University of Iowa, RAND Corp. researchers receive $2.5M CDC grant to study immunization related issues

A team of University of Iowa researchers have been awarded a five-year, $2.5 million grant for a “Rapid-cycle survey collaborative for patient and provider input on immunization issues” from the Centers for Disease Control and Prevention (CDC). The project will survey primary care providers and the general public every three to four months on various immunization-related issues.

Co-investigators from the University of Iowa College of Public Health are Christine Petersen, professor of epidemiology and director of the U’s Center for Emerging Infectious Diseases, and Natoshia Askelson, assistant professor of community and behavioral health. Aaron Scherer, associate professor of Internal Medicine in the University of Iowa Carver College of Medicine, is the principal investigator.

The research team also includes Courtney Gidengil and Andrew Parker from the RAND Corp. and will receive survey and statistical support from the Iowa Social Science Research Center.

The information from the surveys will help the researchers identify and address patient and health care provider barriers to a variety of immunization-related issues and could help inform future immunization-related recommendations and policies.

Where are they now?

An important role for Nanovaccine Institute researchers is training and mentoring the next generation of scientists, who will leave our labs to begin careers in industry, government, and academia. We checked in on three recent alumni:

Stephen Crooke, PhD

Stephen Crooke completed a postdoctoral fellowship in vaccinology with Gregory Poland and Richard Kennedy at the Mayo Clinic Vaccine Research Group in 2020, and has begun a career as a microbiologist at the Centers for Disease Control and Prevention in Atlanta.

His current research in the Viral Vaccine Preventable Diseases Branch at CDC focuses on the design and testing of novel vaccine candidates for measles, mumps, and rubella; the implementation of systems-level approaches to better understand mumps and measles immunology; and the design and development of new diagnostic assays for measles and mumps surveillance.

As a postdoc at Mayo, Crook used systems biology approaches to study the innate and adaptive immune responses to a variety of viral vaccines. He served as the project lead for a study of the immune response to influenza vaccines among older adults and contributed to studies of the T cell response to influenza vaccines at the single-cell level. During his tenure with the Mayo Clinic Vaccine Research Group, Crooke developed an interest in the identification of immunologically relevant viral peptides, and used mass spectrometry and immunoinformatics to classify peptide epitopes from Zika virus and SARS-CoV-2 as potential targets for vaccine development.

Crooke was awarded the Maurice R. Hilleman Early-Stage Career Investigator Award by the National Foundation for Infectious Diseases for his work on Zika virus vaccine development. He is a member of the American Society for Virology, the American Association of Immunologists, and the American Chemical Society.

Sujata Senapati, PhD

Sujata Senapati earned a PhD in Chemical Engineering/Immunobiology from Iowa State in 2020, under the supervision of Balaji Narasimhan. She is now a Research Scientist at Spark Therapeutics, Inc. in Philadelphia, developing new therapies for genetic diseases.

At Iowa State, Senapati worked with Nanovaccine Institute research teams on developing influenza nanovaccines for older adults. She researched how to use vaccine adjuvants to generate a robust immune response without exacerbating some of the issues present in the immune systems of older adults. This unique approach of rational design for a combination nanovaccine showed promising results in aged animals and demonstrated both safety and efficacy.

Senapati says that her time at the Nanovaccine Institute provided a strong foundation for my career. “Working with a cross-functional team gave me knowledge of both nanomaterials and immunology and taught me every quality required to be a good scientist. I also had plenty of opportunities to spend time outside of the lab...
with my teammates and participate in various fun activities—I still do (virtually).”

In her new job at Spark Therapeutics, Senapati is working to develop new and improved vectors for gene delivery to treat rare genetic disorders. “Every day brings a new challenge and with it comes the excitement of solving a problem and finding something new—what more can a scientist ask for?”

Edmund Norris, PhD

Edmund Norris received his PhD in Entomology and Toxicology from Iowa State University in 2018 under the supervision of Joel Coats and Lyric Bartholomay. For his dissertation, he explored the ability of plant compounds to enhance a variety of synthetic insecticides against mosquitoes, but he also focused more broadly on natural product chemistry and the mechanisms by which natural plant compounds affect the physiology of medical and veterinary pest insects. A major focus of his PhD research was tracking the penetration of biodegradable nanoparticles in mosquitoes that had been exposed via various routes. The goal was to use these nanoparticle chemistries to deliver insecticides more effectively against public health pests such as mosquitoes and biting flies.

Norris later did post-doctoral research at the Emerging Pathogens Institute at the University of Florida. There he worked to characterize the neurophysiological effects of insecticides and repellents, with particular focus on the neurophysiological mechanisms of natural product pest control technologies.

Norris recently started his career as a Research Chemist/Entomologist at the USDA Center for Medical, Agricultural, and Veterinary Entomology in Gainesville, FL. He oversees the screening and development of novel repellent, insecticide, and synergist candidates against a variety of pests, such as mosquitoes and biting flies, that vector human and veterinary diseases. His research relies on a number of whole-insect, in vitro electrophysiological, and biochemical assays to characterize the mechanisms of action of these novel chemistries to better understand how they may fit into future integrated pest management control approaches. Norris is interested in the development of novel repellents and insecticidal formulations that may circumvent insecticide resistance, focusing on natural products as his inspiration.

CTO Corner

Mike Roof
Chief Technology Officer
Vaccines & Immunotherapeutics platform
Iowa State Univ.

The first quarter of 2021 could not have gone better relative to high quality innovation and technology development! During the first phase of the Vaccine and Immunotherapeutic (V&I) Bioscience Platform effort, I have had the opportunity to work with over 80 scientists and faculty at Iowa State University, the University of Iowa, and the USDA National Animal Disease Center. The depth and breadth of technology is world class in several strategic areas:

- Animal vaccines and disease prevention
- Human vaccines and cancer
- Advanced diagnostics and biosensors
- The microbiome and probiotics
- Nanovaccines and immunostimulants

To date we have met with five of the eight top global animal health companies with efforts focused on project funding, technology licensing, and commercialization. We hope this is just the beginning and that we can move these discussions from project-by-project funding to longer-term and strategic collaborations and relationships. Seven smaller and mid-sized companies have also been engaged on the behalf of faculty-specific projects that would benefit from an industry partnership and the response to data has been very positive!

In the next three months we hope to also complete three efforts that we believe will benefit many in the V&I platform. First, for Iowa State faculty we have a Vice President of Research-funded seed grant program in which faculty can submit applications for up to $50K in funding to support R&D efforts (application deadline April 5). Second, we plan to conduct our first Bioscience Platform industry meeting focused on Vaccines and Immunotherapeutics on May 12-13. Our target audience is industry business development and senior technical leaders. Selected mature research efforts will be given the opportunity to promote their technology, intellectual property, and commercial opportunities. Finally, we are working to create an advisory committee with business experts to support and accelerate faculty efforts to license or commercialize technology. More to come as this program matures and is implemented.

I would like to share some of the exciting technology and projects within the V&I platform. Iowa State University researchers Albert Jergens and Karin Allenspach-Jorn (Veterinary Clinical Science), and Jonathan Mochel (Biomedical Science) have developed innovative and patent-protected technology for the creation and utilization of organoids. 3D Health Solutions, Inc. is their start-up company that seeks to improve current preclinical screening methods of therapeutic drugs for pharmaceutical research and development. 3D Health Solutions was incubated by the Iowa State Startup Factory and is supported by National Science Foundation funding and a five-year research collaboration agreement with the FDA.

3D Health Solutions’ transformational technology is based on “miniature 3D organs” (or organoids) that can be maintained ex vivo from the culture of canine stem cells. The company uses a fee-for-service laboratory model for screening candidate therapeutic drugs from pharmaceutical and biotechnology companies. 3D Health Solutions recently won the startup pitch competition at IOWA Bio. They have tremendous industry opportunities across both human and animal health.
Iowa State, U Iowa team awarded $3.5 million NIH grant for nanovaccines against influenza in the aged

Marian Kohut of the Iowa State University Kinesiology Department and her research team were awarded $3.5 million of NIH grant funding in February for their five-year project “Combination nanovaccine-based immunization against influenza virus in the aged: immunity and protection.” The team includes Nanovaccine Institute members Balaji Narasimhan, Surya Malapragada, Mike Wannemuehler, David Verhoeven, and Anne Bronkowski at Iowa State, and Kevin Legge at the University of Iowa. Iowa State statistician Daniel Nettleton will help with experimental design and data analysis.

Kohut explained the reason for this research: “The current influenza vaccines have reduced efficacy in older adults. Due to the age-related changes in immune response, or ‘immunosenesce,’ we need different strategies to optimize vaccine formulations for older adults. The ‘one size fits all’ approach doesn’t necessarily apply to vaccine formulations, and different populations may require different vaccines for optimal protection.”

“There’s already a higher-dose influenza vaccine for adults over age 65, and although this vaccine generally results in a higher antibody response, the efficacy remains limited. We also know from gene expression studies that the pattern of immune response is different in older adults than younger people, and many older adults have a low-level chronic inflammation which limits the ability to respond vigorously to a vaccine. A higher dose alone doesn’t overcome these limitations, so we need a newer vaccine formulation that is specifically designed to work effectively on the background of an aging immune system,” Kohut said.

This project builds on preliminary studies using a vaccine containing two safe delivery platforms based on biodegradable nanoparticles and self-assembling micelles. Kohut said, “Researchers at the Nanovaccine Institute have been working to develop a more protective influenza vaccine for quite some time. Current and former research projects by Nanovaccine researchers at Iowa State and the University of Iowa have developed effective nanovaccine candidates delivered by either an intranasal route or injection. We’ll build on this foundational research to further refine the nanovaccine to address the age-associated deficits of immune response.”

Nanovaccine Institute wins $8.7 million of new grant funding this year

With three months still to go in the university’s fiscal year, the Nanovaccine Institute researchers at Iowa State have brought in more than $8.7 million of new funding for nanovaccines against influenza and SARS-CoV-2 (including vaccines, therapeutics, and diagnostics) and cancer-related research (including targeted nanotherapies to modulate the tumor microenvironment and immunomarker probes for immunotherapy). This is in addition to about $4.2 million of fiscal year 2021 funding from ongoing multi-year grants.

Although this total is for sponsored funding at Iowa State, our research projects are increasingly multi-institutional, so these grants include inbound subawards from Nanovaccine Institute members at Kansas State University, University of Iowa, and University of Nebraska Medical Center. There are also outbound subawards from Iowa State to the University of Iowa, University of Nebraska Medical Center, Southwest Research Institute, Skroot Laboratories, St. Jude Children’s Research Hospital, USDA National Animal Disease Center, and Zeteo Biomedical.

Engineers developing COVID-19 test for mass production, mass distribution

Supported by more than $900,000 in federal grants, Iowa State University engineers are using their expertise in graphene-based biosensors to develop better, cheaper, quicker, more accessible testing for the coronavirus that causes COVID-19. The studies are part of two federal programs looking for better ways to test for SARS-CoV-2, the virus that causes COVID-19 infections, and, potentially, any future viral outbreaks.

One study, supported by a one-year, $664,521 grant from the U.S. Department of Health and Human Services and the Centers for Disease Control and Prevention, is looking for effective tests that can be easily scaled up for mass manufacturing. The other, supported by a two-year, $918,000 grant from the National Institutes of Health ($270,000 of which is designated for work at Iowa State) through the Rapid Acceleration of Diagnostics (RADx) program, is looking for tests that can be easily distributed to remote or vulnerable populations, such as employees of meat-processing plants.

“As soon as the pandemic started, we started thinking about using the sensor platforms we have developed to allow for easier testing and help with the pandemic,” said Carmen Gomes, an associate professor of mechanical engineering, a study leader and the chief research officer of NanoSpy, Inc., a biosensor startup based in the Iowa State University Research Park.
“We’re optimistic these sensors will work,” said Nanovaccine Institute member Jonathan Claussen, also an associate professor of mechanical engineering, a project leader and chief scientific officer for NanoSpy. “The biggest challenge will be determining threshold levels for making a medical assessment of infection.”

The engineers’ project started with a $15,000 grant from Iowa State’s Office of the Vice President for Research to develop prototype COVID-19 tests. It has evolved into development of saliva tests similar to the test strips used to monitor glucose levels in people with diabetes. The tests look for the S1 spike protein of the coronavirus.

Claussen said tests could easily be done at home, workplaces, or a doctor’s office, with no need for expensive laboratory instruments. Results will be displayed in about 20 minutes. He expects total cost of the tests to be less than $6. That buys a very sensitive test. Claussen said he expects it to detect viral concentrations down to trillionths of a mole. (Moles are a standard measure of 6.02214076 x 10^23 particles within a substance, such as atoms or molecules).

A key to the technology is use of graphene, a supermaterial that’s a carbon honeycomb just one atom thick and known for its strength, electrical conductivity, flexibility, and biocompatibility. Claussen and Gomes have used the material to print high-resolution electrodes for electrochemical sensors. They’ve developed the technology for a variety of applications, including making sensors to monitor food freshness and safety.

For the HHS/CDC project, Claussen said researchers will use aerosol jet printing technology to print prototypes of graphene electrodes for the sensors. The goal will be to find ways to convert the printing process to the gravure or screen techniques used in mass production.

For the NIH project, Gomes said researchers are working on a one-step laser printing process to produce sensors. She said the NIH has been a valuable partner for the project, providing inactivated samples of the virus as well as saliva samples for testing.

She said the tests can be designed to detect variants of the virus using multiple sensing strategies for the same sample. And they’ll be designed to be long-lasting and work in all kinds of conditions – even a summertime testing center set up in a tent. The engineers, after all, have used their graphene technology to develop soil sensors designed to be buried in the ground and keep working through hot, dry, wet or freezing soil conditions.

“I’m very excited about these projects,” Gomes said. “I do believe our platform can make tests low-cost, scalable and available to large segments of the population. People can easily do these tests.”