

ACUTE CHEMICAL POISONINGS IN THE REPUBLIC OF MOLDOVA: 5 YEARS REVIEW

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Abstract. The incidence and the type of acute chemical poisoning in Republic of Moldova during 2011-2015 were assessed. Records show 22458 cases of poisonings, including 919 death cases. The analysis of poisoning cases involving various types of chemical substances causing the intoxication reveals that the medicines-related poisoning accounts for the highest record of cases (6971), followed by alcohol poisoning (6556 cases); gas poisoning is the third with 1860 cases, and pesticide-related poisoning with 707 cases. Age and gender characteristics of chemical poisonings and ways of exposure to chemicals are discussed.

Keywords: acute chemical poisonings, chemical substances type, poisoning incidence.

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Introduction

Nowadays, chemicals became important parts of our lives, ranging from sustaining human activities and technological progress, preventing diseases, and increasing agricultural productivity. Thus, the risk of chemical poisoning is increased as the chemicals have their own adverse effects on human health and environmental integrity [1,2].

Around 10 thousand substances/chemicals are used in Republic of Moldova (industry, agriculture, household products), which could be potentially damaging to the health of the population. In the last decades, the issue of acute chemical poisoning became an actual worldwide problem because of the environmental pollution with huge quantities of various chemicals [3]. There are over 6 million chemical substances commercially available on the world global market [4-11]. Given the increase in production and use of chemicals, it is therefore not surprising that the potential for inadvertent chemical exposure has increased, giving rise to a greater risk to human health and the environment.

Toxic exposures to medicines and chemicals are among the most common reasons for emergency department visits and hospital admission in developed countries. Spanish authors reported that the rates of toxic exposure requiring medical intervention are in the range between 1.7 and 3.7 per 1000 inhabitants yearly [5]. Chemical poisoning often occurs in domestic conditions across all ages (including children), being caused by the intake of chemical substances that are used

by some family members, which are easy accessible to children. Chemical poisoning records show that in many cases are caused by inadequate storage or usage of the chemical substances, lack of population awareness about the potential danger for the health, suicides involving chemical poisonings or because of the inappropriate use of some home devices (such as the cookers, hobs, *etc.*).

In the past years, it was registered an increasing number of cases of lethal chemical poisoning both for adults and children, which occurred accidentally, or as suicides (defined as intentional self-poisoning). On a global level, there are several million acute poisonings yearly, caused by the accidental or suicidal use of chemicals (*i.e.* medicines substances, pesticides, *etc.*). Acute chemical poisoning is an actual health problem for the Republic of Moldova. The occurrence of chemical poisonings is increasing every year [8-11]. Therefore it is important increase the awareness regarding the chemical poisoning, as a risk factor for human health.

The purpose of the present study is to assess the frequency of acute chemical poisoning recorded in Republic of Moldova during 2011-2015 and to make preventive recommendations.

Materials and methods

In the present study, the data from the Statistical form F. 18-san "Report on State Public Health Surveillance" for 2011-2015 were used, combining with records regarding the acute

chemical poisoning, obtained from the surveys at district level published in the Registers of people with acute chemical poisoning, the extraordinary reports on the poisonings, according to the provisions of Order No. 906 (from 30.11.2015) on the Notification and Research into the Acute Exogenous Non-Occupational Chemical Poisoning Cases [12].

Results and discussions

Yearly, a lot of acute chemical poisoning cases occur in Moldova that require hospitalization, some of them being fatal.

Analysis of the gathered records reveals a number of 22458 cases of acute chemical poisoning during 2011-2015 in Republic of Moldova, of which 919 resulted in deaths (Table 1). The biggest number of poisonings was reported in 2013 – 6292 cases. During 2013 year, as well as in 2014, 219 cases of deaths related to chemical poisonings were reported. The highest records of chemical poisonings followed by death were reported in 2011 and accounts for 6.5% of the acute poisonings records (Table 1).

Table 1
Cases of poisonings during 2011-2015.

| Year | Number of | | Death rate, % |
|------|------------------|-----------------------------------|---------------|
| | acute poisonings | deaths caused by acute poisonings | |
| 2011 | 3263 | 214 | 6.5 |
| 2012 | 3261 | 185 | 5.7 |
| 2013 | 6292 | 219 | 3.5 |
| 2014 | 5619 | 219 | 3.9 |
| 2015 | 4023 | 82 | 2.0 |

Analysis of the chemical poisoning records during 2011-2015 (Figure 1) shows that alcohol poisoning had the highest % ratio from the total number of registered cases – 29.2% (6556 cases), of which 6.1% (397 cases) resulted in death and were reported most frequently in the municipalities of Chisinau, Balti, the districts of Hincesti, Floresti, and Falesti. Chemical poisonings involving alcohol occur as a result of the consumption of spirits (48%), wine (16.4%) and other types of alcoholic beverages. Gabow P.A. *et al.* reported that due to the oxidation of the ingested alcohol, the main biochemical abnormalities observed are metabolic acidosis with an anionic gap [13]. This acidotic state, defined as the increased acidity in the blood, is caused by the accumulation of acidic metabolites and increased lactate production.

According to the data of Haliutin D.A. *et al.*, the alcohol poisoning, including counterfeit

alcohol affected 470 people during 2011-2012, of which 27 died in Czech Republic, 17 – in Slovakia, and 1 in Ecuador [14]. During 2010–2012, an annual average of 2221 alcohol poisoning deaths (8.8 deaths per 1 million population) occurred among persons aged ≥ 15 years in the United States of America [15,16].

Chemical poisoning involving medicines is the second most spread type of poisoning, recording 6971 cases (31% from the total number of cases) during 2011-2015, including 31 deaths (0.4%), with the highest frequency in the municipalities of Chisinau and Balti and the districts of Hincesti, Orhei, and Ialoveni.

It should be noted that, the decrease in the number of poisonings in 2015 might be explained by the fact that all cases were strictly recorded (according to Order No. 906 from 30.11.2015) and this allowed showing the real situation of chemical poisoning in Republic of Moldova. Analysis of the data recorded in 2015 (Figure 1) shows that 1642 cases involved medicines-related poisonings (municipality of Chisinau – 860 people affected, Balti – 73 people, Ialoveni – 70 people, and Ungheni – 40 people), including 7 deaths (while in 2014, poisonings involving medicines had the second highest frequency, with 1676 people affected and one person deceased). Poisoning involving alcohol was the second most spread– 1126 cases with 33 people deceased (in 2014, this category of poisoning ranked first, affecting 1788 people and causing 96 deaths). Acute poisoning with gas ranked third, accounting for 297 cases and 29 deaths, 206 cases less than in 2014, and 59 deaths. In 2015, there were poisoned 122 people with pesticides (35 in the municipality of Chisinau, 13 – in Criuleni district, 6 – in Soroca district, *etc.*) and 5 people died (compared to 2014, when 199 people were affected and 13 died). It should be noted that the type and severity of adverse health effects of pesticides depend on the chemical category, the dose, the duration of exposure, and the exposure route [21].

The number of people poisoned with other toxic substances (strong acids or alkali, chlorine, ammonia, household products *etc.*) was 737 (307 in the municipality of Chisinau, 45 in Hincesti district, 39 – in Ialoveni district *etc.*) and 8 deceased (in 2014, 1290 people were affected and 77 deceased) (Figure 1).

Analysis of the data regarding the poisoning related to medicines, drugs and other chemical substances in the Russian Federation shows that this was the main cause of death of 39898 people during 2005-2008.

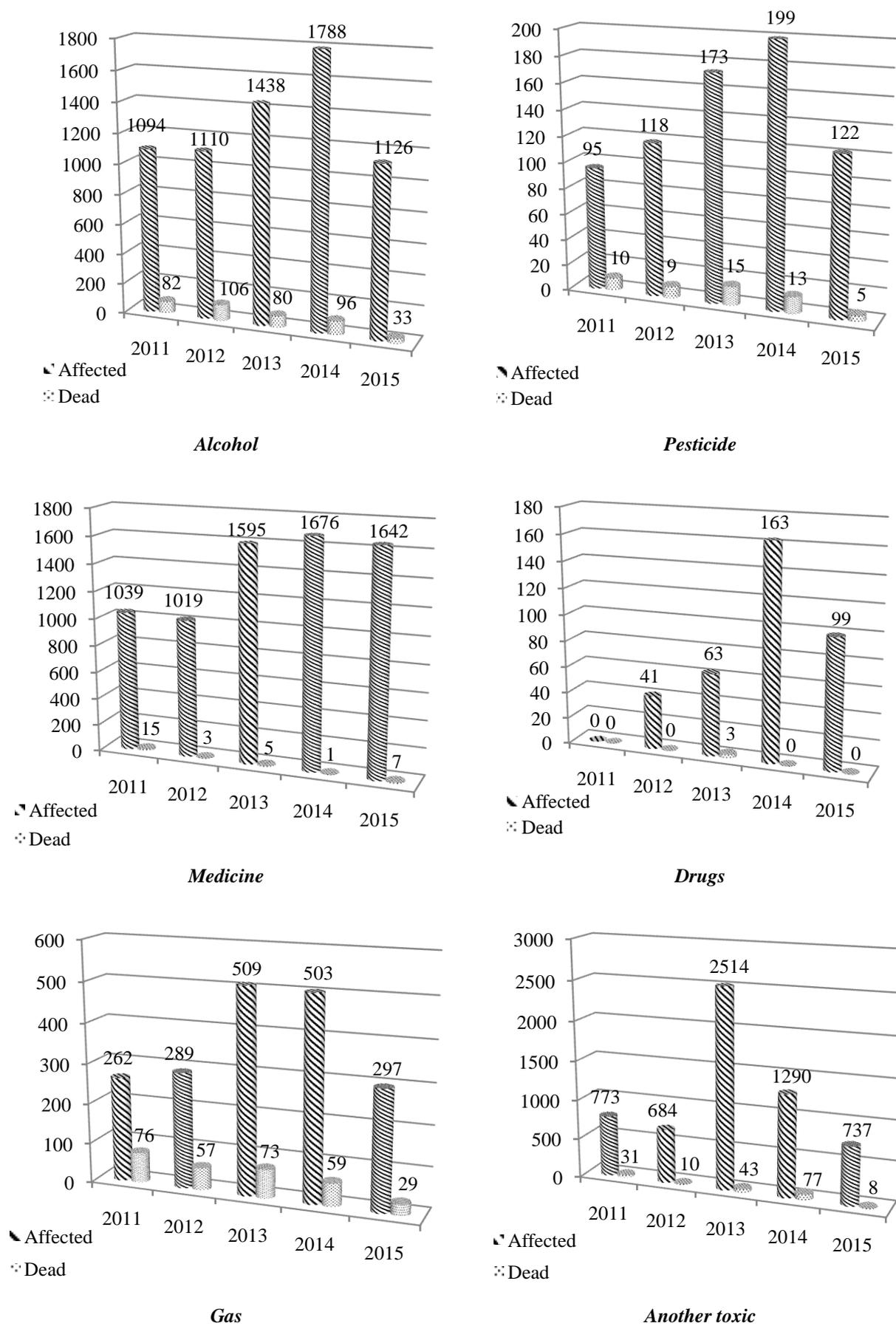


Figure 1. Types of poisonings in the Republic of Moldova during 2011-2015 (number of cases).

In Orlov region (Russian Federation), from 2011 to 2014 there were reported 2000 acute chemical poisoning cases, of which 780 resulted in deaths. In 2014, 475 cases of poisoning with medicines and 1 death were reported [17].

Gas poisoning has the third highest number of affected with 1860 cases (8.3%), including 294 death cases (15.8%). Usually such poisoning occur as a result of the infringement of the legal provisions when operating some appliances (such as cookers, hobs *etc.*). Poisoning with carbon monoxide (CO) poses a major public health problem and may be the cause of more than 50% of fatal poisonings in many countries. The adverse effects of CO poisoning may be more widespread because of the unreported cases and delayed neurologic effects, which may be linked to CO exposure. The health risks associated with CO vary depending on the concentrations and duration of exposure. Because of the risk of occult poisoning, some communities now require the installation of CO detectors in residences, along with smoke detectors and fire alarms [18]. Following the acute poisoning with carbon monoxide, 202 people died in the city of Tomsk (Russian Federation) during 2000-2004. In 2013, over 30 people were poisoned in North Ossetia by 9 carbon monoxide, of which 17 died [19,20].

At the same time, during 2011-2015, 707 poisonings with pesticides were reported (or 3.1%), including 52 deaths (7.4%), of which 90% occurred for suicide purposes (Figure 1).

In the recent years, due to the use of pesticides, poisonings involving these chemicals represent a problem for public health. The agricultural sector of Republic of Moldova uses 740 plant protection products (PPPs) produced based on 315 active substances from different chemical groups: compounds of copper and sulphur; carbamates and thiocarbamates; organophosphorus; chlorophenoxy; synthetic pyrethroids; neonicotinoid derivatives; sulphonyl-urea; strobilurin, among others. The widespread application of PPPs due to the technical and scientific developments help substantially increase agricultural yields, but often cause a negative impact on public health.

Lately, frequent cases of accidental poisonings with pesticides were registered in Republic of Moldova, particularly within the pre-university education institutions. Such poisonings, both in children and in adults occur because of the inadequate storage or usage of pesticides, accessibility, and lack of awareness about the potential danger for the population's health, including lack or non-functioning ventilation

system in closed rooms. Pesticides that caused poisoning during 2011-2015 are from the group of organophosphorus, sulphur-compounds and pyrethroids. The highest rate of poisonings deaths with pesticides was reported in 2011, accounting for 10.5% with 10 deaths. Beginning from 2013, this group of poisonings decreased to 4.1%. Out of the total number of 52 deaths, around 90% were suicidal cases (Figure 2).

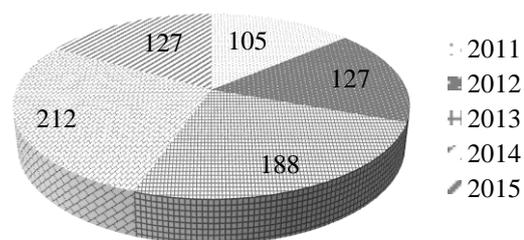


Figure 2. Number of pesticide poisoning cases during 2011- 2015.

Kzerczak, S. and Jaracjavaska, W. reported that in Poland, drugs were the most frequent group of chemical substances responsible for more than 50% of all hospital admissions for acute chemical poisonings [22]. The second most frequent were alcohols, with an increase to about 20% of the total number of poisonings. Carbon monoxide was the third most frequent cause of poisonings. The greatest number of lethal outcomes was also due to poisonings by alcohols, drugs, and carbon monoxide [22].

The analysis of acute chemical poisonings during 2012-2015 by age groups (Figure 3) shows that the most affected group are adults (age of 18 and older), with a number of 9606 people affected. The second most affected is the group of children 3-18 years old, with 3178 cases. During this timeframe, children aged 1-3 accounted for the lowest number of acute poisonings – 1957 cases. Acute poisoning is still a significant public health concern both for children and the adults, due to its high frequency and severity [23,24].

Chemical poisonings among children according to the types of chemical poisoning is presented in Table 2. Medicinal substances and another toxic substances were the most frequently ingested agents for children 1-3 years old (with 997 and 644 total cases respectively) and 3-18 years old (with total 1304 and 827 cases respectively) during 2012-2015. The statistics in Lithuania show that children above the age of 10 often use medicines for suicide purposes. During 2007-2011, were registered 55 cases of death caused by medicines [17].

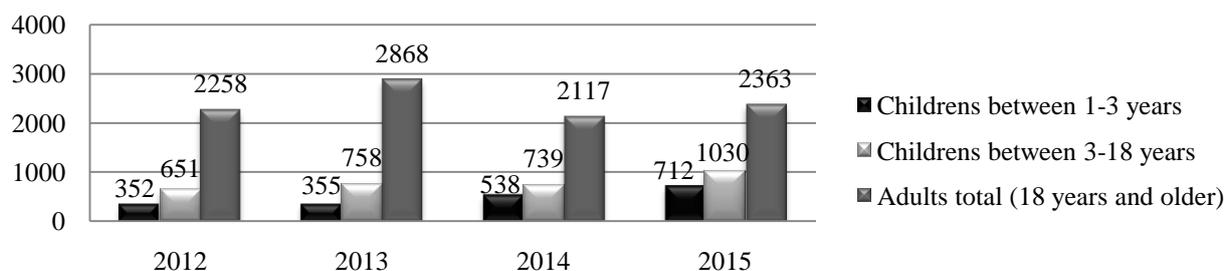


Figure 3. Number of acute chemical poisonings by age groups during 2012-2015.

Table 2

Chemical poisoning among children according to the types of chemical poisoning.

| Source of chemical poisoning | Age group | Year | | | | TOTAL |
|------------------------------|----------------|--------|--------|--------|--------|----------------|
| | | 2012 | 2013 | 2014 | 2015 | |
| Medicinal substances | 1-3 years old | 174/1* | 160/0 | 283/0 | 380/0 | 997/1 |
| | 3-18 years old | 280/1 | 304/2 | 298/0 | 422/0 | 1304/3 |
| Alcohol | 1-3 years old | 14/0 | 9/0 | 24/0 | 24/0 | 71/0 |
| | 3-18 years old | 118/0 | 146/0 | 126/0 | 244/1 | 634/1 |
| Pesticides | 1-3 years old | 15/0 | 17/0 | 21/0 | 18/0 | 71/0 |
| | 3-18 years old | 9/0 | 14/0 | 14/1 | 33/0 | 70/1 |
| Drugs | 1-3 years old | 12/0 | 0/0 | 17/0 | 21/0 | 50/0 |
| | 3-18 years old | 3/0 | 5/0 | 24/0 | 36/0 | 68/0 |
| Carbon monoxide | 1-3 years old | 29/2 | 24/1 | 33/0 | 34/0 | 120/3 |
| | 3-18 years old | 65/2 | 57/0 | 88/1 | 71/2 | 281/5 |
| Another toxic substances | 1-3 years old | 108/0 | 144/0 | 158/0 | 234/1 | 644/1 |
| | 3-18 years old | 176/0 | 234/1 | 196/2 | 221/0 | 827/3 |
| TOTAL | | 1003/6 | 1114/4 | 1282/4 | 1738/4 | 5137/18 |

* Number of death

Within the European Union, medicinal products are responsible for the majority of poisonings in childhood [25–29]. The agents most commonly involved in medicinal poisoning are analgesics, anxiolytics and antidepressants [25–27]. Most commonly involved in poisoning from group of “another toxic substance” are detergents, petroleum products and other household products. Arici, M.A. reported that exposures to household cleaning substances are on the higher side of the poisonings affecting children younger than 6 year olds [30].

Category of alcohol remains as the most of ingested agent among children of 3-18 years old. Underage drinking among the teenagers is a serious public health problem. Alcohol is the most widely used substance of abuse among youth, and drinking by young people poses enormous health and safety risks [31]. During 2012-2015 among children 3-18 years old were registered 634 poisoning cases with one death in 2015. Pesticides stand as one of the important agents of childhood poisoning. Children are more sensitive to both the

uptake and the adverse effects of pesticides due to developmental, dietary and physiologic factors [32-34]. A total of 1232 children aged 0-14 years were identified from the acute pesticide poisoning cases reported across South Korea [35]. During the study period in Republic of Moldova, there were recorded 70 poisoning cases and one death in group 3-18 years old and among children of 1-3 years old – 71 poisoning cases.

In 2015 carbon monoxide became the cause of poisonings of 401 children (Table 2). In group 1-3 years old, there were registered 3 cases of death and in group 3-18 years old – 5 cases of poisoning death. According to literature data, over 20000 people is seen in the emergency room every year because of carbon monoxide exposure [36]. Of those 20000 people, children ages 4 and under are the most likely age group to be seen. Carbon monoxide poisoning is the most common cause of accidental poisoning-related deaths and is often called “the silent killer”. Carbon monoxide (CO) is a poisonous, colorless gas that is made from the incomplete burning of fuels that

contain carbon. Breathing carbon monoxide decreases the blood's ability to carry oxygen. Low levels of oxygen can lead to cell death, including cells in the vital organs, such as the brain and heart. People with existing health problems, such as anemia, heart disease, and lung disease are especially vulnerable, as are unborn babies, infants, children, pregnant women, and older adults [36].

Drug poisoning in children remains a frequent problem. Obtained data concerning drugs poisoning show 118 cases registered in age group of 1 – 18 years old (Table 2). The large majority of drugs were psychotropic agents and principally diazepam. None of the children died. As reported in [37], it is necessary to highlight the need to develop an education program on primary prevention. Parental education and intensified child supervision are the indicated measures of prevention for unintentional poisoning.

On the basis of the obtained data, we recommended that it is advisable for parents to be aware about toxic properties of medicinal substances, alcohol, drugs, and household products due to their higher number of poisoning among children. Pesticides also present the most common agents of poisoning among children. Careful attention in terms of the usage and the storage of chemicals from these categories of sources should also be given to minimizing the risk of chemical poisoning among children.

Analysis of data concerning the ways by which chemicals enter into the human body, show that the most frequent way is through ingestion (alcohol; medicines; pesticide with suicidal purpose; fruit and vegetables with high level of nitrates and pesticides, acids, household products), accounting for 91.3% of cases; inhalation is responsible for 7.1% of the intoxication cases, most of which are caused by carbon dioxide. The 2% of the poisonings occur through skin contact, including parenteral way (Figure 4).

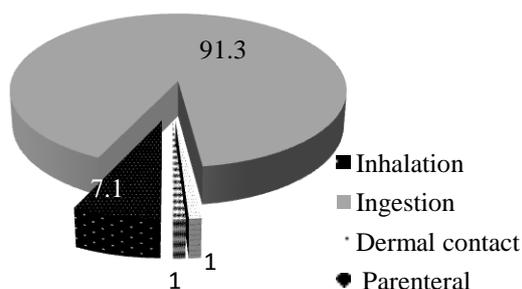


Figure 4. Ways of exposure to chemicals (inhalation, ingestion, dermal contact, parenteral).

Conclusions

According to our study, it was reported about 22458 cases of poisoning, including 919 deaths. The analysis of the recorded cases of chemical poisonings shows that medicines-related and alcohol poisoning are responsible for the highest percentage of poisonings (6971 cases, 31% and 6556 cases, 29.2% respectively), followed by gas poisoning with 1860 cases (8.3%). The fourth most widespread type of poisoning is by pesticides – 707 cases (3.1%).

Analysis of poisonings according to the age and gender shows that the most affected of chemical poisonings is the group of adults (age of 18 and older) with a total number of 9606 people. The second most affected is the group of children aged 3-18 with 3178 cases. During this timeframe, children aged 1-3 accounted for the lowest number of acute poisonings – 1957 cases. Acute chemical poisoning is still a significant public health concern both for children and the adults, due to its high frequency and severity. The monitoring of acute chemical poisonings is one of the weak links of the recordkeeping in the public health system in Republic of Moldova. This has a negative impact on the quality of reporting, the treatment and rehabilitation of the persons poisoned with chemicals.

Preventive recommendations

1. In case of pesticides application, it is necessary to follow the personal hygiene rules by using protection equipment (waterproof clothing, special shoes and gloves, protection glasses, mask or respirator)
2. Checking the heating systems in the dwellings (hobs, biomass and gas boilers, *etc.*) before putting them into operation, in order to clean them from smut, rust or erosions;
3. Securing proper ventilation of the rooms; keeping medicaments away from children, in special medical kits, packed and labelled.
4. The best way to reduce the number and severity of chemical poison exposure is through public awareness and information campaigns.
5. Reducing the attractiveness of chemical product's packing.

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