

Nanotherapeutics for Neurological Disorders



Elizabeth Nance

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Seminar: 4:00-5:00 p.m.

[Physics Astronomy Building \(PAA\)](#) A118

Reception: 3:30 p.m. – PAA A118

Abstract

Compared to conventional drug delivery platforms, nanoparticles can safely provide well-dispersed, sustained-release therapeutics that are directly targeted to diseased regions of the central nervous system (CNS), as well as to specific cell types within those regions.

Neurodevelopmental disorders are associated with chronic disabilities, have no effective cure, and are often underserved by novel drug delivery technologies, which primarily focus on adults. Therefore, there is great potential to bring nanotherapeutic approaches to neurodevelopmental disorders, with results that can also be translated to adult brain disorders. Neuroinflammation, mediated by activated microglia and astrocytes, plays a key role in the pathogenesis of many neurological and neurodevelopmental disorders, including Alzheimer's, autism, cerebral palsy (CP), stroke, and traumatic brain injury (TBI). Recent literature suggests that attenuating neuroinflammation in the early stages can not only delay the onset, but may also provide a longer therapeutic window for treatment. Targeting activated microglia/astrocytes may offer such an opportunity. However, this is a challenge on multiple levels:

- Transport of drugs and drug delivery vehicles across the blood-brain-barrier (BBB) is difficult to achieve.
- Injury is often diffuse, making it difficult for therapeutics to reach target cells, even if administered locally.
- Cerebral edema, BBB disruption, and changes to the extracellular matrix and glial cell function after injury may effect the movement, interactions, and cellular uptake of nanoparticles. This is not well understood, especially in the developing brain.

My research goals focus on understanding nanoparticle interactions, as both biophysical probes and imaging biomarkers, within disease physiology and pathology, with a focus on neurodevelopmental diseases. Rather than the traditional approach of using drugs to manipulate individual disease pathways, this research employs a method whereby nanoparticles are used to probe the disease environment first. This allows the disease to subsequently dictate the optimal therapeutic approach, an approach I've termed "Disease-directed engineering". This knowledge will then be used to better design and implement therapeutic nanoparticle platforms in clinically relevant models of pediatric and adult neurological disorders.

Speaker Biography

Elizabeth Nance is a postdoctoral fellow at the Johns Hopkins University School of Medicine in Anesthesiology and Critical Care Medicine. She is interested in integrating engineering, neuroscience, and medicine to develop translational nanotechnology platforms for application in brain disorders. Elizabeth was just named a Forbes 30 Under 30 in Science and Medicine, described as being one of the "most disruptive, game-changing and innovative young personalities in science." She was recently awarded a Burroughs Wellcome Fund Career Award at Scientific Interfaces (\$500k over 5 years) and has a Hartwell Foundation postdoctoral fellowship. Her postdoctoral training in neuroscience and critical care medicine focuses on understanding how disease pathology, specifically neuroinflammation, impacts nanotherapeutic design for treating pediatric brain disorders, including cerebral palsy and neonatal stroke. Elizabeth received her PhD in 2012 in Chemical & Biomolecular Engineering with Dr. Justin Hanes at Johns Hopkins University. She started a new area of research in the Center for Nanomedicine, developing a brain-penetrating nanoparticle platform (patented) for the treatment of brain tumors.

She has led fundraising efforts for the Cystic Fibrosis Foundation for 6 years, and writes for the Children's Science Center in Northern Virginia. Elizabeth received a B.S. in ChemE, with minors in English and Biotechnology, from NC State University in 2006. Elizabeth is from Charlotte, NC and currently lives in Baltimore with Parker, her 4-year old rescue boxer.