

Modeling adhesion of *bacteria* to artificial surfaces under flowing conditions

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Bloodstream infections associated with intravascular devices are becoming the most frequent cause of community acquired bacteremia –approximately 500,000 central venous lines become infected in the United States annually. Most experimental and modeling work has focused on the behavior of established communities. However, the genesis of biofilms on bloodstream devices is essentially the tipping of a balance of forces upon a bacterium making an otherwise convective random flight past a susceptible artificial surface. Local hydrodynamic shear imposed by the carrier fluid must be overwhelmed by specific or non-specific attraction between a bacterium and a target surface in order for adhesion to proceed.

Not surprisingly, observations of this behavior are affected by the tremendous variety in choice of experimental conditions, including flow cell geometry, carrier fluid viscosity and ionic strength, surface composition, and bacterial species and growth conditions. As a result, it is difficult to compare experimental results from report to report.

Here, I discuss the relevant physics of the problem of bacterial adhesion under flowing conditions as well as summarize the experimental techniques available for quantifying the various mechanical and electrochemical forces felt to participate in bacteria-surface interaction. I then discuss some of the mathematical treatments that have been previously reported, with a specific eye towards their utility in evaluating experimental results in microfluidic adhesion experiments monitored with videomicroscopy.