



Original contribution

## Variability in opioid prescribing for children undergoing ambulatory surgery in the United States



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### ABSTRACT

**Study objective:** We attempted to describe the opioid prescribing patterns for ambulatory pediatric surgery in the United States from 2007 to 2014.

**Design:** Retrospective database review.

**Setting:** Operating room ambulatory encounters as determined by the Truven Health Marketscan Commercial Claims and Encounters database.

**Patients:** A total of 929,874 ambulatory surgical encounters were identified in patients <18 years of age and, of these, 439,286 encounters generated an analgesic prescription.

**Interventions:** N/A

**Measurements:** The analgesic prescription was described in terms of the type of opioid along with the inclusion of acetaminophen and/or NSAIDs.

**Main results:** The probability of receiving a post-operative analgesic prescription increased with age, ranging from 18.2% of infants to 71.7% of teens. Acetaminophen with codeine (APAP/C) was the most common drug for infants (63.8%), while acetaminophen with hydrocodone (APAP/H) was the most common analgesic prescription for teens (53.6%). APAP/C and APAP/H were the predominant drugs used for all procedure types.

**Conclusions:** Substantial variability in analgesic prescribing at the level of the procedure performed, both in terms of the probability of receiving a prescription and in which drugs were prescribed. We observed significant age and procedure-based variability in opioid prescribing following pediatric ambulatory surgery.

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## 1. Introduction

The challenges that face providers seeking to provide analgesia following a painful ambulatory procedure are complex [1]. While opioids remain a mainstay of post-surgical pain control, increasing concerns regarding their safety and the potential for diversion have resulted in efforts to further regulate their use [2–7]. Pediatric patients can vary substantially in body size, body composition, and in their ability to ingest oral medications, requiring patient-specific customization of drug, dose, and formulation. Finally, teaching parents or other care-providers to administer combinations of prescription and non-prescription analgesics is not a trivial task, and may lead to unexpected results [8].

It would not be surprising, given these uncertainties and challenges, to observe substantial variability in the prescribing of analgesics following pediatric surgery as well as variabilities in the success of different strategies employed. There is a lack of evidence-based guidance

regarding the appropriate selection of analgesics for pediatric patients after surgical procedures, and the literature contains little information about current prescribing patterns. The purpose of this study is to describe the present use of opioids following ambulatory pediatric surgeries, as well as to determine major elements of variability in the types of analgesic drugs utilized in these patients.

## 2. Materials and methods

### 2.1. Data sources

This study is a review of data records contained within the Truven Health Marketscan® Commercial Claims and Encounters database, which contains insurance claim data for approximately 50 million privately insured Americans each year. Marketscan contains data across multiple sites of care, including inpatient, outpatient, and pharmaceutical claim data. To estimate the proportion of the US population covered by Marketscan during those years, we analyzed population estimates published by the United States Census Bureau in the 2013 American Community Survey (ACS).

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## 2.2. Inclusion criteria

Our sample included patients aged <18 years with prescription drug coverage who had an invasive and potentially painful ambulatory surgical procedure involving general anesthesia during the years 2007–2012, which were the years of data available to our research group at the time of the analysis.

## 2.3. Define encounter/prescription

We identified invasive surgical procedures by reviewing the list of “Procedure Group” codes used by Marketscan to collapse procedural CPT codes into groups, and used clinical experience to identify codes associated with invasive and potentially painful procedures (see Supplementary Table 2). General anesthesia was identified by the presence of a professional fee claim for general anesthesia on the same day as the professional fee claim for the surgical procedure. Additionally, to minimize inclusion of minor ambulatory procedures, we required a facility fee claim for the surgical procedure on the same calendar day as the two professional fee claims. The analytic dataset was examined on the level of the “patient day”, so each patient's exposure to surgery and anesthesia was counted only once, no matter how many surgical procedure claims were generated on a given day. In cases where more than one procedure was billed, the claim with the highest charge amount (in USD) was used to assign the procedure.

## 2.4. Prescription drug claims

To identify prescriptions written to manage acute postoperative pain, we searched the outpatient pharmaceutical claim database for prescriptions dispensed on the day of or day following outpatient procedures as described above. Drug claims for analgesics were further categorized as: isolated opioids, acetaminophen/codeine (APAP/C), acetaminophen/hydrocodone (APAP/H), acetaminophen/oxycodone (APAP/O), prescription-requiring NSAIDs (excluding ibuprofen and naproxen, even if dispensed), or “other”. While acetaminophen was included in combination therapies, it was not included in the analysis in isolation as it is rarely prescribed by itself and its availability without a prescription would bias estimates of its use.

## 2.5. Other definitions

Age was categorized as follows <1 year, 1–4 years (inclusive), 5–12 years (inclusive), and 13 or greater years. To examine procedure-based differences in prescribing practices, we identified the 5 most common procedure types during the years under study. From 2007 to 2012, the 5 most common ambulatory procedure categories were: (1) tonsillectomy/adenoidectomy, (2) ear procedures, (3) musculoskeletal surgery, (4) eye procedures, and (5) male genital procedures.

## 2.6. Clinical data

Clinical and demographic data about each patient having outpatient invasive surgery was extracted, including age, gender, and geographical region. Presence of absence of a complex chronic condition (CCC) as defined by Feudtner et al. was also determined by searching inpatient and outpatient claims prior to the date of surgery for relevant diagnosis codes [9].

## 2.7. Statistical analysis

Statistical analysis was performed in R version 3.2.2 (R Foundation for Statistical Computing, Vienna, Austria). Univariate statistics were analyzed using counts and percentages. Tests for equivalence across groups were calculated using a chi-squared statistic. To analyze prescription choices in the five most common procedures, a multinomial

logistic regression model was constructed using Zelig and the ZeligChoice packages in R [10,11]. Because of the very small number of prescriptions of NSAIDs and isolated opioids, these choices were collapsed into the “Other” category for this model. The parameter estimates from this model were then used to estimate the probability of each type of prescription, stratified by age and procedure.

## 2.8. IRB/consent

The Truven Health Marketscan® databases are considered completely de-identified and exempt from review by the University of Washington IRB, and as such, this study was not submitted for review.

## 3. Results

Between 2007 and 2012, the Marketscan dataset included healthcare utilization information for between 6.8 and 10.2 million children per year. We further restricted our analysis to children with prescription drug coverage, and estimate that approximately 12.6% of children living in the US during the years covered by this study were included in dataset that serves as the starting point for our analysis (Supplementary Table 1). Our inclusion criteria generated 929,874 ambulatory surgical encounters among patients with prescription drug coverage. Of these, 439,286 encounters (46.8%) generated an analgesic prescription that was filled on the day of or day following surgery, and this subset was used to further examine prescription patterns.

The demographic make-up of the dataset is outlined in Table 1. Patients were 57.3% male and well distributed across the spectrum of age and geographically across the United States. 3.9% of patients had a prior diagnosis consistent with a complex chronic condition. Table 1 also indicates that some variability in the probability of not receiving an analgesic prescription appears to have been associated with demographic factors, particularly age; only 18.2% of infants received a postoperative analgesic prescription compared to 68.1% of teenagers.

Table 2 depicts the association between analgesic prescription type and age. APAP/C was the most common drug selected for younger patients, and its use fell as age increased. Conversely, the prescription of APAP/H increased with age, becoming the predominant (53.6%) analgesic prescription for teens. APAP/O and NSAIDs constituted <4% of the prescriptions in the younger age groups but accounted for 18.6% and 9.7% of prescription in teens, respectively. Isolated opioid prescriptions were rare.

Fig. 1 depicts the output of a multinomial logistic regression model for data from the five most common procedure types in the dataset, adjusted for age, year, geographical region, and procedure category (Model code and output is provided in Supplementary File 1). Two of the most common procedure types, “Major Eye Procedures” and “Major Ear/Auditory Procedures” were dominated by an absence of prescription analgesics, though the proportion receiving no prescription for these two procedures was still predicted to decrease with age. For “Major Musculoskeletal Procedures,” “Male Genital Procedures,” and “Tonsillectomy/Adenoidectomy,” use of APAP/C increased for children aged >1 year and then decreased for teens, while APAP/H use steadily increased with age. APAP/O use was also observed in these 3 procedure types, but again only in substantial quantities among teens, and still at far lower rates than APAP/H. Use of alternative analgesics, including NSAIDs and isolated opioids, collapsed into a single “Other” choice in this model, was predicted to be very rare (<5% probability).

## 4. Discussion

In this large retrospective analysis of opioid prescriptions dispensed to privately insured children following ambulatory pediatric surgery, we have observed substantial age and procedure-based variation in both the probability of receiving analgesics requiring a prescription and the choice of analgesic agent. The probability of receiving a

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