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Clinical Characteristics and Outcomes of Pediatric Emergency Department Encounters With Positive Fentanyl Urine Drug Screens

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Abstract

Background

Pediatric fentanyl-related emergency department (ED) visits represent an important clinical concern, yet outcomes among children and adolescents remain poorly characterized. Prior studies have primarily relied on administrative coding, which may not accurately identify fentanyl exposure or capture detailed clinical characteristics and outcomes.

Purpose

This study aimed to describe the clinical characteristics, healthcare utilization, and outcomes of pediatric patients with positive fentanyl urine drug screens presenting to two EDs in California's Central Valley.

Methods

This was a retrospective cohort study of patients ⩽ 18 years presenting to two EDs within a health system between September 2023 and August 2025. Patients with a urine toxicology screen positive for fentanyl within 24 hours of ED presentation were included. Those who received fentanyl before testing were excluded.

Results

Of the 15 patients included, the median age was 16 years, 10 (66.7%) were male, and 11 (73.3%) identified as Hispanic. Six patients (6/15, 40.0%) received out-of-hospital intranasal naloxone. Unintentional fentanyl exposure occurred in six patients (6/15, 40.0%), frequently involving counterfeit pills believed to be oxycodone-acetaminophen or alprazolam. Polysubstance exposure was common, including cannabis (7/15, 46.7%), cocaine (3/15, 20.0%), and benzodiazepines (3/15, 20.0%). Co-occurring mental health diagnoses were frequently documented. Three patients (3/15, 20.0%) required mechanical ventilation, three (3/15, 20.0%) were admitted to the intensive care unit, and one (1/15, 6.7%) presented in cardiac arrest requiring cardiopulmonary resuscitation. Most patients (8/15, 53.3%) were discharged from the ED, and no deaths occurred.

Conclusion

In this cohort, serious clinical outcomes were observed among pediatric patients with positive fentanyl urine drug screens. Unintentional ingestions, psychiatric and behavioral health concerns, and polysubstance exposure were also common. These findings highlight the importance of harm-reduction strategies, including naloxone distribution, education regarding counterfeit fentanyl-containing medications, safe medication storage, and access to pediatric mental health and substance use services.

Categories: Substance Use and Addiction, Emergency Medicine, Pediatrics
Keywords: fentanyl, naloxone, opioids, overdose, pediatric

Introduction

Approximately two million opioid-related emergency department (ED) visits occurred in the U.S. between 2022 and 2024, with fentanyl implicated in roughly one-quarter of cases [1]. These encounters disproportionately affect adults between 26 and 44 years of age, males, and individuals from socioeconomically disadvantaged and minority populations, including non-Hispanic American Indian and Alaska Native groups [2]. Visits are more common in urban areas but are increasing in rural regions, where limited resources may worsen outcomes [3-6]. Fentanyl-related ED visits are highly resource-intensive, with over one-third requiring intensive care unit (ICU) admission, 8% resulting in in-hospital death, and 6% experiencing prolonged hospital stays, with only 32% discharged the same day [7].

The Central Valley of California, including Fresno County - the region's most populous county - faces substantial socioeconomic and healthcare access disparities, with higher poverty, lower educational attainment, and elevated uninsured and Medicaid-eligible populations compared with state averages [8-12]. These factors contribute to a high burden of opioid-related ED utilization and overdose rates, alongside limited access to outpatient care [4,5,8,10].

Pediatric opioid-related ED visits are increasing across the nation, largely driven by illicit fentanyl use [13-17]. Risk patterns vary by age, with unintentional exposures more common in young children and intentional misuse in adolescents, often in the setting of mental health conditions [16,18]. Despite well-characterized trends in adults, pediatric fentanyl-related ED outcomes remain poorly described. Prior studies have largely relied on International Classification of Diseases-10 (ICD) coding to identify illicit fentanyl overdoses. Although consistent with standard epidemiologic methods, ICD-based approaches may be subject to misclassification and do not specifically identify encounters with positive fentanyl toxicology testing [13,14]. Additionally, ICD-based studies often lack detailed clinical covariates and do not capture important factors of interest, such as out-of-hospital naloxone administration, patient-level characteristics, or granular outcomes beyond mortality [13,14]. Therefore, this study aimed to describe the clinical characteristics, healthcare utilization, and outcomes of pediatric patients with positive fentanyl urine drug screens presenting to two EDs in California's Central Valley.

Materials And Methods

This was a retrospective cohort study conducted at two institutions within a health care system in California's Central Valley. The larger of the two study sites is a 685-bed academic affiliated medical center with more than 130,000 ED visits annually. The smaller site is a 352-bed non-academic community hospital with more than 85,000 ED visits annually. All study measures and procedures were approved by the local Institutional Review Board. The study was determined to present no greater than minimal risk to participants. A waiver of informed consent, waiver of Health Insurance Portability and Accountability Act authorization, and waiver of assent were granted due to the retrospective design and use of existing medical record data.

Eligible cases were identified through an electronic health record query that captured all ED encounters among patients aged ⩽ 18 years with a positive urine fentanyl toxicology result between September 2023 and August 2025. This period was selected because fentanyl testing was introduced at both study sites in September 2023. The source population consisted of all pediatric ED encounters at the two study sites during the study period. Fentanyl exposure was defined as a positive urine fentanyl toxicology screen obtained within 24 hours of ED presentation. Patients were excluded if they received fentanyl for a medical indication before collection of the urine toxicology specimen. Urine toxicology testing was obtained at the discretion of the treating provider and was not routinely obtained for all patients. This study was designed as a descriptive cohort of encounters with positive fentanyl urine drug screens; therefore, only fentanyl-positive encounters were included, and incidence rates were not calculated. Confirmatory testing using a definitive analytical method, such as liquid chromatography-tandem mass spectrometry or gas chromatography-mass spectrometry, was not routinely performed. Therefore, positive fentanyl results were considered presumptive evidence of fentanyl exposure.

Outcomes included measures of healthcare resource utilization, including hospital admission, ICU admission, cardiopulmonary resuscitation (CPR), and mechanical ventilation. Covariates of interest included demographics, out-of-hospital naloxone administration, intent of exposure (unintentional versus intentional), the presence of additional substances on toxicology testing, and co-occurring mental health diagnoses. Demographics, toxicology results, inpatient medications, laboratory data, and clinical outcomes were obtained from the electronic medical record. Intentionality was determined from documentation in the medical record, including patient, caregiver, emergency medical services, and treating clinician documentation. The urinary toxicology screen detected amphetamines, barbiturates, benzodiazepines, cannabis, cocaine, fentanyl, opiates, and phencyclidine. Provider documentation was reviewed to determine whether out-of-hospital naloxone had been administered. Documented psychiatric diagnoses, as well as self-harm and suicidality-related behaviors, were recorded as documented by the treating clinician without modification or reclassification.

All identified charts underwent manual review to confirm eligibility and apply exclusion criteria. Data were collected using a standardized abstraction tool. Initial data abstraction was performed by a medical student trained by the principal investigator, an emergency medicine clinical pharmacist. The principal investigator subsequently reviewed all abstracted data, validated study variables, and resolved discrepancies. Data management was performed using Microsoft Excel (Microsoft® Corp., Redmond, WA). Descriptive statistics were used to summarize the data, and all eligible patients were included in the analysis.

Results

Of the 172 charts reviewed, 157 encounters were excluded because fentanyl had been administered prior to urine drug screening, precluding determination of whether a positive fentanyl result reflected community exposure or medical administration. A total of 15 patients met inclusion criteria and were included in the final analysis. Demographic and clinical characteristics are summarized in Table *1*.

Characteristic	N (%)
Primary language English	13 (86.7)
Hispanic ethnicity	11 (73.3)
Out-of-hospital intranasal naloxone administration, overall	6 (40.0)
Out-of-hospital intranasal naloxone administration, friend/family	3 (20.0)
Out-of-hospital intranasal naloxone administration, paramedic	2 (13.3)
Out-of-hospital intranasal naloxone administration, friend/family and paramedic	1 (6.7)
Anxiety	1 (6.7)
Depression	1 (6.7)
Intentional self-harm	3 (20.0)
Substance use disorder	3 (20.0)
Suicide attempt	2 (13.3)
Unintentional fentanyl-laced pill ingestion, overall	6 (40.0)
Unintentional fentanyl-laced pill ingestion, alprazolam reported	3 (20.0)
Unintentional fentanyl-laced pill ingestion, oxycodone-acetaminophen reported	3 (20.0)
Amphetamine co-exposure	1 (6.7)
Benzodiazepine co-exposure	3 (20.0)
Cocaine co-exposure	3 (20.0)
Cannabis co-exposure	7 (46.7)

TABLE 1: Demographic and clinical characteristics of pediatric patients with positive fentanyl urine drug screens

Percentages are based on N = 15. Psychiatric comorbidities and polysubstance exposure are not mutually exclusive; patients may have had more than one co-occurring comorbidity or exposure.

Among the 15 patients included, 10 (66.7)% were male. The median (interquartile range) age was 16 years (15-17), with the youngest patient being two years old. Most patients identified as Hispanic (11/15, 73.3%), and English was the primary language (13/15, 86.7%). One patient (1/15, 6.7%) presented to the ED in cardiac arrest, three (3/15, 20.0%) following a traumatic event, two (2/15, 13.3%) with gastrointestinal or flu-like symptoms, two (2/15, 13.3%) for intentional self-harm, one (1/15, 6.7%) for suspected overdose without receiving out-of-hospital intranasal naloxone administration, and six (6/15, 40.0%) after receiving out-of-hospital intranasal naloxone.

Of the six patients who received out-of-hospital intranasal naloxone, three (3/15, 20.0%) exclusively received intranasal naloxone from a friend or family member, two (2/15, 13.3%) exclusively received intranasal naloxone from paramedics, and one (1/15, 6.7%) patient received intranasal naloxone from both a friend or family member and paramedics. One patient received out-of-hospital bystander CPR and achieved return of spontaneous circulation after paramedics administered intranasal naloxone. One patient who received out-of-hospital intranasal naloxone received 1 mg intravenous naloxone in the ED and was later discharged from the ED.

Unintentional fentanyl-laced pill ingestion was reported by six patients (6/15, 40.0%), of whom half believed they were taking oxycodone-acetaminophen (Percocet®) and the other half thought they were taking alprazolam (Xanax®). Seven patients (7/15, 46.7%) had urine toxicology screens positive for cannabis, three (3/15, 20.0%) for cocaine, and three (3/15, 20.0%) for benzodiazepines. Documented psychiatric diagnoses included substance use disorder (3/15, 20.0%), depression (1/15, 6.7%), and anxiety (1/15, 6.7%). Self-harm and suicidality-related behaviors were also observed, including intentional self-harm (3/15, 20.0%) and suicide attempts (2/15, 13.3%).

Clinical outcomes and healthcare utilization are summarized in Table *2*. Three patients (3/15, 20.0%) required mechanical ventilation, of whom two were intubated for pulmonary edema following naloxone administration and one for cardiac arrest. Four patients (4/15, 26.7%) were placed on a psychiatric hold, including three placed on an involuntary psychiatric hold (5150 hold) and one placed on a 1799 hold, a temporary emergency detention for individuals who may be a danger to themselves or others or who are gravely disabled. The majority of patients (8/15, 53.3%) were discharged from the ED, while three patients (3/15, 20.0%) required ICU admission. No patients died.

Outcome	N (%)
Cardiac arrest	1 (6.7)
Mechanical ventilation	3 (20.0)
Psychiatric hold	4 (26.7)
Discharged from emergency department	8 (53.3)
Hospital admission, non-intensive care unit	4 (26.7)
Intensive care unit admission	3 (20.0)
Death	0 (0.0)

TABLE 2: Clinical outcomes and healthcare utilization

Percentages are based on N = 15.

Discussion

In this retrospective cohort study of pediatric patients with positive fentanyl urine drug screens presenting to two EDs in California's Central Valley, serious clinical outcomes, including cardiac arrest, ICU admission, and mechanical ventilation, were observed among pediatric patients with positive fentanyl urine drug screens. Unlike prior studies relying primarily on ICD-10 coding, our study used positive fentanyl urine drug screening results and further characterized out-of-hospital interventions, clinical presentations, co-exposures, psychiatric comorbidities, and treatment outcomes. Several observations emerged from this study, including the frequency of unintentional fentanyl ingestions, the occurrence of co-existing mental health disorders, and the frequent involvement of bystander naloxone administration prior to ED arrival.

One notable finding was that six patients (6/15, 40.0%) reported unintentional fentanyl ingestion, including ingestion of pills believed to be oxycodone-acetaminophen (Percocet®) or alprazolam (Xanax®). These findings are consistent with national reports demonstrating increasing circulation of counterfeit pills containing illicitly manufactured fentanyl among adolescents and young adults [18,19]. The U.S. Drug Enforcement Administration has reported that counterfeit prescription tablets resembling Percocet® and Xanax® frequently contain potentially lethal amounts of fentanyl [20]. In pediatric populations, unintentional opioid exposures are particularly concerning because counterfeit medications can be mistaken for legitimate prescription drugs, while younger children remain vulnerable to accidental ingestion within the household [13-17]. The inclusion of a two-year-old child in our cohort demonstrates that fentanyl exposure can occur outside the context of intentional adolescent misuse and is consistent with broader concerns regarding accidental pediatric exposures reported in previous studies [13-17].

Our study identified psychiatric and behavioral health concerns among pediatric patients with positive fentanyl urine drug screens. Documented psychiatric diagnoses included substance use disorder, anxiety, and depression, while self-harm and suicidality-related behaviors, including intentional self-harm and suicide attempts, were also observed. These findings are consistent with prior literature describing associations between adolescent substance use and underlying mental health disorders [21,22]. Polysubstance exposure was also common, including cannabis, cocaine, and benzodiazepines, consistent with national trends in adolescent substance use [17,18]. Given the small sample size, these findings should be considered descriptive and should not be interpreted as evidence of an independent association between psychiatric comorbidities, polysubstance exposure, and clinical outcomes. Nevertheless, these observations highlight the importance of mental health assessment, substance use screening, and multidisciplinary approaches when caring for pediatric patients with positive fentanyl urine drug screens.

Although the sample size was small, the severity of illness associated with fentanyl exposure was substantial. One patient (1/15, 6.7%) presented in cardiac arrest and required CPR, while three patients (3/15, 20.0%) required ICU admission and three patients (3/15, 20.0%) required mechanical ventilation. These findings are consistent with prior adult literature demonstrating that fentanyl-related overdoses are associated with high rates of critical illness and health-care resource utilization [7]. Fentanyl's high potency and rapid respiratory depressant effects increase the risk of hypoxia, cardiopulmonary arrest, and death, particularly in opioid-naïve individuals [23]. Taken together, these findings emphasize the potential severity of pediatric fentanyl exposure and underscore the importance of timely overdose recognition and intervention.

Out-of-hospital naloxone administration was common in our cohort, occurring in six patients (6/15, 40.0%), including administrations by family members, friends, and paramedics. Importantly, one patient in our cohort achieved return of spontaneous circulation after bystander CPR and paramedic-administered naloxone, illustrating the potential role of early overdose recognition and intervention. These observations are consistent with prior studies demonstrating that community naloxone distribution programs can reduce opioid overdose mortality and improve survival following respiratory depression [24,25]. The involvement of family members and peers in naloxone administration indicates that nonmedical responders were frequently involved in overdose response. Together, these findings may have implications for harm-reduction

strategies that increase naloxone availability and overdose-response education within communities.

Notwithstanding the benefits of naloxone, rare complications were observed in our cohort. Two patients (2/15, 13.3%) developed pulmonary edema following naloxone administration. Although pulmonary edema has been reported after naloxone administration, opioid overdose itself is also a recognized cause of noncardiogenic pulmonary edema, and a causal relationship with naloxone cannot be established from these observational data [26,27]. Proposed mechanisms for pulmonary edema in this setting include a catecholamine surge, negative-pressure pulmonary edema, and abrupt reversal of opioid-mediated sympathetic suppression. Clinicians should be aware of this potential complication regardless of the underlying mechanism. Nevertheless, naloxone remains the standard treatment for suspected opioid overdose, and concerns regarding adverse events should not discourage its prompt administration in overdose situations.

This study has several limitations. The study identified encounters with positive fentanyl urine drug screens but did not attempt to determine whether fentanyl was the sole cause of presenting symptoms, as co-ingestants and comorbid conditions may also have contributed to clinical presentation. The retrospective design may have resulted in incomplete documentation of overdose circumstances, naloxone administration, psychiatric history, and exposure intent. The study was conducted within a single healthcare system, potentially limiting generalizability to other regions. Additionally, because a separate pediatric hospital serves the surrounding area, our analysis may not have captured all pediatric fentanyl-associated visits within the region. Our small sample size restricted the ability to perform inferential analyses and limits the generalizability of the findings, particularly to younger pediatric populations, as most encounters involved adolescents. Additionally, 157 encounters were excluded because fentanyl had been administered prior to urine drug screening, precluding determination of whether a positive result reflected medical administration or community exposure. This exclusion may have introduced selection bias and affected the representativeness of the final cohort. Positive toxicology results, including fentanyl and other substances, were obtained from screening urine drug assays and were not confirmed with a definitive analytical method. Consequently, positive results should be interpreted as presumptive evidence of substance exposure, and some exposure misclassification is possible. Similarly, for encounters involving suspected counterfeit pill ingestion, the ingested pills were not available for chemical analysis; therefore, fentanyl involvement in these cases could not be definitively established. Additionally, counseling, treatment referrals, and warm handoff interventions were not evaluated, limiting assessment of linkage to ongoing substance use treatment or other supportive services following ED discharge. Finally, because urine toxicology screening was obtained at the discretion of the treating clinician rather than systematically, some patients with fentanyl exposure may not have been identified, introducing additional selection bias.

Conclusions

This study adds important clinical detail to the limited literature describing pediatric ED encounters associated with positive fentanyl urine drug screens rather than administrative coding alone. In this cohort, serious clinical outcomes, including intensive care admission and mechanical ventilation, were observed among pediatric patients with positive fentanyl urine drug screens. Unintentional ingestions, psychiatric and behavioral health concerns, and polysubstance exposure were also common. Given the small sample size, retrospective design, and potential contribution of co-ingestants and comorbid conditions, these findings should be interpreted cautiously. Nevertheless, they highlight the importance of harm-reduction strategies, including naloxone distribution, education regarding counterfeit fentanyl-containing medications, safe medication storage, and access to pediatric mental health and substance use services.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Francisco Ibarra Jr., Negin Fadaee

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Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Community Health System, Human Research Protection Program Institutional Review Board issued approval 2024068. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the

submitted work.

References

1. Das S, Jones CM, Donnelly N, Goulding D, Spark TL: Trends in Opioid-Involved Emergency Department Visits: Overall and by Type of Opioid, 2021-2024. Substance Abuse and Mental Health Services Administration Center for Behavioral Health Statistics and Quality, Rockville, MD; 2025.
2. Pickens CM, Park J, Casillas SM, et al.: Trends in suspected fentanyl-involved nonfatal overdose emergency department visits, by age group, sex, and race and ethnicity — United States, October 2020-March 2024. MMWR Morb Mortal Wkly Rep. 2025, 74:282-7. 10.15585/mmwr.mm7416a2
3. Kariisa M, Davis NL, Kumar S, Seth P, Mattson CL, Chowdhury F, Jones CM: Vital Signs: drug overdose deaths, by selected sociodemographic and social determinants of health characteristics — 25 states and the District of Columbia, 2019-2020. MMWR Morb Mortal Wkly Rep. 2022, 71:940-7. 10.15585/mmwr.mm7129e2
4. Sistani F, Rodriguez de Bittner M, Shaya FT: Social determinants of health, substance use, and drug overdose prevention. J Am Pharm Assoc (2003). 2023, 63:628-32. 10.1016/j.japh.2022.10.023
5. Owens PL, Weiss AJ, Barrett ML, et al.: Determinants of health and county population rates of opioid-related inpatient stays and emergency department visits, 2016. Healthcare Cost and Utilization Project (HCUP) Statistical Briefs. Agency for Healthcare Research and Quality (US), Rockville, MD; 2020.
6. Urban-rural differences in drug overdose death rates, 2020 . (2022). Accessed: 6/6/26: https://www.cdc.gov/nchs/products/databriefs/db440.htm.
7. Choo LY, Nash S, Farmer B, et al.: Morbidity, mortality, and health outcomes following emergency department visits for fentanyl-related overdoses: a retrospective cohort study. Drug Alcohol Depend Rep. 2026, 18:100405. 10.1016/j.dadr.2025.100405
8. Casillas SM, Pickens CM, Stokes EK, Walters J, Vivolo-Kantor A: Patient-level and county-level trends in nonfatal opioid-involved overdose emergency medical services encounters — 491 counties, United States, January 2018-March 2022. MMWR Morb Mortal Wkly Rep. 2022, 71:1073-80. 10.15585/mmwr.mm7134a1
9. People living below poverty level . (2024). Accessed: 7/18/26: https://www.healthyfresnocountydata.org/indicators/index/view?indicatorId=347&localeId=247.
10. The 2024 CHCF Central Valley Health Policy Survey: Executive Summary . (2024). Accessed: 7/18/26: https://www.chcf.org/wp-content/uploads/2024/04/CentralValleySurvey2024ExecSumm.pdf.
11. Preventing Fentanyl-Related Deaths Among Children Aged Five and Under in California . (2025). Accessed: 10/6/26: https://www.cdph.ca.gov/Programs/CCDPHP/sapb/CDPH%20Document%20Library/SB908CDPHReport_FentanylDeathsFiveandU
12. A Summary of Prescription Opioid Overdoses in Fresno County from 2017 to 2021 . (2023). Accessed: 10/6/26: https://www.fresnocountyca.gov/files/assets/county/v/1/public-health/epidemiology-surveillance-and-data-management/ot....
13. Devlin G, Kanak M, Hall M, Tanaka D, Bohorquez J, Gribbons M, Chaudhari PP: Pediatric emergency department visits for opioid overdose in the United States. Hosp Pediatr. 2026, 16:143-50. 10.1542/hpeds.2025-008620
14. Gaither JR: National trends in pediatric deaths from fentanyl, 1999-2021. JAMA Pediatr. 2023, 177:733-5. 10.1001/jamapediatrics.2023.0793
15. Lu A, Armstrong M, Alexander R, Vest E, Chang J, Zhu M, Xiang H: Trends in pediatric prescription-opioid overdoses in U.S. emergency departments from 2008-2020: an epidemiologic study of pediatric opioid overdose ED visits. PLoS One. 2024, 19:e0299163. 10.1371/journal.pone.0299163
16. Sacco MA, Gualtieri S, Tarallo AP, Tarda L, Verrina MC, Costa A, Aquila I: A review of the literature on episodes of acute fentanyl intoxication in pediatric age and toxicological applications. Toxics. 2024, 12:10.3390/toxics12080534
17. Sandelich S, Hooley G, Hsu G, et al.: Acute opioid overdose in pediatric patients . J Am Coll Emerg Physicians Open. 2024, 5:e13134. 10.1002/emp2.13134
18. Friedman J, Hadland SE: The overdose crisis among U.S. adolescents. N Engl J Med. 2024, 390:97-100. 10.1056/NEJMp2312084
19. Tanz LJ, Dinwiddie AT, Mattson CL, O'Donnell J, Davis NL: Drug overdose deaths among persons aged 10-19 years — United States, July 2019-December 2021. MMWR Morb Mortal Wkly Rep. 2022, 71:1576-82. 10.15585/mmwr.mm7150a2
20. One Pill Can Kill. (2026). Accessed: 10/6/26: https://www.dea.gov/onepill.
21. Substance Use and Prevention . (2026). Accessed: 7/18/26: https://www.aap.org/en/patient-care/substance-use-and-prevention/.
22. Screening and treatment of substance use disorders among adolescents . (2021). Accessed: 7/18/26: https://library.samhsa.gov/sites/default/files/pep20-06-04-008.pdf.
23. Algera MH, Olofsen E, Moss L, et al.: Tolerance to opioid-induced respiratory depression in chronic high-dose opioid users: a model-based comparison with opioid-naïve individuals. Clin Pharmacol Ther. 2021, 109:637-45. 10.1002/cpt.2027
24. McDonald R, Strang J: Are take-home naloxone programmes effective? Systematic review utilizing application of the Bradford Hill criteria. Addiction. 2016, 111:1177-87. 10.1111/add.13326
25. Walley AY, Xuan Z, Hackman HH, et al.: Opioid overdose rates and implementation of overdose education and nasal naloxone distribution in Massachusetts: interrupted time series analysis. BMJ. 2013, 346:f174. 10.1136/bmj.f174
26. Marsalisi C, Guo HJ, Reddy P: The double-edged sword: naloxone-induced noncardiogenic pulmonary edema. Cureus. 2023, 15:e41642. 10.7759/cureus.41642
27. Sporer KA, Firestone J, Isaacs SM: Out-of-hospital treatment of opioid overdoses in an urban setting . Acad Emerg Med. 1996, 3:660-7. 10.1111/j.1553-2712.1996.tb03487.x