Chronic kidney disease is considered one of the most common diseases in Poland. Currently, over 4 million Poles are affected by it, and this number is increasing year by year. The loss of kidney function requires renal replacement therapy (dialysis) or kidney transplantation. A patient undergoing dialysis must go through the process about 3-4 times a week. This limits daily functioning, free time, and requires adjusting life plans to the schedule of multi-hour dialysis sessions. Another significant aspect is the complications associated with dialysis, which can lead to acute and even chronic conditions, ranging from electrolyte imbalances, anemia, bacterial infections, to cardiovascular diseases. Among the potential complications, stroke, hypertension, thrombosis, and heart attacks should be highlighted. Current data indicate that the annual mortality rate among hemodialysis patients is around 20%.

The main component of the hemodialysis system is the membrane, which serves to remove toxic metabolites from the blood. The proposed project plans to develop new membranes that will exhibit better hemocompatibility compared to currently used dialysis membranes. The proposed solution also aims to address the issue of membrane durability. Extending their lifespan will not only support the dialysis process but also address the significant problem of medical waste generation. At a time when all of Europe is focusing on waste minimization, as evidenced by the introduction of the Extended Producer Responsibility (EPR) system, product durability cannot be overlooked. Therefore, **the goal of the project is to produce new, highly hemocompatible membranes based on polymers: polyethersulfone (PES), polyvinylidene fluoride (PVDF), and cellulose acetate (CA) modified with metal nanoparticles (platinum and gold) and natural coating agents (beta-cyclodextrin, lignosulfonate, and sulfobetaines). The use of nanoparticles will enable the production of membranes with antibacterial potential and increased biocompatibility, while the use of coating agents will ensure the retention of nanoparticles within the membrane matrix.**

To achieve this goal, a series of studies in the fields of **chemistry**, including the synthesis of new compounds and the determination of their quality, **materials engineering** supporting the membrane production process, **biological sciences and medicine** to assess the medical potential of the newly designed materials are needed. The project includes the use of modern research techniques that will provide detailed knowledge regarding the characteristics of new compounds and materials, such as FT-IR, XRD, SEM/TEM, and Raman spectroscopy. The use of confocal microscopy, atomic force microscopy, and a series of biological tests for cytotoxicity and antibacterial potential will contribute to acquiring new knowledge in the field of polymer material modification.

In summary, the effect of the project will be interdisciplinary research leading not only to significant knowledge expansion and scientific development but also to providing solutions that support health protection. Understanding and studying the new properties of the proposed polymer materials may contribute to the development of safer and more effective dialysis therapy.

OUTLINE OF THE RESEARCH PROPOSED IN THE PROJECT