REVIEW ARTICLE

Hospital infections in Polish Intensive Care Units

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Introduction

Healthcare-associated infections (HCAIs or HAIs) are a big challenge for modern medicine (Figure 1). They relate to patients who have been under medical care, whether diagnosis, treatment and/or rehabilitation in an outpatient clinic, hospital, dialysis station, or at home during childbirth. HAIs are an inherent element of medicine, especially in surgery and intensive care units − this is an additional risk that the patient bears while expecting therapeutic success. Some of the infections− about 1/5 − can be easily prevented through meaningful and rational prophylaxis: effective infection prevention and control (IPC) measures [1]. The study by Cassini *et al.* showed that in every 20 patients hospitalized in Europe, at least one acquired HAI could be prevented [2].

Figure 1. Prof. Jadwiga Wójkowska-Mach giving a lecture to physicians at the headquarters of Cracow Medical Society on the challenges of hospital infections.

HAIs can cause long-term disability and even death of the patient, increased resistance of microorganisms to antimicrobials, and additional financial burdens related to longer hospitalization of patients. The risk of HAI depends on the infectious agent (including virulence, environmental survival, resistance), the patient's condition (e.g. advanced age, low birth weight, the presence of underlying diseases, debilitating or immunosuppressive status and malnutrition) and the environment. Although the risk of HAI affects all medical facilities around the world, due to difficulties in collecting reliable data, the exact number is unknown [3].

Nosocomial infections can be divided into: central line-associated bloodstream infections (CLABSI) or catheter-related bloodstream infections (CRBSI), catheter-associated urinary tract infections (CAUTI), surgical site infections (SSI) and ventilator-associated pneumonia (VAP) [4]. Before the current SARS-CoV-2 pandemic causing COVID-19, approximately 80-87% of HAIs were caused by 12-17 microorganisms, and these are: *S. aureus, Enterococcus spp., E. coli*, coagulase-negative staphylococci, *Candida* spp., *Klebsiella* spp., *P. aeruginosa*, *A. baumannii*, *Enterobacter* spp., *Proteus* spp. [5]

HAIs in Polish hospitals

There are no comprehensive analyzes of the epidemiology and microbiology of HAIs in Poland, but intensive care units in southern Poland are the ones described best. It was found that in 2013-2015 the overall incidence was 22.4% − which means that the infection was confirmed in every fourth patient hospitalized in the Polish ICU for more than 48 hours. Most often it was pneumonia, with an incidence of 8.0% or bloodstream infections (BSI), at 7.2%. In cases of VAP, both the hospitalization time and the duration of antibiotic therapy were significantly shorter if the microbiological diagnostics of VAP included materials collected using invasive methods, i.e. bronchoalveolar lavage (BAL). Among the BSI, primary catheter-associated infections (35%) and, unfortunately, secondary BSI (47%) dominated. The most common sources of secondary BSI were urinary tract infections (55%) and pneumonia (38%). Only 69% of cases of BSI have been fully microbiologically confirmed. The most common aetiological factors of all infections were Gram-negative rods (69.2%), especially *Enterobacterales* formerly known as *Enterobacteriales* (36.3%) and non-fermenting rods (32.9%). Drug resistance to antibiotics was especially observed in *Acinetobacer baumannii* (over 70% resistance to carbapenems), *Klebsiella pneumoniae* (over 90% resistance to ampicillin and ceftazidime and third generation cephalosporins) [6, 7, 8].

Thus, the general epidemiological situation in the studied ICUs did not differ significantly from those described in the literature, with the exception of BSI, where the incidence was more than twice as high as currently reported for the countries in the European Union (EU). Another problem is the too rarely performed microbiological tests of materials optimal for diagnostic and therapeutic procedures.

Prophylaxis

The organization of IPC programmes must be clearly defined and based on local epidemiology and prioritized according to its judgment. Qualified and committed specialists in each treatment unit are essential. Supporting good-quality microbiological testing is a very important and critical factor. The role of microbiological diagnostics and infection prevention is currently underestimated by physicians who place more emphasis on treatment than prevention. In Poland, health care system employees usually have to pay for microbiological tests from their budgets, and outpatients have to pay from their own pockets. As a consequence, most community-acquired infections are treated empirically [9]. Poland has one of the highest rates of total antibiotic consumption among European countries, and fluoroquinolone resistance occurs in over 50% of *P. aeruginosa, K. pneumoniae* and *Acinetobacter* strains (the highest values among EU countries) [9]. Limited education of physicians and dentists on this topic may play an important role in the pattern of antibiotic consumption. Prescription of appropriate antibiotics should be encouraged as part of undergraduate and postgraduate training. It is also advisable to restrict the prescribing of antibiotics in outpatient care. Equally important are educational campaigns targeted at patients [9, 10]. The surveillance of HAIs should be adapted to the individual, the patient population under care, the possibility of

implementing targeted antibiotic therapy, i.e. access to microbiological diagnostics, and depending on the available resources (especially personal ones)− clear goals and strategies. Hospital infection surveillance systems should be linked to and integrated into the public infection surveillance system. Surveillance reports should be disseminated in a timely manner at the management or administrative level [10].

The elements necessary for effective infection control also include such basic issues as for example, the need to allocate adequate space for each patient, i.e. to maintain the norms regarding appropriate spacing between beds - which will not only ensure freedom of work for medical and auxiliary personnel, but also enable ergonomic arrangement of disinfectant dispensers so that these are easily accessible. These rules apply to all units and divisions. Hospital overcrowding has been identified as a public health emergency that can lead to disease transmission [10].

Hand hygiene

Although as early as 1847 Semmelweis promoted hand washing before contact with a patient, the topic and importance of hand hygiene remains inexhaustible. Inadequate hand hygiene is one of the causes of nosocomial infections and the spread of multi-resistant strains. There is evidence that the number of HAIs can be reduced by proper hand hygiene [12]. In addition, several studies have shown that, following the implementation of a strategy to improve hand hygiene,

a sustained reduction in the number of infections caused by multidrug-resistant bacterial strains and a reduction in patient colonization is observed [13-15].

The World Health Organization (WHO) recommends that there is a need to wash hands with soap and water when they are visibly soiled after exposure to spore-forming pathogens, including *Clostridioides difficile* (formerly *Clostridium difficile*). If hands are not visibly soiled, use an alcohol-based hand cleaner for routine hand hygiene and all other situations. The WHO also makes it clear when hand hygiene is mandatory: before each clean procedure, before and after touching the patient, regardless of whether gloves are worn, after contact with body fluids or secretions, after contact with surfaces and objects (including medical equipment) in the immediate vicinity of the patient, before putting on and after removing sterile or non-sterile gloves. If alcohol-based products are not available, wash your hands with soap and water. Also, use an alcohol-based handrub or wash your hands with soap and water before handling medications or preparing meals. Do not use soap and alcohol-based agents at the same time - during one procedure. The decision which of the hand hygiene methods to choose (alcohol-solution or soap hand washing) depends on the circumstances, e.g. hand wash after reporting to one's workplace, after coming to the ward, social situations, after exposure to biological materials and in the course of working with a patient suffering from a disease caused by sporogenic microorganisms, e.g. pseudomembranous colitis (*C. difficile*) or gas gangrene (*Clostridium perfringens*) [3].

Conclusions

Healthcare-associated infections are one of the greatest challenges in modern medicine. They pose a serious threat to the health and even life of patients. The most important aspects of the fight against HAIs include: optimal organization of IPC programmes, rational use of antibiotics, proper hygiene, for example of hands, and a very important element– education of medical personnel.

References

[1] Harbarth S, Sax H, Gastmeier P. The preventable proportion of nosocomial infections: an overview of published reports. J Hosp Infect 2003; 54:258-66.

[2] Cassini A, Plachouras D, Eckmanns T et al. Burden of six healthcare-associated infections on european population health: estimating incidence-based disability-adjusted life years through a population prevalence-based modelling study. PLoS Med 2016; 13: e1002150.

[3] World Health Organization. WHO Guidelines on Hand Hygiene in Health Care: a Summary. Access valid on 28 December 2020: https://www.who.int/gpsc/5may/tools/who_guidelines-handhygiene_summary.pdf

[4] Centers for Disease Control and Prevention. Types of healthcare-associated infections. Access valid on 28 December 2020: https://www.cdc.gov/hai/infectiontypes.html

[5] Haque M, Sartelli M, McKimm J, Abu Bakar M. Health care-associated infections - an overview. Infect Drug Resist 2018; 11:2321-33.

[6] Walaszek M, Rozanska A, Bulanda M, Wojkowska-Mach J. Polish Society of Hospital Infections team: epidemiology of healthcare-associated infections in Polish intensive care. A multicenter study based on active surveillance. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub 2018. DOI: 10.5507/bp.2018.006;

[7] Wałaszek M, Różańska A, Wałaszek MZ, Wójkowska-Mach J. Polish Society of Hospital Infections team: epidemiology of ventilator-associated pneumonia, microbiological diagnostics and the length of antimicrobial treatment in the Polish Intensive Care Units in the years 2013-2015. BMC Infect Dis 2018; 18: 308. DOI: 10.1186/s12879-018-3212-8;

[8] Wałaszek M, Różańska A, Bulanda M, Wojkowska-Mach J. Polish Society of Hospital Infections team: alarming results of nosocomial bloodstream infections surveillance in Polish intensive care units. Przegl Epidemiol 2018; 72:33-44.

[9] Wojkowska-Mach J, Godman B, Glassman A et al. Antibiotic consumption and antimicrobial resistance in Poland; findings and implications. Antimicrob Resist Infect Control 2018; 7:136. DOI: 10.1186/s13756-018-0428-8

[10] World Health Organization. Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level. Access valid on 28 December 2020: https://apps.who.int/iris/bitstream/handle/10665/251730/9789241549929eng.pdf;jsessionid=1DF73BCA02D4A3E4F5E44FAEDFDC80F5?sequence=1

[11] Allegranzi B, Pittet D. The role of hand hygiene in healthcare-associated infection prevention. Journal of Hospital Infection 2009; 73:305-15.

[12] Brown SM, Lubimova AV, Khrustalyeva NM et al. Use of an alcohol-based hand rub and quality improvement interventions to improve hand hygiene in a Russian neonatal intensive care unit. Infection Control and Hospital Epidemiology 2003; 24:172-9.

[13] Gordin FM, Schultz ME, Huber RA et al. Reduction in nosocomial transmission of drug-resistant bacteria after introduction of an alcohol-based handrub. Infection Control and Hospital Epidemiology 2005; 26:650-3.

[14] Trick WE, Vernon MO, Welbel SF et al. Multicenter intervention program to increase adherence to hand hygiene recommendations and glove use and to reduce the incidence of antimicrobial resistance. Infection Control and Hospital Epidemiology 2007; 28:42- 9.

[15] Girou E et al. Association between hand hygiene compliance and methicillinresistant *Staphylococcus aureus* prevalence in a French rehabilitation hospital. Infection Control and Hospital Epidemiology 2006; 27:1128-30.

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