

Research Article

Monitoring of Etiological Structure of Community-Acquired Urinary Tract Infections in Kazan, Russia, 2012-2013

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ABSTRACT:

Community-acquired urinary tract infections (UTIs) represent a serious public health problem. UTIs can be caused by different pathogens, but most common causative agents include *Escherichia coli*, *Klebsiella pneumoniae* and *Enterococcus faecalis*. The structure of agents of UTIs varies depending on the sex, age, localization and complications of infection. Here, we present data analysis of bacteriological samples collected at the therapeutic and diagnostic center "Biomed", Kazan, for the period from January 2012 to December 2013. Of the 2300 positive samples 2490 uropathogenic isolates were isolated. Analysis of infection frequency showed that majority of community-acquired UTIs occur in women of childbearing age (20 to 40 years). Comparative analysis of etiological structure of UTIs showed that more than half of the UTI cases in women were caused by *E. coli* (51.8%), whereas the most cases of UTIs in men were associated with *E. faecalis* (30.1%).

Keywords: urinary tract infections, uropathogens, gram-positive, gram-negative.

INTRODUCTION

Urinary tract infections (UTIs) represent a severe problem of modern medicine and along with respiratory diseases are considered to be the most common infections among hospitalized and outpatients. In the United States between 1997 and 2007, the annual number of UTIs has increased significantly from 7 to 10.5 million people [1, 2]. Such high frequency can be explained by the fact that in addition to the emergence as an independent disease, UTIs represent the most common complications of respiratory diseases. In general, UTIs can be subdivided into infections of the upper and the lower urinary tract. Infections of the upper urinary tract affect a pyelocaliceal or an interstitial kidney. Infections of the lower urinary tract affect bladder, urethra, and the prostate gland in men. UTIs can be further

subdivided into uncomplicated or complicated infections. Uncomplicated infections could be treated fairly easy and do not require hospitalization. Complicated infections are caused by a variety of anatomical and functional disorders that impede the flow of urine or reflux causing it [3]. All UTIs in men are treated as complicated. UTIs usually have bacterial etiology and most commonly caused by opportunistic bacteria that live in the intestines and accidentally penetrate into the urethra, bladder, and further along the upward path. Women suffer more than men because of the peculiarities of the anatomical structure [3, 4]. As a rule, in non-pregnant adult women UTIs occur without complications and have a favorable disease prognosis. However, UTIs in pregnant women are more dangerous due to

increased risk of complications, such as development of pyelonephritis, preterm birth or fetal death [1]. UTIs can be caused by both gram-negative and gram-positive bacteria. Both Russian and international studies show that the vast majority of urinary tract infections are caused by gram-negative bacteria of the family Enterobacteriaceae and in particular, *Escherichiacoli*, *Klebsiellaspp.* and *Proteus mirabilis* [5-8]. Gram-positive causing agents of UTIs are less common, usually present a problem for the elderly, pregnant women, and for patients with UTIs caused by mixed flora [9]. This article presents the analysis of community-acquired UTIs across different age groups and gender and the study of their etiological structure over the period of two years in the therapeutic and diagnostic center "Biomed", Kazan, Russia.

MATERIAL AND METODS

For the analysis of community-acquired UTIs data from bacteriological samples of the therapeutic and diagnostic center "Biomed", outpatients (n = 6818), Kazan, Russia for the period from January 2012 to December 2013 were used. Positive urine samples (n = 2,300) obtained from patients of both sexes, various age groups with urological infections were tested for the presence of bacterial infection. Pathogen identification from urine was based on phenotypic and biochemical properties according to The Russian Department of Health order No. 535 from April 22, 1985 (<http://www.jurbase.ru/posr/docum1140/part5.htm>). Statistical analysis of the results was done using Microsoft Office Excel standard package. Results were considered significant at the standard deviation $\sigma < 10\%$. Additionally, z-test with Yates correction was used, p value < 0.05 was considered significant.

RESULTS AND DISSCUSION

Over the period from January 2012 to December 2013 the total of 6818 urine samples collected at the therapeutic and diagnostic center "Biomed" were analyzed. Among those, 2300 samples (33.8% of total) were tested positive for the presence of bacterial infection. Vast majority of

positive samples (82.8% of 2300 samples) were collected from women (n = 1905) (Table 1). These data correlate with the studies conducted in different countries. For instance, studies in Trinidad indicated that women accounted for 85.5% of positive urine samples [10]. According to research by Magliano *et al.*, conducted in Italy, women accounted for over 80% of UTI cases [11]. Such high frequency of UTIs among women is related to the female anatomical features: urethra is shorter and wider compare to males, and it is closer to the anus, which makes it easier for the pathogen to get on a rising path. The total of 2490 uropathogenic isolates were isolated and identified from all outpatients. In most cases (91.9%), infection was caused by a single pathogen (2114 cases). In the remaining cases the infection was caused by two or more uropathogens (186 cases, 377 strains isolated) (Fig. 1). Comparative analysis of the data showed a two-fold increase in the proportion of mixed infection in 2013 (approximately 11%) as compared with the same period of 2012 (5.5%). Analysis of age distribution showed that most UTIs (41.5% of all cases) occur in women of childbearing age (20 to 40 years). Women in 20-30 age group account for almost one third of all cases of UTIs, women in the next age group (30-40 years old) account for 16.3% cases. Similar data are presented in other studies: 19-45 years old patients account for 56% of all positive urine samples [12]. The lowest frequency of UTI is observed in individuals of 10-20 years of age group, regardless of the gender (0.2 and 2.5% for boys and girls, respectively) (Fig. 2). The obtained data correlate well with the results of study by Magliano *et al.* according to which 10-20-year-old age group accounted for about 2.5% of UTI cases [11]. According to other data, group of 13-20 year olds account for about 8% of all UTIs cases [10]. Interestingly, there was no significant difference between children of both sexes in the frequency of UTI occurrence in newborns and infants (under 2 years). In this age group frequency of UTI among girls (8.6%) is comparable with the frequency of infections in boys (7.9%). Analysis of etiological structure of UTI showed that the main causative agents of

community-acquired UTIs in Kazan, Russia are *E. coli* (1176/47.2%), *E. faecalis* (575/23.1%) and *K. pneumoniae* (336/13.5%) (Fig. 3a). Gram-negative bacteria account for 67.3% (1677 isolates) of all uropathogens identified in this study. Two thirds of those (65.2%, 1625 strains) consists of *Enterobacteriaceae* family members. According to Russian projects UTIAP-3 and DARMIS, *E. coli* was the most common cause of UTIs followed by *K. pneumoniae* (63.5% and 8.9%, resp.) [8]. These results are in agreement with data from other studies which showed that *E. coli* is the most common cause of UTIs and is responsible for infection from 55.6% to 71% [10-12]. The impact of Gram positive bacteria, including *Enterococcus* spp., was not significant, approximately 7% of all UTIs [7, 8, 13, 14]. Comparative analysis of the etiologic profile of community-acquired UTIs in men and women showed significant differences. More than half of the UTI cases in women were caused by *E. coli* (51.8%), whereas in men this bacterium was responsible for just 26.5% disease cases (Figure 3b, 3c). As shown in Figure 3c, the most cases of UTIs in men were associated with *E. faecalis* (30.1%). Interestingly, infections caused by *K. pneumoniae* occurred in males more frequently than in females (19.8% versus 12.1%). The studies in Milan, Italy, during the period from March 2008 to December 2009, showed a similar pattern of the main etiologic structure of UTI pathogens: *E. coli* (67.6%), *K. pneumoniae* (8.8%), *E. faecalis* (6.3%), *P. mirabilis* (5.2%), *P. aeruginosa* (2.5%) and *Streptococcus agalactiae* (group B) (2.3%). Same study, demonstrated the differences in the structure of UTI pathogens affecting men and women. Women have a higher proportion of *E. coli* (71%) and *K. pneumoniae* (9.1), as oppose to men (55% and 7.3% for *E. coli* and *K. pneumoniae*, respectively). In contrast, men are more likely than women suffer from UTIs caused by *E. faecalis*, *P. mirabilis* and *P. aeruginosa* [11]. Thus, patients' age and gender are significant factors in determining UTIs etiology. The knowledge of UTIs etiology in different groups of patients is important for the

selection of empiric treatment regimens of these infections.

CONCLUSIONS

Thus, the etiological structure of community-acquired UTIs in Kazan's therapeutic and diagnostic center "Biomed" is slightly different from the structure typical for the rest of Russia. Since our study did not take into account the severity of disease, and frequency of relapses, the high proportion of *E. faecalis* and *K. pneumoniae* in the structure of pathogens of community-acquired UTIs may be caused by complications or chronic nosocomial UTIs. Our findings points out the relevance of local monitoring of UTI pathogens, which is important for the analysis of regional peculiarities of disease and therapy adjustments to treat UTI infections.

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Table 1: Results of the analysis of urine samples

	2012 year		2013 year		2012-2013 years	
	N	%	N	%	N	%
Urine samples	3497		3321		6818	
- females	2997	85,7	2753	82,9	5750	84,3
- males	500	14,3	568	17,1	1068	15,7
Infected	1211	34,6	1089	32,8	2300	33,7
- females	999	82,5	906	83,2	1905	82,8
- males	212	17,5	183	16,8	395	17,2

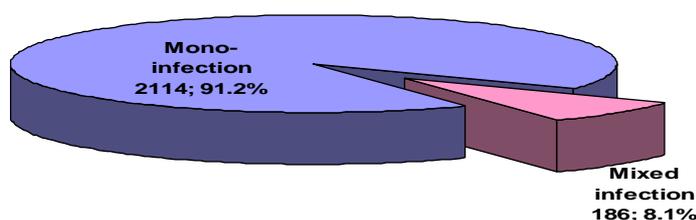


Fig. 1: The prevalence of mono- and mixed infection among community-acquired UTIs in Kazan, 2012-2013. N = 2300

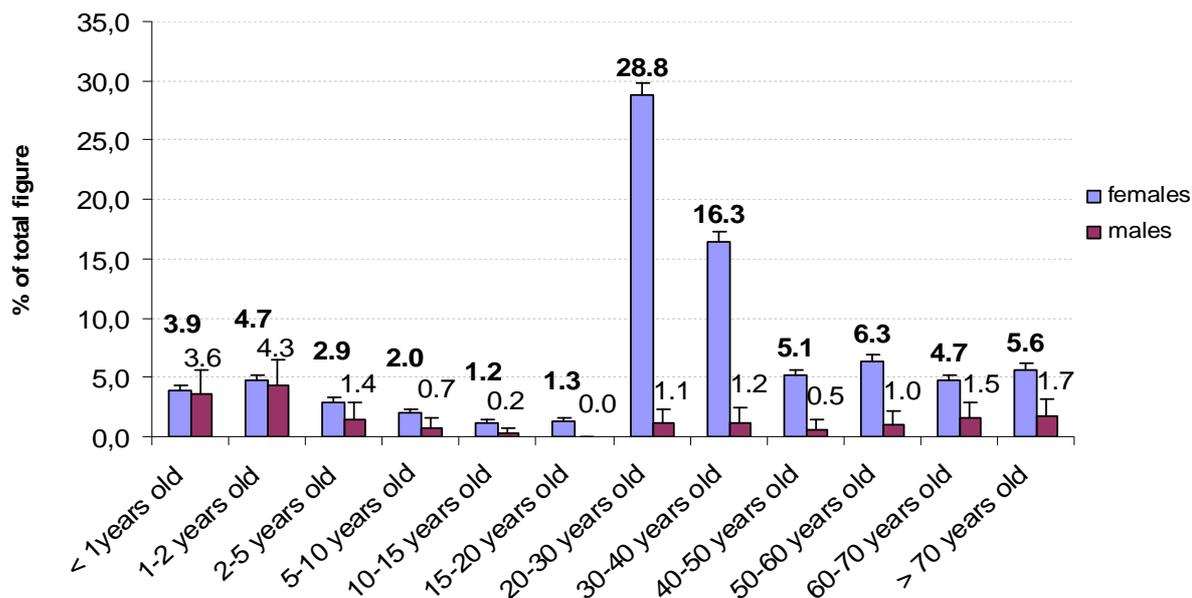
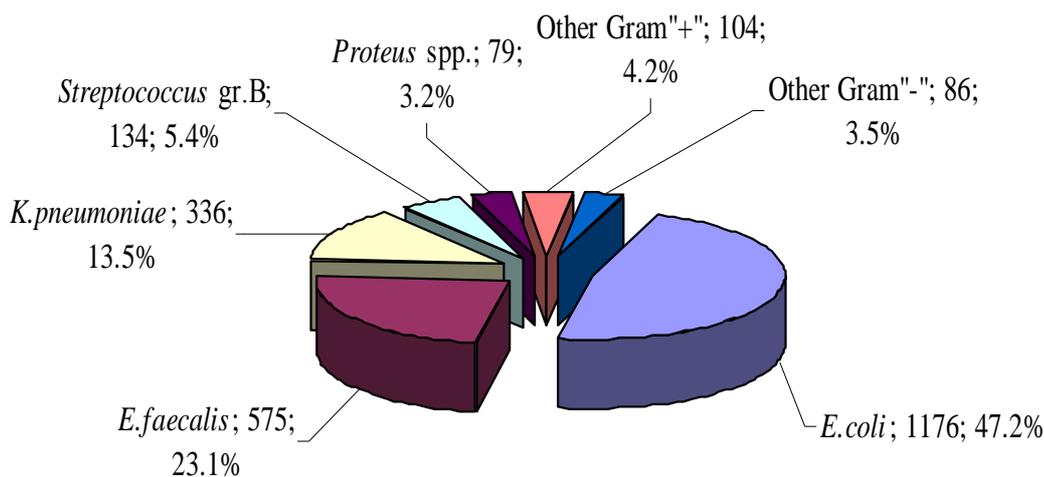
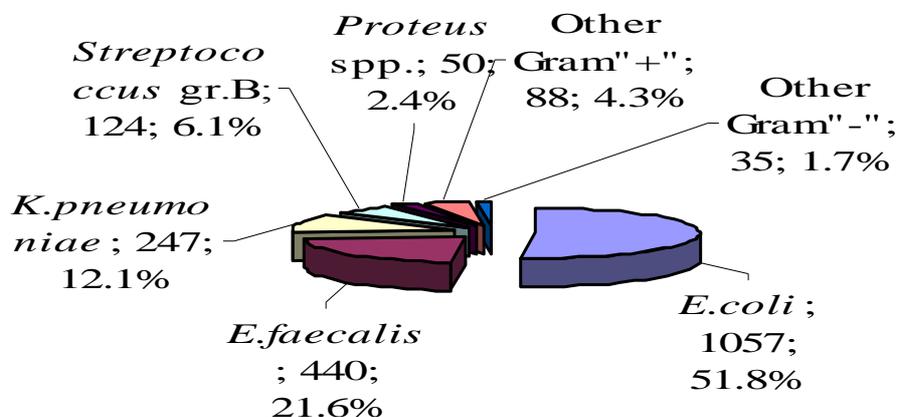


Fig. 2: Comparative analysis of the distribution of positive results by age and sex. According to the medical center "Biomed", Kazan, 2012-2013. Taken as 100% the total number of positive results (n = 2300)

a



b



c

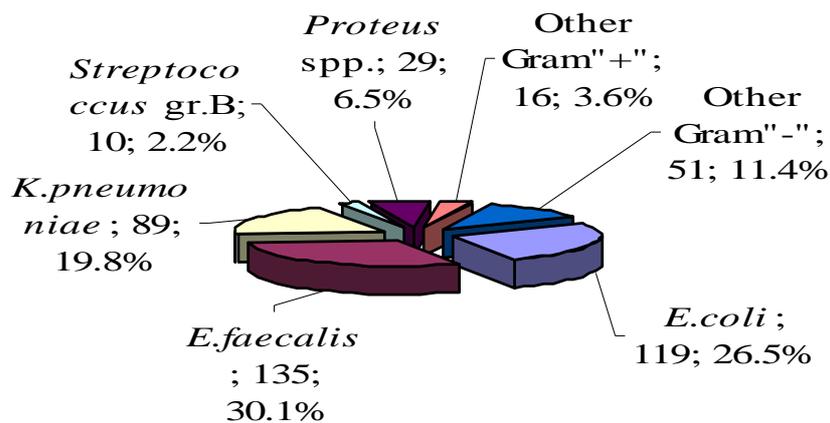


Fig. 3: Structure of the pathogens of community-acquired UTIs, Kazan, 2012-2013, **a** - the total figure, n = 2490; **b** - among females, n = 2041; **c** - among males, n = 449. Other Gram⁺ includes: *Staphylococcus saprophyticus*, *Staphylococcus epidermitis*, *Staphylococcus aureus* and group A *Streptococcus*. Other Gram⁻ includes: *Pseudomonas aeruginosa*, *Morganellamorganii*, *Citrobacter* spp. and *Enterobacter* spp.