**Liposomes as adjuvants for antimicrobial and antiviral therapy (summary)**

Daniel Fologea, Associate Professor of Physics, Boise State University

**Objective.** To investigate the use of liposomes as artificial membrane systems capable of removing microbial toxins and viruses from the bloodstream.

**Overview.** In spite of all the efforts put forth into developing new antibiotics, drugs, and vaccines, over ten million people die each year around the world from infectious diseases. Among other factors, this is a direct result of the development of resistance to antibiotics, lack of vaccination in a timely manner, and/or unavailability of drugs or vaccines. Within the last decades Ebola, SARS, Zika, West Nile, and Corona virus (COVID-19) outbursts found us unprepared with vaccines and resulted in numerous fatalities. Even when antibiotics and vaccines are available and properly used, they do not ensure full protection. This exacerbating situation, of extreme social and economic importance, demands developments of alternative strategies for improving the clinical outcome of antimicrobial and antiviral therapies.

To contribute to its mitigation, we looked into the common features presented by infectiveness, irrespective of its source. It is well known that the final clearance upon infections is actually provided by the immune system of the host organism, and that is why small children, elderly, or persons with a compromised immune system are at high risk. Therefore, we hypothesized that taking some of the burden from the immune system during an infectious attack may improve the clinical effectiveness of the treatment by allowing the allocation of more resources fighting pathogens. Second, irrespective of the nature of the invader, the damage to cells and tissues is always mediated by specific interactions of microbial products or viruses with components of the cell membranes. For example, bacteria may produce toxins that kill target cells, while viruses must cross the cell membrane to multiply inside host cells. Similar interactions with the membrane occur when the toxic materials interfere with essential metabolic pathways inside the cells; to access the cytosol, these materials must have a prior interaction with the membrane.

Based on the above observations, we propose using artificial, membrane-based biomimetic nanostructures as alternatives for mitigating the damage induced by bacteria and viruses. The basic idea behind the use of artificial membrane systems as anti-infective agents is simple: the membrane acts as a decoy target for virulence factors that play essential and strategic roles in the establishment and progression of diseases caused by bacteria and viruses. We propose exploiting this principle by employing liposomes as decoy targets that inactivate toxins and viruses by binding and/or receptor-mediated entrapment. Liposomes are artificial, spherical membranes that mimic the lipid partition of the cell membrane. Their small size and surface functionalization aid in escaping the Reticulo-Endothelial System and evading an immune response from the host organism. Their composition may be tailored to increase the affinity towards target molecules, and their clearance from the vascular system is well documented. Liposomes are already FDA-approved as drug carriers in the human body, and their pharmacology has been extensively investigated for several decades. Most importantly, liposomes do not interfere with the bacterial metabolism and therefore do not exert any selective pressure, which precludes any further resistance development.