May 18th, 6:00 PM - 6:30 PM

Mathematical Models of Pathogen-Induced Single- and Multi-Organ Tissue Damage

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http://scholarscompass.vcu.edu/bamm/2017/thursday/32

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The human body's normal response to bacterial infection is characterized by an inflammatory response, intended to rid the body of pathogens but often resulting in collateral tissue damage near the infection site. However, the effects of this inflammatory tissue damage are not necessarily limited to that organ alone. Instead, system-wide dysfunction can result, as dysfunction in one organ can cause dysfunction in another, leading to conditions such as Multiple Organ Dysfunction Syndrome (MODS) or sepsis, which have incredibly high mortality rates. Accurately capturing the dynamics of this inflammation and subsequent damage in mathematical models is crucial in evaluating treatment strategies for these infections. We present a differential equations model of inflammatory-induced tissue damage in a single organ. We then expand this model to capture the dynamics of cascading organ damage between the lungs and the kidneys, emphasizing functional feedbacks between the two organ systems.