**Title:**

**Characterizing Unintentional Poisoning Cases at the Pediatric Emergency Department at Wolfson Hospital between 2008 and 2013**

**Abstract**

**Introduction:** In Israel there are approximately 180,000 Pediatric Emergency Department (PED) visits, 25,000 admissions and 150 deaths annually due to unintentional injuries. PED visits and subsequent hospitalizations of children after unsupervised ingestion of medication are on the rise despite widespread use of child-resistant packaging and caregiver education efforts. According to the National Toxicology Center there are almost 30,000 consults annually with approximately 50% pediatric cases. Poisoning is considered a major cause of death among these patients. The purpose of this study is to characterize all our PED unintentional poisoning cases. This could help identify prevention priorities and create intervention strategies.

**Patients & Methods:** In this prospective ongoing study, and as a part of the National Pediatric Injury & Safety Surveillance (NAPIS) program, we, in collaboration with the Beterem organization, have created a computerized system for collecting data for all the PED visits due to unintentional injuries. The minimal data set (MDS) is based on the WHO recommendations. In addition, we have used the Poisoning by Medication and by Household Agent codes. The population includes patients aged 0–18 years, seen in PED during 2008-2013. Cases of intentional injuries were excluded.

**Results:** During that period, 46,840 patients of unintentional injuries were seen in the PED. Two hundred and forty four (244) poisoning agents were identified in 199 patients. In 34/199 (17%), more than 1 agent was involved. Drugs were involved in 97.8% of the cases. As expected, the majority (150/199, 75%) were under the age of 5 years. Surprisingly, girls were more common - 118/199 (58%), compared to only 83/199 (42%) boys. The most common poisoning agents were: antipyretic medications (20%). Most cases (80%) took place at home and the most common place outside the home was at the grandparents' home (80%).

**Conclusions:** Focusing on prevention efforts of unsupervised medication ingestion with the highest hospitalization rates may efficiently impact public health.

# **Introduction**

The World Health Organization announced pediatric injuries (accidents) as one of the epidemics of the third millennium in both developed and developing countries. The epidemiological definition defines an accident as any external or internal injury caused by physical contact or poisoning agent on or in the body, which causes harm1.

The injury’s severity can be classified by degree:

1. Injury that does not require medical assistance; the most common and with the mildest degree of injury.
2. Injury that requires medical treatment in the community.
3. Injury that requires treatment at the Emergency Department. A significant portion of the visits to the Pediatric Emergency Department (PED) due to accidents require hospitalization for the purpose of observation and treatment, and in rare cases the hospitalization ends in death.

In Israel, like in other developed countries, unintentional injuries are a predominant problem in pediatric health. Accidents are a main cause of child morbidity, hospitalization, and mortality. Data from the Child Injury Report shows that more than 2000 children and teens die worldwide every day due to unintentional injuries 2. In Israel, according to data collected from all the Emergency Departments, there are 180,000 annual visits to the Emergency Department due to accidents and around 25,000 of them are children that need to be hospitalized. According to estimates, around half of the children in Israel are injured in a way that requires some sort of treatment in the community 3. According to the Child Mortality Report, in 2012, 121 children and teens were killed in accidents. The most common injuries that caused death were car accidents (40%), drowning (13%), suffocation (11%), and poisoning or burns (6%). These four injuries comprise 70% of all injuries. Most cases (43%) of deaths occurred at home, 35% of the deaths occurred on the roads, 19% occurred in the public sphere, and 3% in education institutions 4.

Similar to Israel, unintentional injury is a major problem in the United States and ranks as the seventh leading cause of death among children up to 19 years of age. Every year, around 12,000 children die of unintentional injury and accidents in the United States, which are around 3% of all mortality incidents 5. In European countries, the mortality rate is 6 out of every 100,000 children, compared to developing countries like China or South Africa, where the mortality rate is five times higher or more6.

Children’s injuries are an economic iniquity for hospitals, HMOs, insurance companies, the parents, and their employers. The estimated cost to the health and welfare system exceeds 1,633,000,000 ILS per year, comprising around 0.26% of Israel’s Gross National Product (GNP). The costs of lost productivity may raise the GNP damage to 1.54%. The costs of PED visits due to accidents alone are around 106 million ILS, and hospitalization costs are around 134 million ILS 7.

According to a Beterem report, poisoning was the fourth highest cause of child mortality for unintentional injuries in Israel in 2012, and it is becoming more prevalent with each passing year. There are around 30,000 cases reported to the National Poisons Information Center at Rambam Medical Center each year, around half of which pertain to children 18 and under. The vast majority of these cases occurred in children under the age of 6 3. The high prevalence of children’s injuries can be ascribed to their motor, cognitive, and social developmental stage, as well as to their behavior and personality. Most of these types of injuries occur at home through unsupervised ingestion of chemicals such as cleaning products, medications, and insecticides. The severity of the poisoning varies according to the cause. Ingestion is the most common form of exposure although there are other forms, including contact with skin, eyes, respiratory system, and rectum. The leading risk group is male children under the age of 5 due to their inquisitiveness, small stature, and rapid metabolism. Among 6-12 year olds, most cases of poisoning are a result of ingestion of medications and chemicals, but also exposure to plants. In 13+ year olds, most poisoning cases are from medications as a result of attempted suicide or calls for attention. These poisonings are more common among girls 8,9. The concerning data regarding children’s injuries in Israel do not improve over time, even though most of these injuries are preventable. Prevention is preferable to treatment, since it spares the individual and society from coping with the phenomenon, prevents suffering among children and their parents, prevents physical and emotional pain, and also saves financial costs to the afflicted families and the healthcare system. Reducing injuries and death is a feasible goal but it depends on promoting both preliminary prevention - preventing the accident, and secondary prevention - reducing the severity of the injury. There are several strategies for preventing injuries, such as education, publicity, and changing the environment and the product 2.

Over the past five years there has been a close collaboration between the PED at Wolfson Hospital and Beterem organization, whose aim is to collect data about accidents among children visiting the PED and thus to plan and implement a population-appropriate prevention program.

In light of the importance of creating such a population-appropriate program, and due to the small number of studies in Israel engaged in poisoning among children, we have chosen to characterize the poisoning cases among children that visited the PED at Wolfson Hospital.

**The Purpose of the Study**

To characterize poisoning cases among the children population that visited the PED at Wolfson Hospital.

**Study Population:**

Children up to 18 years of age that visited the PED at Wolfson Hospital and were discharged with a diagnosis of poisoning, between January 2008 and July 2013.

The following ICD diagnosis codes were used -

* 98989 – Poisoning by Household Agent
* 9779 – Poisoning by Medication

Children whose poisoning was suspected as being an attempted suicide via ingestion of medication or chemical substance were not included in the study population.

Epidemiological and demographic data was collected, as well as information about the type of medication, manner of exposure, clinical symptoms, and the inquiry performed at the hospital. The poisoning cases were classified according to the type of medication or involved substance.

The initial assessment at the PED is conducted by a nurse and includes a brief anamnesis and measurement of blood pressure, heart rate, number of breaths, and oxygen saturation. The pediatrician’s examination at the PED includes a detailed anamnesis from the parents or other witnesses to the poisoning, which includes questions about the time of exposure, manner of poisoning, quantity and symptoms, physical examination, and case-specific ancillary examinations if necessary. In addition, the Poison Center, a child psychiatrist, and social worker were also consulted. In several cases, the children were drowsy upon arrival and there was no known exposure to medication or hazardous substances, which was only discovered after lab tests or repeat anamnesis.

**The Study Tools:**

1. A Minimal Data Set-ED (MDS) questionnaire completed by the nursing staff at the PED for each case. The questionnaire was prepared together with the organization Beterem in 2008 and it was designed to help establish a national system for child injury data and contains demographic information, cause and pattern of the injury, type of product or substance involved, place of occurrence, and activity during the injury, in an attempt to identify populations at risk and hazards.
2. Reviewing medical files.

**The Study Variables:**

1. Number of annual poisoning-related visits.
2. Epidemiological data - distribution of ages according to groups, sex
3. Diagnosis - anamnesis, type and quantity of drug or chemicals, place the poisoning occurred, physical examination, lab tests.
4. Treatment - where the child was treated, use of medication or fluids, hospitalization in a pediatric ward or pediatric ICU, duration of hospitalization.

**Statistical Analysis:**

A prospective study, during which data was collected regarding children up to the age of 18 that were examined at the PED after a poisoning incident. The data was entered to an Excel spreadsheet. A frequency distribution test was conducted for categorical variables. Statistical correlations were conducted between several poisoning cases and central variables, including: sex, age, type of poisoning, place of occurrence, tests conducted, and the treatment administered. An analysis of the data enabled an in-depth segmentation of the population and identification of the population at risk.

# **Results**

During the study period there were 47,157 visits to the PED by children aged 0-18 who came to seek treatment for an injury. Of all injury cases, there were 199 poisonings in children aged 0-18 years. Poisoning was defined as ingesting or inhaling a potentially toxic substance and chemical burn after coming into contact with an acidic or alkaline substance. Fires and carbon monoxide inhalations were not included.

**Table 1: Distribution of Cases by Year:**



With regards to the demographic variables, the overwhelming majority of poisonings, 75% (150/199), occurred in the 5 and under age group. Among teens, unintentional poisoning is not common, and most cases of poisoning in this age group are real or demonstrative suicide attempts. The poisoning rates among girls were higher than among boys, 58% (116/199) compared to 42% (83/199) of the cases. In the 0-5 age group, the difference was minor, 52% girls (78/150) compared to 48% boys (72/150). The most significant difference was in the 15-18 age group, 87% girls (21/24) compared to 13% boys (3/24).

**Table 2: The Distribution of Cases by Age and Sex:**

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For 17% (34/199), exposure to more than one substance was reported, and therefore the total number of poisoning agents was 244, the overwhelming majority of which were medications 227/244 (93%). In 17/244 (7%) there was exposure to different chemicals, including: household cleaning products - 7, insecticides - 1, essential oils - 3, solvents - 2, cosmetic products - 2, alcohol - 2.

The most common form of exposure to the poison was ingestion in 95.5% (190/199) of all cases. Skin and eye injuries comprise 1% (2/199) of the cases and inhalation comprises 3.5% (7/199) of the poisonings. In most cases, 78% (155/199), the child was exposed to the poison at home. The most common place where poisoning occurred outside the child’s home was at the grandparents’ home, in 18% (36/299) of the cases. The rest of the cases occurred at friends’ homes, at uncles/aunts, or on the street.

**Table 3: The Distribution of Cases of Exposure to Medication by Prevalence:**

The most common group of medications were neurological drugs in 23% of the cases, which included antipsychotic drugs, antidepressants, anticonvulsants, anesthesia, sedatives and anti-anxiety drugs, anticholinergics, and narcotics. Antipyretics and anti-inflammatory drugs were reported in 2% of the cases.

**Table 4: The Distribution of Poisoning Cases by Type of Medication:**



Of all the children that visited the PED after poisoning, 62% (123/199) were admitted and 38% were discharged (76/199). Most of the admissions, 88% (108/123 cases), were to the pediatric ward and the rest 12% (15/123 cases) were to the pediatric ICU. No deaths were recorded. The average age of the children that were admitted to the pediatric ICU was 2.9 years and to the pediatric ward 6.6 years.

In the majority of cases (69.8%; 139/199) lab tests were conducted, which included blood count, electrolytes, renal functions, liver enzymes, Paracetamol level, coagulation functions, urine toxicology, and an ECG was performed. At the end of the screening process, a decision was made whether to discharge or admit the child from the PED. The most common medical treatments administered were IV fluids in 18.5% of the cases (37/199) and the administration of activated charcoal in 16% (32/199) of the cases.

Of the 123 children that were admitted, 45% were hospitalized for one day (55/123), 32% were hospitalized for two days (40/123), 13% for three days (16/123), 7% for four days (9/123), and 1.6% for five days (2/123). In the most severe case, 0.8% (1/123), a child was hospitalized for two weeks. This was a child under one year old who inhaled and drank a wax solvent that he found at home and he was admitted to the PED in respiratory distress. The infant required artificial respiration due to a serious chemical lung infection.

**Discussion and Conclusions**

This study describes the poisoning patterns among children 0-18 years of age that came to Wolfson Hospital between January 2008 and July 2013. This is the first study of its kind in Israel that examined the population of children visiting the Pediatric Emergency Department as a result of unintentional poisoning among Southern Tel Aviv Metropolitan Area population.

We found a steady rise in the number of PED visits due to unsupervised ingestion, inhalation, or contact with drugs or chemical substances. This finding of an increased number of poisoning cases during the study period is surprising, due to regulations requiring child-resistant packaging; however the regulations do not apply to all drugs. For example, Ventolin solution is found in a bottle without a safety seal and the package will only be changed from 2017 due to reports of numerous cases of the solution being ingested by children 10. In the United States, a federal law was passed in 1970 that required companies to package drugs and toxic products using special seals/caps. Studies that were conducted subsequent to the legislation showed a significant drop in children’s injuries from products that were included in the law, compared to the number of injuries prior to it 11,12.

There is also an improvement in the emergency system and information to the public, such as the emergency hotline of the National Poisons Information Center that opened in 1973 at Rambam Hospital, which is operational 24/7. It appears that the rise in poisoning-related visits reflects a rise in visits to the PED in general, an awareness of the need for treatment post poisoning, less awareness of the existence of the Poisons Information Center, which can provide solutions for mild cases, and as a result of a population growth 13.

Poisoning rates were highest among girls (58%, 115/199), and among the 5 and under age group (75.3%, 150/199). A similar study conducted in the United States found that 70% of poisonings occurred in the 2 and under age group (70%) and that boys were involved in 54.6% of the cases 14. This finding apparently stems from the fact that children in this age group are more susceptible to unintentional injury due to their curiosity, lack of understanding, and their natural inclination to put things in their mouths.

A study from the United States found that 59.5% of poisonings involved medications or nutritional supplements. Other large product categories included cleaning products (13.2%), medications and ointments for external use (4.9%), and toiletries (4.7%). According to data published in the American Association of Poison Control Centers’ annual report found that the ingestion of analgesics comprised 11.3% of the unintentional poisonings for all the ages, while the most common injury in children under 5 was caused by exposure to cosmetic and toiletry products15 Our study found that the most common group of drugs was neurological drugs, in 23% of the cases (53/199). This is a very heterogeneous group of drugs and includes several sub-groups: anti-depressants, sedatives, antipsychotic drugs, stimulants, anticonvulsants, narcotics, anesthesia, and anticholinergics. The most common drugs in this group were antidepressants, in 17/53 cases. However, as a single group of drugs, analgesics and anti-inflammatory drugs were the most common, in 45/199 of the cases (20%).

Lab tests were conducted in 69.8% of the poisonings. Sixty two percent (62%) of the children were hospitalized for at least one day, the majority in the pediatric ward, 88% (108/123 cases), and the rest in the pediatric ICU, 12% (15/123 cases). The lengthiest hospitalization was for two weeks. In this case, a child was hospitalized after inhaling and drinking a wax solvent that he found at home and he suffered from a chemical lung infection that required artificial respiration. A significant portion of the children were given medication according to the type of poisoning. In some of the cases, it took several days until the poisoning was detected while wasting diagnostic and therapeutic resources. A similar prospective study conducted in Spain showed that lab tests and other tests were conducted in 40.7% of the cases. Over eighty three percent (83.3%) of the cases were treated at a clinic or PED, 15.2% were hospitalized, and 1.2% were admitted to the ICU 16.

The study’s main limitation is due to selection bias. The study was conducted at Wolfson Hospital, in central Israel. This is an urban, mid-high socioeconomic status population (cluster 5-8 according to the local authorities index conducted by the Central Bureau of Statistics) 17. Because of this bias, it is not possible to apply the findings to the entire population. Furthermore, collecting data from the PED alone reflects only some of the poisonings since some of the mild cases do not reach the Emergency Department and the families visit their pediatrician, family doctor, or call the Poisons Information Center directly. Finally, collecting data from computerized databases may lead to information errors due to coding errors or typing errors and there may be some degree of inaccuracy in recording the Emergency Department visits.

In summary, this study characterized the poisoning cases among children visiting to the PED. Our findings show that the group most susceptible to poisoning was the 5 and under age group, and that the most common form of poisoning was via drug ingestion. The most common group of drugs was the neurological drug group but analgesics and anti-inflammatory drugs were the most common as a single group of drugs.

These findings enable the planning of prevention strategies such as improving regulations and supervision of drug packaging, such as child resistant caps for the drugs that commonly cause poisoning, increasing the public’s awareness of proper drug storage and the dangers in leaving drugs within children’s reach.

This study represents collaboration between Wolfson Hospital and Beterem organization, for the purpose of characterizing injuries among the population visiting the hospital. Implementing this standard improves the quality of the databases and the possible ways to prevent unintentional injuries.

By implementing the study’s conclusions by improving regulations and inspection, raising the public’s awareness of the issue, legislation and involvement of government institutions such as the Ministry of Health, education institutions, and the involvement of commercial companies, the cases of children’s poisoning injuries can be reduced.

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