Analysis of Interventions Required in 12,021 Children With Acute Intoxications Admitted to PICUs

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Abstract

Objectives: Acute intoxications in children account for 4.6% of annual admissions to the PICU. We aimed to describe the interventions and monitoring required for children admitted to the PICU following intoxications with the ultimate goal of determining patient and intoxication characteristics associated with the need for PICU interventions.

Design: Retrospective review of prospectively collected data from Virtual Pediatric Systems, LLC.

Setting: United States PICUs participating in the Virtual Pediatric Systems database from 2011 to 2014.

Patients: Less than or equal to 18 years old admitted to a PICU with a diagnostic code for poisoning, ingestion, intoxication, or overdose.

Interventions: None.

Measurements and Main Results: In total, 12,021 patients were included with a median PICU length of stay of 0.97 days (interquartile range, 0.67–1.60). Seventy-eight percent of the intoxications were intentional. The top five classes of medications ingested were unknown substances (21.6%), antidepressants (11.5%), other chemicals (10.7%), analgesics (7.3%), and antihypertensives (6.2%). Seventy-six (0.61%) patients died. Any of the interventions reported in the Virtual Pediatric Systems database were performed in only 29.1% of the total cases.

Conclusions: The majority of cases (70.9%) admitted to the PICU following an intoxication did not undergo any significant intervention. Future studies should focus on distinguishing patient and

intoxication characteristics associated with need for PICU intervention to optimize patient safety and minimize resource burden. (*Pediatr Crit Care Med* 2017; 18:e281 -e289)

Due to advances in patient monitoring technology, pediatric early warning sign scores (1–6) and development of rapid response teams (7–9), patient care and monitoring capabilities on the general floors has dramatically improved over the past few decades. Simultaneously, there is a growing shortage of PICU beds as critical care resource utilization is rising (10), especially during the fall and winter months when there is a greater burden of respiratory illness. Pediatric poisonings and intoxications (both intentional and unintentional) account for 4.6% of annual admissions to the PICU (11). The objective of this work was to quantify PICU interventions, monitoring, and therapies required for children admitted to PICU following acute intoxications. Several small, single-center pediatric studies have described the patient characteristics and substances ingested for children and adolescents admitted to a PICU after acute intoxication (12–17). In addition, previous studies have shown that a majority of pediatric poisoning patients can be safely monitored in an observation unit instead of an ICU (13,18). An adult study looking at intentional overdoses showed that Glasgow Coma Scale in the emergency department (ED) is the only predictive factor associated with the need for ICU care (19). However, there is no clinical scoring tool to predict which children require PICU admission following acute intoxications.

The goals of this study were to describe the frequency of interventions performed on children admitted to the PICU following acute intoxications and to determine the risk factors associated with the need for these interventions or monitoring typically performed in an ICU setting. We used Virtual Pediatric Systems (VPS), LLC database to determine the odds of requiring a therapy or intervention only performed in a PICU. Our primary hypothesis was that the majority of children admitted to the PICU for acute intoxication did not require interventions provided only in an ICU setting.

MATERIALS AND METHODS

Study Design and Data Collection

We performed a retrospective chart review of deidentified VPS data from 2011 to 2014. The VPS database is the largest collaboration "for quality improvement based on severity of illness adjusted comparisons of actual, detailed patient records in critical care" from over 135 sites which prospectively collect clinical data using standardized definitions (11). Local institutional review board approval was attained before obtaining VPS data. Patient inclusion criteria were age less than or equal to 18 years with *International Classification of Diseases*, 9th Edition (ICD-9) diagnostic codes for poisoning, ingestion, intoxication, or overdose. We collected patient demographics, PICU length of stay (LOS), ICD-9 description of medication ingested, severity of illness scores (Pediatric Index of Mortality 2 [PIM2], Pediatric Risk of Mortality Score [PRISM] III, Pediatric Logistic Organ Dysfunction), and interventions required during their PICU hospitalization. Patients could have been admitted

more than one time in the dataset; however, for analysis, multiple admissions on the same patient were considered independent and are reported as number of cases.

Classification of ingested substances was based on primary ICD-9 codes. If the primary code was not indicated, the first occurrence of the case in the database and its associated ICD-9 text was used. These classifications are defined in Supplementary Table 1 (Supplemental Digital Content 1, http://links.lww.com/PCC/A448). Our only exclusions were the 2,672 cases without any ICD-9 code for which drug was ingested; however, intoxications with ICD-9 codes indicating unknown agents were included since this accounted for a significant number of cases. For drug class comparisons, we used the ingestion of insulin as the reference group because it was the intoxication class associated with the least number of interventions.

The interventions required were defined by organ system and are reported in Table 2. The mandatory fields in the VPS database that were documented in 100% of the cases include endotracheal intubation, high-frequency oscillator ventilation, conventional mechanical ventilation (including continuous positive airway pressure plus pressure support), extracorporeal membrane oxygenation, and placement of an arterial catheter, hemodialysis or plasmapheresis catheter, percutaneous central venous catheter or peripherally inserted central catheter. Given that all other interventions were not reported for all cases, we could not use these interventions in our model, but we did use them for intervention quantification in our primary analysis.

Outcomes

The primary outcome measure was the number and frequency of cases that required monitoring and/or interventions that could only be performed in a PICU. Secondary outcome measures were patient characteristics and intoxication characteristics associated with increased odds of mortality and the need for PICU monitoring or an intervention defined as requiring PICU admission. We also analyzed mortality in our patient cohort.

Statistical Methods

Descriptive statistics were calculated using counts and frequencies, medians and interquartile ranges for nonnormally distributed variables, or means and 95% CIs for patient demographics, categorization of drugs ingested, and interventions required. The percentages of PICU interventions were calculated and 95% CIs were reported. We used multivariable logistic regression with generalized estimating equations (GEE) to identify characteristics associated with an increase in the odds of undergoing a PICU intervention. GEEs were chosen to adjust the model coefficients and their SEs to account for potential clustering and correlation within hospitals that contribute to the VPS database. Resulting risk factors are presented as odds ratios (ORs) with 95% CIs. Variables included in the final model were selected a priori or due to showing significant associations with requiring a PICU intervention. These included primary drug class, sex, age, accidental versus intentional intoxication, multiple versus single substance intoxication, and PRISM III. Unless otherwise noted, statistical significance was assessed using a significance level of p value of less than

0.05. Two-sided statistical tests are reported. All statistical analyses were performed using SAS 9.4 (SAS Institute, Cary, NC).

RESULTS

Patient Demographics and Characteristics of Acute Intoxications

Between January 2011 and December 2014, there were 12,432 cases of acute pediatric intoxications admitted to PICUs participating in the VPS database. Of the 12,021 patients, 322 patients had multiple PICU admissions within the study timeframe, with the maximum number of cases within a single patient being two. Demographics and characteristics associated with acute intoxications are reported in Table 1. We observed a bimodal age distribution with the majority of intoxications occurring in children less than 5 years old ($n = 4,532$; 36.5%) and in children greater than 13 years old ($n = 6,774$; 54.5%). However, given lack of ability to communicate with infants and toddlers, these numbers may be an underestimate of the true number of accidental intoxications in nonverbal children. The identity of substances ingested classified by age is presented in Supplementary Table 2 (Supplemental Digital Content 1, http://links.lww.com/PCC/A448). The identity of over a fifth of substances ingested was unknown. The median PICU LOS was just under 1 day with an interquartile range of 0.67–1.60 days.

Analysis of Interventions Performed for Intoxication Patients in the PICU

We categorized procedures, interventions, and monitoring performed in the PICU by the organ system involved as shown in Table 2. Interventions that were required to be reported in the VPS database are denoted in bold type. These mandatorily reported interventions are those that require PICU admission; however, many of the other therapies listed without mandated reporting also require the monitoring and care provided in a PICU setting. For nonmandatorily reported interventions, the total numbers of cases for which there are database entries are denoted in parentheses beside the interventions. The interventions listed in Table 2 are not mutually exclusive, and a single patient may have required multiple interventions. At least one of these interventions listed in Table 2 was performed in 3,620 cases (29.1%). Furthermore, only 23.8% ($n = 2,956$) of cases were reported to receive a mandatorily reported intervention. Mechanical ventilation was the single most performed intervention (21.8%; $n = 2,705$). Airway and respiratory interventions accounted for the majority of total interventions performed (62.7%; $n = 4,022$) followed by the need to obtain invasive access (25.8%; $n = 1,653$).

Characteristics of Patients With Intoxications Associated With Mortality

Of the 12,021 patients, 76 died (0.61%). These patients are designated in the database as "brain death"; additional details regarding cause of death were not available. As expected, mortality was associated with PRISM III greater than or equal to 10, but there were no associations with age, sex, race, or intentional versus nonintentional intoxication (Table 3). Other chemicals, opiates/opioids, recreational drugs, and stimulants were significantly associated with increased odds of death $(p < 0.001)$, but surprisingly intoxication with multiple substances was not associated with higher odds of death. Only two of the 76

patients who died did not undergo a PICU intervention; one patient ingested an analgesic and the other ingested a stimulant.

Risk Factors Associated With PICU Intervention

Based on our multivariable logistic regression model, age less than 2 years old or greater than 13 years old, male gender and intentional intoxication were associated with increased odds of needing a mandatorily reported intervention (Table 4). A one-point increase in PRISM III had an adjusted OR of 1.3 (1.26–1.34; $p < 0.001$). The top five intoxications associated with need for PICU intervention were carbon monoxide, alcohols, alkalis/caustics, maternal effects on fetus/newborn, and metals. The only drug classes not significantly associated with need for PICU intervention were hormones, parasympatholytics, and nonsteroidal anti-inflammatory drugs (Table 4). The model is adjusted for demographic factors such as age, sex, and race, and GEE was used to account for site-to-site variability. We also performed multivariable logistic regression of variables and drug classes associated with PICU interventions stratified by age group (Supplementary Table 3, Supplemental Digital Content 1, http://links.lww.com/PCC/A448).

DISCUSSION

There is limited evidence to support the admission of the majority of children with acute intoxications to a PICU (12). Reasons for admission to PICU include the request for continuous cardiorespiratory monitoring including pulse oximetry, a high nurse-to-patient ratio, and the potential need to intervene rapidly should a life-threatening complication occur. However, given the variability in national PICU admission criteria and general ward capabilities, especially in terms of telemetry, we cannot specifically clarify the reason for PICU admission among our 12,021 patients. Over the past several decades, due to advances in patient monitoring technology, pediatric early warning sign scores (1–6) and development of rapid response teams (7–9), a general pediatric inpatient unit should be able to safely care for the majority of children hospitalized for acute intoxications. The accommodation of children on a general pediatric inpatient unit when compared with a PICU limits healthcare costs and allows for PICU beds to remain available for the most critically ill children. Consistent with our hypothesis, we found that only 29.1% of children admitted to a PICU following acute intoxications required any significant interventions. Additionally, the median hospital LOS among our patient population was less than 1 day; given this exceedingly short LOS, many of these patients may not have required hospital admission at all.

In this study, almost all intoxication classes were associated with interventions necessitating PICU admission to some degree despite the fact that other chemicals, opiates/opioids, recreational drugs, and stimulants were most highly associated with mortality in this patient cohort. We anticipated that several other medication classes would have been associated with a higher odds of needing a PICU intervention in the toddler age group given that antimalarials, camphor, clonidine, methyl salicylates, and sulfonylureas can be fatal to toddlers in doses typically prescribed for adults (20). We speculate that one possible explanation for this discrepancy is that toddlers who ingest medications that can be lethal

with one adult dose do not survive to reach the PICU and are therefore not captured in the VPS database.

There are no clinical tools available to predict which children require PICU admission after acute intoxication. There is one adult, single-center observational study with 2,565 patients which found that the Glasgow Coma Scale was the only predictor for ICU admission in adults (19). We used a physiology-based severity of illness score (PRISM III) and class of drug ingested to model which children would require PICU intervention as defined by the need for invasive monitoring, interventions, and procedures typically performed only in a PICU. The ideal predictive model would be able to determine which nontoxic appearing children examined in an ED are at risk for later deterioration and thus should be admitted to the PICU for observation of potentially life-threatening complications following an acute intoxication. The PIM2 score was not used because it includes variables such as mechanical ventilation that inherently require PICU admission. Although PRISM III was not reported for all patients in our cohort, it was available for 92% of cases and was therefore the severity of illness score we included in our multivariable regression model. The PRISM III has 17 physiologic variables subdivided into 26 ranges. The variables most predictive of mortality are minimum systolic blood pressure, abnormal pupillary reflexes, and stupor/coma (21).

In our cohort, only a small percentage of children (3.5%) were admitted to the PICU from a general inpatient unit compared to an ED (91.8%). Prospective studies are needed to determine the number of children misclassified as not requiring the PICU who later deteriorate on the general inpatient unit necessitating transfer to the PICU. We cannot definitively determine from the VPS dataset whether patients who did not receive an intervention would otherwise be safe on the general ward.

There are several limitations to our study. The first limitation is that we defined the necessity for PICU admission based on whether an intervention that can only be provided in an intensive care setting was performed. Although many of the interventions performed only in a PICU must be recorded in VPS, this mandate is not absolute for all interventions typically provided in a PICU. We only included mandatorily reported interventions as an outcome in our multivariable prediction model in order to have the most data from which to construct our prediction model. Also, given our query of the database, we may have missed other cases of intoxication that were not classified as such; a prime example is a young, nonverbal child with altered mental status of unknown etiology that may have been later classified as intoxication after all other factors are ruled out. A second limitation is that we were not able to control for site-level variability in admission criteria to a PICU or the availability of step-down, telemetry, or observation units available to monitor children as alternatives to general inpatient unit or PICU admission; however, we controlled for clustering within centers using deidentified unit codes to account for confounding due to differences in the patient mix, severity of illness, and PICU referral patterns across institutions. A third limitation is that we cannot map out the patients' clinical course or determine the reason for transfer to the PICU from a general inpatient unit; however, most children who are ill enough to require a PICU intervention are symptomatic when they present to the ED. Additionally, for the 76 fatalities, we cannot determine details regarding the cause of death, the timing of death, or the sequence of events leading to death due to the retrospective nature of the VPS database. A

fourth limitation is that we used ICD-9 codes to classify ingested substances, rather than names of medications themselves, limiting the ability to differentiate higher risk medications such as clonidine or β-adrenergic antagonists from other antihypertensive agents. Prospective data are needed to test the utility of the severity of illness scores or other physiology-based tools, to predict which children require PICU admission versus which children can be monitored on the floor with minimal risk of future deterioration necessitating transfer to a PICU. Lastly, while specific antidotes such as naloxone infusion for opioid ingestions or dialysis for lithium or salicylate ingestions do warrant PICU admission, we could not capture these interventions in our study because the VPS database does not explicitly list these antidotes or decontamination procedures in the dataset.

CONCLUSIONS

In our query of the VPS dataset, we found that approximately 70% of children with acute intoxications did not undergo any interventions necessitating PICU admission. Further studies to prospectively develop and validate a simple clinical scoring tool to accurately predict which children can be safely monitored in a general inpatient unit following an acute intoxication will be invaluable in assuring safe care for children at low risk for life-threatening complications following acute intoxications, and in reducing healthcare costs by decreasing unnecessary PICU admissions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

ACKNOWLEDGMENTS

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TABLE 1.

Patient Demographics and Characteristics of Acute Intoxications

Variable	Toxic Intoxication Count, *n* (%)
No. of patients	12,021
No. of cases[a]	12,432
Female	6,914(55.6)
Age at admission (yr), median (IQR)	13.8 (2.7–16.0)
Age distribution (yr)	
<2	2,186(17.6)
2–5	2,346(18.9)
6–12	1,126 (9.1)
13–18	6,774 (54.5)
Weight (kg), median (IQR)	50.0(14.3–65.0)
Race	
White	6,387 (58.9)
Black	2,031 (18.7)
Hispanic	1,131 (10.4)
Other/mixed	847 (7.8)
Unspecified	449 (4.1)
Location of referral for admission	
Emergency department (other location)	6,411 (51.6)
Emergency department (same location)	4,997 (40.2)
General ward	438 (3.5)
Other	586 (4.7)
Length of stay (d), median (IQR)	0.97(0.67–1.60)
Intentional/accidental intoxication	9,644 (77.6%)/2,788 (22.4%)
Pediatric Index of Mortality 2 score, median (IQR), range	−4.65 (−4.79 to −4.34), −6.81 to−4.14
Predicted mortality, median (IQR), range	0.95% (0.82–1.29%), 0.1–1.57%
Pediatric Risk of Mortality Score III[b], median (IQR), range (*n* = 11,392)	0 (0–3), 0–46
Mortality	76(0.61)
Multiple agent intoxication	2,276(18.3)
Primary *International Classification of Diseases*, 9th Edition/drug classification[c,d]	
Unknown	2,680 (21.6)
Antidepressants	1,424(11.5)
Other chemicals	1,329(10.7)
Analgesics	912(7.3)
Antihypertensives	773 (6.2)
Opiates/opioids	635 (5.1)
Alcohols	560 (4.5)
Nonsteroidal antiinflammatory drugs	495 (4.0)
Antihistamines/antiemetics	406 (3.3)

Variable	Toxic Intoxication Count, *n* (%)
Benzodiazepines/barbiturates	406 (3.3)
Stimulants	281 (2.3)
Antiepileptic drugs	275 (2.2)
Noningestions	271 (2.2)
Recreational drugs	257 (2.1)
Other pharmaceuticals	237 (1.9)
Alkalis/caustics	209 (1.7)
Cardiac medications	185 (1.5)
Insulin	169 (1.4)
Maternal effects on fetus/newborn	156 (1.3)
Muscle relaxants	150 (1.2)
Sedatives	148 (1.2)
Parasympatholytics	124 (1.0)
Cough/cold medications	102 (0.8)
Carbon monoxide	66 (0.5)
Anti-infectives	61 (0.5)
Central nervous system depressants	53 (0.4)
Metals	45 (0.4)
Hormones	12 (0.1)
Food/plants	11 (0.1)

IQR = interquartile range.

[a] More cases than total patients due to readmissions.

[b] Missing data.

[c] Defined in Supplementary Table 1.

[d] If no primary code was indicated, then the first occurrence of case in dataset was used.

TABLE 2.

Procedures, Interventions, and Monitoring Performed[a]

Intervention	n (%)
No. of cases with any intervention performed, n (%)	3,620 (29.1)
No. of cases with a mandatorily reported intervention performed, n (%)	**2,956 (23.8)**
Total no. of any interventions performed, n (%)	**6,418**[a]
Airway and respiratory: total n (% of all interventions performed), n (%)	4,022 (62.7)
Mechanical ventilation	**2,705 (21.8)**
Noninvasive ventilation ($n = 8,172$)	430 (5.3)
O_2 therapy ($n = 1,972$)	212(10.8)
Bronchoscopy ($n = 9,147$)	130(1.4)
Tracheostomy tube insertion ($n = 9,149$)	99(1.1)
Airway adjuncts ($n = 9,142$)	32 (0.4)
Continuous nebulizer ($n = 7,232$)	269 (3.7)
High-frequency oscillator ventilation	**42 (0.3)**
Heliox ($n = 7,226$)	48 (0.7)
Inhaled nitric oxide ($n = 7,229$)	49 (0.7)
Hyperbaric O_2 chamber ($n = 1,937$)	6 (0.3)
Cardiorespiratory support, n (%)	53 (0.8)
Cardiopulmonary resuscitation ($n = 7,478$)	34 (0.5)
Defibrillation ($n = 7,473$)	5(0.1)
Pacing ($n = 7,473$)	12 (0.2)
Cardioversion ($n = 7,474$)	2 (0.0)
Imaging, n (%)	345 (5.4)
CT ($n = 3,700$)	236 (6.4)
MRI ($n = 3,649$)	109 (3.0)
Neurology, n (%)	241 (3.8)
Electroencephalogram ($n = 6,742$)	199 (3.0)
Therapeutic hypothermia ($n = 5,415$)	16 (0.3)
Intracranial pressure monitor ($n = 6,617$)	22 (0.3)
Pentobarbital coma ($n = 5,412$)	4(0.1)
Invasive access, n (%)	1,653 (25.8)
Arterial catheter	**680 (5.5)**
Central venous catheter	**658 (5.3)**
Peripherally inserted central catheter	**226 (1.8)**
Hemodialysis/plasmapheresis catheters	**89 (0.7)**
Advanced technologies, n (%)	104(1.6)
Continuous veno-venous hemofiltration, continuous renal replacement therapy ($n = 7,753$)	37 (0.5)
Hemodialysis/peritoneal dialysis	**45 (0.4)**
Extracorporeal membrane oxygenation	**22 (0.2)**
Plasmapheresis	**0 (0.0)**

[a]Not mutually exclusive; multiple interventions could be performed on a single patient or case.

Boldface values represent mandatorily reported interventions obtained on all patients in the database.

n = number of cases for which data were collected.

TABLE 3.

Bivariate Analysis of Characteristics Associated With Mortality

Variables	Mortality ($n = 76$)	Survived ($n = 12,356$)	OR (95% CI)	p
Age (yr), *n* (%)				
<2	12(15.8)	2,174(17.6)	1.07 (0.48–2.40)	0.862
2–5	12(15.8)	2,334(18.9)	Reference	-
6–12	13(17.1)	1,113(9.0)	2.27 (1.03–5.00)	0.041
13–18	39 (51.3)	6,735 (54.5)	1.13(0.59–2.16)	0.719
Sex, *n* (%)				
Female	41 (54.0)	6,873 (55.6)	0.94 (0.59–1.47)	0.769
Male	35 (46.0)	5,483 (44.4)	Reference	-
Race, *n* (%)				
White	36 (54.6)	6,351 (58.9)	Reference	-
Black	9(13.6)	2,022(18.8)	0.79(0.38–1.63)	0.518
Hispanic	10(15.2)	1,121 (10.4)	1.57 (0.78–3.18)	0.206
Other/mixed	7(10.6)	840 (7.8)	1.47 (0.65–3.31)	0.353
Unspecified	4(6.1)	445 (4.1)	1.59(0.56–4.48)	0.384
Intoxication type, *n* (%)				
Intentional	59 (77.6)	9,585 (77.6)	1.00(0.58–1.72)	0.990
Accidental	17(22.4)	2,771 (22.4)	Reference	-
Multiple agent intoxication	12(15.8)	2,264(18.3)	0.84(0.45–1.55)	0.570
PRISM III, median (IQR) ($n = 11,392$)	22(12–30)	0 (0–3)	1.28(1.24–1.31)	<0.001
PRISM III 10, *n* (%)	63(85.1)	470 (4.2)	132.2(69.2–252.5)	<0.001
Primary *International Classification of Diseases*, 9th Edition/drug classification[a], *n* (%)				<0.001
Unknown	7 (9.2)	2,673(21.6)		
Antidepressants	4 (5.3)	1,420(11.5)		
Other chemicals	17(22.4)	1,312(10.6)		
Analgesics	4 (5.3)	908 (7.4)		
Antihypertensives	1 (1.3)	772 (6.3)		
Opiates/opioids	13(17.1)	622 (5.0)		
Alcohols	1 (1.3)	559 (4.5)		

Variables	Mortality (n = 76)	Survived (n = 12,356)	OR (95% CI)	p
Nonsteroidal anti-inflammatory drugs	0 (0.0)	495 (4.0)		
Antihistamines/antiemetics	1 (1.3)	405 (3.3)		
Benzodiazepines/barbiturates	2 (2.6)	404 (3.3)		
Stimulants	4 (5.3)	277 (2.2)		
Antiepileptic drugs	0 (0.0)	275 (2.2)		
Noningestions	1 (1.3)	270 (2.2)		
Recreational drugs	5 (6.6)	252 (2.0)		
Other pharmaceutical	4 (5.3)	233(1.9)		
Alkalis/caustics	0 (0.0)	209(1.7)		
Cardiac medications	1 (1.3)	184(1.5)		
Insulin	2 (2.6)	167(1.4)		
Maternal effect on fetus/newborn	3 (4.0)	153(1.2)		
Muscle relaxants	0 (0.0)	150(1.2)		
Sedatives	1 (1.3)	147(1.2)		
Parasympatholytics	0 (0.0)	124(1.0)		
Cough/cold medications	0 (0.0)	102 (0.8)		
Carbon monoxide	4 (5.3)	62 (0.5)		
Anti-infectives	1 (1.3)	60 (0.5)		
Central nervous system depressants	0 (0.0)	53 (0.4)		
Metals	0 (0.0)	45 (0.4)		
Hormones	0 (0.0)	12(0.1)		
Food	0 (0.0)	11 (0.1)		

IQR = interquartile range, OR = odds ratio, PRISM = Pediatric Risk of Mortality Score.

[a] An odds ratio cannot be calculated due to some drug intoxications with no mortality reported.

Dashes indicate no p value for reference variables.

TABLE 4.

Multivariable Logistic Regression of Variables Associated With PICU Interventions[a] (*n* = 11,392)

Variable	OR (95% CI)	*p*
Pediatric Risk of Mortality Score III	1.30(1.26–1.34)	<0.001
Intoxication classification	46.56(16.73–129.57)	<0.001
Carbon monoxide	33.07(17.11–63.89)	<0.001
Alcohols	23.54 (10.86–51.04)	<0.001
Alkalis/caustics	17.42 (9.26–32.77)	<0.001
Maternal effects on fetus/newborn	12.08 (5.24–27.86)	<0.001
Metals	10.13 (4.60–22.30)	<0.001
Muscle relaxants	9.94 (4.55–21.69)	<0.001
Central nervous system depressants	9.26 (4.98–17.18)	<0.001
Other chemicals	8.61 (4.45–16.66)	< 0.001
Recreational drugs	7.15(3.63–14.10)	< 0.001
Antiepileptic drugs	6.54(1.12–38.25)	0.037
Food/plants	6.26(3.27–12.00)	< 0.001
Benzodiazepines/barbiturates unknown	5.86(3.18–10.80)	< 0.001
Opiates/opioids	5.72 (3.00–10.92)	< 0.001
Cough/cold medications	5.56(2.67–11.58)	< 0.001
Antihypertensives	5.55 (2.94–10.46)	< 0.001
Anti-infectives	5.52 (2.16–14.10)	< 0.001
Sedatives	5.11 (2.51–10.42)	< 0.001
Other pharmaceuticals	4.93 (2.61–9.33)	< 0.001
Antidepressants	4.88 (2.56–9.28)	< 0.001
Antihistamines/antiemetics	4.20 (2.27–7.78)	< 0.001
Stimulants	3.06 (1.62–5.77)	0.001
Cardiac medications	2.99 (1.41–6.34)	0.004
Hormones	2.87 (0.40–20.66)	0.295
Noningestions	2.54(1.03–6.24)	0.042
Analgesics	2.30(1.20–4.41)	0.013
Parasympatholytics	1.91 (0.80–4.52)	0.144

Variable	OR (95% CI)	p
Nonsteroidal anti-inflammatory drugs	1.78 (0.98–3.25)	0.060
Insulin	Reference	–
Intentional intoxication	**1.35 (1.12–1.62)**	**0.001**
Multiple agent intoxication	1.08(0.97–1.21)	0.155
Gender (female)	**0.82 (0.76–0.89)**	**<0.001**
Age (yr)		
<2	**1.23 (1.01–1.50)**	**0.043**
2–5	1.08(0.90–1.30)	0.400
6–12	Reference	–
13–18	**1.36 (1.15–1.61)**	**<0.001**

OR = odds ratio.

[a]Only mandatorily reported PICU interventions are included.

Boldface font indicates $p < 0.05$.