



## Principal characteristics of patients acutely poisoned by ethanol in the region of Belgrade (Serbia)

### Osnovne karakteristike pacijenata akutno otrovanih etanolom na području Beograda (Srbija)

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#### Abstract

**Background/Aim.** Acute intoxication by ethanol constitutes a significant part of the acute pathology caused by toxic chemicals, which require medical care in specialized health care institutions. The aim of the study was to determine some principal characteristics of the patients treated after acute ethanol poisoning, such as: participation in the total number of patients treated after acute poisoning by all chemical agents, age, sex, severity of poisoning and capacities for ambulatory or hospital treatment. **Methods.** A five-year retrospective case study was conducted on 20,891 acute poisoned patients, of which 10,731 were treated after acute ethanol poisoning during the period 2011–2015. All the subjects satisfied the diagnostic criteria of poisoning according to the World Health Organization International Classification of Diseases-10 and standardized Poison Severity Score scale. **Results.** Monitored parameters were analyzed in 10,731 patients acutely poisoned by ethanol, and their average number during one study year was  $2146.2 \pm 437.95$ . The average number of treated patients due to poisoning by ethanol ( $51.47 \pm 2.86\%$ ) was statistically significantly higher than that of other causes of acute poisoning ( $p < 0.001$ ). The majority of poisoned patients were men, aged 19 to 65 years, with mild to moderate symptoms of acute ethanol intoxication. The highest

number of patients poisoned by ethanol had Poison Severity Score 1 ( $70.25 \pm 5.04\%$ ,  $p < 0.001$ ). Very few acute poisoned with ethanol required hospital treatment (1.05%). Anticipated number of patients acutely poisoned by ethanol had high percentage of increase for the period 2016–2020 (slightly more than 20%), which is worrying, primarily due to their high absolute number. **Conclusion.** Acute alcohol poisoning represents a significant part of the pathology in the total number of patients treated due to acute poisoning with various chemical substances. The results of this analysis showed that certain populations are particularly vulnerable to abuse of alcohol to the level requiring health care (male population, age 19–65 years). Only a small number of patients (1% of all patients treated for acute alcohol poisoning) required clinical treatment. The obtained data provided the basis for a more targeted preventive action in certain population groups, as well as the adequate planning of professional medical staff engagement, material, spatial and other capacities. These data, also, provided the basis for additional detailed social, economic, health and other researches in this area as well as a more detailed registration of this type of poisoning and establishing a monitoring system and database.

#### Key words:

ethanol; poisoning; serbia; demography; risk factors.

#### Apstrakt

**Uvod/Cilj.** Akutno trovanje etanolom čini značajan deo akutne patologije izazvane toksičnim hemikalijama, a koja zahtevaju medicinsko zbrinjavanje u specijalizovanim zdrav-

stvenim ustanovama. Cilj studije bio je da se utvrde osnovne karakteristike pacijenata lečenih zbog akutnog trovanja etanolom, kao što su: prosečna starost, pol, stepen težine trovanja, smrtnost, učešće u ukupnom broju pacijenata zbrinutih zbog akutnog trovanja hemijskim agensima i odnos

ambulantno i bolnički zbrinutih bolesnika. **Metode.** Peto-godišnja retrospektivna studija slučaja je obuhvatila 20891 akutno otrovanog pacijenta u periodu 2011–2015. godina, od čega je 10731 zrinut zbog akutnog trovanja etanolom. Svi pacijenti zadovoljavali su dijagnostičke kriterijume trovanja prema Međunarodnoj klasifikaciji bolesti, 10 revizija, propisanoj od strane Svetske zdravstvene organizacije i Standardizovanoj skali težine trovanja. **Rezultati.** Praćeni parametri analizirani su kod 10731 pacijenta akutno otrovanog etanolom, a njihov prosečan broj u toku jedne studijske godine iznosio je  $2146,2 \pm 437,95$ . Prosečan broj zbrinutih pacijenata zbog akutnog trovanja etanolom ( $51,47 \pm 2,86\%$ ) bio je statistički značajno veći od prosečnog broja zbrinutih zbog akutnih trovanja uzrokovanih drugim agensima ( $p < 0,001$ ). Većina otrovnih pacijenata bile su osobe muškog pola, životne dobi od 19 do 40 godina i 41 do 65 godina, sa blagim do umerenim simptomima akutne intoksikacije etanolom, pri čemu je najviše pacijenata akutno otrovanih etanolom imalo skor težine trovanja 1 ( $70,25 \pm 5,04\%$ ,  $p < 0,001$ ). Veoma mali broj akutno otrovanih etanolom zahtevao je hospitalno lečenje ( $1,05\%$ ). Pretpostavljeni broj pacijenata sa akutnim trovanjem etanolom imao je visok procenat povećanja za razdoblje od 2016. do

2020. godine (nešto više od 20%), što je zabrinjavajuće, prvenstveno zbog njihovog visokog apsolutnog broja. **Zaključak.** Akutno trovanje alkoholom predstavlja značajan deo patologije u ukupnom broju bolesnika koji se leče zbog akutnog trovanja različitim hemijskim materijama. Rezultati ove analize pokazali su da su određene populacione grupe posebno osetljive na zloupotrebu alkohola do nivoa koji zahteva zdravstveno zbrinjavanje (muška populacija, životne dobi od 19 do 65 godina). Samo mali broj (1% svih bolesnika lečenih nakon akutnog trovanja alkoholom) zahteva klinički tretman. Dobijeni podaci pružili su osnovu za ciljano preventivno delovanje u određenim populacionim grupama, kao i odgovarajuće planiranje angažovanja profesionalnog medicinskog osoblja, materijalnih, prostornih i drugih kapaciteta. Takođe, oni predstavljaju i osnovu za dodatna detaljna društvena, ekonomska, zdravstvena i druga istraživanja u ovoj oblasti, kao i detaljniju registraciju ove vrste trovanja i uspostavljanje sistema praćenja, kao i baze podataka.

#### Ključne reči:

**etanol; trovanje alkoholom; srbija; demografija; faktori rizika.**

## Introduction

The development of science, technology and industry leads to the development and production a lot of new chemicals and their broad use creates the possibility for potential acute poisoning, which represents one of the important causes of morbidity and mortality in many countries<sup>1</sup>. According to the available data, around 355,000 persons dies in the world every year as a result of the unintentional poisoning<sup>2</sup>. Causes of poisoning, gender and age structure, severity of poisoning, as well as the outcome of treatment are specific and different among local regions within countries, as well as among countries and regions all over the world<sup>3–11</sup>. More precise data can be obtained only in those countries that have developed health information system and the exact records of illnesses and causes of death. Acute intoxications by chemical substances are very important in terms of the organization of care for emergency cases in Serbia<sup>12–15</sup>. As a part of the emergency pathology, patients requiring medical treatment and observation after acute intoxication caused by different chemical substances participate with about 8% of the total number of treated patients in the Center of the Emergency Care of the Military Medical Academy in Belgrade.

Ethanol, ethyl alcohol or alcohol, is one of the most frequently used substances of abuse all over the world. There are many reasons for that and among the most important ones are: easy availability, low price, certain types of customs, aggressive advertisements, limited legal sanctions, etc. Excessive and frequently use of alcohol often leads to the emergence of alcoholism, as well as many health and social problems<sup>16,17</sup>. About two thirds of adult population in the United States of America (USA) consume alcohol drinks, and about 10% of them in the case-history have excessive

alcohol consumption. A particular area of concern is the fact that a certain number of these acute intoxication has death as a final outcome<sup>18</sup>. According to the World Health Organization (WHO) data around 208 million of people consumed alcohol during the year 2010 that was about 4.10% of all world population aged over 15 years<sup>19,20</sup>. Also, according to the WHO data, Serbia is at a very high, 12th place, with registered 12.6 liters of consumed alcoholic beverages *per capita* during one year in population older than 15 years. Ethanol is very often cause of acute intoxication which requires an urgent care in the health care institutions.

Assessment of the frequency of an acute ethanol intoxication, gender and age of poisoned patients, severity of poisoning, as well as a level of therapeutic measurements are not fully investigated, but they are of great importance for preventive work and capacity planning (material, human resources, spatial and other capacities) necessary for medical treatment.

The aim of this study was to estimate the frequency of ethanol intoxication and to assess the basic characteristics of the patients treated due to acute ethanol poisoning including age, gender, severity of poisoning and modality of treatment. These results may be important for further prospective investigation and adequate preventive intervention in certain age and gender population, as well as for necessary staff and hospital capacities planning.

## Methods

### Study design

This study was done in the National Poison Control Centre (NPCC), Military Medical Academy (MMA), Belgrade, Serbia, which usually provides medical treatment for 4,000 to 4,500 acutely poisoned patients *per year*.

A five-year retrospective study was done in a period from 2011 to 2015. It included the patients admitted to the emergency unit due to suspected poisoning. All poisoning cases were classified according to the WHO's International Classification of Diseases-10 (ICD-10) <sup>21</sup>. The medical records were reviewed for all patients with acute ethanol intoxication (10,731 cases). They were provided with the necessary initial diagnostic procedures at the admission [history, physical examination, electrocardiogram, vital signs, laboratory and toxicological tests, and in some specific situations, with other diagnostic procedures – radiography (X-ray), computed tomography, etc.] and therapy treatments.

In accordance with their age, patients were divided into following groups: the group 1:  $\leq 18$  years; the group 2: 19-40 years; the group 3: 41-65 years; the group 4:  $> 65$  years and the group 5: patients with undetermined age.

#### Poison Severity Score

For determining the severity of the poisoning the standardized Poison Severity Score (PSS) was used: PSS 0 - no symptoms and signs related to poisoning; PSS 1 - mild or spontaneously resolving symptoms; PSS 2 - moderate, pronounced or prolonged symptoms, PSS 3 - severe or life-threatening symptoms and PSS 4 - with lethal outcome <sup>22, 23</sup>.

#### Ethical approval

According to the Medicines and Medical Devices Agency of Serbia on Researches Involving Human Subjects, a retrospective research/patient file research does not fall under the scope of the Ministry of Health of the Republic of Serbia. Therefore, ethical approval by the institutional medical ethical review board (the Ethics Committee of the Military Medical Academy) was not needed.

This research was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. For this type of study, a formal informed consent is not required.

#### Statistical analysis

The complete statistic data processing was performed in the IBM SPSS Statistics 19.0 computer program (IBM,

USA, 2011). All continuous variables were represented in the form of the mean  $\pm$  standard deviations (SD), while the categorical variables were represented with the percentage of certain category frequency. For categorical variables the statistical significance of differences was examined by chi-square ( $\chi^2$ ) test. Ratios between variables were tested by Pearson's correlation coefficient. All the analyses were evaluated at the level of statistical significance of  $p < 0.05$ . Health forecasting, as a novel area of forecasting, is a valuable tool for predicting future health events or situations such as demands for health services and healthcare needs. For purpose of our study, exponential smoothing (dampened trend) method was chosen for number of patient's time series prediction.

#### Results

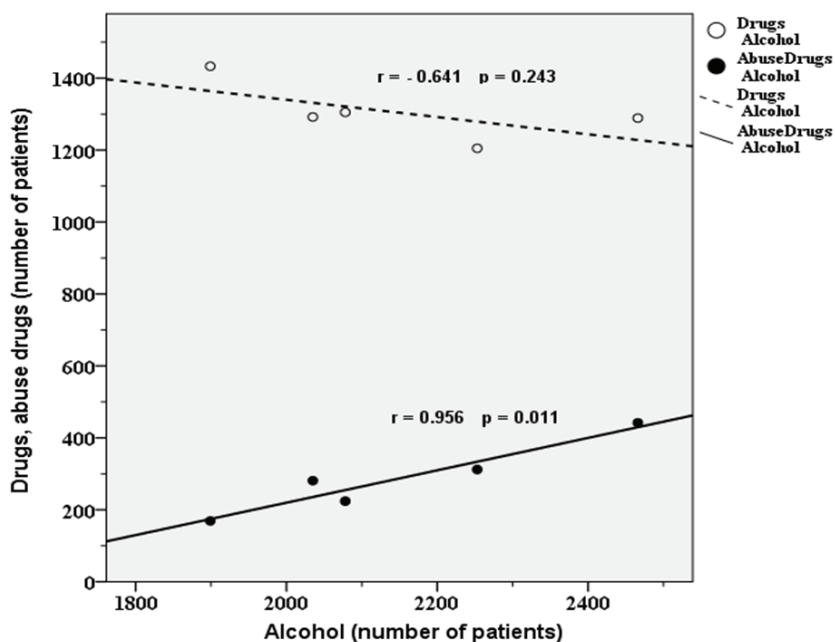
In a period from year 2011 to 2015, 20,891 patients intoxicated by different types of chemical agents were treated (average number per year was  $4,178.8 \pm 606.51$ ) including 10,731 patients treated due to acute ethanol poisoning ( $2,146.2 \pm 437.95$  per year). The share of ethanol intoxicated patients in the total number of patients did not differ significantly over the observed years, the average was  $51.47 \pm 2.86\%$ . Their number was statistically significantly higher ( $p < 0.001$ ) in comparison to the other poisoned patients (Table 1).

The number of patient intoxicated by ethanol significantly positively correlated with the number of patient poisoned by abuse drugs ( $r = 0.956$ ;  $p < 0.05$ ). There was no positive correlation with number of patients poisoned by prescribed drugs ( $r = -0.641$ ; n.s.) (Figure 1).

Generally, the frequency of intoxication was greater in male than in female population due to high prevalence of ethanol poisoning. In the male population, a slight increasing trend of patients who were treated due to intoxication by ethanol, as well as by other agents was evident. The increase in the number of patients treated due to acute alcohol poisoning was higher than the number of patients treated after poisoning with other agents ( $p < 0.001$ ). In the female population, a statistically significant increase of acute ethanol poisonings in comparison with the number of treated patients after poisoning by other chemicals was evident ( $p < 0.001$ ).

**Table 1**  
The total number of patients poisoned by different chemicals in the period from year 2011 to 2015

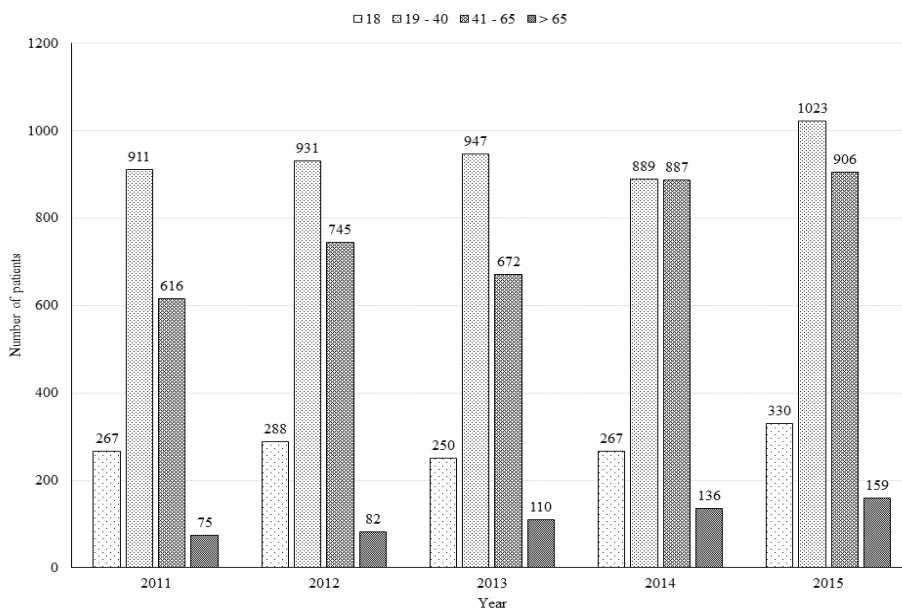
Agents	Number of patients <i>per year</i>					Total/average number
	2011	2012	2013	2014	2015	2011–2015
Alcohol	1,899	2,078	2,035	2,253	2,466	10,731/2,146.20
Drugs	1,433	1,305	1,292	1,205	1,289	6,524/1,304.80
Substances of abuse	169	224	281	312	442	1,428/285.60
Gas/Vapors	120	144	173	176	189	802/160.40
Corrosives	59	82	83	120	97	441/88.2
Pesticides	58	97	81	89	62	387/77.40
Fungi/Plants	21	57	53	64	32	227/45.40
Other	73	76	76	64	62	351/70.20
<b>Total</b>	<b>3,832</b>	<b>4,063</b>	<b>4,074</b>	<b>4,283</b>	<b>4,639</b>	<b>20,891/4,178.80</b>



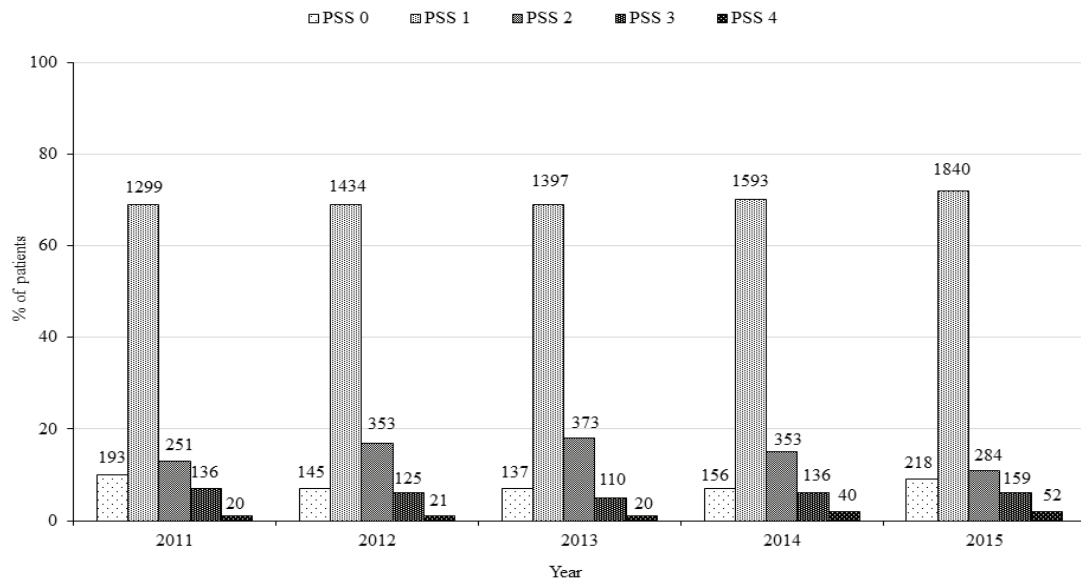
**Fig. 1 – Correlation of the total number of patients poisoned by alcohol and drugs, or drugs of abuse in the period from year 2011 to 2015.**

Most of patients intoxicated by ethanol were aged from 19 to 40 years, and their number was significantly higher in comparison with other age groups of poisoned patients ( $p < 0.001$ ). The total number of the patients poisoned by ethanol was significantly lower in the following groups: the group  $\leq 18$  years ( $13.08 \pm 1.94\%$ ), the group  $> 65$  years ( $5.16 \pm 2.32\%$ ) and the group of unknown age ( $2.49 \pm 1.76\%$ ). Figure 2 shows a reduction in the number of ethanol intoxicated patients aged from 19 to 40 years during 2014, and then, in 2015, their significant growth. In the group of patients aged from 41 to 65 years, the reduction of the number of poisonings in 2013 year was registered, while in

2014 and 2015 a significant increase in the number of patients poisoned by ethanol was observed. In the group of patients poisoned by other chemicals, the average number of treated patients was as follows: in the group of  $\leq 18$  years  $10.12 \pm 1.80\%$ , in the group of 19–40 years  $47.43 \pm 3.93\%$ , in the group of 41–65 years  $34.04 \pm 3.02\%$ , in the group of more than 65 years  $6.81 \pm 0.81\%$  and in the group in which the age was not precisely determined  $1.61 \pm 1.01\%$ . Comparison of age distribution between patients acutely intoxicated by ethanol and those acutely intoxicated by other chemicals, revealed a statistically significant difference ( $p < 0.001$ ) only between groups of patients aged 41 to 65 years during 2014 and 2015 year.



**Fig. 2 – Annual age distribution of patients poisoned by ethanol in the period from year 2011 to 2015.**



Numbers above columns represent absolute number of patients regarding PSS.

**Fig. 3 – Distribution of ethanol poisonings by the Poison Severity Score (PSS).**

**Table 2**

**Predicting number of patients (five year period) regarding causal agents**

Agents	Forecast number <i>per</i> year (LCL-UCL)				
	2016	2017	2018	2019	2020
Alcohol	2,532 (2,038-3,027)	2,663 (2,159-3,167)	2,794 (2,281-3,307)	2,925 (2,402-3,447)	3,056 (2,524-3,587)
Drugs	1,197 (811-1,583)	1,158 (759-1,558)	1,120 (707-1,532)	1,081 (656-1,506)	1,043 (606-1,480)
Substances of abuse	473 (301-645)	537 (361-712)	600 (421-779)	663 (480-846)	727 (540-913)
Gas/Vapors	210 (155-265)	227 (160-285)	244 (183-305)	260 (197-324)	277 (211-344)
Corrosives	121 (25-217)	133 (33-232)	144 (41-247)	155 (49-262)	166 (57-276)
Pesticides	77 (0-191)	76 (0-192)	76 (0-194)	76 (0-196)	76 (0-199)
Fungi/Plants	44 (0-166)	44 (0-168)	44 (0-170)	44 (0-172)	44 (0-174)
Other	61 (34-87)	57 (30-84)	54 (27-81)	50 (23-78)	47 (20-74)

**Forecast – predicting number of patients; LCL – lower confidence limit; UCL – upper confidence limit.**

Analysis of the severity of poisoning by ethanol showed that the highest number of patients had PSS 1 ( $70.25 \pm 5.04\%$ ,  $p < 0.001$ ), while the rest of the severity of poisoning were represented in the significantly lower percentages: PSS 0 –  $13.00 \pm 2.07\%$ , PSS 2 –  $14.71 \pm 4.57\%$ , PSS 3 –  $6.03 \pm 5.48\%$  and PSS 4 –  $0.02 \pm 0.07\%$ . In  $1.39 \pm 1.25\%$  of the patients the severity of poisoning was not registered (Figure 3).

The average number of patients hospitalized due to acute ethanol intoxication (after initial treatment in the Emergency room) was  $1.05 \pm 0.62\%$  and it was significantly lower in comparison with poisoning by all other groups of agents ( $p < 0.001$ ). During the entire period observed, a significant increase in the trend of hospitalized patients after acute ethanol poisoning was registered in 2014. Of the total number of hospitalization *per* year due to acute poisoning, ethanol one was the reason in only  $0.35 \pm 0.17\%$  of patients ( $p < 0.001$ ).

The number of patients treated for acute ethanol poisoning showed the trend of increasing, so that at the end of the observation period it was higher than the number of patients poisoned by all other chemicals. With intention to predict future poisoning trends and healthcare needs, exponential smoothing (dampened trend) method was used. Table 2 shows the predicted number of poisonings by the type of causal agents. The largest increase was registered in the category of poisoning by substances of abuse, followed by ethanol. The minimal growth trend was registered in the categories of corrosives and vapours, while in other categories declining trend was registered.

Graphical presentation of registered cases of poisoning by categories (for the period from 2011 to 2015), as well as the projected trends for the same categories of agents (for the period from 2016 to 2020) are shown in Figure 4.

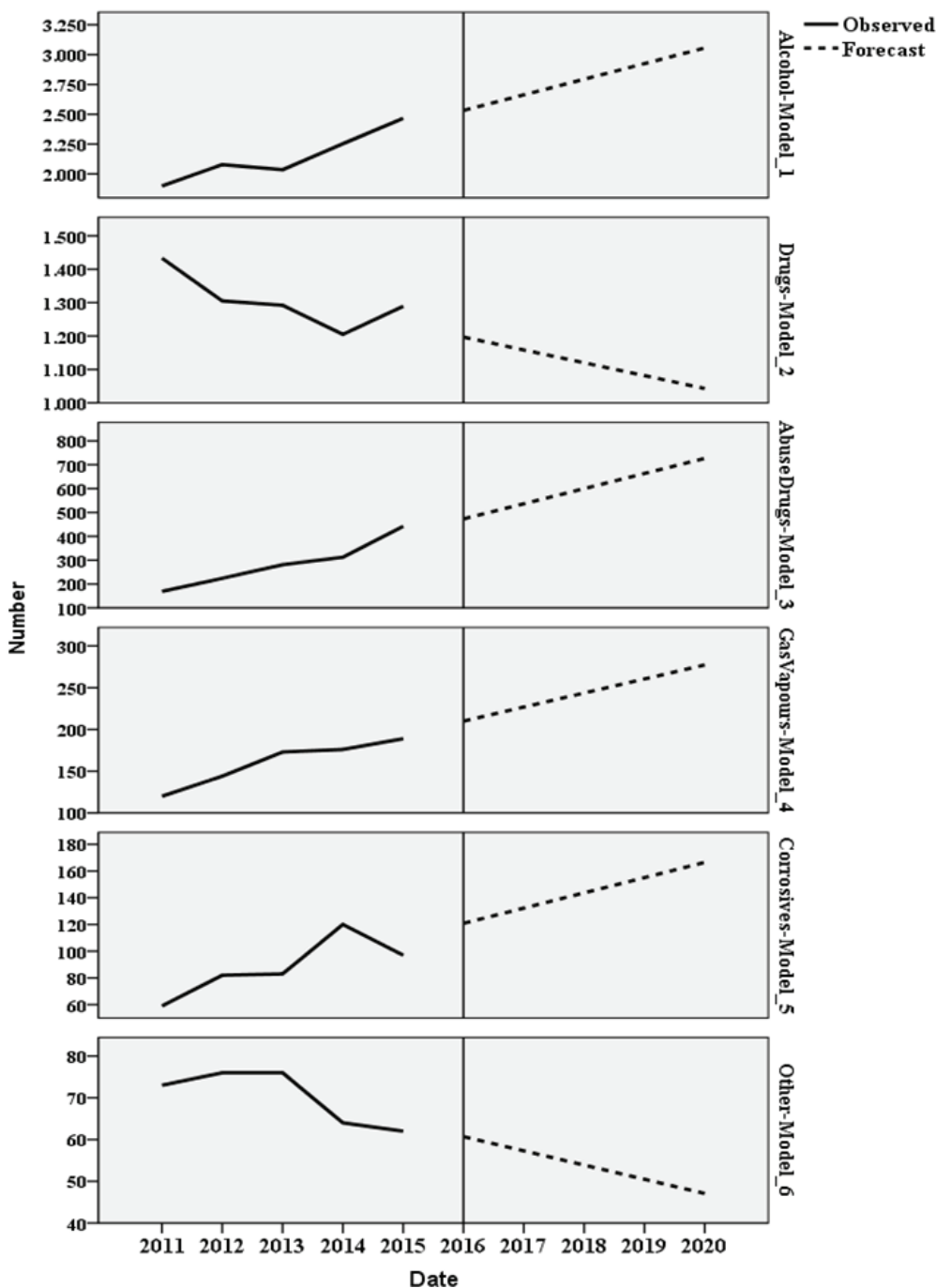


Fig. 4 – Graphic presentation of historical data (2011–2015) and forecasting (2016–2020) (agents without increasing or decreasing trend are excluded).

## Discussion

Ethanol is the most common psychoactive substance used by adolescents and adults in Serbia<sup>24–26</sup> and is one of the most commonly abused substances in the world<sup>27</sup>. Excessive and uncontrolled consumption of ethanol greatly increases the risk of trauma, especially trauma due to motor vehicle collisions or violent crimes. Excessive consumption of ethanol results in serious health and social consequences such as acute drunkenness, chronic alcoholism and dependence

with all its consequences. Alcohol causes 1.8 million deaths (3.2% of total) and a loss of 58.3 million (4% of total) of Disability-Adjusted Life Years (DALY)<sup>2</sup>. Unintentional injuries alone account for about one third of 1.8 million deaths, while neuro-psychiatric conditions account for close to 40% of 58.3 million DALYs. The burden is not equally distributed among countries. In Europe alone, alcohol consumption was responsible for many deaths among young people<sup>28</sup>.

In a study of Meropol et al.<sup>29</sup>, in which relationship between alcohol abuse injuries in a population of adolescents

treated in the emergency department was investigated, the highest percentage of positive ethanol test results was registered in a group of 295 young patients treated at an urban trauma center (15% of total subjects, and 22% of subjects aged 17–21 had positive ethanol test).

Also, in the Clinic for Emergency Assistance in Oslo (Oslo study) 2,343 adult patients have been treated after overdose by substances of abuse during one-year period, and 55.10% (1,291) of these patients were treated due to acute ethanol poisoning<sup>30</sup>. In our study, the average number of treated patients after acute ethanol poisoning in comparison to the total number of all treated patients after acute poisonings was 51.47%. In the Oslo study<sup>30</sup>, more than 89.00% of all patients were treated after excessive consumption of ethanol, drugs, as well as substances of abuse. In our study, share of patients with acute intoxication by drugs, substances of abuse and ethanol was almost equal - 89.43%. Comparing the total numbers of poisoning from the Oslo study with those treated in our centre, and taking into account the number of Oslo inhabitants of 900,000 and Belgrade of about 1,660,000, the incidence was almost the same - 0.26% and 0.25%, respectively.

By comparing gender representation in both studies, the results are as follows: in our study the relationship between the male and female patients treated for acute ethanol poisoning was 77.40%: 22.60%, respectively, and in the Oslo study it was 68.29%:31.71%, respectively<sup>30</sup>. We can conclude that sex representation is also very similar in both studies - the male subjects are more often treated for acute ethanol poisoning.

The Oslo study used different criteria for classification by age. Patients were divided into three groups: the group I ≤ 25 years, the group II 26–50 years and the group III > 50 years. In this study over than 52% of treated patients were in the group of 26–50 years<sup>30</sup>. In our study, the highest number of treated patients after acute ethanol poisonings was observed in the age groups from 19 to 40 years (44.03%) and from 41 to 65 years (35.47%). In both studies is evident that these patients belonged to a working population. It specifically indicates the possible socio-economic implications and the need for more active prevention work in these population groups.

The severity of poisoning was assessed by the different criteria: Glasgow coma scale in the Oslo study and PSS in our study. Both studies showed that most of the treated patients did not had severe clinical signs of poisoning. The first study showed that most of treated patients (85.19%) were in the group with Glasgow coma scale of 10–15. Our study showed that in a population acutely poisoned by ethanol 77.43% of patients were in the group with PSS score ≤ 1. Due to the different criteria which define scores used, it was difficult to perform accurate comparison, but it is

evident that in both studies the proportion of patients with mild to moderate level of poisoning severity was high.

In accordance with severity of poisoning, only 1.05% of our patients intoxicated by ethanol, after initial treatment in the Emergency department required additional hospital treatment. At the same time, this group of patients was only 0.35% ± 0.17% of all poisoned and treated patients in the observed period. This data is very important for the planning of adequate spatial capacities primarily in an emergency service, as well as the planning and scheduling of staff engagement.

Another important planning factor is estimated number of patients in the future. Our forecast for the period 2016–2020 indicates the highest increase of poisoning by substances of abuse (about 40%). However, predicted increase of slightly more than 20% for acute ethanol intoxicants, may represent the greatest burden for emergency due to high absolute number of patients.

### Conclusion

Acute alcohol poisoning represents a significant part of the pathology in the total number of patients treated for acute poisoning by various chemical substances. The results of this study showed that certain populations are particularly vulnerable to abuse of alcohol to the level requiring health care (male population, aged 19–65 years). Most of patients had mild signs and symptoms of poisoning and required only supportive and symptomatic treatment in the emergency room.

The presented data provide the basis for a more targeted preventive action in certain population groups, as well as the adequate planning of professional medical staff, material, spatial and other capacities. Given the potential impact of excessive alcohol consumption on the national health, along with the monitoring of chronic alcohol abuse, more detailed data on acute ethanol intoxication should be obtained. Enhancement of the monitoring system and database should enable the dissemination of data and information on trends in alcohol consumption, actual epidemiological situation regarding alcohol drinking, including alcohol-related mortality and possible details of health policy responses.

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