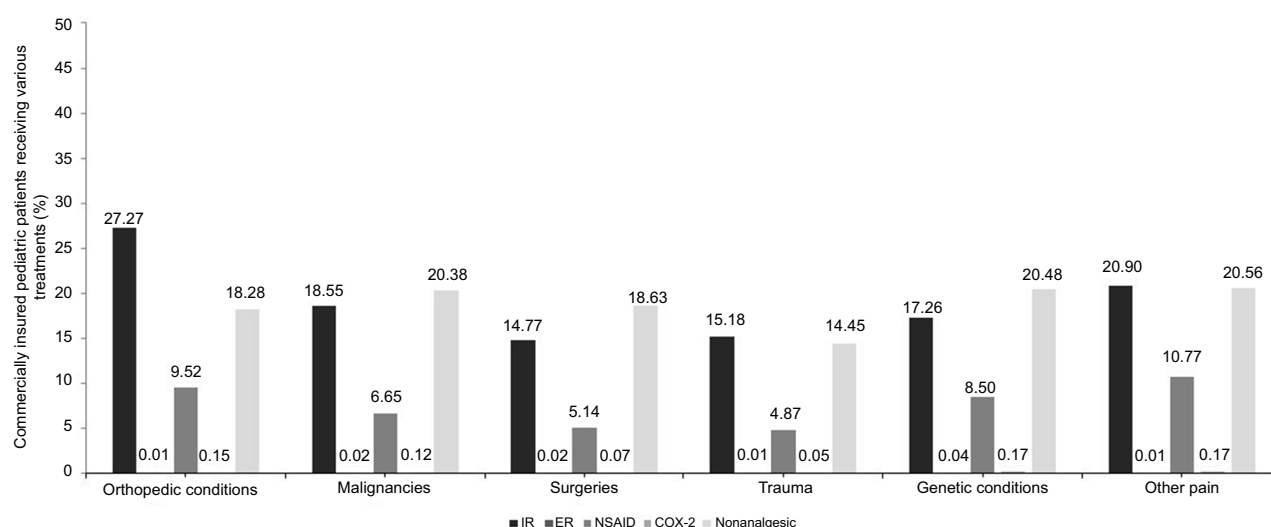


Figure 3 Proportion of commercially insured pediatric patients receiving various treatments by category.

Abbreviations: COX-2, cyclooxygenase 2; ER, extended release; IR, immediate release; NSAID, nonsteroidal anti-inflammatory drug.

those with Medicaid (Figure 2) and for 15.2% of those with commercial insurance (Figure 3). In patients with orthopedic conditions such as fracture or dislocation, IR opioids were prescribed for 45.3% of those with Medicaid and for 27.3% of those with commercial insurance. In that same orthopedic population, NSAIDs were prescribed for 29.0% of those with Medicaid and for 9.5% of those with commercial insurance. ER opioids were rarely used. For patients with Medicaid, prescriptions for ER opioids ranged from 0.02% to 0.09% (Figure 2), whereas for patients with commercial insurance, the prescription ranged from 0.01% to 0.04% (Figure 3).

Most treatments were used short-term, but duration of treatment varied substantially according to the condition

and treatment type. For example, in commercially insured patients, 97.7% of IR opioids were prescribed for less than 30 days compared with 66.1% of ER opioids, 71.0% of NSAIDs, and 48.3% of nonanalgesics; in patients with Medicaid insurance, the corresponding percentages were 97.4%, 61.3%, 87.7%, and 54.0%, respectively (Tables 1 and 2).

Discussion

Describing the prevalence of conditions causing pain in children and associated treatment patterns will contribute to an understanding of the complexities associated with managing such patients. Professional organizations such as the American Pain Society Pediatric Chronic Pain Task

Table 1 Duration of treatment among patients in the age group of 0–16 years in Medicaid-eligible patients

Treatment	Medicaid-eligible patients							
	All patients		0 to <6 years		6 to <12 years		12 to 16 years	
	N	%	N	%	N	%	N	%
IR Opioid								
<30 days	339,490	97.4	128,930	96.8	125,995	97.7	84,565	98.1
30<60 days	8149	2.3	4082	3.1	2514	1.9	1553	1.8
60<90 days	523	0.2	168	0.1	274	0.2	81	0.1
90+ days	341	0.1	67	0.1	233	0.2	41	0.0
ER Opioid								
<30 days	306	61.3	285	63.3	10	35.7	11	52.4
30<60 days	148	29.7	129	28.7	14	50.0	5	23.8
60<90 days	27	5.4	22	4.9	3	10.7	2	9.5
90+ days	18	3.6	14	3.1	1	3.6	3	14.3
IR+ER Opioid								
<30 days	1260	75.6	174	68.8	807	76.1	279	78.8
30<60 days	245	14.7	54	21.3	141	13.3	50	14.1
60<90 days	59	3.5	15	5.9	34	3.2	10	2.8
90+ days	103	6.2	10	4.0	78	7.4	15	4.2
COX-2 Inhibitor								
<30 days	154	26.1	3	5.8	131	32.8	20	14.3
30<60 days	307	51.9	27	51.9	214	53.6	66	47.1
60<90 days	41	6.9	8	15.4	17	4.3	16	11.4
90+ days	89	15.1	14	26.9	37	9.3	38	27.1
NSAIDs								
<30 days	269,877	87.7	120,003	95.3	92,863	80.0	57,011	86.9
30<60 days	34,234	11.1	5386	4.3	21,096	18.2	7752	11.8
60<90 days	2064	0.7	289	0.2	1318	1.1	457	0.7
90+ days	1490	0.5	289	0.2	824	0.7	377	0.6
Nonanalgesics								
<30 days	230,314	54.0	112,290	70.6	49,362	38.5	68,662	49.2
30<60 days	109,179	25.6	28,356	17.8	42,772	33.3	38,051	27.3
60<90 days	23,793	5.6	4842	3.0	10,260	8.0	8691	6.2
90+ days	63,562	14.9	13,608	8.6	25,915	20.2	24,039	17.2

Abbreviations: COX-2, cyclooxygenase 2; ER, extended release; IR, immediate release; NSAIDs, nonsteroidal anti-inflammatory drugs.

Force call for studies of the epidemiology and treatment of chronic pain in children as part of a larger research agenda to understand complex chronic pain conditions in this special population.¹¹ Our study provides a unique perspective, using 2 large-scale databases to describe the prevalence of painful conditions in children and associated prescription treatment. Findings from this study can be used to inform the design of clinical trials for pediatric pain as well as education for pediatric health care professionals.

Pharmacological treatments for conditions associated with pain in children vary substantially according to condition, treatment type, insurance, and age of the patient. Previous epidemiological studies in this field are limited due to inpatient characteristics or reports of survey data.^{1,2,12–13} This is the first study which analyzed data on such a large scale, using 2 databases of over 30 million pediatric patients to describe the prevalence and treatment of painful conditions. The data presented here differ from the data presented in previous reports regarding

the prevalence of pediatric pain, as these data were analyzed on the basis of conditions and diagnoses associated with pain in children. This unique approach is limited to the reported ICD-9-CM codes associated with the identified conditions.

A major finding of this study is the variation in prescribing patterns between commercially insured and Medicaid-insured patients. In general, the proportion of prescribed analgesic and nonanalgesic drugs was nearly twice as high in Medicaid-insured patients as in commercially insured patients. This difference was particularly observed for NSAIDs. One possible explanation for this is that Medicaid patients may be prescribed medications that can be obtained over the counter to ensure that they receive those medications. This may also explain why the prevalence of nonanalgesic prescriptions was much higher among Medicaid-insured patients than among commercially insured patients.

Prescription medications and treatment duration varied considerably according to patient age, condition, and insur-

Table 2 Duration of treatment among patients in the age group of 0–16 years in commercially insured patients

Treatment	Commercially insured patients							
	All patients		0 to <6 years		6 to <12 years		12 to 16 years	
	N	%	N	%	N	%	N	%
IR Opioid								
<30 days	795,256	97.7	148,417	96.0	194,821	97.8	452,018	98.3
30<60 days	16,936	2.1	5980	3.9	4157	2.1	6799	1.5
60<90 days	830	0.1	171	0.1	128	0.1	531	0.1
90+ days	684	0.1	111	0.1	122	0.1	451	0.1
ER Opioid								
<30 days	323	66.1	231	72.6	19	57.6	73	52.9
30<60 days	144	29.4	74	23.3	13	39.4	57	41.3
60<90 days	13	2.7	10	3.1	0	0.0	3	2.2
90+ days	9	1.8	3	0.9	1	3.0	5	3.6
IR+ER Opioid								
<30 days	4239	80.1	167	73.9	460	77.7	3612	80.7
30<60 days	680	12.8	37	16.4	81	13.7	562	12.6
60<90 days	133	2.5	10	4.4	16	2.7	107	2.4
90+ days	243	4.6	12	5.3	35	5.9	196	4.4
COX-2 Inhibitor								
<30 days	1519	31.3	8	7.8	115	19.0	1396	33.7
30<60 days	2569	52.9	50	48.5	322	53.2	2197	53.0
60<90 days	270	5.6	9	8.7	37	6.1	224	5.4
90+ days	495	10.2	36	35.0	131	21.7	328	7.9
NSAIDs								
<30 days	244,114	71.0	14,954	86.0	40,209	71.4	188,951	70.0
30<60 days	90,726	26.4	1716	9.9	14,304	25.4	74,706	27.7
60<90 days	4813	1.4	216	1.2	862	1.5	3735	1.4
90+ days	4115	1.2	511	2.9	976	1.7	2628	1.0
Nonanalgesics								
<30 days	400,108	48.3	139,671	78.2	105,240	54.6	200,624	46.2
30<60 days	216,107	26.1	24,164	13.5	42,716	22.2	123,344	28.4
60<90 days	49,838	6.0	3310	1.9	9868	5.1	28,053	6.5
90+ days	162,916	19.6	11,421	6.4	34,867	18.1	81,784	18.9

Abbreviations: COX-2, cyclooxygenase 2; ER, extended release; IR, immediate release; NSAIDs, nonsteroidal anti-inflammatory drugs.

ance provider. Variation in opioid prescription for pediatric inpatients was demonstrated in a recent epidemiological study, with 41.2% of the hospitalized patients exposed to opioids, yet exposure proportion and length varied significantly.¹⁵ The authors concluded that the variation in opioid exposure presented an opportunity to improve clinical practice regarding the use of opioids in pediatric patients.¹⁵ The variability of outpatient prescriptions for analgesics and other medications demonstrated in our study also suggests an opportunity to impact clinical practice through education or clinical trials, as outpatient prescriptions varied significantly among clinical conditions and between payer groups.

The variation of treatment between patients with commercial insurance and those with Medicaid is worthy of additional analysis. The differences may be related to outpatient prescription coverage, severity of disease managed in the outpatient setting, complexity, or severity of the disease of Medicaid recipients, or preferences of the providers who

are managing these patients. Although the US pediatrician survey demonstrated that physicians with higher percentages of Medicaid-insured patients were less likely to prescribe opioids, our study demonstrates that larger percentages of Medicaid-insured patients are receiving prescriptions for opioids, as well as other prescription medications. Research has shown that many pediatric Medicaid recipients are medically complex, and among the group of children with the highest Medicaid expenditures, medical complexity is a common characteristic.¹⁰ With cost of pharmacy as a substantial contributor to overall expenses for pediatric Medicaid recipients, further analysis may be needed to explore the differences in treatment patterns.¹⁰

Limitations

The use of insurance claims data and third-party databases is limited to the identification and use of ICD-9-CM codes that are associated with conditions related to pain in children. Our study

does not evaluate severity of pain as well as it does not associate treatment with severity. In this study, we used data from health care claims, which has some limitations. For example, we were unable to conclusively establish an indication for a given prescription, since prescriptions for some treatments, particularly nonanalgesics, may be used for conditions other than pain. Claims data also do not capture over-the-counter analgesics such as nonprescription NSAIDs and acetaminophen, which are likely to be commonly used in children. Finally, data on prescription duration may overestimate actual use.

Conclusion

Conditions associated with pain in children are relatively common, especially in older children. Outpatient analgesic treatments were prescribed in less than half of the patients with conditions known to cause pain in this study. Analgesic treatments varied substantially according to the condition, insurance type, and age of the patient, and outpatient non-analgesic treatments were used slightly more frequently than opioid analgesics.

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Author contributions

All authors were involved in the study conception and design, acquisition of data, and analysis and interpretation of data;

drafted and revised the manuscript for intellectual content; approved the final version to be published; and agree to be accountable for all aspects of the work.

Disclosure

All authors were employees of Purdue Pharma at the time of the research and writing of the manuscript. The authors report no other conflicts of interest in this work.

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