

# ANALYSIS OF REPORTED ADVERSE EVENTS ASSOCIATED WITH INTRAVENOUS PATIENT-CONTROLLED ANALGESIA: FINDINGS FROM THE FDA CENTER FOR DEVICES AND RADIOLOGICAL HEALTH MANUFACTURER AND USER FACILITY DEVICE EXPERIENCE (MAUDE) DATABASE

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## ABSTRACT

**Purpose:** Single case reports suggest that serious injuries or deaths can result from problems associated with intravenous patient-controlled analgesia (IV PCA) infusion pumps. The objective of this study was to examine these types of adverse events systematically, using a large, publicly available database: the US Food and Drug Administration's Manufacturer and User Facility Device Experience (MAUDE) database.

**Methods:** We extracted all IV PCA-related MAUDE records from January 2002 through December 2003 to identify and abstract the following patient outcomes: death, naloxone administration, respiratory depression or arrest, excessive sedation, and other events (eg, injury due to IV PCA device falling on the patient). Possible causes of adverse events are documented within MAUDE reports. We classified these as follows: possible operator errors (eg, errors in programming made by the healthcare professional responsible for programming the pump), possible patient-related events (eg, tampering), possible device-related events (eg, device malfunction), possible adverse drug reactions, events unrelated to IV PCA (eg, terminal illness), and indeterminate events (causes unspecified).

**Results:** There were 165 documented patient adverse events. They included 32 (19%) deaths, 95 (58%) cases of naloxone administration, 15 (9%) cases of respiratory depression/arrest, 5 (3%) cases of excessive sedation, and 18 (11%) other events. Among the 32 deaths, 6 (19%) were reportedly due to possible operator error, 7 (22%) due to a possible adverse drug reaction, 12 (38%) due to factors unrelated to IV PCA, and 7 (22%) were indeterminate. Among the 95 cases of naloxone administration, 42 (44%) were reportedly due to possible operator error, 4 (4%) due to possible patient-related events, 4 (4%) due to possible device-related events, 12 (13%) due to possible adverse drug reaction, 1 (1%) possibly unrelated to IV PCA, and 32 (34%) were indeterminate. Among the 15 cases of respiratory depression/arrest, 6 (40%) were reportedly due to possible operator error, 4 (27%) due to possible adverse drug reaction, and 5 (33%) were indeterminate. Four of the 5 cases of excessive sedation were reportedly due to possible operator error, and the remaining case was the result of a possible adverse drug reaction. Of other adverse events, 6 (33%) were reportedly due to possible operator error, 4 (22%) due to a possible device-related event, 1 (6%) to possible adverse drug reaction, and 7 (39%) were indeterminate.

**Conclusions:** Thirty-nine percent (n = 64) of the adverse events that occurred during this 2-year index period were attributable to possible operator error; these errors had the greatest potential for serious harm, reportedly accounting for 19% of deaths, 44% of cases of naloxone administration, and 40% of cases of respiratory distress/arrest. New approaches, including novel technologies, capable of reducing operator error could potentially result in a substantial reduction in the number of deaths and serious injuries.

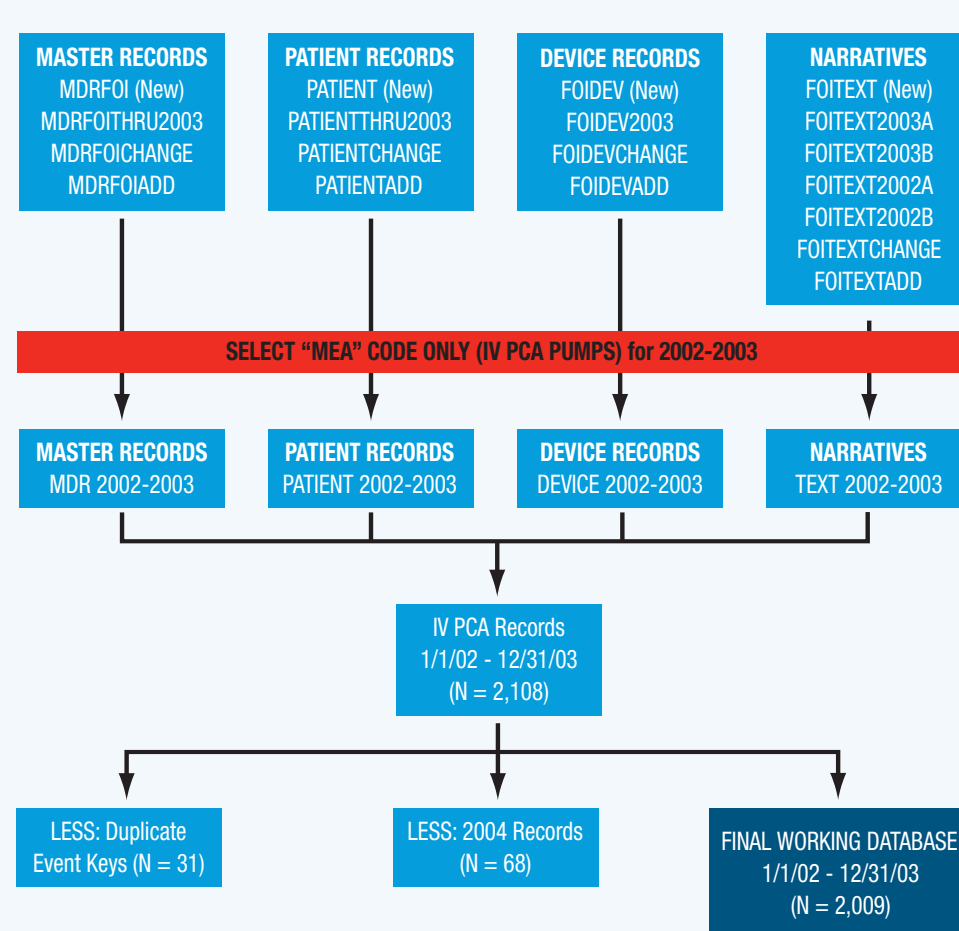
## BACKGROUND/OBJECTIVES

- Intravenous patient-controlled analgesia (IV PCA) infusion pumps deliver healthcare provider-programmed doses of intravenous analgesia in response to patient request
  - The device is commonly used in the postoperative setting to treat acute pain
- Single case reports suggest that serious injuries to the patient or even deaths can result from problems associated with intravenous patient-controlled analgesia (IV PCA) infusion pumps<sup>1</sup>
- Clinicians, patients, user facilities, manufacturers, and distributors may report IV PCA-related adverse events or product problems through a variety of mechanisms
- The Food and Drug Administration (FDA) Center for Devices and Radiological Health (CDRH) provides the only government-sponsored mechanism for such reporting
- The objective of this study was to systematically examine patient adverse outcomes using a large, publicly available database of reported adverse events: the United States FDA's Manufacturer and User Facility Device Experience (MAUDE) database

## METHODS

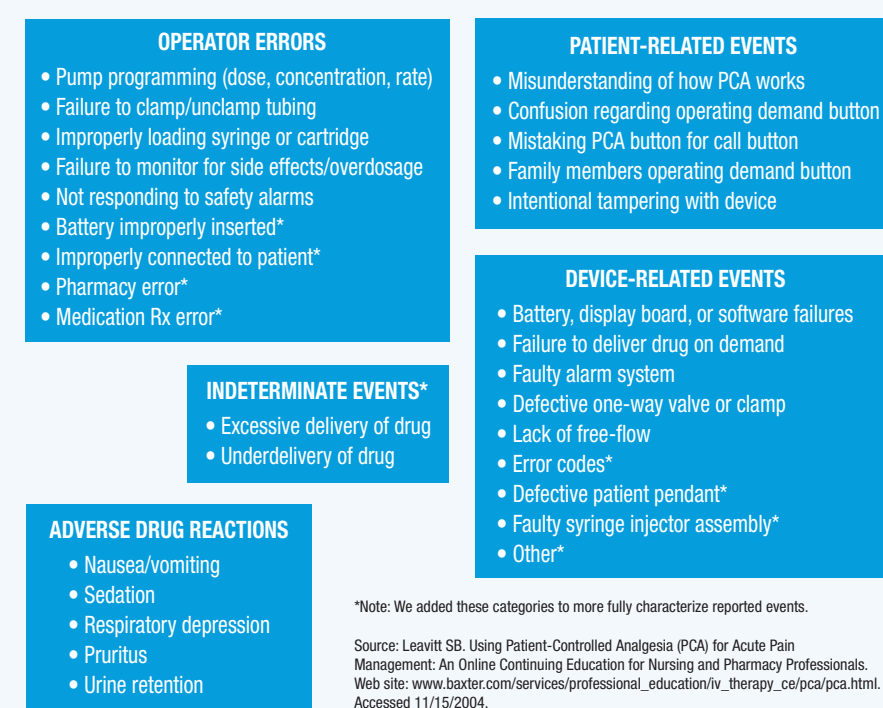
- MAUDE data are available to the public in text files that can be downloaded into Microsoft Access format<sup>2</sup>
- We downloaded all records pertaining to IV PCA (FDA product code "MEA") for the period 1/1/02 through 12/31/03 into an Access database (Figure 1)

Figure 1. Extraction of MAUDE data.



- Data were then exported into statistical software (SPSS version 13.0) for further analysis
- Publicly available MAUDE reports include information regarding event type (patient adverse event or device problem), patient outcome (eg, death, medical intervention required), and suspected drug or device involved in the event (including brand and manufacturer)
  - Patient-specific information, such as diagnosis or demographics, is not available to the public, however
- Narrative text describing potential causes of the event that were provided by the reporting facility or manufacturer were abstracted and classified into 5 categories per Leavitt<sup>3</sup> (Figure 2):

Figure 2. Classification of text information regarding event cause.<sup>3</sup>



- Possible operator errors (eg, pump programming errors)
- Possible patient-related events (eg, patient tampering)
- Possible device-related events (eg, device malfunction)
- Possible adverse drug reactions
- Indeterminate events (unspecified causes)

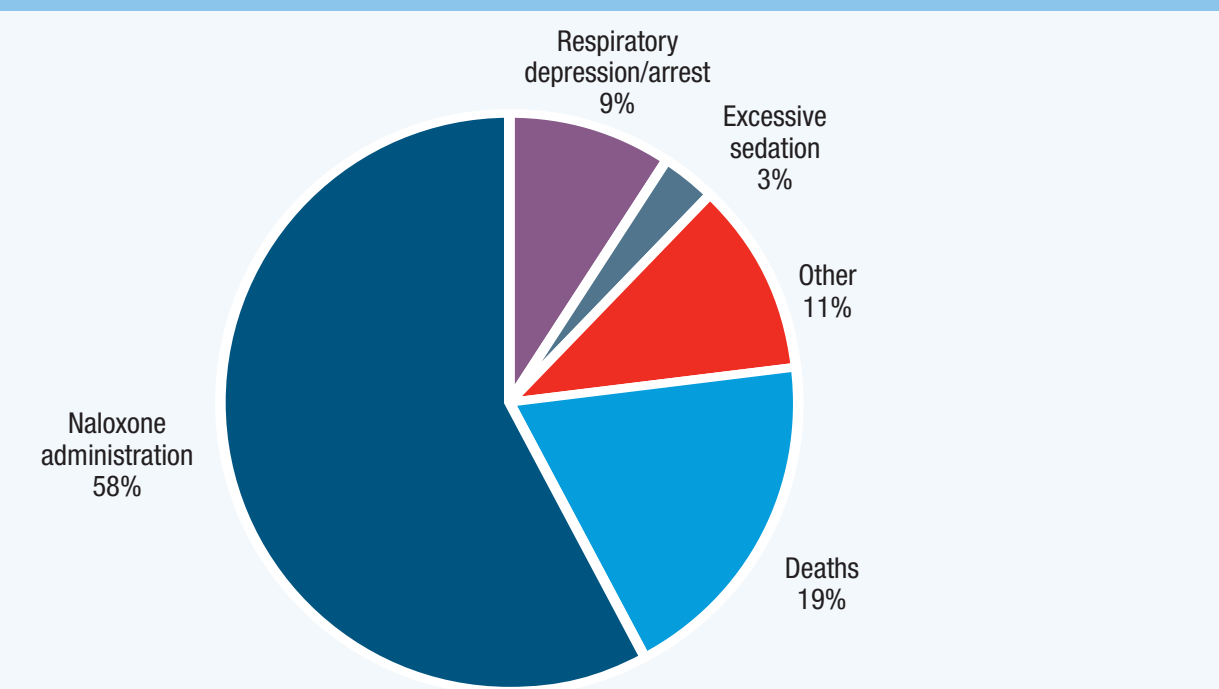
## RESULTS

- Among the 2,009 IV PCA-related MAUDE reports recorded from January 1, 2002 through December 31, 2003, 79.1% (n = 1,590) were attributed to possible device-related events, 6.5% (n = 131) possible operator errors, 1.2% (n = 25) possible adverse drug reactions, 0.6% (n = 12) possible patient-related events, and 12.6% (n = 251) were indeterminate events

– More than half (61%) of the reported possible device-related events were confirmed upon inspection by the device manufacturer

- There were 165 documented patient adverse events during the 2-year index period
  - Adverse events included 32 (19%) deaths, 95 (58%) cases of naloxone administration (suggesting opioid overdose), 15 (9%) cases of respiratory depression/arrest, 5 (3%) cases of excessive sedation, and 18 (11%) other events (eg, blurred vision or dizziness) (Figure 3)

Figure 3. MAUDE documented IV PCA-related adverse events by reported cause (n = 165).



– Reported possible attributions of adverse events are shown in Table 1

- Among the 32 deaths, 6 (19%) were reportedly due to possible operator error, 7 (22%) due to a possible adverse drug reaction, 12 (38%) due to factors unrelated to IV PCA (eg, terminal illness), and 7 (22%) were indeterminate
- Among the 95 cases of naloxone administration (which suggests opioid overdose), 42 (44%) were reportedly due to possible operator error, 4 (4%) due to possible patient-related events, 4 (4%) due to possible device-related events, 12 (13%) due to possible adverse drug reaction, 1 (1%) possibly unrelated to IV PCA, and 32 (34%) were indeterminate
- Among the 15 cases of respiratory depression/arrest, 6 (40%) were reportedly due to possible operator error, 4 (27%) due to possible adverse drug reaction, and 5 (33%) were indeterminate
- Four of the 5 cases of excessive sedation were reportedly due to possible operator error, and the remaining case was the result of a possible adverse drug reaction
- Of the other adverse events, 6 (33%) were reportedly due to possible operator error, 4 (22%) due to a possible device-related event, 1 (6%) due to possible adverse drug reaction, and 7 (39%) were indeterminate

Table 1. Reported Possible Attributions of Adverse Events (n = 165)

	Operator error	Patient-related events	Device-related events	Drug reaction	Factors unrelated to IV PCA	Indeterminate
Patient deaths	19%	0%	0%	22%	38%	22%
Naloxone administration	44%	4%	4%	13%	1%	34%
Respiratory depression/arrest	40%	0%	0%	27%	0%	33%
Excessive sedation	80%	0%	0%	20%	0%	0%
Other adverse events	33%	0%	22%	6%	0%	39%

## CONCLUSIONS

- There were 165 reported adverse events documented in the MAUDE database that occurred during this 2-year index period
  - More than one third (39%; 64/165) of these were reportedly attributable to possible operator error; these errors had the greatest potential for serious harm, reportedly accounting for 19% of deaths, 44% of cases of naloxone administration, and 40% of cases of respiratory distress/arrest
  - Voluntary and mandatory reporting systems for adverse events typically suffer from severe under-reporting, ranging from 1.2% to 7.7% of actual reportable events<sup>1,4,5,6,7</sup>
    - If these estimates of under-reporting are applied to the number of MAUDE-documented adverse events, then an estimated 2,143 (165/7.7%) to 13,750 (165/1.2%) IV-PCA-related adverse events may have actually occurred during the period 1/1/2002 through 12/31/2003
  - New approaches, including novel technologies, capable of reducing operator error could potentially result in a substantial reduction in the number of deaths and serious injuries

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## DISCLOSURE

Authors of this presentation have the following to disclose concerning possible financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter of this presentation: Cheryl Hankin: Yes; Consultant to Ortho-McNeil Pharmaceutical, Inc. Mingliang Zhang: Yes; Employee of Ortho-McNeil Pharmaceutical, Inc.

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