

**Original article**

**Epidemiological characteristics of acute intestinal infection outbreaks in Ukraine under the current conditions**

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**Abstract:**

**Objective:** determination of epidemiological peculiarities of acute intestinal infections outbreak incidence in Ukraine for the period 2014-2017. **Materials and methods:** Applying descriptive and analytical techniques of an epidemiological research method and statistical methods, using materials of the official statutory records of the Ministry of Health of Ukraine, the nature of acute intestinal infection outbreaks by etiology, transmission routes and affected cohort groups was investigated. **Result and discussion:** At the current stage AII outbreaks are registered every year and throughout Ukraine. Herewith, their specific gravity in total diarrheal infection incidence, excluding shigellosis and salmonellosis, is insignificant. Outbreak incidence levels in the industrial and tourist centres of Ukraine exceed similar rates in other regions by several times. Salmonellosis dominates in the nosological structure of outbreak incidence. The majority of outbreaks is transmitted by food. Most of diarrheal infection outbreaks are connected with catering facilities and children's pre-school institutions, as well as with visiting festive occasions arranged at home. A rise in outbreak incidence is observed from May till September. Rotaviral enteritis outbreaks are more frequently registered in January through March. **Conclusion:** The detected peculiarities of acute intestinal infection outbreak incidence shall be considered when developing regional programs of epidemiological surveillance over diarrheal infections.

**Keywords:** diarrheal infection; outbreak incidence; nosological structure.

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**Introduction:**

In Ukraine for many years the relevance of acute intestinal infections (AII) has not been decreasing<sup>1</sup>. According to statutory records of the Ministry of Health of Ukraine, annual morbidity rates of diarrheal infections come second only to acute respiratory diseases<sup>2</sup>. AII epidemiology is characterized by irregularity in territorial distribution, opportunistic pathogen (OP) and virus dominance in the etiological structure. A significant part of AII remains etiologically undeciphered<sup>3,4,5</sup>.

High incidence is encouraged by the social factors of urbanization, population movement, animal breeding and poultry production intensification and changes of traditions in food culture<sup>6</sup>. The epidemiological situation is complicated by the fact that around 100 AII outbreaks, whereof causes are not always established, are registered every year<sup>7</sup>.

**Objective of the paper:** determination of epidemiological peculiarities of AII outbreak incidences in Ukraine for the period 2014-2017.

**Materials and methods:** Applying descriptive

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and analytical techniques of an epidemiological research method, and statistical methods, while using materials of the official statutory records of the Ministry of Health of Ukraine, the nature of AII outbreaks by etiology, transmission routes and affected cohort groups was investigated. For intensity estimation of outbreaks of various etiology among different population groups, a nidus index, the average number of cases of the corresponding AII nosological entity per outbreak, was calculated. The necessary calculations and analysis were carried out using Microsoft Office Excel.

**Ethical approval:** The study was approved by Ministry of Health of Ukraine

**Results of the work:** For 2014-2017 434 AII outbreaks were registered across the population of Ukraine, of which  $43.6 \pm 2.4\%$  were of salmonella etiology,  $22.6 \pm 2.0\%$  of AII were caused by OP,  $20.0 \pm 1.9\%$  by rotavirus etiology,  $12.4 \pm 1.6\%$  of AII were of unknown etiology,  $0.9 \pm 0.5\%$  (or 5 outbreaks) by shigellosis and  $0.5 \pm 0.3\%$  (or 2 outbreaks) by typhoid fever (Figure 1).

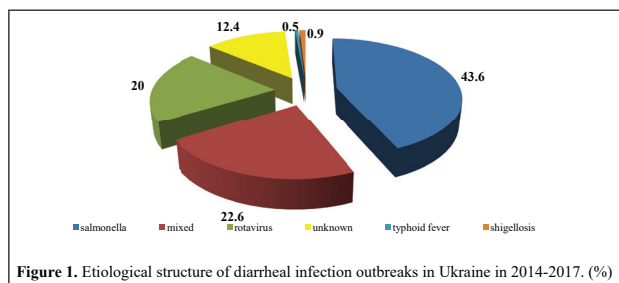


Figure 1. Etiological structure of diarrheal infection outbreaks in Ukraine in 2014-2017. (%)

Hence, at the present time in Ukraine Salmonella is the major cause of diarrheal infection outbreaks, except that *S. enteritidis*, *S. muenchen*, *S. blegdam*, *S. typhimurium*, *S. glostrup* were isolated. Total 6896 persons were involved in outbreak incidences, wherein  $42.9 \pm 0.6\%$  were patients with salmonellosis,  $36.2 \pm 0.6\%$  of AII were caused by OP, patients with rotaviral enteritis –  $11.8 \pm 0.4\%$ , AII of unknown etiology –  $8.4 \pm 0.3\%$ , patients with shigellosis –  $0.6 \pm 0.09\%$ , and  $0.1 \pm 0.04\%$  had typhoid fever. The Nidus index revealed the highest for AII of determined etiology was (25.4), while the lowest was for typhoid fever (3.5).

Diarrheal infection outbreaks were registered for the whole territory of Ukraine. Territorial distribution of outbreak incidence was irregular. The most unfavourable situations arose in Kyiv and in the Kyivoblast, where 44 (of which 40.9 % were in Kyiv) AII outbreaks were registered, representing 10.1 % of all outbreaks and exceeded the rates of most regions of Ukraine by more than three times. Besides,

high outbreak incidence rates were determined for industrial and tourist regions, in particular for Lviv (7.6 %), Odesa (6.5 %) and Kharkiv (6.2 %), which have the developed public catering enterprise network.

Concerning the nosological structure of diarrheal infection outbreaks, we have determined some peculiarities. Salmonellosis outbreaks most often were registered in Lviv (11.1 % of the total outbreak number) and in the Kyiv and Kharkiv oblasts (correspondingly, 16.0 % and 8.5 % each). Rotaviral enteritis outbreaks most often arose in Cherkasy (11.5 %), Chernihiv (9.2 %), Donetsk (6.9 %), Zaporizhzhia (6.9 %) and Dnipropetrovsk (6.2 %) oblasts, regions either where the largest rivers of Ukraine, Dnipro and Desna, flow or else are washed by the Black or Azov Seas.

Regardless of the fact that a great number of AII outbreaks is registered every year, it has been established that total diarrheal infection incidence rates in Ukraine are determined by sporadic morbidity, as in general, specific gravity of persons involved in outbreak incidence turned to be insignificant and was in total  $1.4 \pm 0.02\%$ .

Herewith, it should be noted that a proportion of various nosological entities differed significantly. The specific gravity of those suffering effects from typhoid fever foci was  $46.7 \pm 12.9\%$ , from salmonellosis –  $8.8 \pm 0.2\%$ , from rotaviral enteritis –  $1.4 \pm 0.05\%$ , from shigellosis –  $0.99 \pm 0.3\%$ , from AII caused by OP –  $1.1 \pm 0.02\%$  and from AII of unknown etiology –  $0.33 \pm 0.01\%$ .

Hence, the outbreak of salmonellosis incidences had the greatest impact on diarrheal infection morbidity levels. Moreover, according to the data of statutory records, in 2016 the proportion of persons suffering from foci increased by 1.8 as compared to 2014. There were registered cases of typhoid fever being imported from endemic territories. For example, in 2016 all four persons affected by typhoid fever came from the Islamic Republic of Pakistan.

According to the published results of researches performed in Ukraine, diarrheal infection incidence rates of children exceed adult incidence rates<sup>8,9</sup>. The proportion of children suffering from diarrheal infection foci was rather significant and varied depending on the nosological entity. The specific gravity of children among the total quantity of those affected by shigellosis was  $47.5 \pm 0.8\%$ , by rotaviral enteritis –  $46.6 \pm 0.2\%$ , by AII caused by OP – 39.7 % 0.1 %, by AII of unknown etiology –  $26.9 \pm 0.1\%$  and by salmonellosis –  $19.5 \pm 0.2\%$ .

More than half ( $55.8\pm 2.9\%$ ) of diarrheal infection outbreaks in Ukraine were traced to food intake,  $23.5\pm 2.5\%$  resulted from contact and household transmission,  $1.8\pm 0.8\%$  were due to contaminated water, and  $18.9\pm 2.3\%$  were from unknown cases (Figure 2).

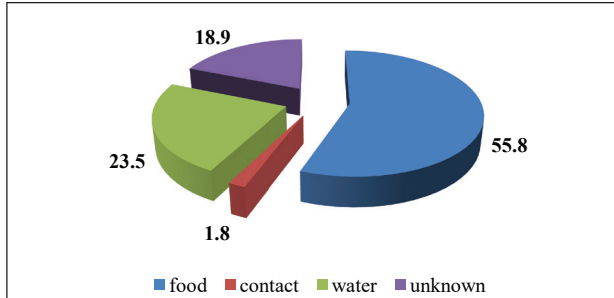


Figure 2. Structure of outbreak incidence transmission routes (%)

The prevailing transmission route for salmonellosis was food, while for rotaviral enteritis it was by contact and home. The food route dominated in the AII foci caused by OP. We failed to determine transmission routes for the majority of AII of unknown etiology

**Table 1: Outbreak distribution by etiology and transmission routes**

Etiology	Transmission routes			
	Food	water	home	unknown
Typhoid fever	-	-		100
Shigelloses	-	-	50.0±35.4	50.0±35.4
Salmonellosis	92.6±2.1*	-	0.7±0.5*	6.7±2.1*
Rotaviral enteritis	-	3.8±2.6*	81.1±5.4*	15.1±4.9*
AII caused by OP	40.3±6.2	4.9±2.7	29.0±5.8	25.8±5.6
AII of unknown etiology	3.7±3.6*	-	22.2±7.9*	74.1±8.4*

Note \* -  $p < 0.05$

The majority of food outbreaks was connected with violations of cooking technology and of expiry dates for food products. The main cause of illness was mentioned by those affected as consumption of foods “doubtful” in quality, consisting of eggs and meat. While investigating salmonellosis outbreaks, employees of the State Sanitary and Epidemiological Service discovered that food outlets in most cases lacked documents certifying food origin, quality and safety; storage and transportation conditions were violated, regular laboratory control of finished products was not carried out, and terms for taking regular medical examinations by employees were

not observed. The major reason for AII outbreaks due to contaminated water was emergency situations at water supply facilities. For example, in January 2015 in Kyiv, due to an accident at a water pipeline, an AII outbreak arose, wherein one hundred and fifty five persons were affected. Rotavirus and OP in etiologically significant doses were isolated from the faces of those affected. A sample of home AII outbreak is registered in four cases of Flexner dysentery among children of boarding school. Ignorance of personal hygiene rules on the part of children, unsatisfactory sanitary and hygienic conditions of the institution premises encouraged the spread of Shigella. While investigating a rotaviral enteritis outbreak in a nursery, wherein nine babies became ill because of two rotavirus carrier children, violations of operation practices were discovered. Studying official data, it was determined that most frequently AII outbreaks arose in public catering facilities, in children’s pre-school institutions, and at home when hosting events, such as weddings, commemoration meetings, etc. (Table 2).

**Table 2: Outbreak distribution by place of occurrence**

Place of occurrence	Specific gravity of outbreaks (%)	Specific gravity of injured (%)	Nidus index
Children’s pre-school institutions	22.8±2.5	12.6±0.5	9.2
Secondary schools	7.1±1.5	3.9±0.3	9.3
Higher educational establishment of various accreditation levels	1.7±0.8	1.6±0.2	15.6
Recreation institutions for adults	0.4±0.4	0.5±0.1	22.0
Recreation institutions for children	3.7±1.1	3.1±0.3	13.9
Public catering facilities	38.1±2.8	40.9±0.7	17.9
Enterprises	2.0±0.8	1.3±0.2	10.7
Healthcare facilities	0.7±0.5	0.5±0.1	7.5
Home focus	23.5±2.5	35.6±0.7	25.3
Total	100	100	16.7

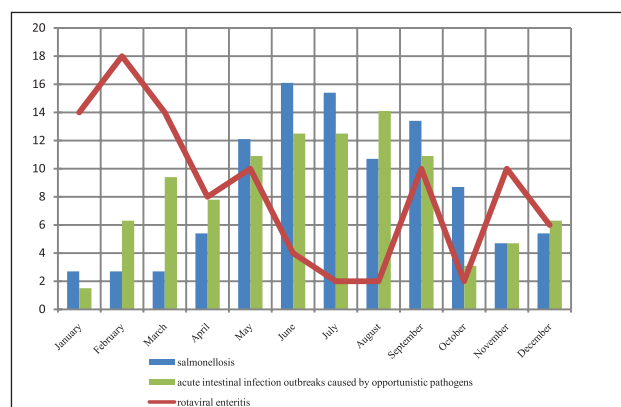
40.0% of those affected were persons visiting cafes, restaurants, pizzerias, etc. Outbreak intensity was the most expressed in home foci, wherein the nidus

index was 25.3. The least outbreak intensity was in healthcare institutions (nidus index was 7.5).

During the period under observation, a considerable increase in the number of establishment profiles, wherein diarrheal infection outbreaks were registered, indicates probable weakening in the system of sanitary and epidemiological control over them in general and where violations of sanitary legislation are found.

Diarrheal infection outbreaks were registered during the year, but their distribution was unequal. A rise in outbreak incidence was reported from May to September inclusively. In May 10.5% of all appeared outbreaks was registered, while in June – 12.2 %, in July – 12.6 %, in August – 10.5 %, and in September – 13.9 %.

Registration frequency of outbreak cases of salmonellosis and AII caused by OP was growing with an increase in air temperature and exceeded average monthly rates in May, (correspondingly – 12.1 and 10.9 %), June (correspondingly – 16.1 and 12.5 %), July (correspondingly – 15.4 and 12.5 %), August (correspondingly – 10.7 and 14.1 %), September (correspondingly – 13.4 and 10.9 %) (Figure 3).



**Figure 3** Seasonal distribution of salmonellosis, acute intestinal infection outbreaks caused by opportunistic pathogens

Rotaviral enteritis outbreaks were more frequently registered in the cold season (January – 14.0 %, February – 18.0 %, March – 14.0 %). Average annual rates were also exceeded in May, September and November (10.0 %). A majority of AII outbreaks of unknown etiology was registered in July-September (each third ( $29.6 \pm 8.8$  %) – in September, each fifth ( $18.5 \pm 7.5$  %) – in July and August).

### **Discussions:**

At the current stage AII outbreaks are registered every year and throughout Ukraine. Herewith, their specific gravity in total diarrheal infection incidence, excluding shigellosis and salmonellosis, is insignificant. Outbreak incidence levels in the industrial and tourist centres of Ukraine exceed similar rates in other regions by several times. Salmonellosis dominate in the nosological structure of outbreak incidence. The majority of outbreaks is transmitted by food. Most diarrheal infection outbreaks are connected with catering facilities and children's pre-school institutions, as well as with visiting, festive occasions arranged at home. A rise in outbreak incidence is observed from May till September. Rotaviral enteritis outbreaks are more frequently registered in January through March.

**Conclusion:** The detected peculiarities of AII outbreak incidence shall be considered, when developing regional programs of epidemiological surveillance over diarrheal infections.

### **Competing interests**

The authors declare that they no competing interests

**Conflict of interest:** None

### **Authors' contributions**

N.M. was responsible for final approval of the article, analysis and interpretation of the data. N.M., M.C. and S.D. were involved in the writing of the manuscript. N.M., S.D. and R.R. participated in the writing and editing of the manuscript. All authors read and approved the final manuscript.

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