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ANALYSIS OF ACCUTE INTESTINAL INFECTIONS MORBIDITY BY INTERGRAL INDICATOR IN THE REPUBLIC OF SAKHA (YAKUTIA)

Summary. The paper presents data of complex epidemiological analysis of acute intestinal infections in the Republic of Sakha (Yakutia) for the period from 2002 to 2011.

Keywords: acute intestinal infections, dysentery, morbidity, the epidemiological situation, the integral indicator.

Introduction. Infections of fecal-oral transmission hold a significant position among inflectional pathologies. With Russia annually witnessing 600-700 thousand people catching acute intestinal infections (AII), their number in the past decade (2002-2011) totaled to over six million people. The negative impact of these infections is even greater due to the fact that the infections hit primarily children, making up to 60% of the patients; and they also result in hundred-million-ruble-worth economic damage. The situation with acute intestinal infections is especially severe on the territory of the Siberian and Far-Eastern regions, regarded as the territories with a risk of the fecal-oral transmission occurrence [1, 4, 6, 7].

The recent years have also seen global transformation of the AII morbidity structure and changes in some epidemiological peculiarities of certain groups of acute intestinal infections. For example, the territories with established laboratory diagnostics of the rotavirus infection have seen transfer of the diseases which used to be registered as acute intestinal infections of **unknown** etiology (AIIUE) to the group of acute intestinal infections of **known** etiology (AIIKE). At the same time we must remember that the AII occurrence is extremely uneven, that is to say that there are territories with different incidence and the epidemiological situation, from region to region, can change from favorable to very unfavorable.

Given the above, **the present paper aims** at analyzing the epidemiological situation with acute intestinal infections on the territory of the Republic of Sakha (Yakutia).

Materials and Methods. We have analyzed the multiyear morbidity of shigellosis, AIIKE, AIIUE, as well as such integral indicator as total AII (shigellosis + AIIKE + AIIUE) for the past ten years (2002 – 2011).

The morbidity data was processed statistically with the use of common parametrical and non-parametrical statistical criteria with preliminary testing of the dynamic rows for normalcy of distribution [3, 4]. We also used integral epidemiological indicators. The algorithm of their calculation is called the method of “occupied cells sum” [2, 8, 9], which selects the list of territories and indicators for comparison. Each of the indicators is ranged (from minimum to maximum) for a certain period of time, then they are summed up giving the integral indicator (II) as a sum of a certain indicator or object cells.

At the final stage of the method, the illustrative coefficient (Ki in %) is calculated with the following formula:

$$Ki = \left(1 - \frac{Sx - Sp}{Sx - Sy} \right) \times 100$$

where S_x- the worst sum of cells; S_p- the sum of cells for a certain object; S_y- the best sum of cells. The worst sum of cells (S_x) is determined by the formula: $S_x = x \times n_1$, where x – is the number of members from the dynamic row selected fro ranging; n_1 – is the number of indicators selected for analysis. The best sum of cells (S_y) corresponds to the number of indicators selected for analysis or the number of the years of monitoring.

Results and discussion. Table 1 illustrates main indicators of the multiyear dynamics of acute intestinal infection morbidity in the Republic of Sakha (Yakutia) (RS(Y) and the Russian Federation (RF).

Table 1

Indicators of the multiyear dynamics of acute intestinal infection morbidity in 2002 – 2010

Types of AII	Territory	$\overline{M}$	±m	Criterion t	Regression equation (У=ax+b)**	Rate of increase
Shigellosis	Russian Federation	29.7	4.6	115.2 P < 0.01	-5.5x + 60.0	-24.1
	Republic of Sakha (Yakutia)	↑*56.3	17.2		-12.2x + 123.5	-38.7
AIIKE	Russian Federation	113.0	6.6	127.2 P < 0.01	7.6x + 71.1	8.4
	Republic of Sakha (Yakutia)	↓*78.6	10.7		5.8x + 46.8	9.3
AIIUE	Russian Federation	324.5	10.6	18.9 P < 0.01	9.6x + 271.7	3.3
	Republic of Sakha (Yakutia)	↓*315.7	28.4		14.4x + 236.7	5.4
Total AII	Russian Federation	467.2	14.6	33.4 P < 0.01	11.71x + 402.8	2.9
	Republic of Sakha (Yakutia)	↓*450.5	37.6		7.9x + 407.0	2.0

Notes: *↑ lower, ↓ higher in comparison with the RF data;
** У=ax+b, where У – a theoretical indicator of a dynamic row, a – a regression coefficient, x – an index number of a dynamic row, b – the starting level of a dynamic row.

The comparative analysis of the data shows that out of all kinds of the inflectional pathology for the studied period, the shigellosis morbidity statistically significantly (p<0.01) exceeded the all-Russian level. For all the other compared kinds of inflectional pathologies, the inflectional morbidity in Yakutia was considerably lower than in the RF. At the same time, analyzing the long-term dynamics of morbidity one may conclude that the only AII kind that showed any significant (p<0.01) reducing pattern is bacterial dysentery, both in the Russian Federation and in Yakutia. And this trend was more obvious in the republic than in the entire RF, which is proven by the presented regression equations and rates of growth, describing the process of decrease in shigellosis morbidity for both the territories (see Table 1).

Over this long period, the rest of the inflectional pathology forms (AIIKE, AIIUE and total AII) showed a considerable trend for growth, both in the entire Russian Federation and Yakutia, in particular.

Analyzing the average multiyear morbidity rate for the studied AII forms by their errors, one may conclude that the long-term dynamics of the inflectional pathology epidemic process in the

Republic of Sakha (Yakutia) is characterized by greater instability than the RF data, which is seen in the relation between the minimum and maximum figures in the studied morbidity dynamic rows:

Shigellosis	RF – 1 to 5.2;	RS(Y) – 1 to 9.8;
AIIKE	RF – 1 to 1.7;	RS(Y) – 1 to 4.4;
AIIUE	RF – 1 to 1.4;	PC (Я) – 1 to 2.3;
Total AII	RF – 1 to 1.3;	RS(Y) – 1 to 2.1.

The study of the morbidity structure ∑AII showed that in general, for the monitored period, it is as follows: shigellosis accounted for 12.6 ± 2.8 %, AIIKE 17.4 ± 1.6 % and AIIUE 70.0 ± 3.2 %. At the same time, the structure of the studied inflectional pathology forms considerably changed over the past 10 years. For example, while in 2002 shigellosis accounted for 30.1% in ∑AII, in 2011 this parameter fell to 3.7%; the share of AIIKE increased from 13.1 % to 27.2 %; AIIUE – from 56.7 to 69.1%, respectively for the same years. This change in the morbidity structure results, first of all, from extremely intensive decrease in bacterial dysentery morbidity rate (see Table 1).

Therefore, we have established that the epidemiological situation in the Sakha Republic (Yakutia) is more serious than in the Russian Federation.

Next we studied in detail epidemiological peculiarities of intestinal infections in children and adults in the RS(Y). We found out that the largest share falls on children under 14 years, making 69.6 ± 1.1%; with the children population share ranging from 61.3 % to 76.8 %.

For the monitored period (2002-2011), both in adults and children, the dominant acute intestinal infections were those of the unknown etiology, making 77.8 ± 1.6% and 66.5 ± 2.3 % , respectively. The average multiyear figure of AIIUE morbidity exceeded the one for AIIKE in adults by 10.1 times and for dysentery by 2.5 times, and in children – by 3.1 and 5.9 times, respectively ($p<0.01$). In the long term, the statistically significant increase in occurrence of acute intestinal infections of unknown and known etiology was found in children only ($p<0.01$, $p=0.05$). At the same time, both in children and adults there was a significant decrease in shigellosis morbidity ($p<0.05$), with this process being more intense in adults than in children (Table 2).

The studied period showed some changes in the structure of the studied inflectional pathology forms. For example, in 2002 shigellosis in the age group under 14 years accounted for 18.1% in ∑AII, and in 2011 this figure dropped to 2.4 %; AIIKE share increased from 10.7 % to 25.8 %; and AIIUE share – from 32.5 % to 44.7 %, respectively for the same years. In adults, shigellosis share in ∑AII decreased from 12.1 % in 2002 to 1.3 % in 2011; whereas the share of AII of known and unknown etiology did not change significantly.

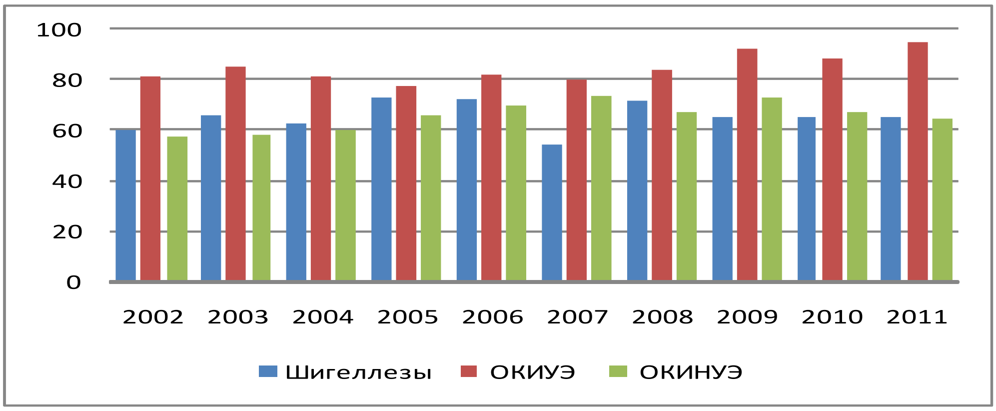
Table 2

Multiyear dynamics of acute intestinal infections morbidity in different age groups in the Republic of Sakha (Yakutia) for the period 2002 – 2010

Inflectional pathology	Age group	$\overline{M}$	±m	Share (%)	Regression equation (У=ax+b)*	Rate of increase	Trend
Shigellosis	children	154.1	43.1	64.6	-31.8x + 323.7	-36.2	P < 0.5
	adults	26.1	9.5	35.4	-6.3x + 60.9	-168.8	P < 0.5
AIIKE	children	300.3	50.6	86.5	33.7x + 114.8	16.4	P = 0.5
	adults	13.8	1.1	13.5	-0.8x + 18.0	-6.3	P >0.5
AIIUE	children	915.4	99.7	65.9	73.1x + 513.9	10.3	P < 0.1
	adults	139.6	9.6	34.1	0.6x + 136.0	0.5	P >0.5
Total AII	children	1369.8	139.5	69.3	77.8x+941.8	6.9	P >0.5
	adults	179.5	19.9	30.7	-6.449+214.9	-3.9	P >0.5

Notes:* У=ax+b, where У – a theoretical indicator of a dynamic row, a – a regression coefficient, x – an index number of a dynamic row, b – the starting level of a dynamic row.

The lowest shigellosis morbidity rate in RS(Y) adults was 6.8 $^0/_{0000}$ (2007), the highest – 99.3 $^0/_{0000}$ (2002). In children under 14 years, over the studied period, dysentery morbidity rate decreased by 7.8 times, with the lowest figure registered also in 2007 (26.9 $^0/_{0000}$), and the highest – in 2002 (445.4 $^0/_{0000}$). The share of children under 14 years in shigellosis morbidity, over the studied period, was 64.6 ± 1.9% (Fig. 1).



Shigellosis AIIKE AIIUE

Figure 1. Share of children under 14 years in AIIKE, AIIUE and shigellosis patients in the Republic of Sakha (Yakutia) (%).

Over the monitored period, the rate of AIIKE morbidity in children increased by 2.3 times, reaching the maximum in 2011 (606.7 $^0/_{0000}$). In adults, the figures decreased from 20.0 $^0/_{0000}$ in 2002 to 8.9 $^0/_{0000}$ in 2011; however, this trend failed to show any statistically significant values (p>0.05). The shares of children under 14 years in AIIKE morbidity structure for the studied period was above 77.7 %, and, on average, made 86.5 ± 1.8 % (See Fig. 2).

The morbidity rate for intestinal infections of unknown etiology in adults ranged widely from 107.5$^0/_{0000}$ (2006) to 206.5 $^0/_{0000}$ (2010). In children under 14 years, AIIUE morbidity for the period 2002-2011 increased by 1.3 times ($p<0.01$), reaching its maximum in 2010– 1521.9 $^0/_{0000}$. The adult population did not follow this pattern ($p>0.05$). The major share in AIIUE patients for the studied period fell on children under 14 years (65.9 ± 1.7 %) (See Fig. 1).

Analyzing the morbidity rate for the AII total, we note that while this figure increased in children, the adult population demonstrated the trend for decrease, which, however, failed to be statistically significant ($p>0.05$).

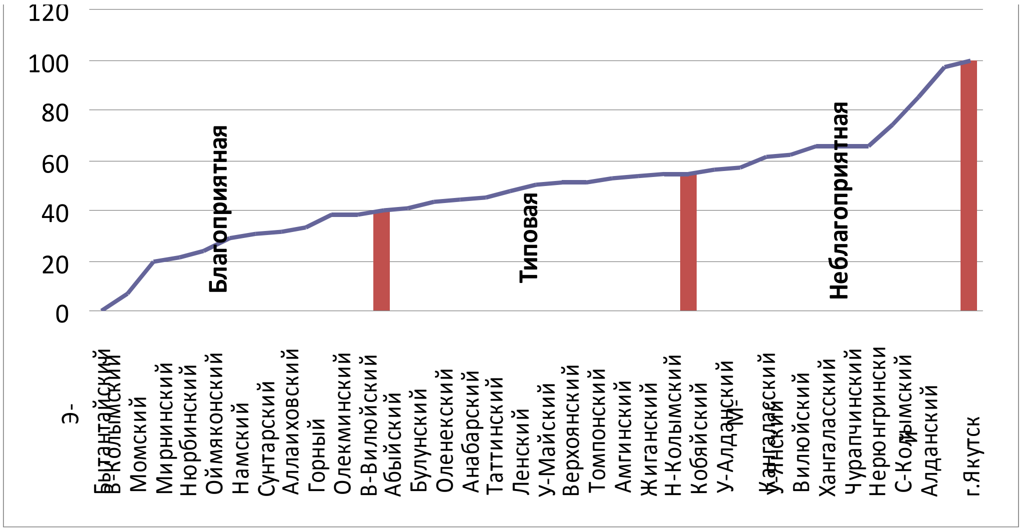
The next stage in our research was the comprehensive analysis of the epidemiological situation with acute intestinal infections in regions of the Republic of Sakha (Yakutia). Here we used the method of integral analysis “by the occupied cells sum”.

The analysis covered morbidity rates for shigellosis, AIIKE and AIIUE in adults and children under 14 years in ten years (2002 – 2011) for each administrative unit of the republic. For calculation of the integral indicators, we analyzed all the 35 administrative units.

The analysis done makes it possible to divide the republic into three categories of the epidemiological situation, namely:

14. favorable;
15. typical;
16. unfavorable;

Then, the AII epidemiological situation in the regions of the RS(Y) in adults and children is as follows (Figures.2, 3).

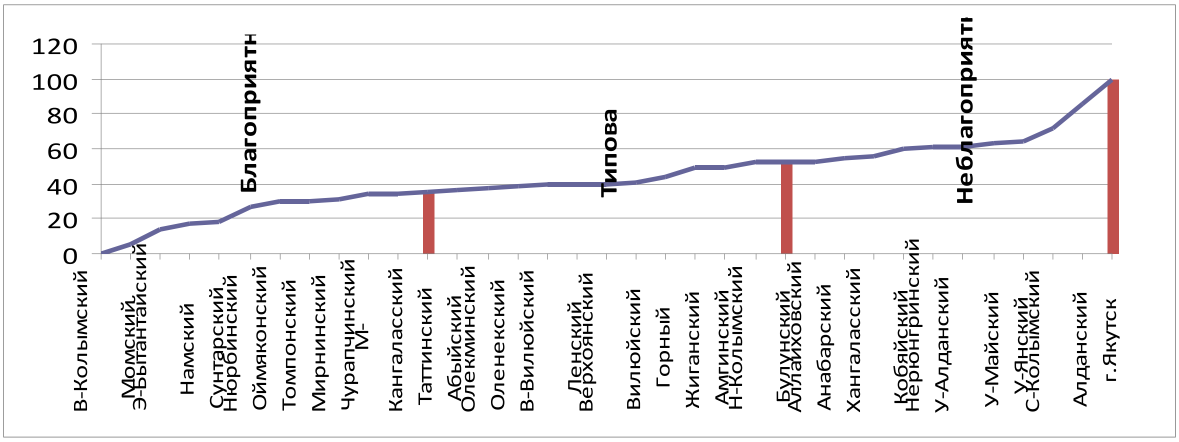


E-Bytantaisky
V-Kolymsky
Momsky
Mirninsky
Nyurbinsky
Oimyakonsky
Namsky
Suntarsky
Allaikhovsky
Gorny
Olyokminsky
V-Vilyuisky
Abyisky
Bulunsky
Olenyoksky
Anabarsky
Tattinsky
Lensky
U-Maisky
Vekhoyansky
Tomponsky
Amginsky
Zhigansky
N-Kolymsky
Kobyaisky
U-Aldansky
M-Kangalassky
U-Yansky
Vilyuisky
Khangalassky

Churapchinsky
Neryungrinsky
S-Kolymsky
Aldansky
Yakutsk City

Figure 2. Epidemiological situation with AII in adults for regions of the Republic of Sakha (Yakutia), given integral indicators (II).

The analysis of the epidemiological situation data with the use of integral indicators enabled detection of the territories with the worst situation with acute intestinal infections. Out of 35 regions of the republic of Sakha (Yakutia), 11 regions have an epidemiological situation which is considered unfavorable. In both the adult and children population, the worst epidemiological situation is observed in Aldansky and S-Kolymsky regions, and the city of Yakutsk, being the largest city of the republic. The most favorable situation is observed in V-Kolymsky, Momsky and E-Bytantaisky regions, both in adult and children.



V-Kolymsky
Momsky
E-Bytantaisky
Namsky
Suntarsky
Nyurbinsky
Oimyakonsky
Tomponsky
Mirninsky
Churapchinsky
M-Kangalassky
Tattinsky
Abyisky
Olyokminsky
Olenyoksky

V-Vilyuisky
Lensky
Vekhoyansky
Vilyuisky
Gorny
Zhigansky
Amginsky
N-Kolymsky
Bulunsky
Allaikhovsky
Anabarsky
Khangalassky
Kobyaisky
Neryungrinsky
U-Aldansky
U-Maisky
U-Yansky
S-Kolymsky
Aldansky
Yakutsk City

Figure 3. Epidemiological situation with AII in children for regions of the Republic of Sakha (Yakutia), given integral indicators (II).

Conclusion. Therefore, the analysis of AII morbidity in population of the Republic of Sakha (Yakutia) showed that over the period from 2002 to 2011, along with significant decrease in shigellosis morbidity, there was increase in AII of known and unknown etiology, which is in line with the all-Russian trend. Shigellosis morbidity in the Republic of Sakha (Yakutia) was registered at a statistically higher level compared to the similar data for the Russian Federation. Children under 14 years made the largest share of the patients, under the dominance of acute intestinal infections of unknown etiology. Dysentery morbidity tended to decrease, both in children and adult population. In children population, there was a trend for increase in acute intestinal infections morbidity, both of unknown and known etiology.

In addition, we detected the AKI risk territories in adults and children in the Republic of Sakha (Yakutia). It was established that the city of Yakutsk is a zone of epidemiological problems.

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