

# About Active Digital Epidemiological Monitoring Cases of Infections Caused by Catheterizing of the Urinary Tract

Darina M.G.

Medical Information and Analytical Center,  
North-West State Medical University named I.I. Mechnikov,  
St. Petersburg, Russia  
DaryinaM@spbmiac.ru

Svetlichnaya J.S.

Medical Information and Analytical Center,  
North-West State Medical University named I.I. Mechnikov,  
St. Petersburg, Russia  
YSvetlichnaya@spbmiac.ru

Movchan K.N.

Medical Information and Analytical Center,  
North-West State Medical University named I.I. Mechnikov,  
St. Petersburg, Russia  
MovchanK@spbmiac.ru

Chernov K.E.

Medical Information and Analytical Center,  
St. Petersburg, Russia  
chernov\_ke@mail.ru

Artyshin B.S.

Medical Information and Analytical Center,  
St. Petersburg, Russia  
artyushin\_boris@mail.ru

Zharkov A.V.

North-West State Medical University named I.I. Mechnikov,  
St. Petersburg, Russia  
doctor1605@mail.ru

Chernova A.Y.

North-West State Medical University named I.I. Mechnikov,  
St. Petersburg, Russia  
panasova\_anna1309@mail.ru

Rusakevich K.I.

North-West State Medical University named I.I. Mechnikov,  
St. Petersburg, Russia  
kseniariusakevich@yandex.ru

**Abstract** — The authors retrospectively studied the data of 48 hospitals in St. Petersburg on urinary tract infections associated with bladder catheterization. The results of the introduction in medical organizations of an active epidemiological observation of the outcomes of treating patients with identified risks of infectious complications in cases of catheterization of the urinary tract using an electronic medical record were purposefully assessed.

**Keywords** — *infections associated with medical activity; catheter-associated urinary tract infections; epidemiological observation*

## I. INTRODUCTION

Analysis of data on the possibilities of active epidemiological monitoring of infections associated with medical activities (IAMA), taking into account information about medical technologies that affect the induction and development of infectious pathology, is an important aspect of managing the daily work of hospital-type workers. The development of preventive measures for IAMA should be based on information not only about typical risk factors for the development of infectious complications, but also on data reflecting the features of the process of providing medical care

(MC) to patients and injured according to certain medical activity profiles [1, 2]. Special attention is given to cases of infections of the urine, among which the IAMA observations induced by the activation of conditionally pathogenic microorganisms against the background of medical manipulations separately stand out [3]. In particular, such a manipulative action is a catheterization of the bladder – a procedure associated with an increased risk of infection of the urinary tract (UTI).

Indicators of detectability of UTIs taking into account in medical organizations (MO) of Russia are significantly different from the data presented in reports of hospitals in European countries, in which the frequency of nosocomial infections is about 5–10 % of all cases of medical care for patients. The latter can probably be explained by the lack of a full accounting of data on UTI in the institutions of domestic health care [6].

At the present stage of medical knowledge, obtaining reliable information on the prevalence of UTI in MO is possible through the introduction of active epidemiological monitoring of patient outcomes [7].

All information about the features of the implementation of medical manipulations that are unfavorable in terms of the prognosis of UTIs is reflected in the medical card of the

inpatient. However, for various reasons (most often, a methodical plan), the features of invasive procedures are noted in medical records protocols are not always correct [8, 9]. Against the background of large-scale informatization of domestic health care, a unified form of an electronic medical card of an inpatient patient has already been created. Selection in its content of the information of the epidemiological plan about the alleged causes and features of the course of UTIs caused by medical activity (in particular – prolonged drainage of the urinary tract in the early postoperative period) is important for the practical work of specialists [10, 11].

**II. OBJECTIVE**

To justify the use of modern digital systems for collecting, storing and processing information about the main risk factors for the development of UTI (based on data models on catheter-induced infections), taking into account the quality of medical manipulations that affect the formation of infectious complications, for reasoned targeted preventive measures.

**III. MATERIAL AND METHODS**

Since 2009, as part of monitoring UTI in inpatient hospitals in St. Petersburg, work has been carried out on introducing into

the inpatient medical record a section containing information on medical interventions that affect the occurrence and development of infectious diseases with subsequent use in its electronic version (EMC).

The analysis of data (the period 2009–2018) on the incidence of UTIs was in 48 hospitals in St. Petersburg with the staff of resuscitation and intensive care (ICU). Of these, in 42 medical organizations, the MC turns out to be patients with surgical-related diseases. Information was studied on the activities of employees of multidisciplinary hospitals for adults (29 institutions) and children (8 MO), obstetric facilities (8 hospitals) and three hospitals for patients with tuberculosis, mental disorders and drug addiction.

**IV. RESULTS AND DISCUSSION**

When MC are provided to patients in hospitals of St. Petersburg, cases of UTI are recorded annually. The incidence rate of this pathology in the city MO for many years varies from 8.07 to 0.80 per 1000 catheter-days (Fig. 1).

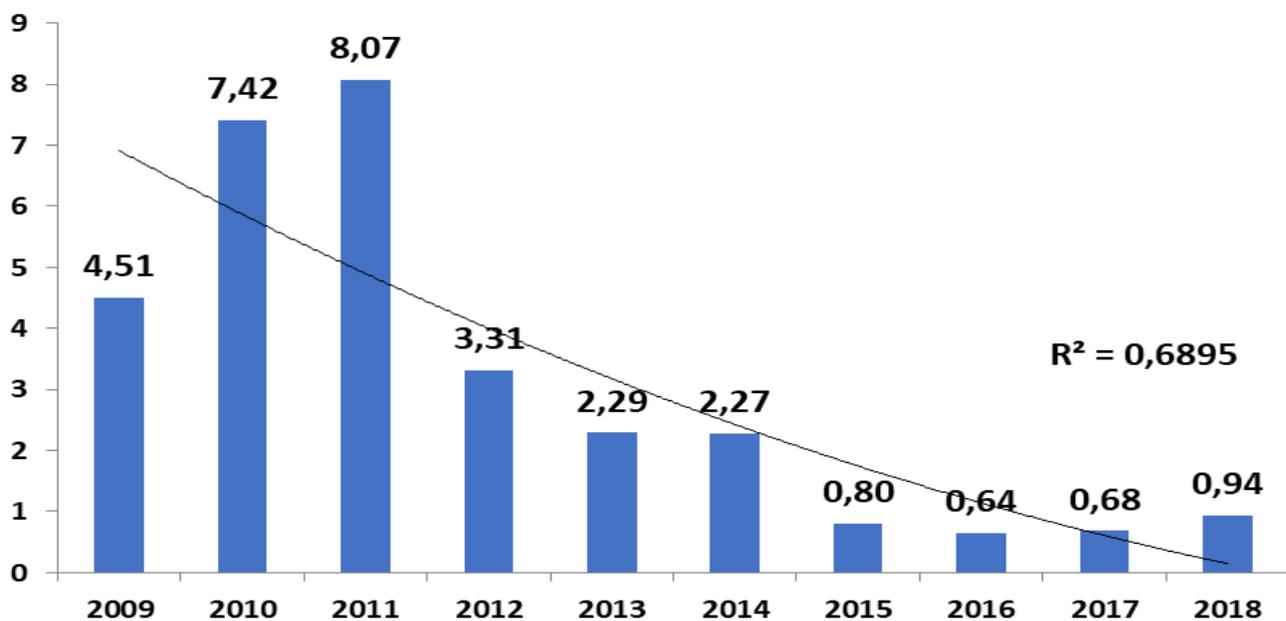


Fig. 1. Indicators of the frequency of UTIs caused by the use of urinary catheters in the ICU MO SPb in 2009-2018

TABLE I. DISTRIBUTION OF CASES OF UTI IN ST. PETERSBURG MO IN 2018

Types of hospitals	Number of contingents of ICU patients (people)	Duration of use of urinary catheters (catheters)	Cases of UTI	Frequency of UTI (per 1000 catheter days)
Multidisciplinary for:				
adults	94 248	304 593,0	310	1,02
children	8 369	11 687,0	0	-
obstetric aid	11 520	9 976,0	0	-
drug treatment	378	0,0	0	-
psychiatric	357	1 617,0	0	-
tuberculosis	629	2 010,0	0	-
Total	115 501	331 217,0	310	0,94

The magnitude of the accuracy of the approximation ( $R^2 = 0.6895$ ) is high, which indicates a downward trend in the incidence of UTIs. The reason for this decrease is likely to be the inferiority of information about this pathology in relation to all nosocomial infections (NI) and, apparently, is due to the lack of adequate epidemiological monitoring of the outcomes of treatment of patients in the ICU city hospitals. In particular, in 2018, hospital epidemiologists reported cases of UTIs associated with catheterization of the urinary tract, only in 10 (18 %) hospitals with ICUs (2017 – 11 (22 %); 2016 – 9 (19 %); 2015 – 11 (22 %); 2014 – 12 (27 %)), and the dates and times of insertion and removal of urinary catheters were reflected in the medical record by the ICU specialists only 9 (19 %) of MO.

In 2018 during the stay of patients in the ICU, 310 cases of UTI were recorded associated with catheterization. All observations of UTI are stated when MC was provided to patients of multidisciplinary hospitals for the adult population (Table 1).

Among the leading causative agents of UTI in 2018, a high proportion of antimicrobial agents (AA) resistant strains was noted (Fig. 2). Thus, the share of cefoxitin-resistant *S.aureus* strains was 38.3 % (in 2017 – 32.0 %, in 2016 – 16.0 %). At the same time, the proportion of strains of *E.coli* and *Klebsiella* spp. resistant to meropenem (producing carbopenemases and resistant to all  $\beta$ -lactam AMPs) was 3.7 and 44.9 %, respectively (in 2017 – 7.5 and 45.2 %, 2016, 5.9 and 38.3 %, respectively).

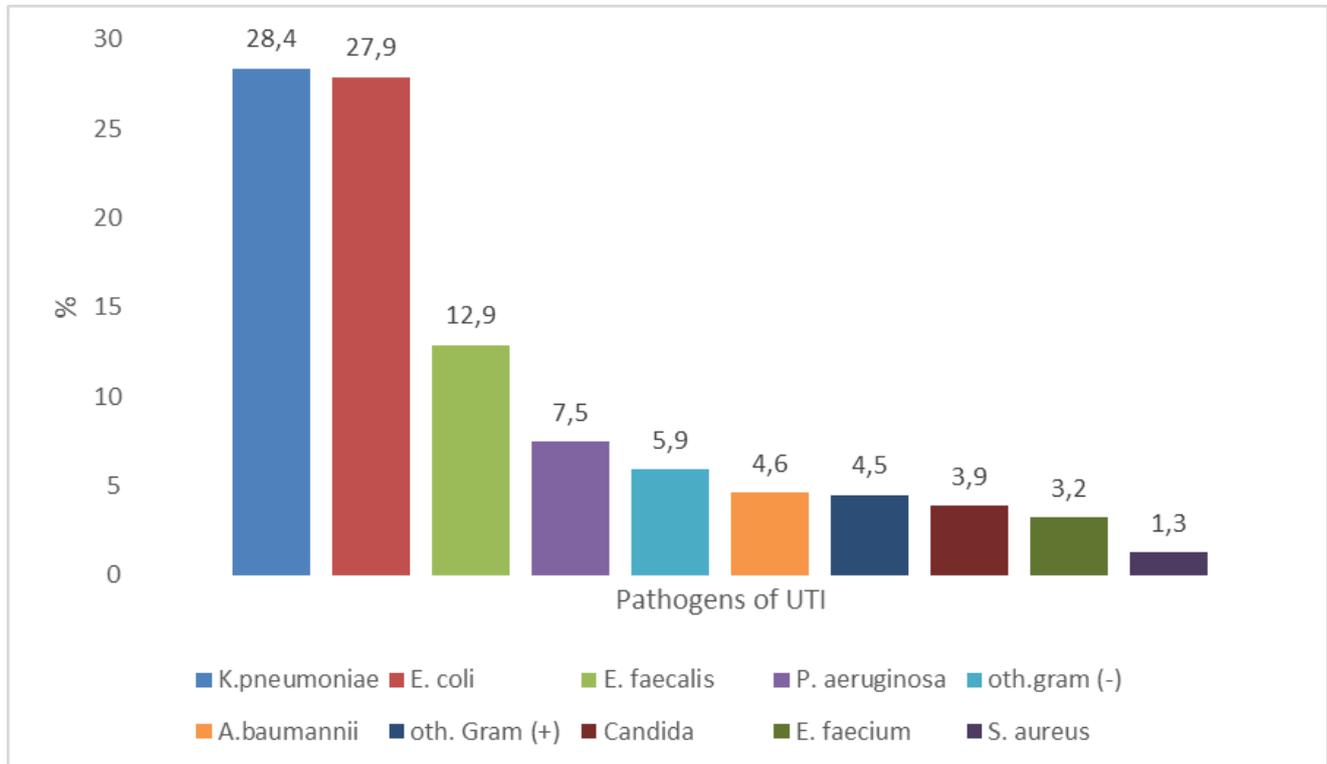


Fig. 2. Types of UTI causative agents and the proportion of their excretion from the urine of patients of ICU in multi-disciplinary hospitals for adults in St. Petersburg in 2018

The share of pathogens such as *P.aeruginosa* and *Acinetobacter* spp. that are resistant to meropenem, producing metalbetalactomas, and resistant to many potentially effective AA, in particular, antipseudomonas penicillins and cephalosporins, 56.8 and 87.3 %, respectively. In 2017 they were 64.1 and 80.6 %, in 2016 – 60.4 and 83.3 %, respectively. And the share of vancomycin-resistant *Enterococcus* spp. strains (resistant to most of the AA available in clinical practice) was 8.3 % (4.5 % – in 2017, 6.7 % – in 2016).

Objectives of the war against antibiotic resistance of the main causative agents of UTIs remain unsolved. Only an interdisciplinary approach, containing measures for infection control, adequate use of AA used in the hospital, optimization of dosing regimens of drugs and rational use of new AA, can

be the basis for restraining the growth in the number of observations of antimicrobial resistance.

In general, the data presented so far do not allow us to state a sufficient level of implementation of the monitoring process for UTI cases in hospitals of St. Petersburg. The latter is probably due to the lack of unambiguous views on the methodology for quickly obtaining information on the state of the IAMA epidemic process in the MO. Nevertheless, without this information it is impossible to conduct targeted preventive and anti-epidemic measures.

One of the tools for collecting, storing, and processing information on UTI events and the main characteristics of medical interventions that affect the emergence and development of an IAMA may be a medical information

system (MIS) and in a number of Moscow municipalities reflection of the main characteristics of operations and manipulations in the EMC is already underway. In particular, information on the main risk factors for UTI is already available in an on-line mode in 4 (8 %) city hospitals with regular ICUs.

#### V. CONCLUSION

The need for rigorous compliance with the algorithms of the therapeutic and diagnostic process in order to improve the quality of the MC delivery is beyond doubt. The possibilities of reflecting in the EMC of the main parameters of the condition of patients and medical technologies, the use of which contains a potential threat of developing nosocomial infections in patients, are just as obvious. Through the use of EMC, it is actually possible to fully monitor cases of IAMA in MO. In this perspective, the creation of the so-called epidemiological module in the EMC allows you to quickly influence the course of the epidemic process of nosocomial infections, as well as to take timely measures to ensure the quality of the MC for patients, including in cases of urinary tract infection caused by medical manipulations.

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