Medication Errors in Labor and Delivery: Reducing Maternal and Fetal Harm

ABSTRACT
Practitioners who work in labor and delivery units may administer an assortment of high-alert medications during the birthing process. These medications, such as oxytocin (used to induce and augment labor) and magnesium sulfate (used to treat preeclampsia and to delay preterm birth), are often administered intravenously. Medications used to manage pain, such as morphine and HYDROmorphine, may also be administered intravenously, while others, such as bupivacaine and fentanyl, may be administered via the epidural route. When high-alert medications are used in error in labor and delivery units, the event can affect both the mother and the fetus. Between June 2004 and April 2009, Pennsylvania healthcare facilities submitted 2,611 event reports involving medication errors in labor and delivery units. Analysis reveals that the most common medication error event type associated with this area is dose omission (22.5%), followed by wrong drug (10.7%). Further analysis showed that 46.4% of wrong-dose/overdose errors and 55.2% of wrong-rate errors involved high-alert medications. Strategies to prevent medication errors and patient harm in this specialty setting include standardizing the dosing and administration protocols as well as standardizing the concentrations and dosing units of drug infusions and adopting a policy that all infusions be administered with an infusion pump. (Pa Patient Saf Advis 2009 Dec 16;6[Suppl 1]:1-6.)

Practitioners who work in labor and delivery units may administer a variety of medications during the birthing process. These medications, such as oxytocin (used to induce and augment labor) and magnesium sulfate (used to treat preeclampsia and delay preterm birth), are often administered intravenously. Medications to manage pain, including morphine and HYDROmorphine, may also be administered intravenously, while others, such as bupivacaine and fentanyl, may be administered via the epidural route. All these medications are high-alert medications and, when used in error, bear a heightened risk of causing significant patient harm. When used in error in labor and delivery units, the medications may adversely affect both the mother and the fetus.

Many errors have been reported in the literature involving high-alert medications in labor and delivery; some of these errors have resulted in fatalities. Most of these errors were the result of unfamiliarity with safe dosage ranges and signs of toxicity, inadequate patient monitoring, pump programming errors, and confusion between magnesium sulfate, oxytocin, and intravenous (IV) fluids used for hydration.  

Analysis of Authority reports involving dose-omission errors in the labor and delivery unit revealed that 34.8% (n = 204) were associated with antibiotic doses. Antibiotics (e.g., penicillin, ampicillin) are often used during labor and delivery to prevent neonatal Group B Streptococcus (GBS) infection. GBS is a type of bacteria that can cause life-threatening infections in neonates, occurring in approximately 1 in every 3,000 infants born in the United States. Infections are commonly contracted from their mothers during vaginal birth. Infants with an early-onset infection suffer from one or more of the following conditions: pneumonia, sepsis, and less commonly, meningitis. Infants with a late-onset infection usually have sepsis or meningitis. However, GBS can also cause complications in the mother, unrelated to neonatal infection, including uterine infection before or after delivery. Infection before delivery, or chorioamnionitis, causes fever, uterine tenderness, and increased heart rate in the fetus. This infection is also treated with antibiotics. While only 11 (5.4%) of the 204 dose-omission
Wrong-Drug Errors in the Labor and Delivery Unit

Analysis of Authority reports involving wrong-drug errors showed that 180 (64.3%) reached the patient and 11 (3.9%) resulted in patient harm. In addition, 70 events (25%) involved high-alert medications, the majority of which were infusions. In 11 (15.7%) cases involving high-alert medications, oxytocin was administered instead of the prescribed medication, while in 7 (10%) cases, magnesium sulfate was given instead of the intended drug.

Wrong-drug medication errors reported to the Authority include the following:

The patient was in labor, and the anesthesiologist was in the process of inserting an epidural catheter. The patient’s blood pressure dropped, and the patient complained of feeling dizzy. The anesthesiologist handed a vial of ephedrine to the RN [registered nurse] and told the nurse to mix it with normal saline and administer 1 mL of the prepared solution to the patient. The RN did so, but then the patient became nauseated and dizzy and began to hypertensurate. It was then realized that the RN had been handed a vial of epinephrine instead of ephedrine. The patient was hydrated, and within a few minutes, all her symptoms had subsided. A vial of epinephrine was in the disposable epidural tray. The anesthesiologist was uncertain if he picked up that vial in error as opposed to the ephedrine vial, which is kept in the epidural cart.

The patient was admitted for induction of labor. Lactated Ringer’s fluid was ordered. IV access was obtained, and the IV fluid was connected. The fetal heart monitor started to show deceleration of the heartbeat. The patient was placed on her right side, and the ultrasound showed a fetal bradycardia. The patient was given terbutaline with a return of fetal heart rate to the baseline. Upon repositioning the patient, the IV fluid infusing was noted to contain Pitocin®. The IV fluid was immediately discontinued; lactated Ringer’s was started as ordered. Both patient and fetal heart rate remained stable; labor progressed without complications with a successful vaginal delivery of a healthy baby.

Ampicillin was ordered for a laboring patient due to premature ruptured membranes. An IV solution of bupivacaine was pulled by the nurse and hung. The error was discovered by another RN after 125 mL infused. Physicians were notified, and the error was discussed with the patient and family. The patient had transient symptoms. The patient delivered without incident.

This last case is similar to a nationally known case in which, in 2006, a 16-year-old woman in labor died after an epidural analgesic including bupivacaine and fentanyl was inadvertently infused intravenously instead of penicillin. A few minutes after the start of the infusion, the woman experienced seizures, a clenched jaw, and gasping respirations. The woman eventually died despite efforts to resuscitate her. In 2008, the UK National Patient Safety Agency and the British media published information involving a similar incident in which a young woman died after receiving IV bupivacaine. In this case, the woman in labor should have received normal saline intravenously, but a nurse accidentally selected an identical bag of bupivacaine located in the same unlocked drawer as the saline. The bupivacaine infusion did not contain fentanyl, and therefore, did not require locked storage. Since the nurse thought she was administering a bag of normal saline, she had no reason to require another nurse to double-check the product before giving it. The patient developed seizures and cardiac arrest that could not be reversed.

Wrong-Dose/Overdosage Errors in the Labor and Delivery Unit

Dose omission accounted for 587 of the total reports (22.5%). The wrong drug was involved in 280 cases (10.7%), and medication error—other was involved in 272 cases (10.4%). Wrong time occurred in 213 events (8.2%), Wrong patient was involved in 177 cases (6.8%), and wrong dose/overdosage was involved in 166 events (6.4%). Wrong dose/underdosage was involved in 99 cases (3.8%), and monitoring error—documented allergy was involved in 86 cases (3.3%). Wrong rate (intravenous) was involved in 58 cases (2.2%).

Table 1. Predominant Medication Error Event Types Associated with the Labor and Delivery Unit (n = 2,442), June 2004 to April 2009

<table>
<thead>
<tr>
<th>EVENT TYPE</th>
<th>NUMBER</th>
<th>% OF TOTAL REPORTS (N = 2,611)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose omission</td>
<td>587</td>
<td>22.5%</td>
</tr>
<tr>
<td>Wrong drug</td>
<td>280</td>
<td>10.7%</td>
</tr>
<tr>
<td>Medication error—other</td>
<td>272</td>
<td>10.4%</td>
</tr>
<tr>
<td>Wrong time</td>
<td>213</td>
<td>8.2%</td>
</tr>
<tr>
<td>Wrong patient</td>
<td>177</td>
<td>6.8%</td>
</tr>
<tr>
<td>Wrong dose/overdosage</td>
<td>166</td>
<td>6.4%</td>
</tr>
<tr>
<td>Prescription/underdosage</td>
<td>145</td>
<td>5.6%</td>
</tr>
<tr>
<td>Unauthorized drug</td>
<td>136</td>
<td>5.2%</td>
</tr>
<tr>
<td>Extra dose</td>
<td>120</td>
<td>4.6%</td>
</tr>
<tr>
<td>Wrong route</td>
<td>103</td>
<td>3.9%</td>
</tr>
<tr>
<td>Wrong dose/underdosage</td>
<td>99</td>
<td>3.8%</td>
</tr>
<tr>
<td>Monitoring error—documented allergy</td>
<td>86</td>
<td>3.3%</td>
</tr>
<tr>
<td>Wrong rate (intravenous)</td>
<td>58</td>
<td>2.2%</td>
</tr>
</tbody>
</table>

Authority reports involving wrong-dose errors associated with an overdose of a medication accounted for 6.4% (n = 166) of overall errors in labor and delivery. There were 117 (70.5%) overdoses that reached the patient, eight (4.8%) of which resulted in harm. Seventy-seven (46.4%) of these events involved high-alert medications. See Table 2 for the top 10 medications involved in wrong-dose/overdosage errors in labor and delivery.
Qualitative analysis of the top five high-alert medications involved in wrong-dose/overdosage errors (oxytocin, morphine, magnesium sulfate, HYDROMorphone, and meperidine) indicate a strong correlation with failure points related to infusion pump management. Thirty-five (64.8%) of the 54 wrong-dose/overdosage reports with high-alert medications specifically mentioned issues with the use of infusion pumps, including pumps that were not programmed correctly (e.g., wrong-drug concentrations, wrong infusion rates), free-flowing or "wide-open" IVs, and IV pump tubing mix-ups. Important to note is the potential for harm to the fetus with oxytocin wrong-dose/overdosage errors. Nine (47%) of the 19 oxytocin wrong-dose/overdosage errors mentioned the presence of fetal distress, each of which also involved a pump-related contributing factor. The authors of one study noted that errors involving oxytocin administration during labor are predominantly dose-related and often involve a lack of timely recognition and appropriate treatment of excessive uterine activity (tachysystole).12

Additional analysis of these reports suggests frequent prescribing errors with misoprostol. Ten (77%) of the 13 misoprostol wrong-dose/overdosage errors involved doses mistakenly ordered in milligrams instead of micrograms. Of note among this error type was the correlation of each of the Vitamin K concentrations involved in wrong-dose/overdosage errors with high-alert medications, accounting for 55.2% of the errors. The top three drugs involved in wrong-rate (IV) errors were oxytocin (25.9%), HYDROMorphone (11.4%), and magnesium sulfate (13.8%).

Wrong-rate (IV) Errors in the Labor and Delivery Unit

Another medication error event type that often leads to overdoses is wrong-rate errors. A total of 58 (2.2%) medication error reports associated with the labor and delivery unit submitted to the Authority involved wrong-rate errors associated with IV infusions. Of these, 49 (84.5%) events reached the patient, and 2 (3.4%) resulted in patient harm. A total of 32 reports involved high-alert medications, accounting for 55.2% of the errors. The top three drugs involved in wrong-rate (IV) errors were oxytocin (25.9%), HYDROMorphone (20.7%), and magnesium sulfate (13.8%).

The following are examples of wrong-rate errors reported to the Authority:

The RN increased the rate of the oxytocin infusion to 725 μU instead of 5 μU. The infusion ran for several minutes before being discovered. Brief fetal deceleration was noted. There were no anticipated sequelae to mother or baby. The RN was notified, and no further intervention was required.

A new nurse on orientation confused the IV lines, connecting the IV fluids to the pump at the rate of infusion for the Pitocin drip and vice versa. The patient received an increased dose of Pitocin. The nurse reported this event to the Authority. Reversal of Pitocin was attempted without success. The RN was notified, and no further intervention was required.

The patient was receiving IV fluid (lactated Ringer’s) as ordered. The Pitocin (oxytocin) protocol was then initiated. The IV fluid was taken off the pump so that Pitocin could be placed on the pump. Another fluid bolus was ordered for the patient. The nurse mistakenly [bolused] the fluid on the pump, which was the Pitocin. The patient received 25 mL of Pitocin. The fetal heart rate dropped; the patient was given terbutaline and was taken for a stat cesarean section.

A new nurse on orientation confused the IV lines, connecting the IV fluids to the pump at the rate of infusion for the Pitocin drip and vice versa. The patient received an increased dose of Pitocin. The electronic fetal monitor showed fetal bradycardia. Reversal of Pitocin was attempted without success. The baby was delivered via a stat cesarean section with reasonable Apgar scores.

The fetal heart tones were low. Pitocin was found to be programmed to run at 72 milliunits/minute. The RN stated she had meant to place Pitocin at 12 milliunits/minute and inadvertently set it at 72. The Pitocin was turned off, and the patient was positioned on her right side. An IV fluid bolus was given.

The nurse mistakenly opened the magnesium sulfate infusion wide open instead of lactated Ringer’s as ordered. The patient complained of feeling flushed. The RN increased the rate of the oxytocin infusion to 725 μU instead of 5 μU. The infusion ran for several minutes before being discovered. Brief fetal deceleration was noted. There were no anticipated sequelae to mother or baby. The RN was notified, and no further intervention was required.

The physician gave a verbal order for Brethine® (terbutaline) 0.25 mg subcutaneous, but the nurse administered a 2.5 mg dose. Transient fetal tachycardia and maternal hypotension occurred. The patient was monitored, and no further intervention was required.
Risk Reduction Strategies

Based on the review of reports submitted to the Authority, as well as observations at the Institute for Safe Medication Practices and in the literature, the following strategies may help prevent medication errors in the labor and delivery unit and mitigate patient harm when errors do occur.

Standardization

Establish standardized concentrations and dosing regimens for oxytocin, magnesium sulfate, and other high-alert medication infusions, and if possible, provide commercially available or pharmacy prepared solutions to eliminate the need for nurse preparation at the point of care. Avoid using nonstandard concentrations. Develop specific protocols for the administration of bolus doses. Establish dosing and administration protocols and standard order sets for magnesium sulfate, oxytocin, and other high-alert medication infusions. As part of this work, standardize the unit of measure used to prescribe magnesium sulfate (e.g., g, mEq) and to report lab values (e.g., mg/dL, mEq/L, mmol/L).

Infusion Pumps and Administration Sets

Adopt a policy that all IV medications be administered via infusion pump, preferably a smart pump with operational dose range alerts. For epidural infusions, use pumps that look different than pumps used for IV infusions. Avoid the use of dual-channel pumps for simultaneous administration of IV and epidural drugs. In addition, use yellow-lined tubing without injection ports for epidural infusions in order to set its appearance apart from regular IV tubing, and never use it for anything other than epidural administration. Likewise, when drug infusions are discontinued, require the immediate removal of those drug infusions from the patient’s access site, pump, and IV pole to prevent later accidental infusion.

Labeling

Use bold fonts to label IV infusion bags of oxytocin, magnesium sulfate, and other high-alert infusions to differentiate them from each other and from IV hydration infusions. In addition, label infusion pumps with the name of the solution being infused as well as the IV tubing near the IV pump. When infusions are started or the rate is adjusted, trace the tubing by hand from the IV bag, to the pump, and then to the patient for verification. For epidural medications, clearly label infusion bags and syringes that contain epidural medications as well as epidural infusion pumps with the designation “For Epidural Use Only” in large type.

Storage

Reduce the risk of mix-ups by separating the storage of high-alert IV drug infusions, epidural infusions, and regular fluids, such as lactated Ringer’s solution, used for hydration. Create designated areas to place medications needed during different phases of the labor and birth process (e.g., containers or drawers labeled with bold fonts, in which products can be neatly organized). Restrict access to unneeded medications. In addition, never store look-alike products, such as EPINEPHrine and ePHEDrine, side by side in anesthesia or epidural carts.

Look- and Sound-Alike Products

Distinguish products with look and sound-alike names through the use of “tall man” lettering, in which uppercase letters are applied to the parts of the names that are different (e.g., EPINEPHrine, ePHEDrine). This form of differentiating look-alike products should be used on computer screens, pharmacy and nursing unit shelf labels and bins (including automated dispensing cabinets), pharmacy product labels, and medication administration records. In addition, prescribers should use tall man letters when creating electronic order sets as well as in written orders.

Verbal Orders

Reserve verbal orders for true emergency situations or when the prescriber is physically unable to write or electronically transmit orders (e.g., working in a sterile field). If the medication prescribed requires emergency administration (or the nurse is working within a sterile field), repeat back the order, and announce the medication again just before administration (e.g., “I am now giving ePHEDrine 5 mg intravenously.”).

Double Checks

Require an independent double check of the drug, concentration, infusion rate, pump settings, line attachments, and patient before administering high-alert medications, such as magnesium sulfate and oxytocin and epidural medications. Point-of-care barcode systems can also assist in verification of the drug, strength, and the patient. When transferring patients, have the receiving and transferring nurse verify the patient, drug/concentration, line attachment, and pump settings at the bedside against the original order.

Monitoring

Frequently monitor patients’ vital signs, oxygen saturation, and level of consciousness, as well as fetal heart tones, maternal uterine activity, and other necessary patient parameters when infusing high-alert medications. When the status of the mother and fetus changes suddenly, include as part of the assessment an immediate check of the infusing solution to ensure that it is the one prescribed. Signs and symptoms of fetal distress often alert the staff that a medication error is in progress. When giving drug boluses, remain at the bedside to monitor the patient continuously. Establish standard rescue procedures in the event of drug overdoses and toxicity, and ensure that required medications are readily accessible to staff on code carts or with other secured emergency supplies.

Notes


Self-Assessment Questions

The following questions about this article may be useful for internal education and assessment. You may use the following examples or come up with your own.

1. All of the following are medications frequently involved in wrong-dose/overdosage medication errors in labor and delivery EXCEPT:
   a. Morphine
   b. Oxytocin
   c. Magnesium sulfate
   d. Cefazolin
   e. Misoprostol

2. The most frequently reported type of medication error occurring in labor and delivery is _____________.
   a. extra dose
   b. drug omission
   c. wrong drug
   d. wrong dose/overdosage
   e. prescription/refill delayed

3. All of the following are true about antibiotic use and potential complications from antibiotic omissions in labor and delivery EXCEPT:
   a. Group B streptococcus (GBS) occurs in approximately 1 in every 3,000 infants born in the United States.
   b. Antibiotics (e.g., penicillin, ampicillin) are often used during labor and delivery to prevent neonatal GBS infection.
   c. GBS is a type of bacteria that can cause life-threatening infections in neonates including pneumonia, sepsis, and meningitis.
   d. Infected babies usually contract GBS infection from their mothers during vaginal birth.
   e. GBS bacteria will not contribute to complications in the mother.

4. All of the following are true about wrong-dose/overdosage errors in labor and delivery EXCEPT:
   a. Almost half of the oxytocin wrong-dose/overdosage error reports included the presence of fetal distress.
   b. Among this error type, reports submitted indicated frequent dispensing errors with misoprostol.
   c. More than 60% of wrong-dose/overdosage error reports involving high-alert medications included issues with infusion pumps.
   d. Analysis of Authority reports involving wrong-dose errors associated with an overdose of a medication accounted for less than 10% of all labor and delivery errors.
   e. The Vitamin K wrong-dose/overdosage errors involved the wrong concentration (adult instead of neonatal).

(continued on next page)
5. Which of following is the most effective strategy to reduce the risk of harm from medication errors in the labor and delivery setting?
   a. Differentiate products with look- and sound-alike names through the use of tall man lettering (e.g., EPINEPHrine, ePHEDrine).
   b. Require an independent double check of the drug, concentration, infusion rate, pump settings, line attachments, and patient before administering high-alert medications.
   c. Separate the storage of high-alert intravenous (IV) drug infusions, epidural infusions, and regular fluids (e.g., lactated Ringer’s solution) used for hydration.
   d. Use bold fonts to label IV infusion bags of oxytocin, magnesium sulfate, and other high-alert infusions to differentiate them from each other.
   e. Establish standardized concentrations and dosing regimens for oxytocin, magnesium sulfate, and other high-alert medication infusions.

6. A patient admitted for induction of labor was ordered lactated Ringer’s solution. The fetal heart monitor started to show deceleration of the heartbeat. The patient was placed on her left side and given terbutaline with a return of fetal heart rate to the baseline. Upon repositioning the patient, the IV fluid infusing was noted to be Pitocin®.

Select which of the following strategies would not help prevent this event from reoccurring nor minimize harm.
   a. Label infusion pumps with the name of the solution being infused as well as the IV tubing near the IV pump.
   b. Separate the storage of the lactated Ringer’s solution from other high-alert IV drug infusions.
   c. Frequently monitor patients’ vital signs, oxygen saturation, and level of consciousness, as well as fetal heart tones, maternal uterine activity, and other necessary patient parameters.
   d. Use individualized concentrations of IV high-alert infusions like Pitocin, magnesium sulfate, and morphine sulfate solutions.
   e. Educate staff about the risk of serious errors in labor and delivery.