

BIOMEDICAL & VETERINARY SCIENCES

GRADUATE PROGRAM



ANNOUNCES

The Doctor of Philosophy Seminar and Examination of

Anna M Hassebroek

**"Severe Acute Respiratory Syndrome Coronavirus-2
Vaccine Development:
A Virus-Like Particle Vaccine Approach"**

Tuesday, November 21st, 2023

9:00AM

Classroom 102

Zoom: [https://virginiatech.zoom.us/j/83319402632?](https://virginiatech.zoom.us/j/83319402632?pwd=S0d6TjR5ZUd4QzdoRS83ODZHk4dz09)
[pwd=S0d6TjR5ZUd4QzdoRS83ODZHk4dz09](https://virginiatech.zoom.us/j/83319402632?pwd=S0d6TjR5ZUd4QzdoRS83ODZHk4dz09)



Bio

Anna grew up in a small town in Northwest Iowa. She graduated from Creighton University (Omaha, NE) in 2001 with a B.A. in Psychology. Looking for adventure, Anna moved to Chicago and worked for a few years while enjoying the city and traveling as often as possible.

After learning about public health from a high school friend, Anna decided to pursue a Master of Public Health with a concentration in biostatistics at the University of Iowa (GO HAWKS!!). During this program, she became exposed to One Health and the overlap between veterinary and human medicine. Following graduation in 2006, Anna joined family and friends in Minneapolis, MN, and worked as a biostatistician for a non-profit organization (now called Be The Match), and subsequently as a consultant for a pharmaceutical company as an epidemiology programmer. Anna continued to reflect on veterinary medicine's role in One Health and ultimately decided to make a run at a "career shift", graduating with her Doctorate in Veterinary Medicine from Purdue University's College of Veterinary Medicine in 2019.

Anna joined Virginia-Maryland College of Veterinary Medicine in 2019 to pursue specialty training in anatomic pathology and a PhD in the Biomedical and Veterinary Sciences program, with an emphasis in virology and vaccine development. She recently received Diplomate status with the American College of Veterinary Pathologists and has promised her incredibly supportive family that the completion of the PhD represents the final step in her academic training. Anna's professional interests include pathogenesis of infectious disease and emerging zoonotic viruses. She plans to remain in academia and hopes to utilize and build upon the skills learned at each stage of her career thus far, as well as train and mentor veterinary students and pathology residents.

Funded by

VMCVM Office of Research and Graduate Studies

Awards and Academic Achievements

- 2023 Boehringer Ingelheim Veterinary Research Award for Graduate Veterinarians
- 2023 American Society of Virology Travel Award Recipient

Lay Language Abstract

Coronaviruses have caused gastrointestinal and respiratory disease in humans and a variety of veterinary species for decades. In response to the onset of the COVID-19 (Coronavirus Disease) pandemic in late 2019, we created a vaccine against the virus that causes this disease: the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). SARS-CoV-2 infects human cells by attaching via one of its surface proteins (the Spike protein) to the human ACE2 receptor (angiotensin converting enzyme 2). After this binding occurs, the virus can enter the cell and begin to replicate, resulting in cellular damage, organ-level dysfunction, and clinical disease. An effective vaccine against SARS-CoV-2 would induce antibodies that bind to this Spike protein, thereby blocking its ability to infect host cells and preventing the downstream effects of infection. Our vaccine consisted of a protein from the hepatitis B virus (HBcAg), which naturally folds into a virus-like particle (VLP). This VLP can be used as a stable backbone and foreign epitopes can be inserted into the particle for presentation to the immune system as a vaccine. We inserted three SARS-CoV-2 Spike protein epitopes into the HBcAg backbone and tested the vaccine's ability to elicit an immune response and protect against infection with live virus. Results from these studies showed an antibody response to the vaccine and higher levels of anti-viral cytokines in vaccinated mice compared to controls. Additionally, we identified areas for vaccine optimization that will inform future studies utilizing this type of vaccine platform.

Publications

* denotes shared first authorship

Hassebroek AM & Meng X-J. Veterinary coronavirus vaccines: successes, challenges & lessons learned for SARS-CoV-2 control. *Vaccine Insights*. Jul 2023; 2(28), 259-77.

DOI: 10.18609/vac.2023.039.

Hassebroek AM, Sooryanarain H, Heffron CL, Hawks SA, LeRoith T, Cecere TE, Stone WB, Walter D, Mahsoub HM, Want B, Tian D, Ivester HM, Allen IC, Auguste AJ, Duggal NK, Zhang C, Meng X-J. A hepatitis B virus core antigen-based virus-like particle vaccine expressing SARS-CoV-2 B and T cell epitopes induces epitope-specific humoral and cell-mediated immune responses but confers limited protection against SARS-CoV-2 infection. *J of Med Virology*. Jan 2023; 95(2), e28503. PMID: 36655751.

Acevedo HD*, **Hassebroek AM***, Leventhal HR, Duhamel GE, Carvallo FR. Colonic T-cell right large B-cell lymphoma associated with a fistula and Equine Herpesvirus-5 in a horse. *J Vet Diagn Invest*. Feb 2023. PMID: 36786313.

Leventhal HR*, **Hassebroek AM***, Carvallo F, McKenzie HC. Multi-focal small intestinal pseudodiverticulosis in a 14-year-old Welsh pony mare. *J Vet Diagn Invest*. Nov 2021; 33(6):1123-7. PMID: 34293994.

Mahsoub HM, Heffron CL, **Hassebroek AM**, Sooryanarian H, Wang B, LeRoith T, Raimundi Rodriguez G, Tian D, Meng X-J. Fetal loss in pregnant rabbits infected with genotype 3 hepatitis E virus is associated altered inflammatory responses, enhanced virus replication and extrahepatic virus dissemination with positive correlations with increased estradiol level. *mBio*. Mar 2023;e0041823. PMID:36939322.

Wang B, Mahsoub HM, Li W, Heffron CL, Tian D, **Hassebroek AM**, LeRoith T, Meng X-J. Ribavirin treatment failure-associated mutation, Y1320H, in the RNA-dependent RNA polymerase of genotype 3 hepatitis E virus (HEV) enhances virus replication in a rabbit HEV infection mode. *mBio*. Feb 2023;e0337222. PMID: 36809085.

Publications continued

Sooryanarain H, Heffron CL, Mahsoub HM, **Hassebroek AM**, Wang B, Tian D, Ahmed SA, Meng X-J. Modulation of SOCS3 levels via STAT3 and estrogen-ER α 66 signaling during hepatitis E virus replication in hepatocellular carcinoma cells. *J Virol*. Oct 2022;96(19): e0100822. PMID: 36102649.

Wang B, Tian D, Sooryanarain H, Mahsoub HM, Heffron CL, **Hassebroek AM**, Meng X-J. Two mutations in the ORF1 of genotype 1 hepatitis E virus enhance virus replication and may associate with fulminant hepatic failure. *Proc Natl Acad Sci USA*. Aug 2022;119(34):e2207503119. PMID: 35969750.

Stewart J, Clark S, Claffey E, Cardona G, Helms A, **Hassebroek AM**. Theriogenology Question of the Month: Aggressive behavior in a female alpaca. *J Am Vet Med Assoc. Theriogenology Question of the Month*. Jul 2022; 260(10). PMID:35482559.

Tian D, Li W, Heffron CL, Wang B, Mahsoub HM, Sooryanarain H, **Hassebroek AM**, Clark-Deener S, LeRoith T, Meng X-J. Hepatitis E virus infects brain microvascular endothelial cells, crosses the blood-brain barrier, and invades the central nervous system. *Proc Natl Acad Sci USA*. Jun 2022;119(24):e2201862119. PMID: 35671427.

Rahman A, Uzal F, **Hassebroek AM**, Carvallo F. Retrospective study of fatal pneumonia in backyard horses of California. *J Vet Diagn Invest*. May 2022. PMID: 3553586.

Maeda DLNF, Tian D, Yu H, Dar N, Rajasekaran V, Meng S, Mahsoub HM, Sooryanarain H, Wang B, Heffron CL, **Hassebroek A**, LeRoith T, Meng X-J, Zeichner S. Killed whole-genome reduced-bacteria surface-expressed coronavirus fusion peptide vaccines protect against disease in a porcine model. *Proc Natl Acad Sci*. May 2021; 118(18). PMID: 33858942.

Tian D, Subramaniam S, Heffron CL, Mahsoub HM, Sooryanarain H, Wang B, Cao QM, **Hassebroek A**, LeRoith T, Foss DL, Calvert JG, Meng XJ. Construction and efficacy evaluation of novel swine leukocyte antigen (SLA) class I and class II allele-specific poly-T cell epitope vaccines against porcine reproductive and respiratory syndrome virus. *J Gen Virol*. Nov 2020; 101(1):1191-1201. PMID: 32894211

Presentations

Hassebroek AM, Sooryanarain H, Heffron CL, Hawks SA, LeRoith T, Cecere TE, Stone WB, Walter D, Mahsoub HM, Wang B, Tian D, Ivester HM, Allen IC, Auguste AJ, Duggal NK, Zhang C, Meng X-J. A virus-like particle-based vaccine against SARS-CoV-2. Veterinary Scholars Symposium, Oral Presentation, July 2023.

Hassebroek AM, Sooryanarain H, Heffron CL, Hawks SA, LeRoith T, Cecere TE, Stone WB, Walter D, Mahsoub HM, Wang B, Tian D, Ivester HM, Allen IC, Auguste AJ, Duggal NK, Zhang C, Meng X-J. A hepatitis B core antigen-based virus-like particle vaccine expressing SARS-CoV-2 T and B cell epitopes induces epitope-specific humoral and cell-mediated immune responses. American Society of Virology Annual Meeting, Poster Presentation and Flash Talk, June 2023.

Hassebroek AM, Sooryanarain H, Heffron CL, Hawks SA, LeRoith T, Cecere TE, Stone WB, Walter D, Mahsoub HM, Wang B, Tian D, Ivester HM, Allen IC, Auguste AJ, Duggal NK, Zhang C, Meng X-J. A hepatitis B core antigen-based virus-like particle vaccine expressing SARS-CoV-2 T and B cell epitopes induces epitope-specific humoral and cell-mediated immune responses. Virginia Tech, Biomedical and Veterinary Sciences Research Symposium, Oral Presentation, March 2023.

Hassebroek AM, Oakes, V. Hancock S, & Cecere T. Amoebic enteritis in an adult panther chameleon. Oral slide presentation, Southeastern Veterinary Pathology Conference, May 2022.

Hassebroek AM, Carvallo F. Gastrointestinal T-cell rich, B-cell lymphoma associated with a fistula and Equine Herpesvirus Type-5 in a horse. Oral slide presentation, Northeastern Veterinary Pathology Conference, September 2021.

Hassebroek AM, Lahmers K, Carvallo F. Microsporidium-Associated Arteritis and Aneurysm in an Adult Bearded Dragon. Oral slide presentation, American Association of Veterinary Laboratory Diagnosticians (AAVLD) annual meeting, 2020.

Examination Graduate Committee

Major Advisor/Chair:

X.J. Meng, MD, PhD

University Distinguished Professor

Molecular Virology

Center for Emerging, Zoonotic and Arthropod-borne Pathogens

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Clinical Professor

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Associate Professor

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Lijuan Yuan, PhD

Professor

Virology and Immunology

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Chenmin (Mike) Zhang, PhD

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