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Comparison of the Clinical Characteristics of Pediatric Poisoning Patients Who Visited Emergency Department Before and During the COVID-19 Pandemic

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ABSTRACT

Background: We aimed to investigate changes in the clinical characteristics of pediatric poisoning patients who visited the emergency department (ED) before and during the coronavirus disease 2019 (COVID-19) pandemic.

Methods: Poisoning cases below age 18 who visited the ED from January 2018 to December 2021 were retrospectively analysed. The study period was then divided into pre-COVID-19 and COVID-19 pandemic to compare poisoning patterns.

Results: During the study period, 86,153 visits to the pediatric ED had been recorded, with 625 patients being included in the final analysis. During the COVID-19 period, the proportion of poisoned patients increased from 0.62% to 0.98%. The average age of the patients was higher in the COVID-19 period, with 53.4% of the cases being intentional (pre-COVID-19, 32.5%; $P < 0.001$). Moreover, 70.4% of poisoning cases during the COVID-19 period were caused by drugs (pre-COVID-19, 60.6%; $P = 0.038$). More patients underwent decontamination and laboratory investigation during the COVID-19 period than during the previous period ($P = 0.007$ and $P < 0.001$, respectively). The length of ED stay and the proportion of hospitalisation were significantly greater during the COVID-19 period. After analysing accidental poisoning cases, we found that antipyretics/nonsteroidal anti-inflammatory drugs and respiratory drugs were more common in the pre-COVID-19 group, whereas iron/vitamins, cardiovascular drugs and hormones were more common in the COVID-19 group. After analysing intentional poisoning cases, we found that 73.6% and 76.4% of the patients in the pre-COVID-19 and COVID-19 group had a history of psychiatric disease, respectively. Although no difference was observed in the frequency of previous first suicide attempts, 19.0% of the patients in the COVID-19 group attempted suicide more than three times.

Conclusion: During the COVID-19 pandemic, intentional poisoning cases, especially in adolescence, increased and were treated more. Many of the patients with intentional poisoning had a history of mental illness or suicide in the past. Therefore, it seems that policy consideration for mentally vulnerable adolescents during this new pandemic period is necessary.

Keywords: Pediatric, Poisoning; Emergency Department; COVID-19; Suicide; Intentional Poisoning

Disclosure

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Jeon W, Lee J. Data curation: Park J, Ko Y. Formal analysis: Jeon W, Choi YJ, Yang H, Lee J. Software: Choi YJ, Yang H. Writing - original draft: Park J, Lee J. Writing - review & editing: Jeon W, Ko Y, Lee J.

INTRODUCTION

Declines in deaths from infectious or congenital disease have given way to increases in deaths from injury-related causes, including drug overdose.¹⁻³ Poisoning has been identified as one of the major causes of pediatric emergency presentations and intentionally poisoned adolescent patient rate has been increasing annually.⁴⁻⁷ Given the changes in the patterns and main risks of acute poisoning, epidemiological surveillance is necessary to determine the extent and characteristics of the problem, according to which related preventive measures can be taken.^{2,8-10}

The coronavirus disease 2019 (COVID-19) first appeared in December 2019 and spread rapidly worldwide, prompting the World Health Organization to characterise COVID-19 as a pandemic on 11 March 2020. While continuously trying to increase the vaccination rate, many countries have implemented various social distancing measures to prevent the spread of the virus, which have changed the current way of life. The use of masks/disinfectants has become routine, with many countries imposing quarantine, leading to the closure of public parks and meeting places, including schools, recreational institutions and sport centres, which play a significant role in socialisation.¹¹ Consequently, people experienced forced social isolation, which can promote not only psychological distress and a depressive mood but also psychotic bouts and suicidal thoughts. Moreover, several people have dealt with the fear of falling ill while also perceiving the eventual economic stress and loss of loved ones, which promotes a growing feeling of uncertainty and anxiety.¹² These considerable and abrupt changes of social circumstances during the COVID-19 pandemic have caused substantial changes in the everyday life of children and adolescents; hence, mental health problems in this vulnerable group have been inevitable, with children also experiencing some psychological impact.¹¹⁻¹³ Consequently, the increase in mental illness among adolescents during the COVID-19 pandemic has increased the incidence of substance use disorders and self-harm attempts.¹⁴ However, since the start of the COVID-19 pandemic, changes in the status of acutely poisoned patients, particularly among children and adolescents, have remained unclear.

The current study was therefore conducted to investigate the changes in the epidemiology and clinical characteristics of pediatric poisoning cases who visited the emergency department (ED) before and during the COVID-19 pandemic.

METHODS**Study population**

We retrospectively reviewed the medical records of pediatric patients under the age of 18 who visited the ED of Ajou University Hospital, South Korea, a regional tertiary referral centre, from January 2018 to December 2021. We included patients with the keywords 'poisoning' and 'toxic effect' in the final diagnosis on discharge from an ED. Patients who had incomplete data or visited for follow-up were excluded.

Data collection

We divided enrolled patients into the pre-COVID-19 and COVID-19 group to compare the poisoning patterns before and during the COVID-19 pandemic. The pre-COVID-19 period spanned from January 2018 to December 2019, whereas the COVID-19 period spanned from

January 2020 to December 2021. The general characteristics, intentionality of poisoning, caused materials, underlying disease, history of past suicide attempts, etc. were subsequently determined. Treatment methods, the length of ED stay and treatment results were analysed. Poisonous materials were classified into therapeutic drugs, artificial poisonous materials, natural toxins and gases. The clinical characteristics of poisoning before and during the COVID-19 pandemic were then compared.

Statistical analyses

The primary purpose of this study was to compare the number of patients visiting the ED due to poisoning between the pre-COVID-19 and COVID-19 period. The secondary purpose was to compare the clinical characteristics of poisoning between both groups. Continuous variables were presented as medians or means \pm standard deviations. Categorical variables were presented as frequencies or percentages. Student's *t*-test was used for continuous variables with normal distribution, whereas the Mann–Whitney test was used for continuous variables without a normal distribution. The χ^2 test or Fisher's exact test was used to analyse categorical data. Statistical analyses were performed using SPSS 15.0 (SPSS, Chicago, IL, USA), with *P* values < 0.05 indicating statistical significance.

Ethics statement

Ethical approval was obtained from the Institutional Review Board of Ajou University Hospital (AJIRB-MED-MDB-21-721) which waived the need for informed consent. The study was also conducted in accordance with the principles of the Helsinki Declaration.

RESULTS

Clinical comparison between the pre-COVID-19 and COVID-19 groups

From January 2018 to December 2021, 86,153 visits had been recorded at our pediatric ED. A total of 633 patients were identified as the initial study subjects. We excluded eight patients: one who swallowed a foreign body, two whose diagnosis was incorrectly entered as 'toxic effect,' and five who revisited the ED for follow-up management without additional poisoning events. Ultimately, 625 patients were analysed.

A total of 61,064 pediatric patients visited during the pre-COVID-19, among whom 378 were due to poisoning. During the COVID-19 period, the total number of ED patients dropped sharply to 25,089, among whom 247 were due to poisoning. During the COVID-19 period, the proportion of patients who visited with poisoning among all patients who visited increased from 0.62% to 0.98%.

Compared to the pre-COVID-19 group, the average age of patients was higher in the COVID-19 group ($P < 0.001$), with no difference in sex composition despite the high proportion of girls. The proportion of adolescent patients aged 10 or older was also higher during the COVID-19 group (Table 1). When comparing the purpose of poisoning between two groups, 53.4% of the cases in the COVID-19 group were intentional poisonings, which differed significantly to the 32.5% in the pre-COVID-19 group ($P < 0.001$) (Fig. 1). In both groups, therapeutic drugs were the most common causes; however, 70.4% of the COVID-19 cases showed a significant increase ($P = 0.038$). Notably, the frequency of artificial poisonous materials during the COVID-19 period decreased by nearly 10%. Decontamination and laboratory investigation were performed in more patients during the COVID-19 period than

Table 1. The clinical differences of the poisoning between pre-COVID-19 and COVID-19 groups

Variables	Pre-COVID-19 (n = 378)	COVID-19 (n = 247)	P value
Incidence	0.62%	0.98%	
Age, yr	7.1 ± 6.7	10.0 ± 7.0	< 0.001
< 10	235 (62.2)	105 (42.5)	< 0.001
≥ 10	143 (37.8)	142 (57.5)	
Sex, female	229 (60.6)	167 (67.6)	0.075
Purpose of poisoning			< 0.001
Accidental	255 (67.5)	115 (46.6)	
Intentional	123 (32.5)	132 (53.4)	
Poisoned materials			0.038
Therapeutic drugs	229 (60.6)	174 (70.4)	
Artificial poisonous materials	126 (33.3)	61 (24.7)	
Natural poisons	7 (1.9)	1 (0.4)	
Gases	16 (4.2)	11 (4.5)	
Treatment			
Decontamination	90 (23.8)	83 (33.6)	0.007
Laboratory investigation	214 (56.6)	190 (76.9)	< 0.001
Antidote	41 (10.8)	37 (15.0)	0.126
Length of stay, min	262.0 ± 305.6	412.7 ± 354.6	< 0.001
Treatment results			0.011
Discharge	293 (77.5)	169 (68.4)	
Admission	85 (22.5)	78 (31.6)	

Values are presented as mean ± standard deviation or frequency (%).
 COVID-19 = coronavirus disease 2019.

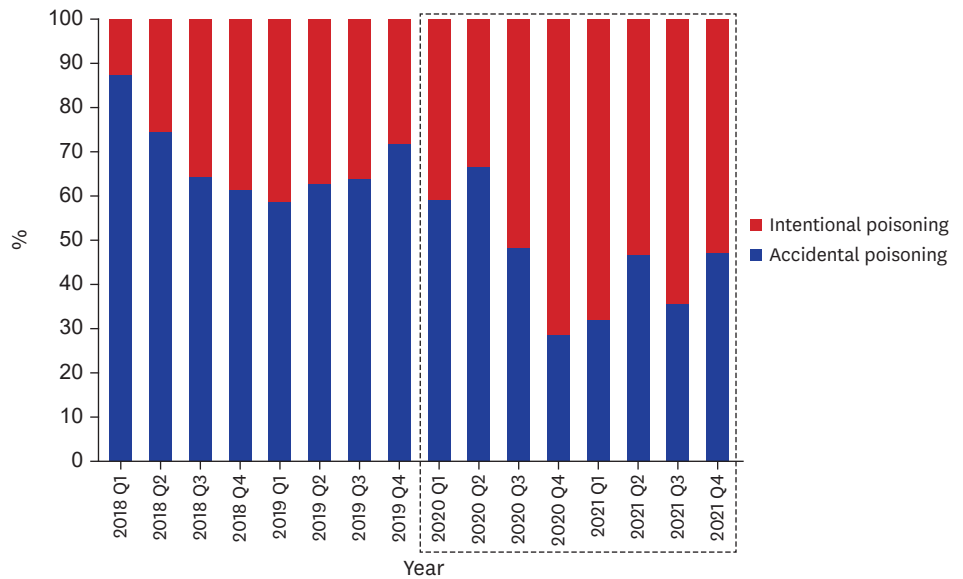


Fig. 1. Patient distributions according to poisoning purpose over time. The period before COVID-19 is from January 2018 to December 2019. It can be seen in the dotted box from January 2020 to December 2021, during the COVID-19 pandemic. The patient distribution is shown over an annual period categorized as a three-month quarter (Q). When comparing the purpose of poisoning between two groups, the rate of intentional poisoning was higher during the COVID-19 pandemic.
 COVID-19 = coronavirus disease 2019.

in the previous period ($P = 0.007$ and $P < 0.001$, respectively). More antidote therapies were performed in the COVID-19 group, although the difference was not significant ($P = 0.126$). The length of stay at the ED ($P < 0.001$) and the proportion of hospitalisation ($P = 0.012$) were significantly greater in the COVID-19 group.

Table 2. The characteristics of accidental poisoning according to COVID-19 periods

Variables	Pre-COVID-19 (n = 255)	COVID-19 (n = 115)	P value
Age, yr	3.0 ± 3.9	3.2 ± 4.0	0.706
Sex, female	122 (47.8)	56 (48.7)	0.879
Poisoned materials			0.296
Therapeutic drugs	116 (45.5)	45 (39.1)	
Artificial poisonous materials	118 (46.3)	59 (51.3)	
Natural poisons	7 (2.7)	1 (0.9)	
Gases	14 (5.5)	10 (8.7)	
Treatment			
Decontamination	8 (3.1)	0 (0.0)	0.055
Laboratory investigation	92 (36.1)	59 (51.3)	0.006
Antidote	5 (2.0)	2 (1.7)	0.885
Length of stay, min	144.3 ± 146.8	233.3 ± 224.9	< 0.001
Treatment results			0.139
Discharge	234 (91.8)	100 (87.0)	
Admission			
GW	19 (7.5)	14 (12.1)	
ICU	2 (0.8)	1 (0.9)	

Values are presented as mean ± standard deviation or frequency (%).

COVID-19 = coronavirus disease 2019, GW = general ward, ICU = intensive care units.

Accidental poisoning

A group of patients with accidental poisoning was separately identified and compared according to the difference in clinical patterns before and during the COVID-19 (Table 2). The age of the patients was 3.0 ± 3.9 and 3.2 ± 4 years old in the pre-COVID-19 and COVID-19 groups, respectively. Girls accounted for 47.8% and 48.7% of the pre-COVID-19 and COVID-19 groups, respectively, with no significant difference therein. In both periods, therapeutic drugs and artificial poisonous materials accounted for most of the poisoning causes. In the pre-COVID-19 group, the most common therapeutic drugs included antipyretics/nonsteroidal anti-inflammatory drugs (NSAIDs), respiratory drugs and antibiotics. In the COVID-19 group, the most common therapeutic drugs included order of iron/vitamin drugs, cardiovascular drugs and hormone drugs (Supplementary Tables 1 and 2). More laboratory investigations were performed during the COVID-19 ($P = 0.006$). The length of stay at the ED was 233.3 ± 224.9 min in the COVID-19 group, which was significantly longer than the 144.3 ± 146.8 min in the pre-COVID-19 group ($P < 0.001$). No significant difference was observed in the rate of discharge from the ED.

Intentional poisoning

Extracted intentional poisoning and changes in clinical patterns before and during the COVID-19 were analysed (Table 3). The average age of the patients was 15.9 ± 1.6 years in the COVID-19 group, which was significantly higher than that of the pre-COVID-19 group (15.5 ± 1.6 years; $P = 0.028$). When the age was divided by period, there were more patients in the middle adolescent age during the COVID-19. Both groups were female predominant, with therapeutic drugs accounting for more than 90% of the causes. A total of 63 (51.2%) and 76 patients (57.6%) in the pre-COVID-19 and COVID-19 groups were poisoned with multiple drugs. Among single drug poisoning cases, acetaminophen was the most frequent cause (22.0% and 28.0% in the pre-COVID-19 and COVID-19 groups, respectively), followed by central nervous system action drugs (12.2% and 9.1% in the pre-COVID-19 and COVID-19 groups, respectively). Patients with a history of psychiatric disorders or were undergoing treatment for psychiatric diseases accounted for 71.6% and 76.5% of the pre-COVID-19 and COVID-19 groups. After comparing previous suicide attempts, no difference was observed between the two groups, with 68.3% and 68.9% of the cases in the pre-COVID-19 and

Table 3. The characteristics of intentional poisoning according to COVID-19 periods

Variables	Pre-COVID-19 (n = 123)	COVID-19 (n = 132)	P value
Age, yr	15.5 ± 1.6	15.9 ± 1.6	0.028
< 10 (childhood)	1 (0.8)	1 (0.8)	
10–13 (early adolescent)	24 (19.5)	15 (11.4)	
14–17 (middle adolescent)	97 (78.9)	115 (87.1)	
18 (late adolescent)	1 (0.8)	1 (0.8)	
Sex, female	107 (87.0)	111 (84.1)	0.511
Poisoned materials			0.096
Therapeutic drugs	113 (91.9)	129 (97.7)	
Artificial poisonous materials	8 (6.5)	2 (1.5)	
Natural poisons	0 (0.0)	0 (0.0)	
Gases	2 (1.6)	1 (0.8)	
Past medical history			0.340
None	34 (27.6)	28 (21.2)	
Psychiatric	88 (71.6)	101 (76.5)	
Medical	1 (0.8)	3 (2.3)	
Surgical	0 (0.0)	0 (0.0)	
Previous attempts of suicide			0.161
None	84 (68.3)	91 (68.9)	
1 time	18 (14.6)	13 (9.8)	
2 times	7 (5.7)	3 (2.3)	
≥ 3 times	14 (11.4)	25 (19.0)	
Treatment			
Decontamination	82 (66.7)	83 (62.9)	0.527
Laboratory investigation	122 (99.2)	131 (91.2)	0.960
Antidote	36 (29.3)	35 (26.5)	0.845
Length of stay, min	506.0 ± 393.4	569.1 ± 373.0	0.190
Treatment results			0.539
Discharge	59 (48.0)	69 (52.3)	
Admission			
GW	18 (14.6)	13 (9.8)	
ICU	46 (37.4)	50 (37.9)	

Values are presented as mean ± standard deviation or frequency (%).

COVID-19 = coronavirus disease 2019, GW = general ward, ICU = intensive care units.

COVID-19 groups having attempted their first suicide. However, 19.0% of the patients in the COVID-19 group had a history of attempting suicide for more than three times. The use of decontamination, laboratory investigation and antidote therapies were all higher following intentional poisoning than following accidental poisoning, although no difference in the intentional poisoning patients was observed before and during the COVID-19 pandemic. The most frequently used antidote in both groups was identified as N-acetylcysteine. The length of stay in the ED was 569.1 ± 373.0 min in the COVID-19 group, which was longer than the 506.0 ± 393.4 min in the pre-COVID-19 group, albeit not significantly. The results after ED treatment did not differ between the groups.

DISCUSSION

The current study has been the first to analyse the changes in poisoning characteristics among children and adolescents visiting the ED before and during the COVID-19 pandemic. During the COVID-19 period, the number of visits to the pediatric ED due to poisoning increased to 0.98%. In particular, the number of adolescent patients increased to 57.5% and intentional poisoning events accounted for 53.4% of all poisoning cases. The results of a previous study at the same hospital showed a significant difference compared to 33.6% of adolescents and 16.8% of intentional poisoning. Although not confirmed in previous studies,

our study found that patients with many suicide attempts in the past tend to be more exposed to intentional poisoning during the COVID-19 pandemic.

Owing to the COVID-19 pandemic, the government had implemented various quarantine policies. In line with this, wearing of masks has become commonplace, whereas social distancing, suspension of schools, remote education and social activities had a considerable impact on the life patterns of children and adolescents.¹¹⁻¹³ As such, the epidemiology of childhood and adolescent diseases also changed significantly, and the number of pediatric patients visiting the ED also plummeted as the incidence of infectious disease shared by near-field droplet transmission decreased.¹⁵ However, several studies have suggested an increase in mental health problems among children and adolescents due to the prolonged social distancing.^{12,13} Changes in the living environment have been confirmed to include an increase in patients with sleep disorders, post-traumatic stress disorder, depression, anxiety, increased suicidal thoughts, increased actual suicide attempts and addiction.¹⁶ The current study confirmed that the total number of pediatric patients visiting the ED decreased by less than half during the COVID-19, whereas the proportion of patients visiting due to poisoning increased from 0.62% to 0.98%. Moreover, the increase in the frequency of intentional poisoning cases during the COVID-19 period reaffirmed the results of several previous studies showing that suicide attempts of poisoning were increasing.

Poisoning among younger children can be characterised as highly accidental, whereas adolescents suffer from highly intentional poisoning, with the frequency being greater in females.^{1,6-8} During the COVID-19 period, the average age of the patients increased with females comprising most of the cases, reflecting the increased number of adolescents visiting due to intentional poisoning. In addition, therapeutic drug poisoning increased during the COVID-19 period, which also reflects the characteristics observed in intentional poisoning. In fact, an epidemiological study on pediatric poisoning conducted at the same hospital more than a decade ago revealed that artificial poisonous materials accounted for 32.1% of all poisoning cases.¹ While the proportion of artificially poisonous materials accounted 33.3% during the pre-COVID-19 period, we found a gradual decrease in the proportion (24.7%) during the COVID-19 period. Given the need for social distancing due to the COVID-19 pandemic, parents spent more time directly caring for infants and toddlers. Notably, with the increase in parental education regarding safety accidents at home compared to the past, accidental poisoning may have decreased.

We conducted a sub-analysis of patients according to poisoning purposes before and during COVID-19. Accordingly, among those who suffered accidental poisoning, no difference in age and sex ratio was observed between the pre-COVID-19 and COVID-19 groups. During both periods, several therapeutic drugs and artificial toxins had been involved in accidental poisoning cases. In the case of therapeutic drugs, a difference in the frequency of detailed drug types was noted during the two periods. Notably, antipyretics/NSAIDs, respiratory drugs and antibiotics were more frequent in the pre-COVID-19 group. Our findings on the common therapeutic drugs involved in poisoning during the pre-COVID-19 period were similar to that reported in previous studies.^{1,3} On the other hand, iron/vitamin supplements, cardiovascular drugs and hormones were most frequent during the COVID-19 period. The different frequencies of poisonous drugs may be attributed to the decrease in infectious diseases rates during the COVID-19 pandemic.¹⁵ During the pre-COVID-19 period, many children had suffered from infectious diseases, such as common colds, with visits largely being due to misuse and accidental ingestion of their prescribed drugs.¹ During the

COVID-19 period, the frequency of pediatric medication decreased as infection rates slowed and the number of patients visiting the hospital due to drug misuse itself decreased. On the other hand, iron/vitamin supplements, which are personal health products, are taken more often. Accordingly, their guardian's drugs have been considered the primary cause of majority of the accidental poisoning cases among children. Among the COVID-19 group, more children visited the ED due to exposure to drugs that may have toxic effects, such as hypertension drugs and hormones, consequently increasing the frequency of blood tests and observation time at the ED. No difference was observed in other treatment or hospitalisation rates. We can reaffirm that toddlers rarely suffer fatal consequences with small amounts of toxic material.

Previous studies have reported that intentional poisoning occurs mainly in adolescents aged 13–18, with more than half occurring among girls and acetaminophen, carbon monoxide, alcohol and psychiatric drugs involved in majority of the causes.^{1,3,4,6-8} The current study found similar results in both the pre- and COVID-19 groups. In particular, we observed an increase in the proportion of multi-drug poisoning. Unlike previous studies, we investigated whether patients with intentional poisonings had a history of psychiatric illnesses or past suicide attempts. However, no difference was observed between the pre- and COVID-19 groups, although more than 70% of the patients had a psychiatric illness and more than 30% had previously attempted suicide in both groups. According to studies published during the COVID-19 period, stronger social distancing protocols made it challenging for patients with an existing psychiatric illness to receive regular psychological care from specialised institutions, which increases the risk of developing psychiatric symptoms among these groups.^{17,18} The results presented herein showed that 19.0% of the patients in the COVID-19 group had a history of more than three suicide attempts. This suggests that adolescents with underlying psychiatric diseases may be more vulnerable to social isolation during this pandemic and can be repeatedly exposed to psychiatric emergencies, such as suicide attempts. Adolescence is an important period where individuals transition into social adults. Throughout this process of maturity, a sense of belonging and interaction with friends are absolutely necessary.¹⁸ However, during severe social disasters, social isolation paralyses daily life, such as school and play, with fear of infection and death of a loved one potentially increasing the risk of poisoning attempts in vulnerable adolescents. Should there be a major interest in implementing quarantine policies to prevent the spread of infection at present, the results of our study may help form the basis for evaluating the impact of such policies on adolescents' mental development and preparing supplementary measures for children with underlying mental diseases in social panic.

This study has some limitations worth noting. First, given that this study was conducted at a regional emergency centre, it does not represent the results of all children and adolescents. In addition, considering the retrospective nature of the study, some information could not be investigated, such as the amount of poisonous substances or the duration from ingestion to visitation. In the future, additional research is needed by prospectively collecting large-scale data.

In conclusion, this study confirmed an increase in the incidence of pediatric poisoning patients visiting the ED and a higher rate of intentional poisoning during the COVID-19 pandemic. Also, the frequency of adolescence and girls' incidence increased, and the use of treatment resources and hospitalization rate increased. Many of the patients with intentional poisoning had a history of mental illness or suicide in the past. Therefore, it seems that policy consideration for mentally vulnerable adolescents during this new pandemic period are necessary.

SUPPLEMENTARY MATERIALS

Supplementary Table 1

The frequencies of therapeutic drugs in accidental poisoning cases

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Supplementary Table 2

The frequencies of therapeutic drugs in intentional poisoning cases

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