

**"THE QUALITY OF DIAGNOSTICS OF MULTI-RESISTANT HUMAN BACTERIAL PATHOGENS
IN POLAND BASED ON ANALYSES OF THE RESULTS OF THE POLISH NATIONAL EXTERNAL
QUALITY ASSESSMENT SCHEME IN MICROBIOLOGICAL DIAGNOSTICS – POLMICRO"**

The doctoral dissertation entitled: "The quality of diagnostics of multi-resistant human bacterial pathogens in Poland based on analyses of the results of the Polish National External Quality Assessment Scheme in Microbiological Diagnostics – POLMICRO" is a series of three original publications and one review on the issues of quality and credibility of diagnostics of multi-resistant pathogens in Polish microbiological laboratories participating in the POLMICRO programme. POLMICRO is an external quality control programme in microbiological diagnostics organized by the Centre of Quality Control in Microbiology.

The aim of the work cycle was to assess and analyse the quality of diagnostics of multi-resistant human bacterial pathogens, including proficiency in identifying and detecting resistance mechanisms, and their clinical interpretation based on the results obtained in the microbiological laboratories participating in the programme. The results of the work are presented together as they refer to a common topic, which is the quality of diagnostics of antibiotic resistant human bacterial pathogens.

Publication no. 1 "Quality assurance in the medical microbiological laboratory" presents guidelines and issues regarding the principles of organisation of the quality assurance programme in the laboratory, i.e. conducting internal quality control in the laboratory and participating in external quality control programmes, which allow continuous monitoring of the laboratory's performance and to obtain reliable results of the microbiological tests. Reliable microbiological diagnostics permit rapidly and correctly identify drug susceptibility phenotypes and resistance mechanisms of human bacterial pathogens. A participation in the inter-laboratory quality control programmes organised by the Centre of Quality Control in Microbiology is the fulfilment of the legal obligation of the laboratory specified in the quality standards for medical microbiology laboratories.

The emergence and spread of multi-drug resistant bacteria is increasing and affects almost all bacterial species, therefore rapid and reliable their identification in microbiological

laboratories is extremely important. The set of publications included in the doctoral dissertation presents an evaluation of the quality of diagnostics of leading etiological agents of infections.

Publication no. 2 "Antimicrobial susceptibility patterns of *Staphylococcus aureus* in Poland obtained by the National Quality Assurance Programme" presents the results of the only study on this scale carried out in Poland as part of the POLMICRO programme. The study was able to assess the quality of diagnostics of *Staphylococcus aureus*, one of the most important human pathogens. In addition, very important epidemiological information was also obtained about the frequency and role of MRSA (methicillin resistant *S. aureus*) in various infections depending on the country regions and the prevalence of *S. aureus* in different sites of infection. Furthermore, an information on the susceptibility profile to a wide range of antibiotics among the Polish MRSA and MSSA (methicillin susceptible *S. aureus*) strains was also obtained.

In publication no. 3 "The assessment of microbiological diagnostics' credibility in Poland on the basis of the POLMICRO 2018 Programme results", an assessment of laboratory proficiency in the interpretation of Gram-stained microscopic slides, the correctness of microbial identification and determination of susceptibility to antimicrobials and detection of resistance mechanisms are presented. Among Gram-negative bacilli, one of the dominant resistance mechanisms is the production of extended spectrum β -lactamases, ESBLs. They are a source of serious clinical and epidemiological problems worldwide. At present, however, the most serious challenge is *Enterobacterales* that produce carbapenemases (CPE – Carbapenemase Producing *Enterobacterales*). CPE spread all over the world, also in Poland, therefore their correct detection is one of the diagnostic priorities of medical microbiological laboratories.

In publication no. 4 "Assessment of the correctness of identification and determination of antimicrobial susceptibility of *Streptococcus pneumoniae* in microbiological laboratories in Poland" the quality analysis of diagnostics of pneumococci, one of the leading bacterial human pathogens, obtained in Polish laboratories over the 20 years of the POLMICRO programme is presented. The key task of a laboratory is not only the ability to determine the species of microorganism tested but also the correct determination of antibiotic susceptibility and underlying resistance mechanisms, as well as the proper

interpretation of the results of susceptibility testing in relation to the clinical material and the site of infection.

Knowledge of the principles and workflows of microbiological diagnostics and implementation of the quality assurance programme allows laboratories to obtain high-quality reliable results, which in turn permit making the right therapeutic, prophylaxis and anti-epidemic decisions.

Analysis of the quality of diagnostics of the key bacterial human pathogens in the microbiological laboratories participating in the Polish National External Quality Assessment Scheme in Microbiological Diagnostics – POLMICRO presented as the cycle of publications allows to draw the following conclusions:

- Systematic quality control by the implementation of internal quality control procedures and their evaluation through participation in external quality control programmes are the basis for obtaining reliable results of microbiological tests
- The proficiency of laboratories participating in the POLMICRO programme in the field of microscopic slides remains continuously at a high level.
- The quality of bacterial pathogens identification to the species level in most Polish laboratories participating in the Programme is very good.
- Polish microbiological laboratories use proper tests for identification and antimicrobial susceptibility testing of *Staphylococcus aureus* clinical isolates. The reliability of methicillin resistance determination is at an appropriate level.
- Detection of antibiotic resistance in *Streptococcus pneumoniae* is a challenge for about 10% of the laboratories participating in the programme.
- Detection of antimicrobial resistance mechanisms in Gram-negative rods by laboratories participating in the POLMICRO programme requires continuous improvement, in particular the detection of extended spectrum β -lactamases as well as MBL and KPC carbapenemases.
- POLMICRO programme contributes to increasing the level of preparation of Polish laboratories for the diagnostics of one of the biggest problems of modern medicine, which are hospital infections and antibiotic resistance of bacterial pathogens.