



Full length article

Geographic variation in postpartum prescription opioid use: Opportunities to improve maternal safety

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ABSTRACT

Background: Obstetric delivery is among the most common in-hospital procedures experienced by reproductive-age women, yet there is little literature on patterns of postpartum opioid prescriptions after such episodes.**Methods:** We used claims data from 871,195 vaginal deliveries to 768,455 privately-insured women with an in-hospital delivery between June 2001 and July 2013 to examine the state- and census division-level proportions of women who filled an opioid prescription within four days of hospital discharge after vaginal delivery. Our primary outcome examined the proportion of women who filled an opioid prescription after uncomplicated vaginal delivery (e.g., without forceps extraction, vacuum extraction, or 3rd/4th degree perineal laceration). Secondary outcomes examined state- and census division-level variation in opioid prescription duration (proportion of prescriptions exceeding five days) and dose (proportion of prescriptions exceeding 280 morphine milligram equivalents). We also displayed national temporal trends in opioid prescribing rate and dose for uncomplicated vaginal delivery in comparison to complicated vaginal delivery.**Results:** Across states, we found a 7-fold variation in postpartum opioid prescription rates (7.6–53.4%), a 5-fold variation in opioid prescriptions for greater than five days' duration (5.1–25.7%), and a 19% absolute difference in opioid prescriptions for greater than 280 morphine milligram equivalents (0–19.3%) following uncomplicated vaginal delivery.**Conclusions:** These wide variations in postpartum opioid prescription practices suggest opportunities to develop guidelines on postpartum opioid use, to improve prescription safety, and to reduce opioid-related harms among women in the postpartum period.

1. Introduction

The rapid growth in opioid-related overdose deaths over the last two decades is closely linked to the growth in opioid analgesic prescriptions (Centers for Disease Control and Prevention, 2011; Dart et al., 2015; King et al., 2014). Among opioid-naïve patients, use of prescription opioid analgesics after minor surgery is associated with increased risk of long-term opioid use compared to patients treated with non-opioid analgesics, and higher doses and durations of prescription opioid use are associated with greater risks (Alam et al., 2012; Bateman et al., 2016; Beauchamp et al., 2014; Bohnert et al., 2011; Carroll et al., 2012; Deyo et al., 2017; Shah et al., 2017). Guidelines affirm that

opioids are not necessary for all acute pain and that non-opioid approaches to pain management should be promoted (Dowell et al., 2016; Hooten et al., 2016; Washington State Agency Medical Directors' Group, 2015). When opioids are used, guidelines recommend that prescriptions should be for the lowest effective dose and for a duration only as long as pain is expected to be severe. Despite these recommendations, over-prescribing remains common. Evidence suggests that roughly half of prescription opioids received by patients in the post-surgical period are never used (Bates et al., 2011; Bicket et al., 2017; Harris et al., 2013; Maughan et al., 2016; Rodgers et al., 2012).

Obstetric delivery is among the most common in-hospital procedures experienced by reproductive-age women (Hamilton et al., 2015),

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yet there is relatively little published literature on opioid prescribing practices in the immediate postpartum period (Bateman et al., 2016; Jarlenski et al., 2017; Osmundson et al., 2017). Substantial geographic variation exists in opioid prescribing and mortality, both among pregnant (Bateman et al., 2014; Desai et al., 2014) and general adult populations (King et al., 2014; McDonald et al., 2012; Paulozzi et al., 2014), but no study has yet examined national geographic variation in the use of prescription opioids following in-hospital delivery. Significant variation in postpartum opioid use would suggest an opportunity to develop relevant guidelines and educate physicians on best practices for pain management in this setting.

The primary objective of this study was to describe state- and census division-level variation in opioid analgesic use after discharge following uncomplicated vaginal delivery in the United States. Our secondary objectives were to describe census division- and state-level variation in opioid prescription duration and dose as well as to illustrate national-level temporal trends in opioid prescription rate and dose following vaginal delivery.

2. Methods

2.1. Data sources

We identified all deliveries from the Clinformatics™ Data Mart (OptumInsight, Eden Prairie, MN), a de-identified claims database from a large national insurer. This database includes enrollment data, medical claims, and all filled prescriptions for approximately 51 million individuals between July 2001 and June 2013. Enrollment data included each enrollee's year of birth, race/ethnicity, state of residence, and dates of insurance coverage. Medical claims included all inpatient and outpatient claims with accompanying diagnostic and procedural codes, as well as an "encounter-level" identification number to group multiple claims from the same admission. Claims data on filled prescriptions included fill date, drug class, brand or generic name, dosage, quantity dispensed, and duration (days' supply).

We identified in-hospital deliveries using International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9) codes. Deliveries were classified by presence or absence of coded complications (forceps extraction, vacuum extraction, or a third or fourth degree perineal laceration), as shown in Supplementary Table 1. This approach selected for complications that would potentially alter the provision of an opioid prescription or the quantity of opioid prescribed; it was not intended to identify all potential complications.

The data set included many different medical claims for a given hospital stay; we defined delivery date as the last encounter date with an ICD-9 delivery code, and discharge date was the last date with inpatient claims following delivery.

2.2. Participant selection

Fig. 1 illustrates the selection of our analytic sample. The initial data set consisted primarily of privately-insured women; there were small numbers of Medicaid-covered women in the dataset, but only for a limited number of states and for a portion of the time covered by our study, and as a result these women were excluded. We excluded out-of-hospital deliveries and records with obvious coding errors (deliveries coded to men, individuals with age less than 10 or greater than 50 years, or women with multiple live deliveries in less than nine months). Due to the data structure, we were unable to assess prescription fills for women whose hospitalizations extended beyond the end of a calendar quarter, so these deliveries were excluded. We excluded women who were discharged more than five days following delivery; these delayed discharges may be related to atypical complications and could have non-representative prescription patterns.

We also excluded women who filled opioid prescriptions within 90 days before delivery because pre-existing opioid tolerance may impact

opioid prescriptions. Prior research has shown that pre-operative opioid use has been linked with prolonged post-operative opioid use (Carroll et al., 2012). Finally, for state and division-level analyses, we excluded women who moved between divisions or states during their enrollment period, women with insurance plans in multiple states, women living outside of the fifty U.S. states and District of Columbia, or women for whom state of residence was unavailable.

2.3. Outcomes

Our primary outcome was the percentage of women who filled an opioid prescription within four days of hospital discharge (e.g., on the discharge date or during the three subsequent days) following an uncomplicated vaginal delivery. Opioids typically used for acute pain (codeine, hydrocodone, hydromorphone, meperidine, morphine, oxycodone, pentazocine, propoxyphene, tapentadol, tramadol) were included in the analysis. Opioids more often used to treat chronic pain or substance use disorders (e.g., buprenorphine, methadone, fentanyl patch) were excluded, as were Schedule V opioids typically used for antitussive or antidiarrheal effects (e.g., dihydrocodeine).

Secondary outcomes included the state-level proportion of prescriptions exceeding five days' duration and the state-level proportion of prescriptions for 280 MME or greater. Morphine milligram equivalents standardize the relative dose strength across different opioids, with MME dose for each prescription calculated by using established conversion factors (Centers for Medicare and Medicaid Services, 2015; Von Korff et al., 2008). Propoxyphene and pentazocine were excluded from MME calculations due to inconsistencies in reported conversion factors. Thresholds of five days and 280 MME were based on prior associations between these characteristics and the probability of continuing long-term opioid use (Deyo et al., 2017; Shah et al., 2017). If a woman received multiple opioid prescriptions, values for duration and MME were summed across all prescriptions to reflect the total opioid exposure. To illustrate temporal trends in prescribing practices and to clarify differences in prescribing patterns between uncomplicated and complicated vaginal deliveries, we also examined the opioid prescription rate and average prescribed opioid dose for both delivery types on a quarterly basis during 2001–2013.

Outcomes were compared across delivery type, states, and census divisions using two-tailed chi-squared tests of independence. All analyses were performed using STATA/MP 14.2. The University of Pennsylvania Institutional Review Board determined this research was exempt from review.

3. Results

The final analytic sample included 871,195 deliveries among 768,455 women. Table 1 displays demographic characteristics of the study population, the frequency of uncomplicated versus complicated vaginal deliveries, and the proportion of women with each delivery type who filled postpartum opioid prescriptions. A total of 243,963 deliveries (28%) were associated with a filled postpartum opioid prescription, and only 5236 deliveries (0.6%) were associated with more than one such prescription.

3.1. Primary results

Among women with uncomplicated vaginal deliveries, there were significant geographic differences in rates of postpartum opioid prescriptions across states and census divisions ($p < 0.001$), as shown in Table 2. Postpartum opioid use in the highest-use division (East South Central, 46.8%) was nearly five times greater (37% percentage points higher) than the lowest-use division (Middle Atlantic, 9.5%). This variation was even more pronounced across states: the postpartum opioid prescription rate in the state with the highest prescription rate (Oklahoma, 53.4%) was more than seven times higher (45% percentage

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