

Original Article

# Drug abuse-related accidents leading to emergency department visits at two medical centers

Isaac Chun-Jen Chen<sup>a</sup>, Dong-Zong Hung<sup>b,c</sup>, Chi-Ho Hsu<sup>d</sup>, Ming-Ling Wu<sup>e,f</sup>, Jou-Fang Deng<sup>c,e</sup>,  
Chin-Yu Chang<sup>g</sup>, Hsin-Chin Shih<sup>a,h</sup>, Chen-Chi Liu<sup>a</sup>, Chien-Ying Wang<sup>a</sup>, Yi-Szu Wen<sup>a,h</sup>,  
Jackson Jer-Kan Wu<sup>a,h</sup>, Mu-Shun Huang<sup>a,h</sup>, Chen-Chang Yang<sup>e,f,g,\*</sup>

<sup>a</sup> Division of Trauma, Department of Emergency Medicine, Taipei Veterans General Hospital, Taipei, Taiwan, ROC

<sup>b</sup> Division of Toxicology, Trauma and Emergency Center, China Medical University Hospital, Taichung, Taiwan, ROC

<sup>c</sup> Graduate Institute of Drug Safety, China Medical University, Taichung, Taiwan, ROC

<sup>d</sup> Department of Nursing, National Taipei University of Nursing and Health Sciences College of Nursing, Taipei, Taiwan, ROC

<sup>e</sup> Division of Clinical Toxicology, Department of Medicine, Taipei Veterans General Hospital, Taipei, Taiwan, ROC

<sup>f</sup> Department of Environmental and Occupational Medicine, Faculty of Medicine, National Yang-Ming University School of Medicine, Taipei, Taiwan, ROC

<sup>g</sup> Institute of Environmental and Occupational Health Sciences, National Yang-Ming University School of Medicine, Taipei, Taiwan, ROC

<sup>h</sup> Departments of Emergency Medicine, Faculty of Medicine, National Yang-Ming University School of Medicine, Taipei, Taiwan, ROC

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## Abstract

**Background:** Drug abuse is becoming more prevalent in Taiwan, as evidenced by increasing reports of drug trafficking and drug abuse-related criminal activity, and the wide use of more contemporary illicit drugs. Consequently, drug abuse-related accidents are also expected to occur with greater frequency. However, no study has yet specifically evaluated the prevalence, pattern, and outcomes of drug abuse-related accidents among patients visiting emergency departments (EDs) in Taiwan.

**Methods:** We conducted an ambidirectional study with patients who visited the EDs of Taipei Veterans General Hospital (TVGH) and China Medical University Hospital (CMUH) due to drug abuse-related accidents from January 2007 through September 2009. Information on the patients' baseline characteristics and clinical outcomes was collected and analyzed.

**Results:** During the study period, a total of 166 patients visited the EDs of one of the two study hospitals due to drug abuse-related accidents. This yielded a prevalence of drug abuse of 0.1% among all patients visiting the ED due to accident and/or trauma. Fifty-six out of the 166 patients visited the ED at TVGH, most patients being between 21 and 40 years old. Opioids (41.1%) were the drugs most commonly abused by the patients, followed by benzodiazepines (32.1%). More than two-thirds of the patients ( $n = 38$ , 67.9%) required hospitalization, and three patients died (5.4%). In contrast, 110 patients with drug abuse-related accidents visited the ED at CMUH during the study period. Most of these subjects had abused benzodiazepines (69.1%), were between 21 and 40 years old, and were female. Fewer than one-fifth of the patients ( $n = 19$ , 17.3%) required hospitalization, with no deaths reported. There were significant between-hospital differences in terms of patient gender, drugs of choice, injury mechanisms, method and time of the ED visit, triage levels, and need for hospitalization.

**Conclusion:** Although the prevalence of drug abuse-related accidents was low, and only three patient deaths were reported in this study, many patients presented to the EDs with severe effects and later required hospitalization. Better and timely management of such patients will help to minimize the adverse health impacts associated with drug abuse. Governmental agencies and all healthcare professionals should also work together to fight against the surging trend of drug abuse in Taiwan.

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**Keywords:** accident; benzodiazepine; club drug; drug abuse; injury; trauma

\* Corresponding author. Dr. Chen-Chang Yang, Division of Clinical Toxicology, Department of Medicine, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 112, Taiwan, ROC.

E-mail address: [ccyang@vghtpe.gov.tw](mailto:ccyang@vghtpe.gov.tw) (C.-C. Yang).

## 1. Introduction

Drug abuse (i.e., taking a psychoactive drug or performance-enhancing drug for a nontherapeutic or nonmedical effect) has existed throughout human history, in all inhabited continents of the world. With the increasing volume of illicit drugs, and easier access to these drugs, the prevalence of drug abuse has increased dramatically, particularly the abuse of designer drugs such as ecstasy, which produces an enormous burden on many societies.<sup>1</sup>

A single drug abuse experience can have unpredictable and serious consequences (e.g., accident or overdose), particularly for naive users. Individuals who frequently abuse drugs over an extended period of time can also suffer structural damage to the brain (e.g., psychosis due to chronic cocaine or methamphetamine abuse) or other organs, undergo deteriorating family relations, see reduced performance in school or at work, increase the likelihood of unsafe sexual activity, and become more prone to violent behavior. According to the World Health Organization, it is estimated that about 185 million people worldwide struggle with drug abuse, and drug abuse-related deaths accounted for 0.4% of total deaths worldwide.<sup>1</sup> Furthermore, some 1% of poor health worldwide can be attributed to drug abuse, and the attributable proportion is even higher (about 2.3%) in developed countries.<sup>2</sup>

Since the occurrence of a methamphetamine epidemic in Taiwan in 1990, drug abuse (especially of methamphetamine and heroin) has become a serious public health problem in this country.<sup>3,4</sup> Despite the government's antidrug abuse efforts over the past two decades, the prevalence of drug abuse in Taiwan has continued to increase, with surveys estimating that more than 1% of the population now abuse drugs.<sup>4,5</sup> In recent years, abuse of various newer drugs has also emerged in Taiwan,<sup>4</sup> with such drugs as ketamine, ecstasy (MDMA, methylenedioxy-methamphetamine), cannabis (marijuana), cocaine, nimetazepam (Erimin), PMMA (paramethoxy-methamphetamine), GHB (gamma-hydroxybutyrate), 2C-B (2,5-dimethoxy-4-bromophenethylamine), and zolpidem, and this has consequently led to an increased incidence of drug abuse-related toxicities (e.g., liver toxicity and neuropsychiatric effects) and/or accidents.<sup>4,5</sup>

Drug abuse-related toxicities or accidents frequently result in emergency department (ED) visits. In the United States, it was reported that more than 800,000 ED visits involved serious substance abuse, with cocaine being involved in more than half of such visits in 2005.<sup>6</sup> According to the 2008 annual report of the US Drug Abuse Warning Network, despite the fact that fewer than half (48.1%) of illicit drug use-related ED visits required follow-up care, 35.7% of those visits among older adults resulted in hospitalization.<sup>7</sup> In Taiwan, there is no established surveillance system for drug abuse-related ED visits. Therefore, the prevalence, pattern, and outcome of drug abuse-related accidents leading to ED visits are rarely understood. The current study aimed to assess the clinical characteristics of drug abuse-related accidents presenting to EDs in Taiwan.

## 2. Methods

We conducted an ambidirectional cohort study among patients who visited the EDs of two medical centers, the Taipei Veterans General Hospital (TVGH) and the China Medical University Hospital (CMUH), from January 2007 through September 2009. We selected the two study hospitals because both are Level I trauma centers and both have a well-trained clinical toxicology unit and toxicology laboratory. Both hospitals are therefore likely to be representative of other hospitals in Taiwan in terms of drug abuse-related accidents. Moreover, the diagnosis of drug abuse-related accidents would be more accurate in the two study hospitals.

The study protocol was approved by the Institutional Review Board at the two study hospitals. For the study period of 2007 and 2008, patients with drug abuse-related accidents were identified through retrospective chart review, and by employing the International Classification of Diseases (ICD-9-CM) codes (i.e., 292 for drug psychoses; 304 for drug dependence; 305 for nondependent abuse of drugs; 960–979 for poisoning by drugs and medicinal and biological substances; E850–858 for accidental poisoning by drugs, medicinal substances, and biologicals; and E980–989 for poisoning by various substances, undetermined whether accidentally or purposely inflicted) and/or toxicology laboratory analysis results. As for the study period between January and September 2009, eligible patients were prospectively found through a similar strategy.

We first reviewed the medical records of all potentially eligible patients. We then excluded patients who had taken an excessive amount of prescribed medications (e.g., benzodiazepines) due to accidental, homicidal, or unknown intent. We also excluded those patients less than 18 years of age, and patients whose medical records were not available for review.

For the remaining patients, the diagnosis of drug abuse-related accidents was made by two investigators who specialized in clinical toxicology, to ensure that all patients fulfilled the criteria of drug abuse/dependence defined by the Diagnostic and Statistical Manual of Mental Disorders, 4<sup>th</sup> edition.<sup>8</sup> When there was disagreement between the two investigators, a third investigator reviewed the medical records and the diagnosis was then made by a majority vote. To minimize the possibility of between-hospital differences in making the diagnosis of drug abuse, the medical records of all potentially eligible patients from the two study hospitals were reviewed by the same group of investigators.

For all ED patients who fulfilled the diagnostic criteria of drug abuse-related accidents, the following information included in the medical records was abstracted and analyzed: baseline characteristics (e.g., age, gender, residence, history of drug abuse, and past medical history), cause of accident (e.g., a vehicle accident or other trauma), drug of abuse (e.g., benzodiazepines), method of ED visit (e.g., by ambulance), time of ED visit, level of ED triage, clinical manifestations, hospitalization, and outcomes. For patients who abused more than one class of drug (e.g., opioids plus benzodiazepines), we

arbitrarily assigned them to the drug that had contributed most to the harmful clinical effects.

To compare the differences in baseline characteristics between the two study hospitals, we employed the  $\chi^2$  test for categorical variables. A value of  $p < 0.05$  was considered statistically significant. All analyses were performed using SPSS version 17.0 (SPSS, Chicago, IL, USA).

### 3. Results

During the study period, a total of 56 patients with drug abuse-related accidents were identified at TVGH, resulting in an estimated prevalence of 0.1% among all patients visiting the ED at TVGH due to accidents or traumas. The estimated annual prevalence was 0.2%, 0.1%, and 0.1% for the years 2007, 2008 and 2009, respectively. As for the CMUH, a total of 110 patients with drug abuse-related accidents were identified during the study period, which yielded an estimated prevalence of 0.1% among patients visiting the ED at CMUH due to accidents or traumas. The estimated annual prevalence was 0.1%, 0.2%, and 0.1% for 2007, 2008 and 2009, respectively.

Table 1 shows the demographic and clinical characteristics of the 56 patients with drug abuse-related accidents who presented to the ED at TVGH. The majority of patients were between 21 and 40 years of age ( $n = 32$ , 57.1%), and residents of Taipei City ( $n = 31$ , 55.4%). The main causes of accidents were knife injuries ( $n = 13$ , 23.2%), followed by road traffic accidents ( $n = 11$ , 19.6%). Most patients sought medical help either by ambulance ( $n = 20$ , 35.7%) or by self-referral ( $n = 20$ , 35.7%); the majority of them were classified as triage level I ( $n = 20$ , 35.7%) or level II ( $n = 26$ , 46.4%), indicating their clinical severity of presentation to the ED. More than two-thirds of the patients ( $n = 38$ , 67.9%) required hospitalization with surgical attention. Three cases (5.4%) died during the study period, including a 31-year-old woman and methamphetamine abuser who died from a gunshot wound, a 29-year-old woman with diagnosed zolpidem and benzodiazepine abuse who died from complications of esophageal corrosive injury, and a 28-year-old male zolpidem abuser who fell from a great height and died from multiple fractures and shock.

Among the 56 patients who visited the ED at TVGH due to drug abuse-related accidents, the most commonly abused drugs were opioids ( $n = 23$ , 41.1%) and benzodiazepines ( $n = 18$ , 32.1%). Ketamine, nonbenzodiazepine hypnotics (e.g., zolpidem), and methamphetamine were also found in some patients (Table 2). It is noteworthy that urine drug abuse screening test was positive in 52 out of the 56 patients.

The demographic and clinical characteristics of the 110 patients who visited the ED at CMUH are also shown in Table 1. The majority of these cases involved patients between 21 and 40 years of age ( $n = 69$ , 62.8%), women ( $n = 81$ , 73.6%), and residents of Taichung County ( $n = 79$ , 71.8%). The main causes of accident were knife injuries ( $n = 59$ , 53.6%) followed by slips and falls ( $n = 23$ , 20.9%). Most patients visited the ED during the night shift ( $n = 47$ , 43.1%) and accessed the

ED by ambulance ( $n = 91$ , 82.7%). Although most patients were classified as level II triage ( $n = 79$ , 71.8%), less than one fifth of them ( $n = 19$ , 17.3%) required hospitalization. Moreover, none of them died. The most commonly abused drug was benzodiazepines ( $n = 76$ , 69.1%; Table 2). Furthermore, 93 out of the 110 patients had a positive urine drug abuse screening test.

There were many differences in baseline characteristics between the patients with drug abuse-related accidents who visited the ED at TVGH, and those who visited the ED at CMUH. For example, more female patients presented to the ED at CMUH ( $p < 0.001$ ). In addition, a larger proportion of patients in the ED at CMUH (71.8% vs 46.4%) were classified as triage level II ( $p < 0.001$ ). The majority of patients (67.9%) visiting the ED at TVGH required hospitalization, while only 17.3% of patients visiting the CMUH needed hospitalization ( $p < 0.001$ ). Furthermore, most patients presenting to TVGH abused opioids (41.1%) compared to benzodiazepines (69.1%) among those patients who visited CMUH ( $p < 0.001$ ).

The most common underlying diseases for patients with drug abuse-related accidents were psychosis and/or affective disorders. There were 20 patients (35.7%) with the above-noted diseases in the ED at TVGH and 11 patients (10.0%) in the ED at CMUH. Eight of the 20 patients visiting the ED at TVGH abused hypnotics (benzodiazepines and/or zolpidem/zolpiclone), while all of the 11 patients visiting the ED at CMUH abused hypnotics.

### 4. Discussion

To our knowledge, this was the first study in Taiwan that specifically looked at the pattern and outcome of patients who visited EDs because of drug abuse-related accidents. We found that the prevalence of drug abuse-related accidents among patients who visited an ED because of accidents and/or traumas was around 0.1% between 2007 and 2009. Although the prevalence was low, three (5%) out of 56 patients at TVGH died, and quite a few patients at both study hospitals manifested severe effects when they presented to the EDs. We further noticed that there were many differences in the baseline characteristics between patients visiting the ED at different study hospitals, indicating the possible variation in drug abusers' demographic and clinical characteristics across hospitals in Taiwan.

The prevalence of drug abuse-related ED visits observed in this study was lower than that reported in previous studies evaluating drug abuse-related visits among all ED patients.<sup>9,10</sup> The discrepancy might be related to the following reasons. First, the prevalence in this study was probably somewhat underestimated because the diagnosis of drug abuse was primarily based on the patients' pertinent history. For those patients who did not provide a history of drug abuse on ED presentation, relevant diagnoses would be overlooked. Although we performed urine drug screening for certain "high-risk" patients (e.g., patients with multiple trauma and those who attempted suicide) and found some extra cases, urine drug screening was not routinely performed on all

Table 1

Demographic and clinical characteristics of 166 patients who visited the emergency departments of two medical centers in Taiwan because of drug abuse-related accidents from January 2007 through September 2009.

Characteristics	Total (n = 166)		ED at TVGH (n = 56)		ED at CMUH (n = 110)		p value
	n	%	n	%	n	%	
Age (y)							< 0.001
18–20	4	2.4	2	3.6	2	1.8	
21–30	59	35.5	20	35.7	39	35.5	
31–40	42	25.3	12	21.4	30	27.3	
41–50	18	10.8	8	14.3	10	9.1	
51–60	19	11.4	5	8.9	14	12.7	
61–70	10	6.0	7	12.5	3	2.7	
71–80	6	3.6	0	0	6	5.5	
81+	8	4.8	2	3.6	6	5.5	
Gender							< 0.001
Males	57	23.2	28	50.0	29	26.4	
Females	109	65.7	28	50.0	81	73.6	
Injury mechanism							< 0.001
Road traffic accident	16	9.6	11	19.6	5	4.5	
Fall from height	10	6.0	6	10.7	4	3.6	
Slip and fall	31	18.7	8	14.3	23	20.9	
Knife injury	72	43.4	13	23.2	59	53.6	
Burn	2	1.2	2	3.6	0	0	
Others <sup>a</sup>	35	21.1	16	28.6	19	17.3	
Method of ED visit							< 0.001
By ambulance	111	66.9	20	35.7	91	82.7	
Self-referral	39	23.5	20	35.7	19	17.3	
Hospital transfer	13	7.8	13	23.2	0	0	
Unknown	3	1.8	3	5.4	0	0	
Time of ED visit							0.492
8 AM – 4 PM	53	31.9	24	42.9	29	26.6	
4 PM – 12 AM	50	30.1	17	30.4	33	30.3	
12 AM – 8 AM	62	37.3	15	26.8	47	43.1	
Unknown	1	0.6	0	0	1	0.9	
Triage level							< 0.001
I	47	28.3	20	35.7	27	24.6	
II	105	63.3	26	46.4	79	71.8	
III	10	6.0	6	10.7	4	3.6	
Unknown	4	2.4	4	7.1	0	0	
Hospitalization							< 0.001
Yes	57	34.3	38	67.9	19	17.3	
No	109	65.7	18	32.1	91	82.7	
Outcome							0.139
Discharge	146	88.0	53	94.6	93	84.5	
Death	3	1.8	3	5.4	0	0	
Discharge against medical advice <sup>b</sup>	17	10.2	0	0	17	15.5	

CMUH = China Medical University Hospital; ED = emergency department; TVGH = Taipei Veterans General Hospital.

<sup>a</sup> The category “others” included abrasions, lacerations, contusions, blunt trauma resulting from fighting with others, ingestion of corrosive substances, and other accidents with an uncertain mechanism of injury.

<sup>b</sup> A patient was classified as “discharge against medical advice” when his or her physical condition still required some form of treatments yet the patient insisted on being released from the ED without obtaining the attending physician’s approval.

patients visiting EDs due to drug abuse-related accidents. In addition, not all of the frequently abused drugs (e.g., GHB) could be identified by routine drug screening. Therefore, the prevalence of drug abuse-related accidents could be underestimated. Conducting a comprehensive urine drug testing and/or questionnaire survey among all ED patients could theoretically identify the overwhelming majority of drug abusers; unfortunately, such an approach is inefficient and difficult to implement in everyday practice.<sup>11</sup>

Second, the prevalence of drug abuse might vary between different hospitals due to differences in the distribution of case

mix, referral pattern, level of hospital accreditation, and/or geographical location. Finally, the prevalence of drug abuse related accidents might change from year to year.

The demographic characteristics of drug abusers included in this study, such as age and gender, were consistent with those of previous studies on drug abuse among all ED patients in Taiwan.<sup>9,10</sup> Moreover, we found that the majority of patients who had had drug abuse-related accidents accessed the EDs by ambulance and were more likely to have severe effects on initial presentation to the ED, as evidenced by their urgent triage category (levels I and II) and the relatively high

Table 2  
Distribution of abused drugs among 166 patients who visited the emergency departments of two medical centers in Taiwan because of drug abuse related accidents from January 2007 through September 2009.

Drug categories	Total (n = 166)		ED at TVGH (n = 56)		ED at CMUH (n = 110)		p value
	n	%	n	%	n	%	
	Benzodiazepines	94	56.6	18	32.1	76	
Opioids	28	16.9	23	41.1	5	4.5	
Zolpidem/zopiclone	24	14.5	2	3.6	22	20.0	
Methamphetamine	8	4.8	7	12.5	1	0.9	
Ketamine	2	1.2	2	3.6	0	0	
Miscellaneous <sup>a</sup>	10	6.0	4	7.1	6	5.5	

CMUH = China Medical University Hospital; ED = emergency department; TVGH = Taipei Veterans General Hospital.

<sup>a</sup> Miscellaneous drugs included unknown sedatives and unknown stimulants.

probability of eventual hospitalization. Although only three patients died, the above-mentioned findings indicate the importance of the timely management of such patients. Well-trained ED staff and an appropriate algorithm for drug abuse assessment are important in effectively managing drug abuse-related accidents, and in preventing repeated ED visits for drug abusers.

During the study period, we found that the majority of drug abuse-related accidents were related to benzodiazepine use, especially among those patients visiting the ED at CMUH. Such a finding was consistent with previous studies.<sup>9–11</sup> Benzodiazepines such as flunitrazepam and nimetazepam (Erimin) are the most commonly used medications for sleep disorder in Taiwan. In a study based on a random sample of 187,413 people enrolled in Taiwan's National Health Insurance Program between 2000 and 2002, 15,833 patients (10.4%) who were benzodiazepine-free in 2000 received benzodiazepine therapy in 2001.<sup>12</sup> Furthermore, only 4.8% (n = 125) of 2,619 long-term benzodiazepine users (defined as benzodiazepine use for 180 or more days per year) between 2000 and 2001 discontinued benzodiazepines in 2002.

Given the likelihood of prolonged benzodiazepine use, especially among those patients with pre-existing psychiatric diseases (e.g., depression) and elderly patients with various chronic illnesses, the prevalence of benzodiazepine-related accidents has thus remained high in recent years, despite the inclusion of various benzodiazepines as controlled drugs in Taiwan. More appropriate prescribing of benzodiazepines and more education on the potential hazards of prolonged benzodiazepine use are indicated to reduce the prevalence of benzodiazepine-related accidents and/or poisonings.<sup>13</sup>

In addition to benzodiazepines, we found that zolpidem was another drug that was frequently associated with drug abuse-related accidents during the study period. The abuse of zolpidem has been an emerging issue in Taiwan in recent years. According to previously reported data, the amount of zolpidem prescribed in Taiwan has increased rapidly in recent years, and more than 130 million zolpidem tablets were prescribed in 2008, equivalent to the consumption of 56 mg zolpidem per person per year.<sup>14</sup> The statistics from a reporting

system that included most psychiatric hospitals in Taiwan also revealed that zolpidem ranked as the fifth most abused agent among those patients admitted for psychiatric services.<sup>4</sup> Although the addiction potential of nonbenzodiazepine hypnotics is expected to be less than that of benzodiazepines, the increasing number of zolpidem abusers identified in both study hospitals should strongly suggest the need for a stricter control of zolpidem use in the future.

Abuse of illicit club drugs such as ecstasy and ketamine has become increasingly popular among young adults in Taiwan, especially in urban areas. However, we did not find many patients categorized as club drug abusers in this study, and only two ketamine abusers were identified at TVGH. The possible explanations for a low rate of club drug abuse in our study might include the following reasons. First, the proportion of young adults (up to 30 years of age) who were more likely to abuse club drugs was relatively smaller in this study. In a large-scale study conducted by Liu et al in Taiwan, it was found that among those arrested by law enforcement, who were primarily young adults, the positive rate of drug abuse was 74%, and 39 different drugs were identified.<sup>3</sup>

Second, patients who abused illicit club drugs might have been less willing to visit an ED when they experienced an accident. This could occur because patients with illicit club drug abuse might have had a false belief that they would be reported to and arrested by the police if they presented themselves to an ED. Therefore, unless they developed severe effects, they would not seek medical assistance. Finally, drug abusers might not reveal their relevant history of illicit drug use on presentation in an ED. Appropriate screening for drug abuse would be helpful to reach the correct diagnosis in the latter circumstance.

There are certain limitations inherent in this study. In addition to the probable underestimation of the prevalence of drug abuse-related accidents, misclassification of abused drugs was possible because we did not perform urine screening for drugs in all patients who visited the EDs because of drug abuse-related accidents. Although we could not completely rule out such a possibility, the consistency between the patients' pertinent history and toxicological testing results at both hospitals suggested that this should not be a significant problem.

Another limitation was essentially the retrospective nature of the current study. Although we compared the prevalence of drug abuse-related accidents derived from both the retrospective and the prospective part of the study, and did not find a significant difference in the estimated prevalence, the inclusion of patients with misplaced/inappropriate ICD codes or with insufficiently detailed medical records would lead to an underestimate of the prevalence of drug abuse-related accidents. Moreover, because we did not have detailed data on patients' baseline characteristics and outcomes, we were unable to conduct an in-depth analysis of the association between the baseline characteristics and the causes/outcomes of the accidents. We also did not have detailed information on the source of the abused drugs and thus could not distinguish "prescription" from "illegal use" of benzodiazepines and/or

zolpidem/zopiclone. A prospective multicenter study would be helpful in these regard.

The possible lack of ability to generalize the results of this investigation is another threat to this study. Given the observed differences in the baseline characteristics between patients who visited the EDs of the two study hospitals, the pattern and outcome of drug abuse-related accidents among patients in other EDs could be different from the findings of our study. A larger scale study incorporating more hospitals is mandatory to better delineate the true picture of drug abuse-related accidents throughout Taiwan.

In conclusion, although the prevalence of drug abuse-related accidents was low (0.1%) among patients presenting to the EDs, and only three out of 166 patients died, many such patients manifested severe effects and/or needed hospitalization. A better and timely management of such patients will help to minimize the adverse health impacts associated with drug abuse. Governmental agencies and all healthcare professionals should work together to confront the surging trend of drug abuse in Taiwan.

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