

## TREND OF METHEMOGLOBINEMIA CASES IN EASTERN ROMANIA

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**Abstract.** The results of an epidemiological descriptive study based on the cases reported by the Districtual Public Health Departments are presented. The incidence of methemoglobinemia rates in 0-1 years aged infants varied between 1.5 ‰ and 7.0 ‰ during 1996-2000 in eastern Romania territory. An increasing trend of cases was also found and the results outlined that the highest frequencies appeared in the infant's early life (three months). The analyses of well water samples indicated both chemical (especially by nitrogenous substances) and bacteriological contamination, the frequencies of improper samples varying between 45.8% and 65.9 %. Thus, the high risk areas in Moldova territory were defined and scaled on risk level.

**Key words:** infants, methemoglobinemia cases, nitrites, nitrates in water, descriptive epidemiology

**Rezumat.** Sunt prezentate rezultatele unui studiu epidemiologic descriptiv pe baza incidentelor raportate de Direcțiile de Sănătate Publică din Moldova (România). Incidența cazurilor de methemoglobinemie la copiii 0-1 an a variat între 1,5 ‰ și 7,0 ‰ în perioada 1996-2000 în zona de est României. S-a constatat, de asemenea, o tendință crescătoare a cazurilor, rezultatele evidențiind faptul că cele mai ridicate frecvențe s-au calculat pentru copiii în vârstă de până la trei luni. Analiza probelor de apă din fântâni a indicat atât o contaminare chimică (în special cu substanțe azotate) cât și bacteriologică, frecvențele probelor necorespunzătoare variind între 45,8% și 65,9%. Rezultatele au permis stabilirea și ierarhizarea zonelor cu risc crescut din teritoriul Moldovei (România).

**Cuvinte cheie:** copii 0-1 an, intoxicații acute cu nitrați, nitriți, nitrați în apă, studiu epidemiologic descriptiv

### INTRODUCTION

The drinking water of local systems – wells in rural areas – can be contaminated by nitrites-nitrates of different sources (1,2). The high household density, the precarious hygienic conditions regarding the well sitting and maintenance, the use of natural and nitrogenous fertilizers frequently in Moldova rural territories, generate frequent and intense drinking water pollutions by high nitrate

concentrations (3). Thus, during 1974-1975, 150 well water samples were investigated in Bacău county, the nitrate levels being found over 45 mg/L (maximum allowable concentration – MAC) in 73% of samples (4). In Iași county, 8-16% of well water samples investigated during 1983-1990 and 35-55% of a total of 640 samples investigated in 54 villages during 1994-1995 showed nitrate concentrations over MAC (4).

Recent results suggest that high risk areas could be defined throughout eastern territory (5).

As consequence, the 0-1 year aged infants formula fed are at the high risk to develop methemoglobinemia (5,6).

The aim of present study was to investigate the chronological and geographical distribution of methemoglobinemia cases related to the nitrate concentration in well drinking water.

#### METHODOLOGY

The methemoglobinemia cases found in the last five years (1996-2000) in the whole Moldavian territory have

been recorded. The most of them were hospitalised due to severe symptoms.

The chronological, geographical and individual criteria were used for each case and the relationship to drinking water quality was established (7,8,9).

#### RESULTS AND DISCUSSION

Our previous results indicated a high frequency of nitrate pollution of water wells of 45 to 96%, as table 1 data shows. 945 cases of methemoglobinemia occurred in the seven counties in eastern Romania during 1996 – 2000, with a mean incidence rate of 3.26 ‰ with territorial variations between 1.5‰ and 7 ‰ (table 2).

**Table 1. Frequency of water samples with nitrate concentration over MAC in rural territorial collectivities in Moldova (% of total samples analyzed)**

County	No. of investigated localities	Period of study	No. of water samples	Frequency of samples over MAC
Botoșani	118	1989-1998	1363	95.97
	2	1999	105	78.1
Bacău	9	1996-1997	274	64.3
Vrancea	2	1997-1998	74	44.6
Galați	1	2000	144	76.4
Iași	5	2000	159	79.2

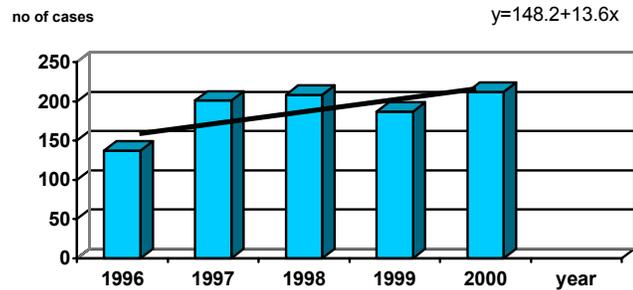
**Table 2. The annual incidence rate of methemoglobinemia cases of 0-1 year aged infants in Moldova for the 1996 – 2000 period**

County	Year					Total cases	Annual incidence rate p.1000 of 0-1 year aged infants
	1996	1997	1998	1999	2000		
	no of cases						
Iași	65	101	72	55	82	375	7.0
Vaslui	-	-	1	3	18	22	3.3
Bacău	19	18	19	45	43	144	3.9
Neamț	10	15	12	9	8	54	1.6
Galați	9	14	40	32	12	107	2.9
Vrancea	6	11	6	2	10	35	1.5
Botoșani	28	42	58	41	39	208	6.7
Total	137	201	208	187	212	945	
p.1000	2.24	3.29	3.40	3.06	3.46		3.26

## TREND OF METHEMOGLOBINEMIA CASES IN EASTERN ROMANIA

An increasing trend of methemoglobinemia cases in Moldova territory for the last

five years was found (figure 1).



**Fig. 1. The trend of methemoglobinemia cases in Moldova territory during 1996 – 2000**

The analysis of the trend in the seven counties revealed differences between them. Thus, slowly but surely increasing trends were found in Bacau, Galati and Iasi counties; suddenly increasing trend in Vaslui and Botosani counties, a decreasing trend in Neamt county whereas, in Vrancea county the trend had a lower and almost constant level (figure 2).

The following features characterized the 212 cases diagnosed during the 2000 y (figures 3-7):

- over 9/10 of them occurred in 0-3 months aged infants (figure 3);
- more than half of cases were boys (figure 4);
- more than a half of cases have had mild symptoms (figure 5);
- the most of cases were healed but two death were recorded (figure 6);
- the acute diaphorrea was associated in about fourth of cases;

- more than three fourths of infants were formula or breast and formula – feeding (figure 7).

As known, the main cause of those effects can be the increased nitrate level in drinking water. For this reason, the chemical and bacteriological analyses of well water samples were made, especially the measurement of nitrogenous substances (nitrites, nitrates).

The results showed that the cases were associated with an improper quality of well water. The frequency of improper water samples was as follows:

- frequencies between 6.6 % of water samples with chloride levels over MAC and 56.3 % of water samples having increased hardness,
- 45.8 – 65.9 % of water samples were bacteriologically improper (table 3).

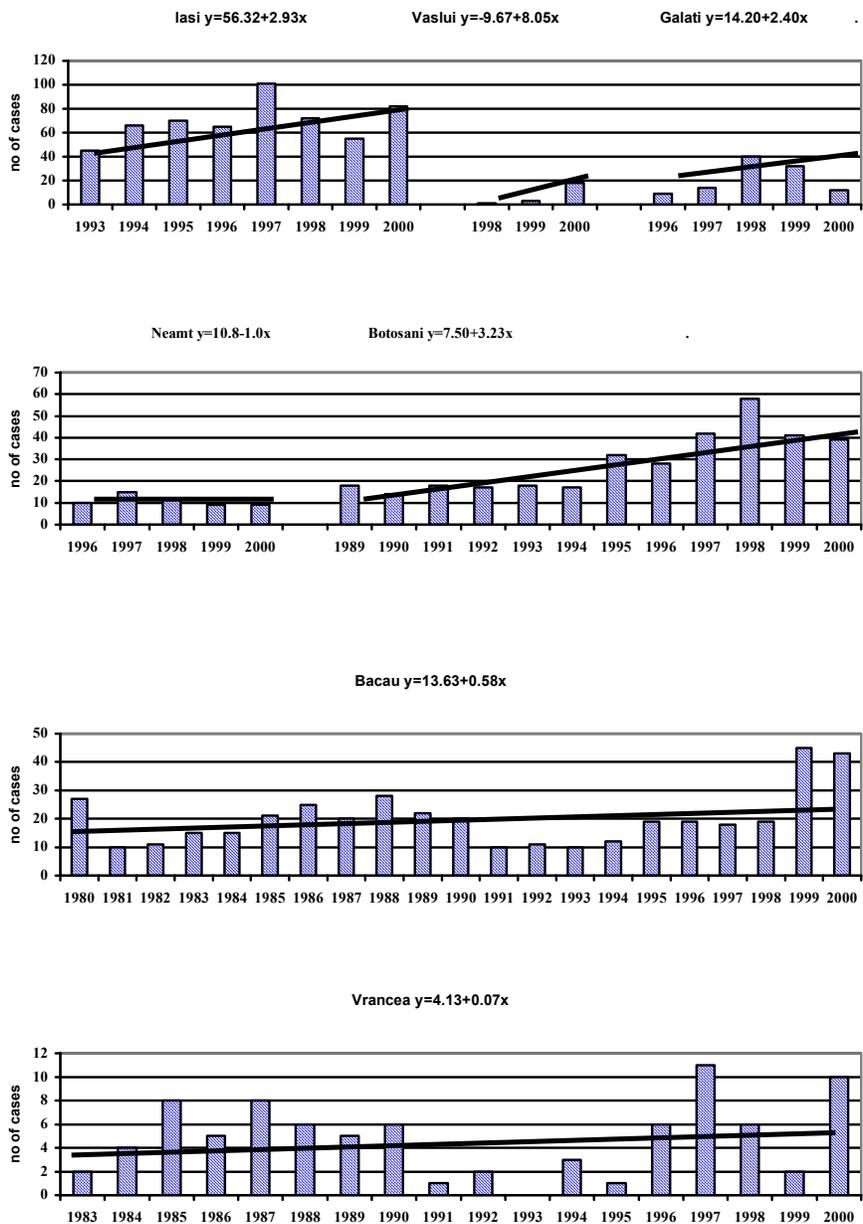


Fig. 2. The trend of cases in the different counties

TREND OF METHEMOGLOBINEMIA CASES IN EASTERN ROMANIA

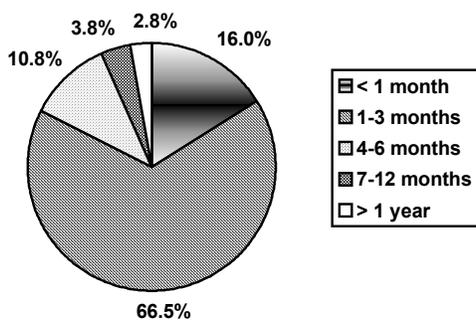


Fig. 3 Age distribution of methemoglobinemia cases

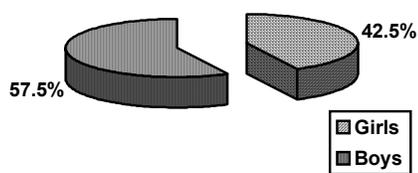


Fig. 4 Sex distribution of methemoglobinemia cases

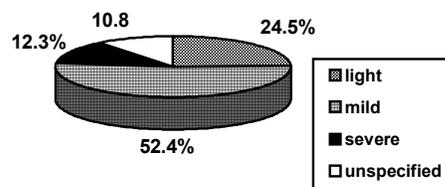


Fig. 5 Distribution of cases on clinical symptoms

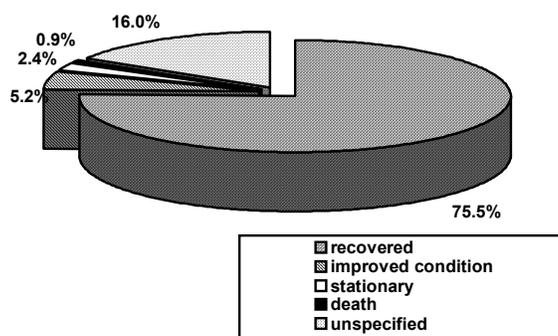


Fig. 6 Patient's condition at hospital discharge

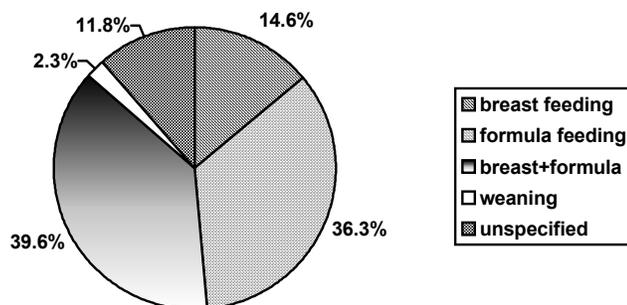


Fig. 7 The type feeding frequency

Table 3. Frequency of improper water samples (chemical and bacteriological indicators)

Chemical indicator	Improper samples (p.100 samples analyzed)	Bacteriological indicator	Improper samples (p.100 samples analyzed)
Organic matter	26.9	total germs number	45.8
Ammonia	29.9	total coliform counts	58.7
Hardness	56.3	faecal coliform counts	65.9
Chlorides	6.6		

As for the contamination by nitrogenous substances of samples, there were found:

- 29.7 % of water samples with nitrite concentrations over 0.03 mg/L (MAC)

- 88.6 % of water samples with nitrate concentrations over 45 mg/l (MAC)

The geographical distribution of methemoglobinemia cases related with water nitrate concentrations is shown in table 4.

Table 4. Geographical case distribution on nitrates levels in well water samples (number of cases and percent of total cases)

County	Nitrate concentration in water samples (mg/L)					Unspecified
	≤ 45	46-100	101-150	151-200	≥200	
Iași	3	40	13	9	12 (243)	5
Vaslui	-	-	-	-	-	18
Bacău	7	2	13	3	3 (389)	15
Neamț	-	-	-	-	-	8
Vrancea	1	-	-	-	5 (540)	4
Galați	5	1	-	-	4 (1324)	2
Botoșani	2	3	10	5	17 (783)	2
Total	18	46	36	17	41	54
p.100 analyzed samples	11.4	29.1	22.8	10.8	25.9	25.5

( ) the maximum values of nitrate levels

## TREND OF METHEMOGLOBINEMIA CASES IN EASTERN ROMANIA

Excepting a quarter of cases which cannot be investigated about the quality of consumed water, it results that almost 60 % of diagnosed cases occurred due to infants exposure to nitrate concentration over 100 mg/L; the maximum concentration was found in Galati county (over 1.300 mg nitrates/liter of water).

The counties of Moldova are at different risk levels related to the high case number and to the more or less increasing trends.

The results also showed that the counties of Moldova maintained the same risk levels during 1996-2000 as those established in a previous national study (10) (table 5).

**Table 5. Distribution of Moldova counties on methemoglobinemia cases during 1996-2000 versus 1991-1993 period**

Area	1991 - 1993	1996 - 2000
Areas without information (F)	Suceava, Neamț	Suceava
Areas without risk (E)	-	-
Areas with incidence rate < 1‰ (D)	Vrancea	Vaslui
Areas with incidence rate of 1-5 ‰ (C)	Bacău, Vaslui, Galați	Bacău, Neamț, Galați, Vrancea
Areas with incidence rate of 6-10 ‰ (B)	Iași	Iași, Botoșani
Areas with incidence rate + 10 ‰ (A)	Botoșani	-

The results of this study were useful for an hierarchy of the territories at risk within every county, based upon the annual incidence rate of cases. The data of Iasi county are presented as an example in this respect (figure 8).

### CONCLUSIONS

1. The high incidence rates of methemoglobinemia cases had an increasing trend in the most part of territory. The highest number of cases appeared during the first three months of life in formula or

mixed-fed infants, more frequently in boys.

2. The most cases have had a favorable clinical evolution, only two deaths being recorded.
3. The analyses of well waters indicated both a chemical contamination especially by nitrogenous substances (nitrate levels over 100 mg/L) and a bacteriological one.
4. High risk areas in Moldova territory were defined and scaled on risk level.

**Fig. 8 Iasi county localities with different methemoglobinemia risk levels**

## TREND OF METHEMOGLOBINEMIA CASES IN EASTERN ROMANIA

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