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THE MEDIC-STATISTICAL CHARACTERISTIC INCIDENCE OF PNEUMONIA IN THE UDMURT REPUBLIC

Abstract

Community-acquired pneumonia (CAP) is an urgent problem of modern medicine due to its high prevalence, severe course, the increasing resistance to antibacterial therapy, a large number of complications, and high mortality. Udmurt Republic is one of the leaders in respiratory diseases incidence, including CAP, among other regions of the Russian Federation. It is therefore necessary to analyse and predict CAP incidence for further improving the health care. **The objective** of the study was to analyse respiratory disease incidence and mortality in the Udmurt Republic over a period of 2009–2016. **Materials and methods.** A retrospective and prospective clinical and epidemiological study on the prevalence and primary incidence of respiratory diseases among the adult population of the Udmurt Republic (UR) living in 4 cities (Izhevsk, Sarapul, Glazov, Votkinsk) and 25 rural areas for the 8-year period (2009–2016) was conducted. The analysis is carried out based on the data from state statistical accounts and records of the Budgetary Healthcare Institution of the Udmurt Republic Republican Medical Information and Analytical Center of the Ministry of Health of the Udmurt Republic. **The results of the study.** The prevalence of respiratory diseases in the Udmurt Republic was $49,871.39 \pm 1.33$ per 100,000 people. Mean growth rate was 2.3%, and mean increment rate was 0.25%. Compared to the data for the same period in Russia, mean growth rate was 1.7%, and mean increment rate was 5.48%, which indicates a slight decrease in the incidence. In the analysis of the structure of respiratory diseases incidence in the population of the Udmurt Republic it was found that this rate has not changed significantly throughout the follow-up period. At the same time, pneumonia and chronic obstructive pulmonary disease (COPD) dominate every year. Assessing the rate of the primary respiratory diseases incidence, it is noted that mean growth rate in the UR is 105.42%, the mean increment rate is 5.42%, compared to the mean growth rate (87.07%) and mean increment rate (12.93%) in the Russian Federation. **The conclusion.** Thus, in the UR, as in the entire Russian Federation, there is a consistently high pneumonia incidence. At the same time, there is a tendency to higher incidence and mortality caused by this pathology. This circumstance requires further study of the problem of pneumonia, including the improvement of methods for its medical treatment.

Key words: *respiratory diseases, community-acquired pneumonia, the Udmurt Republic, medic-statistical characteristic of incidence rate*

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CAP — community-acquired pneumonia, UR — the Udmurt Republic, COPD — chronic obstructive pulmonary disease

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Respiratory diseases dominate in the structure of the overall incidence and mortality worldwide [1, 4, 5, 14]. Among them, community-acquired pneumonia (CAP) is an urgent problem of modern pulmonology. Despite the great progress made in understanding the etiology, pathogenesis and treatment of this pathology, there is an increase in the number of patients worldwide, and, consequently, mortality [4, 6]. Thus, the average annual incidence of community-acquired pneumonia among adults in recent years in Europe was 1.07–1.2 per 1,000 inhabitants per year, and in older age groups it was 14 per 1,000 person-years [10]. Primary incidence rates in the CIS generally indicate a significant increase in the incidence of respiratory diseases [8]. In 2015, the primary incidence of respiratory diseases in Russia increased by 1.3%, amounting to 338 cases per 1,000 people [7]. Thus, the level of incidence and mortality from CAP remains at a consistently high level, thereby giving the prerequisites for development and methods of improving the treatment of this disease.

Study Objective

Analysis of incidence and mortality rate from respiratory diseases in the Udmurt Republic over a period of 2009–2016.

Materials and Methods

A retrospective and prospective clinical and epidemiological study on the prevalence and primary incidence of respiratory diseases among the adult population of the Udmurt Republic (UR) living in 4 cities (Izhevsk, Sarapul, Glazov, Votkinsk) and 25 rural areas for the 8-year period (2009–2016) was conducted. The analysis is carried out based on the data from state statistical accounts and records of the Budgetary Healthcare Institution of the Udmurt Republic Republican Medical Information and Analytical Center of the Ministry of Health of the Udmurt Republic.

A special epidemiological map was developed on paper to collect information. The source of information was in-patient medical records (003/y form), the register of patients and refusals for hospitalization (001/y form). The following nosological forms of pneumonia in accordance with

ICD-10 were taken into account: J12.0 — Viral pneumonia; J18.0 — Bronchopneumonia, unspecified organism; J18.1 — Lobar pneumonia, unspecified; J18.2 — Hypostatic pneumonia, unspecified organism; J18.8 — Other pneumonia, unspecified organism; J18.9 — Pneumonia, unspecified organism.

After collecting the actual material, the incidence and prevalence of respiratory diseases, including pneumonia, were calculated. The incidence rates were calculated for 100,000 people per year.

The calculation of the incidence rate was carried out according to the formula:

$$Y = n \times 105 / N, \text{ where}$$

Y is incidence or prevalence (per 100,000 people of the corresponding age) per year;
 n is the number of detected cases per year;
 N is the mean annual population of the study age group.

The prognosis of the incidence for the next five years using the method of exponential smoothing was carried out by the following formula to identify patterns of respiratory diseases at the present stage and to identify risk factors:

$$U_{t+1} = \alpha \times y_t + (1 - \alpha) \times U_t, \text{ where}$$

U_{t+1} is the incidence rate in the prognosis period;
 α is the smoothing parameter;
 y_t is the incidence rate preceding the projected parameter;
 U_t is the incidence rate calculated as an exponentially weighted mean (for the period preceding the predicted one).

Statistical analysis was performed according to the methods used in biomedical statistics [2, 3]. Study results are presented in international SI units and subjected to statistical processing using STATISTICA 6.0 and BioStat 2008 software packages.

Results

The prevalence of respiratory diseases in the Udmurt Republic was $49,874.39 \pm 1.33$ per 100,000 people. At the same time, these parameters tended to

decrease from 2009 to 2014 and increased from 2015 compared to 2009 by 1.01%. Mean growth rate was 2.3%, and mean increment rate was 0.25%. Compared to the data for the same period in Russia, mean growth rate was 1.7%, and mean increment rate was 5.48%, which indicates a slight decrease in the incidence (Figure 1).

A comparative analysis of the overall respiratory diseases incidence between cities and districts of the UR showed that the incidence in urban population was significantly higher ($p > 0.05$) compared to the same parameter in rural areas, which may be due to higher contagiousness within this group (Figure 2).

In the analysis of the structure of respiratory diseases incidence in the population of the Udmurt Republic it was found that this rate has not changed significantly throughout the follow-up period. At the same time, pneumonia and chronic obstructive pulmonary disease (COPD) dominate every year. In 2015 pneumonia (47.43%) was ranked first among respiratory diseases, followed by chronic bronchitis (17.73%), and COPD (15.2%) (Figure 3).

Among patients diagnosed with moderate CAP, chest X-ray examination revealed predominantly bisegmented nature of lung tissue lesions in 45.3%, segmented nature of the lesion was observed

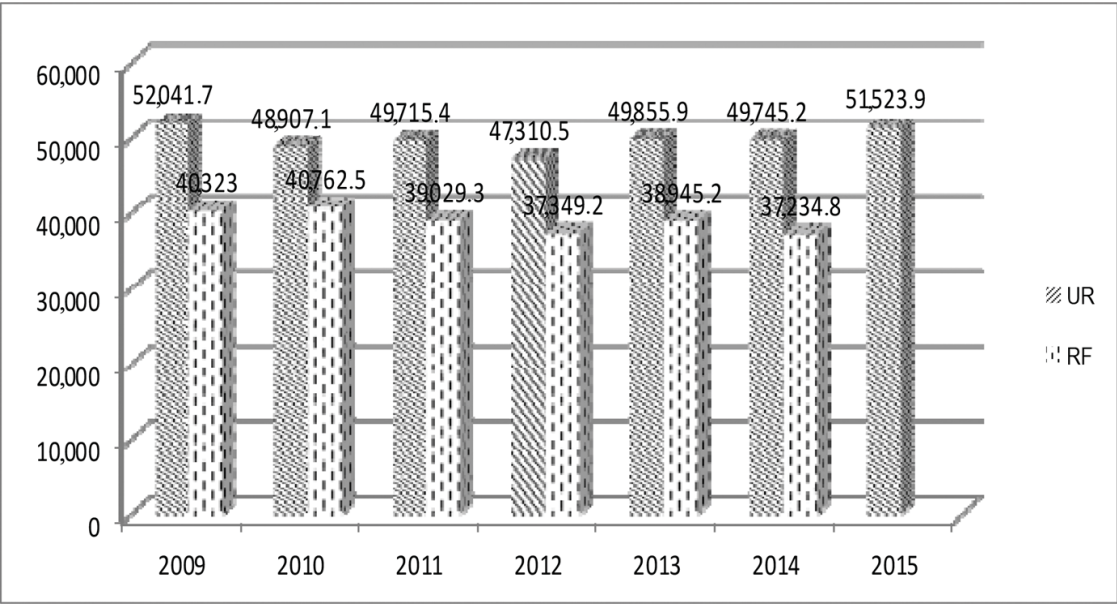


Figure 1. Dynamics of the general respiratory disease incidence level in the Udmurt Republic and the Russian Federation over a period of 2009–2015 (per 100,000 people)

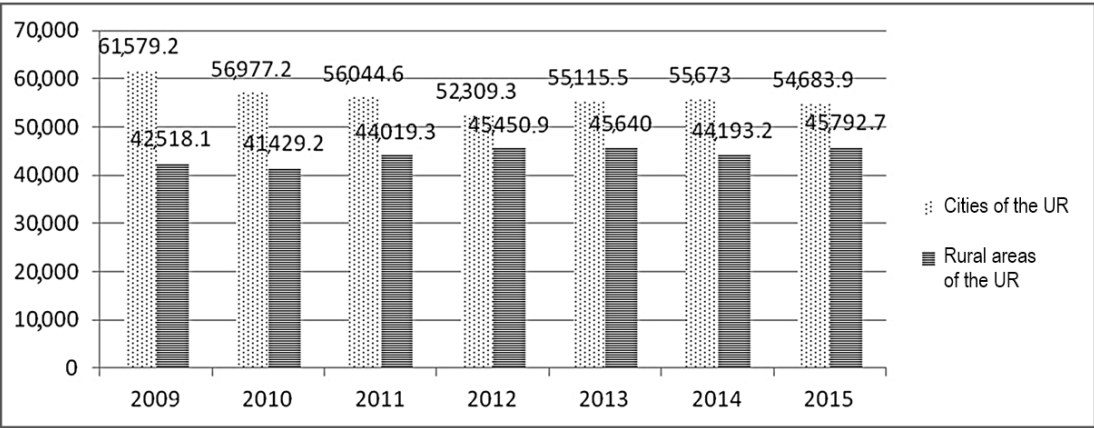


Figure 2. Dynamics of the general respiratory disease incidence level in urban and rural population of the UR over a period of 2009–2015 (per 100,000 people)

in 28.2%, and multisegmented — in 26.5%. In patients with severe CAP, multisegmented nature of the lesion was revealed in 100%. All patients received antibiotic therapy for CAP mainly with cephalosporins in combination with respiratory fluoroquinolones or macrolides. Patients in intensive care rooms or ICU received mainly carbapenems and detoxification therapy. According to the literature, detection of pathogens in CAP is possible only in 30–50% [9]. However, studying the pathogens by ELISA, it was found that in the UR in 30% of cases of CAP in patients not from ICU the causative agent of pneumonia was *S. pneumoniae*, and atypical bacteria accounts for 11 to 28%, namely *Chlamydia pneumoniae*, *Legionella pneumophila*,

Mycoplasma pneumoniae, and in 2.9% of patients diagnosed with severe CAP *Staphylococcus aureus* was revealed as the causative agent. At the same time, in our opinion, the effective detection of pathogens in CAP in the UR requires further improvement. The criteria of public health also include parameters of primary respiratory diseases (Figure 4). During the analyzed period, it was noted that the UR had a consistently high level of the primary incidence compared to the Russian Federation, compared to federal values (Figure 4). Assessing the rate of the primary respiratory diseases incidence, it is noted that mean growth rate in the UR is 105.42%, the mean increment rate is 5.42%, compared to the mean growth rate (87.07%)

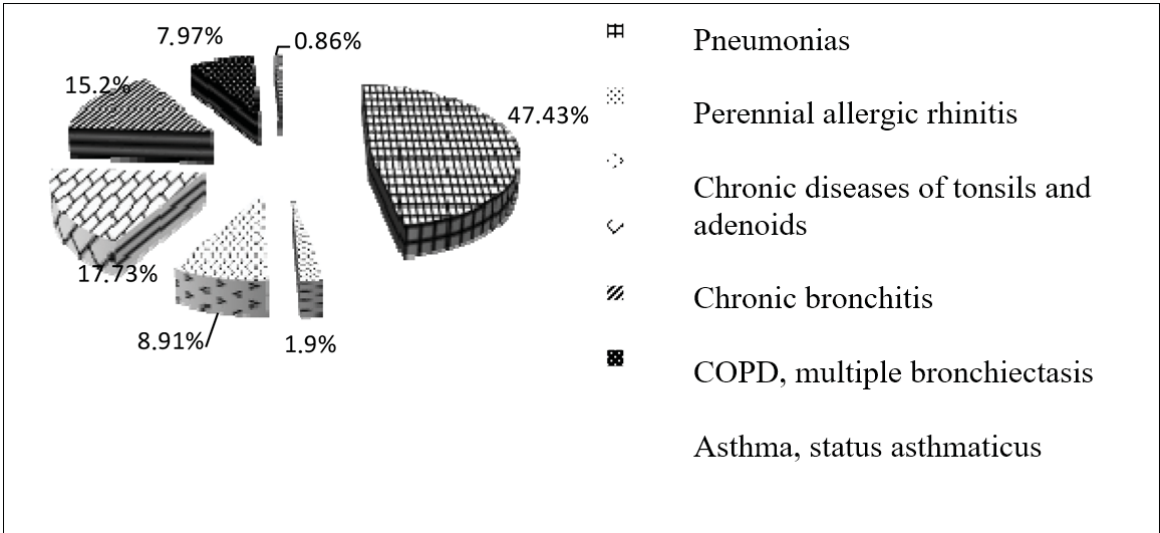


Figure 3. Structure of respiratory diseases in the UR in 2015

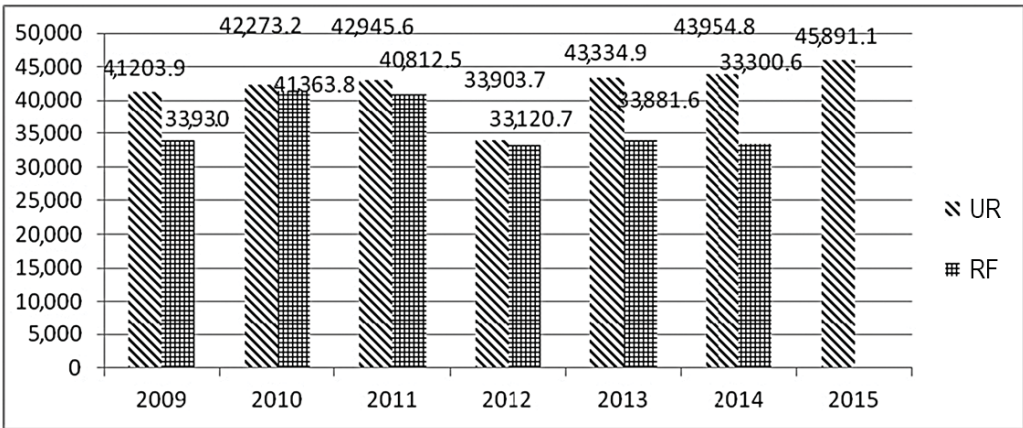


Figure 4. Dynamics of primary respiratory disease incidence level in the UR and the RF over a period of 2009–2015 (per 100,000 people)

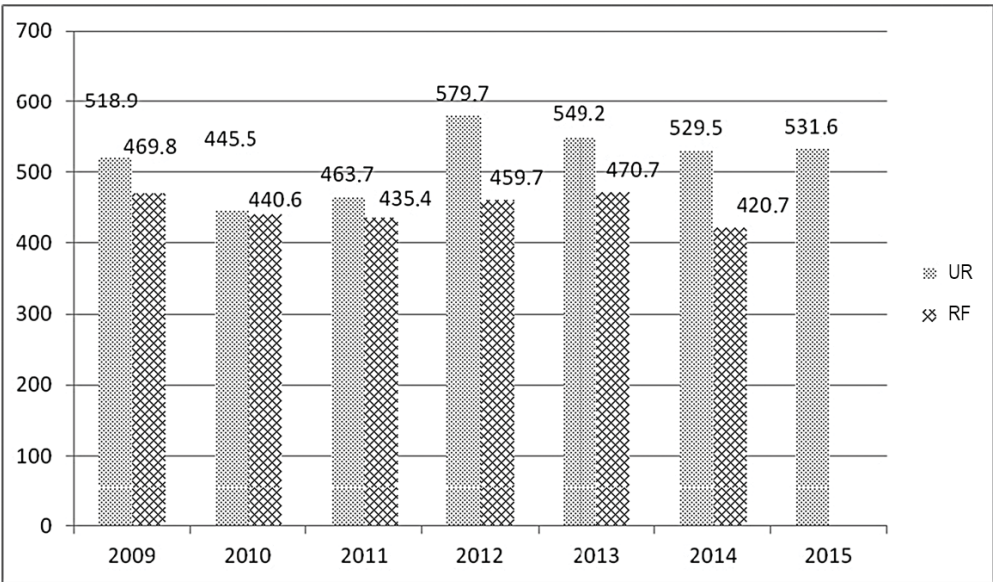


Figure 5. Dynamics of the pneumonia incidence in the UR and the RF over a period of 2009–2015

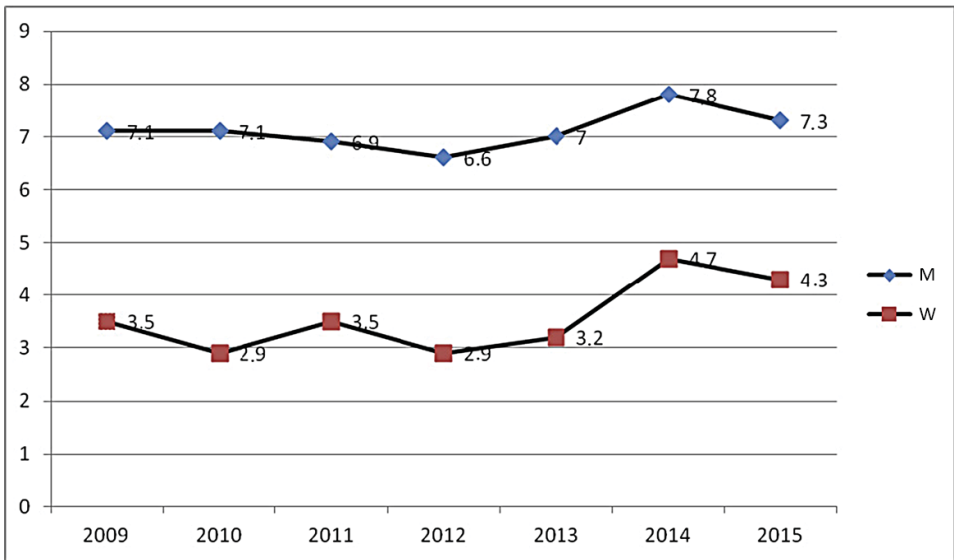


Figure 6. Dynamics of respiratory disease mortality structure in the UR over a period of 2009–2015 (%)

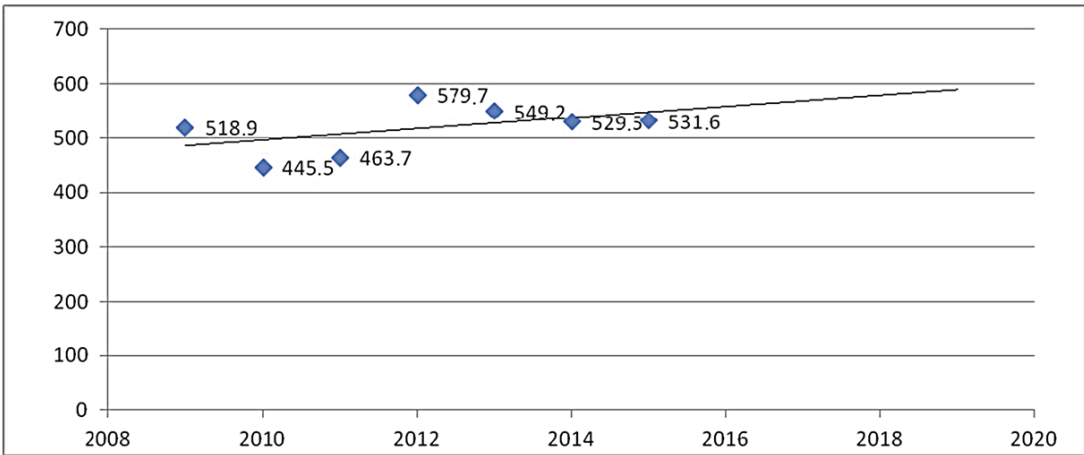


Figure 7. The pneumonia incidence prediction for 2019

and mean increment rate (12.93%) in the Russian Federation.

Data on the total pneumonia incidence in the UR: mean growth rate was 102.41%, and mean increment rate was 2.41%.

The study revealed significant differences in the overall pneumonia incidence on average for the analyzed period that allowed to divide the districts of the UR into 3 groups.

Group 1 included districts where the mean rate of the general incidence was 1.5 to 2.0 times higher than the same parameter for the UR. These districts included Grakhovsky, Vavozhsky, Yarsky, Yukamensky, Kezsky, and Balezinsky districts ($2,527 \pm 217.8$).

Group 2 included districts where the mean level of the total pneumonias incidence was consistent with that of the UR: Yakshur-Bodinsky, Glazovsky, and Mozhginsky districts ($1,559.5 \pm 249.6$).

In group 3, the overall pneumonia incidence was 1.2–1.4 times lower than in the UR. These districts included Alnashsky, Votkinsky, Debessky, Zavvalovsky, Kambarsky, Sharkansky, Karakulinsky, Kiznersky, Kiyasovsky, Malopurginsky, Sarapulsky, Syumsinsky, Seltinsky, and Uvinski districts ($1,139.7 \pm 130.4$).

The mapping carried out allowed to plan further treatment and diagnostic and preventive actions differentially, depending on incidence rate.

In analysis of the pneumonia incidence rate over the time, it is observed that the incidence rate in the UR is significantly ($p \leq 0.05$) higher compared to the Russian Federation (Figure 5).

When analyzing the mortality rate for pneumonia, there is a consistently high mortality rate in men compared to women (Figure 6).

During the prognosis of the incidence rate in the UR up to 2019, we predicted a further increase in the pneumonia incidence, which reflects the need for further development of methods for prevention and treatment of this pathology (Figure 7).

Conclusion

Thus, in the UR, as in the entire Russian Federation, there is a consistently high pneumonia incidence. At the same time, there is a tendency to higher incidence and mortality caused by this pathology. This circumstance requires further study of the problem

of pneumonia, including the improvement of methods for its medical treatment.

Conflict of interests

The authors declare no conflict of interests.

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