ANTIMICROBIAL AGENTS – commonly called antibiotics – have dramatically reduced deaths from infectious diseases since their introduction 70 years ago. However, through overuse and misuse, many microorganisms have developed antimicrobial resistance (AMR). Antibiotic-resistant strains of tuberculosis (TB) are emerging, and Methicillin-resistant Staphylococcus aureus (MRSA) infections are a growing problem in hospitals. This AMR problem causes approximately 25,000 deaths each year and over €1.5 billion in healthcare expenses and productivity losses in Europe alone.

The situation is serious because people’s lives depend on the effectiveness of antibiotics to cure bacterial infections. Many surgical operations could not be performed without them. Yet, industrial investment in the development of new antibiotics has declined dramatically, and only a few products are in the late stage of development. The pipeline of new antibiotics is now almost empty!

A coordinated and large-scale European research effort is therefore underway to bring new effective antibiotics or alternative treatments to patients, and to re-engage industry to carry out research and develop new products in this area.

EU RESEARCH PROJECTS ON AMR

44 innovative SMEs are involved in 15 new EU research projects on AMR. Seven projects aim to develop novel antibiotics, vaccines or alternative treatments for drug-resistant microbial infections. Other projects set out to identify better methods to use currently available antibiotics or to study antibiotic resistance within the food chain. Three projects are working to develop novel nanotechnology-based AMR approaches:

**PneumoNP: Nanotherapeutics to treat pneumonia infections**

PneumoNP aims to develop a theranostic system to treat lung Gram-negative bacterial infections. The project will create a diagnostic kit for rapid and precise identification of the bacteria strain causing the infection and to monitor the therapy’s efficacy. Identifying the strain causing the infection determines the type of antibiotic needed, thus avoiding use of wide spectrum antibiotics. PneumoNP will also develop a novel nanotechnology-based inhalable antibiotic that utilises nanocarriers combined with a novel antimicrobial peptide. In addition, the project will produce an aerosol spraying system for a uniform distribution of the drug dose to the lung alveoli.

**FORMAMP: Innovative nanoformulation of antimicrobial peptides to treat bacterial infectious diseases**

Antimicrobial peptides (AMPs) have huge potential as new therapeutics against infectious diseases as they are less prone to induce resistance due to their fast and non-specific mechanism of action. The aim of FORMAMP is to explore formulation and delivery strategies based on nanotechnology to improve the efficiency and stability of AMPs in clinical development. It will develop functional delivery systems that can be applied directly on the infected site to treat lung infections, and infections in skin and burn wounds. The project will evaluate different nanoformulation platforms, including lipid-based systems, polymer-based structures and nanostructured mesoporous silica. It will also gauge the possibility of formulating nanostructured materials into efficient drug delivery systems such as a topical spray or gel and pulmonary aerosol.

**NAREB: Nanotherapeutics for antibiotic resistant emerging bacterial pathogens**

NAREB’s main objective is to optimise several nanoformulations of antibiotic therapeutics to improve the therapy of multidrug-resistant TB and MRSA infections. NAREB will address the problem of drug bioavailability inside the infected macrophages and transport across the bacterial cell wall and while avoiding the pathogen’s escape mechanisms. The project will also focus on improved formulations of multifunctional particles containing selected antibiotics and transcription factor decoys to increase the bioavailability of active molecules in the site of infection. Safety assessment, regulatory and production, and future clinical testing will also be taken into account.

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Continuing our nanomed series, Nicolas Gouze from the European Technology Platform Nanomedicine Secretariat explains the role nanomedicine plays in combating antimicrobial resistance