Sepsis afflicts 30.7 million people globally per year and remains the primary cause of death from bacterial infections. Progressive emergence of multi-drug antibiotic resistance is a significant and growing factor in fatal bacterial toxemia. A number of approaches, founded on separation biophysics, have been demonstrated to isolate bacteria from simple fluids. Design-based development of such approaches is required to understand the parameters and conditions that control performance for potential translation to clinical practice. The design goal of this interdisciplinary research project is the reduction of pathogen load during sepsis under conditions that are estimated to provide clinical benefit. This presentation will describe the fabrication and characterization of colistin-functionalized nanoparticles. Colistin is an antibiotic with an uncommon mechanism of action due, in part, to polycationicity. Colistin-functionalized nanoparticles and microparticles rapidly bind the cell envelope of Acinetobacter baumannii, a Gram-negative bacteria. A. baumannii is an opportunistic pathogen with increasing prevalence in the United States and possessing a rapidly emerging multi-drug resistant (MDR) phenotype. A quantitative assessment of wild-type (WT) and colistin-resistant (CR) A. baumannii interaction with colistin-functionalized particles estimated that complexation reaches half-maximum saturation in approximately seven minutes regardless of phenotype. This rate of nanoparticle binding to bacteria is the fastest reported, to our knowledge, and is essential to inform the design of devices intended for the separation of bacteria from blood, including the dangerous CR and, potentially, MDR phenotypes. Electron micrographs superimposed with elemental information from energy-dispersive X-ray (EDX) spectroscopy confirm localization of colistin-functionalized particles on the bacterial surface. Quantitative characterization of nanoparticle-bacteria association mediated through colistin enables the design-based consideration of new approaches to bacterial detection and isolation with the potential for human benefit.

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abstract (cont’d) with elemental information from energy-dispersive X-ray (EDX) spectroscopy confirm localization of colistin-functionalized particles on the bacterial surface. Quantitative characterization of nanoparticle-bacteria association mediated through colistin enables the design-based consideration of new approaches to bacterial detection and isolation with the potential for human benefit.

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