



## Driving Tomorrow Research Initiatives—Grand Challenges Research Grants Phase 3 Fall 2018

Executive Vice President and Provost Karen Hanson in December 2018 announced a third phase of UMN *Driving Tomorrow* Research investments for interdisciplinary collaborations aligned with goals of the Twin Cities campus strategic plan. Grand Challenges Research Interdisciplinary Team Awards totaling \$1.95 million in support over two years have been awarded to six projects engaging more than 157 faculty and external partners.

This is the latest internal research investment that will engage University of Minnesota faculty and external partners in new or expanded work addressing one or more of the [University's five Grand Challenges focus areas](#). The Phase 3 projects focus especially on complex issues related to *Advancing Health through Tailored Solutions*, *Enhancing Individual and Community Capacity for a Changing World*, and *Feeding the World Sustainably*. Phase 2 of Driving Tomorrow research investments in Fall 2017 awarded a total of \$2.96 million to six faculty teams and two research collaboratives across the Grand Challenge focus areas of *Assuring Clean Water and Sustainable Ecosystems* and *Fostering Just and Equitable Communities*. An initial phase of *Driving Tomorrow* investments, in fall 2016, spanned all five Grand Challenges focus areas and awarded a total of \$3.9 million to 29 teams of faculty.

### Interdisciplinary Team Awards for 2019–21

Six interdisciplinary teams of faculty received awards, with investments of \$1.95 million supporting ambitious work by co-PIs, extended teams of faculty members, representatives of external partner organizations, and students.

#### Advancing Health through Tailored Solutions

**Clinical Precision Medicine Based on Single Cell Analysis.** Co-PIs: Boris Winterhoff, Obstetrics, Gynecology & Women's Health; Jinhua Wang, Masonic Cancer Center; Tim Starr, Obstetrics, Gynecology & Women's Health; Andrew Nelson, Laboratory Medicine & Pathology; Constantin Aliferis, Institute for Health Informatics; Doug Yee, Masonic Cancer Center; and Stephen Schondelmeyer, Pharmaceutical Care & Health Systems. *\$321,000 interdisciplinary team award.*

**Extended Team—Members and Partners:** Anja Bielinsky, College of Biological Science; Sally Mullany, Department of Obstetrics, Gynecology & Women's Health; Melissa Geller, Department of Obstetrics, Gynecology & Women's Health; Mahmoud Khalifa, Department of Laboratory Medicine & Pathology; Ahmad Abusalah, Institute for Health Informatics; Steve Shen MD, Institute for Health Informatics; Sisi Ma, Institute for Health Informatics; Reuben Harris, College of Biological Science; Kenneth Beckman, Biomedical Genomics Center; Locke Uppendahl, Department of Obstetrics, Gynecology & Women's Health; Zenas Chang, Department of Obstetrics, Gynecology & Women's Health; Shobhana Talukdar, Department of Obstetrics, Gynecology & Women's; Juri Habicht, Department of Obstetrics, Gynecology & Women's Health; Chad Myers, College of Science and Engineering; Stefan Kommos, Department of Women's Health, Tübingen, Germany; Florian Heitz, Kliniken Essen-Mitte, Germany; Gottfried E Konecny, Department of Medicine, University of California Los Angeles.

Molecular profiling of cancer (MPC) is an interdisciplinary, state-of-the-art form of precision medicine (PM) that has produced considerable advances in the ability to treat patients with a variety of cancers. MPC enables personalization of treatment through the selection of effective targeted therapies and avoidance of unnecessary chemotherapy. These qualities minimize chemo-related adverse effects, increase quality of life, and reduce the length of hospitalizations and costs of patient care. Because the science of MPC is relatively new, the majority of possible MPC tests (covering the entire spectrum of diseases and treatments) are yet to be discovered, offering immense opportunities for research and care

improvements using MPC. The current state of the art in MPC-based PM has hit a performance ceiling that still places an unacceptable number of patients in a “grey zone” of indeterminate biologic/outcome stratification which precludes selection of optimal treatment plans for these patients. Our Grand Challenge is to build on a foundation of prior accomplishments by our team, (including the creation of the only precision test for ovarian cancer treatment in existence that is accurate enough to be clinically actionable), leveraging the UMN scientific environment, as well as a network of external scientists with whom we have a track record of productive collaboration, to develop a leading-edge PM program focused on single cell analytics.

This program will enable the scalable creation of optimal therapy selection tests, with an accuracy that vastly exceeds the present generation of such tests, thus conferring the advantages of PM to patients that currently cannot be helped by conventional MPC tests. The overall

driving theme of the project’s objectives is a significant improvement in outcomes of cancer patients via transformative advances in the way personalized molecular profiles are created.

**Improving Health and Well-Being with Personalized, Pervasive Technology.** Co-PIs: Maria Gini, Computer Science & Engineering; Serguei Pakhomov, Pharmacy; Brad Holschuh, Design, Housing & Apparel. *\$325,000 interdisciplinary team award.*

**Extended Team—Members and Partners:** Lucy Dunne, Design, Housing, and Apparel; Joseph E. Gaugler, Health Policy Management; Michael Kotlyar, Experimental and Clinical Pharmacology; Wilma Koutstaal, Psychology; Martin Michalowski, School of Nursing.

This Grand Challenge research project focuses on improving the health, wellbeing, and independence of individuals with reduced capacity due to illness or advanced age. Toward this aim, we will develop and deploy novel, personalized technology that integrates conversational voice assistants with wearable sensors and smart-textile clothing technology to provide real time, in home, unobtrusive sensing and on-body stimulation solutions (e.g., pressure, heat, etc.). This project brings together an interdisciplinary team of faculty and students in computer science, apparel design, wearable technology, cognitive psychology, psycholinguistics, nursing, and pharmacy to develop a proof-of-concept transformative framework for individually tailored detection and management of mental stress and anxiety in everyday

life—a major risk factor for conditions that greatly impact public health including heart disease, Alzheimer’s disease, diabetes, obesity, and addiction. The framework we will develop and pilot-test over the two years of the project will integrate three major components: 1) natural language interaction with the user via a conversational voice assistant; 2) physiological signal sensing of activity, heart rate, body temperature, and electrical conductivity of skin; and 3) garment-based delivery of heat and compression interventions to reduce stress and anxiety detected via voice and wearable sensors. The results of this work will provide feasibility data and integrated technology to expand our efforts with community partners to a broad range of populations and therapeutic areas.

**Toward Pharmacogenomics-Enabled Healthcare at Statewide Scale: Implementing Precision Medicine.** Co-PIs: Constantin Aliferis, Medicine; Pamala Jacobson, Pharmacy; Catherine A. McCarty, Medicine/Duluth campus; and Susan M. Wolf, Law. *\$325,000 interdisciplinary team award.*

**Extended Team—Members and Partners:** Suzette J. Bielinski, Mayo Clinic; Jeffrey R. Bishop, College of Pharmacy; Jacob Brown, College of Pharmacy; John Capacchione, Medical School; Pedro J. Caraballo, Mayo Clinic; Joel F. Farley, College of Pharmacy; Bret E. Friday, Essentia Health; Steven S. Fu, Minneapolis VA Health Care System; Jyothsna Giri, Mayo Clinic; David Gregornik, Children’s Minnesota; R. Stephanie Huang, College of Pharmacy; Steve Johnson, Institute for Health Informatics; Robert B. Jones, Northern Pines Mental Health Center; Edris Kosar, Banadir Pharmacy; Pinar Karaca Mandic, Carlson School of Management; Meena N. Murugappan, College of Pharmacy; Bonnie LeRoy, College of Biological Sciences; Eric T. Matey, Mayo Clinic; William McGeveran, Law School; Genevieve B. Melton-Meaux, Fairview Health Systems; ShuYing (Sharon) Ng, Northern Pines Mental Health Center; Wayne T. Nicholson, Mayo Clinic; Paul Owen, OneOme; Rep. Duane Quam, Minnesota House District 25A; Zachary Rivers, Masonic Cancer Clinic; Samuel A. Roiko, Children’s Minnesota; Jason Ross, OneOme; Allyson M. Schlichte, Fairview Specialty Services Pharmacy; Erica Schnettler, OneOme; Stephen Schondelmeyer, College of Pharmacy; Daniel Schwarcz, Law School; Laura Schwartzwald, GuidePoint Pharmacy Services; Randall Seifert, College of Pharmacy; Richard R. Sharp, Mayo Clinic; Todd Sorensen, College of Pharmacy; Lindsay A. Sorge, College of Pharmacy; Marilyn Speedie, College of Pharmacy; David J. Sperl, Essentia Health; David Stenehjem, College of Pharmacy; Bharat Thyagarajan, Medical School; Brian Van Ness, College of Biological Sciences; Laura Vaughn, Northern Pines Mental Health Center; Liewei Wang, Mayo Clinic; Stephen C. Waring, Essentia Institute of Rural Health; Richard Weinshilboum, Mayo Clinic; Boris Winterhoff, Medical School; Dianne L. Witten, Essentia Health; Doug Yee, Masonic Cancer Center; Heather Zierhut, College of Biological Sciences.

Precision medicine is transforming the diagnosis and treatment of many diseases. The leading edge of precision medicine is pharmacogenomics (PGx)—a powerful tool using an individual’s genetic makeup to prescribe the correct medication, at the appropriate dose, at the right time. PGx reduces the risk of adverse drug reactions and maximizes the effectiveness of treatment for every patient. Yet despite its proven scientific basis, immense

promise, and successful deployment by a small group of pioneering provider organizations, incorporating PGx into clinical practice across the nation has proved slow and challenging—even at advanced academic medical centers. This Grand Challenge project will take a statewide approach to deploying PGx, in order to bring the benefits of this major healthcare innovation to all Minnesotans and to launch the research and innovation needed to make

Minnesota a national leader in PGx. As a strong, interdisciplinary team across multiple institutions in our state, we will systematically identify the barriers to PGx implementation and create evidence-based solutions. We will build on the work of our state's early adopters of pharmacogenomics—Mayo Clinic and Children's Minnesota—and forge a collaboration including urban and rural health care providers, large and small pharmacies, private and public institutions, and researchers at the

University of Minnesota. The ultimate goal is to improve patient outcomes, reduce health care costs, and place our healthcare systems and state at the cutting edge of precision medicine research and implementation. Our project creates a framework for statewide PGx that will advance the work of multiple health systems caring for millions of patients. More details can be found at [<http://mpmc.umn.edu/pgx-mn>].

## Enhancing Individual and Community Capacity for a Changing World

**Back to Indigenous Futures: Cultural Revitalization and Sustainability through Trans-Indigenous Partnerships, Participatory Design, and Embodied Computing.** Co-PIs: Vicente Diaz, American Indian Studies; Katie Johnston-Goodstar, Social Work; Dan Keefe, Computer Science & Engineering; Roxanne Gould, Indigenous and Environmental Education; Virajita Singh, Center for Sustainable Building Research. Intersecting with *Fostering Just and Equitable Communities*. \$324,958 interdisciplinary team award.

**Extended Team—Members and Partners:** Christine DeLisle, American Indian Studies, University of Minnesota: Twin Cities; Stephen Guy, Department of Computer Science & Engineering, College of Science and Engineering, University of Minnesota: Twin Cities; James Rock, Swenson College of Science and Engineering and the Marshall Alworth Planetarium, University of Minnesota: Duluth; Hyun Soo Park, Department of Computer Science & Engineering, College of Science and Engineering, University of Minnesota: Twin Cities; Lower Sioux Indian Community, Community Council; Upper Sioux Indian Community, Board of Trustees; Mat Pendleton, Director, Lower Sioux Indian Community Youth Center; Adam Savariego, Upper Sioux Indian Community; Charlene O'Rourke, Lakota Elder; Waziyatawin, Makoce Ikiccupi; Gabriel Elias, Micronesian Community of Milan, MN; Michael Elias, Micronesian Community of Milan, MN; Robert Ryan, Project Angechu Community Development Plan, Micronesian Community of Milan.

*"In a field of tall grass, with only the wind for company, there is a language that transcends the differences between scientific and traditional understandings, the data or the prayer."* --Robin Kimmerer, Potawatomi botanist, in *Braiding Sweetgrass* (2014).

Back to Indigenous Futures heeds Kimmerer's plea for alternative ways of apprehending the world around us, modes that can recognize and go beyond the violent histories that favor systems that know only in terms of data over deeper and older indigenous knowledge systems that are often also expressed through prayer. Addressing two Grand Challenge goals -- enhancing individual and community capacity for a changing world and fostering just & equitable societies -- the project partners with Upper and Lower Sioux Dakota communities as they themselves partner with migrant Pacific islanders from Micronesia, now residing in rural west MniSota, in a shared effort to revitalize their respective cultural traditions and Traditional Ecological Knowledge (TEK) about watercraft and water-related ceremonies, rituals, and practices. Centering indigenous and decolonial values and principles, and deploying participatory action research methods, Back to Indigenous Futures integrates the work of humanities and humanistic social and applied sciences in American

Indian and Global Indigenous studies with participatory action for TEK preservation, teaching, and research in both Architecture and Computer Science to design mixed reality experiences that integrate physical architecture with virtual embodied simulations of canoes in water, waves, and wind while also assisting in community-identified needs. Sensing the potential impact on teaching, practice, and research within these disciplines as just as important as the products, we ask, how might TEK-integrated teaching and research lead to more socially conscious and equitable designers, technologies, engineers, scientists, and scholars, and also make our work beneficial for indigenous community? This project has potential to cast the University of Minnesota into the winds of national and international leadership in research through indigenous community-based partnership at the interphase of computer science, design, humanities, indigenous environmentalism and community and nation-building.

**The Minnesota Model: Building Interdisciplinary Capacity to Defend Human Rights in Challenging Times.** Co-PIs: Fionnuala Ní Aoláin, Law; Joachim J. Savelsberg, Sociology; Jessica Stanton, Humphrey School; Barbara Frey, Global Studies. Intersecting with *Fostering Just and Equitable Communities*. \$325,000 interdisciplinary team award.

**Extended Team—Members and Partners:** Alejandro Baer, Sociology, Genocide Studies; Cosette Creamer, Political Science; Elizabeth Heger Boyle, Sociology; Karen Brown, ICGC; Joan DeJaeghere, OLPD; Giovanna Dell’Orto, Journalism; Christina Ewig, Center on Gender, Women & Public Policy; Tanisha Fazal, Political Science; Ana Forcinito, Spanish & Portuguese Studies; Greta Friedemann-Sanchez, Humphrey; V.V. Ganeshanathan, English/Creative Writing; James S. Gerber, Institute on the Environment; Jennifer Green, Law; Catherine Guisan, Political Science; Lisa Hilbink, Political Science; Serra Hakyemez, Anthropology, Global Studies; Sara Hoffman, Nursing; Krisztina Huszti-Orban, Law; Neha Jain, Law; Sonja Kufnec, Theatre Arts & Dance; Harry Lando, Public Health; Deborah Levison, Public Policy; Amanda Lyons, Law; Patrick McNamara, History; Stephen Meili, Law; Steven Miles, Medicine; Leigh Payne, Human Rights Program; Christopher Roberts, Law; Cheryl Robertson, Nursing; William Toscano, Public Health.

This project will count on a minimum of 14 external non-governmental or institutional partners to be selected within the first two months of the project. Each Minnesota Model and Lab project will have a graduate or professional student as a team member for a total of at least 14 graduate students participating in the Lab.

The post-World War II project of advancing global human rights protections faces serious retrenchment on all continents. Building on strengths of the University of Minnesota as a global leader in innovative education, path-breaking research and incisive policy solutions, the Minnesota Model expands and deepens the capacity of faculty and students to contribute to human rights protections around the world.

The Minnesota Model is an inter-disciplinary initiative to support a series of diverse faculty-student-practitioner partnerships that identify critical challenges to human rights and propose innovative, timely solutions. Drawing on faculty expertise from across the University, and working in partnership with human rights defenders around the world, the project addresses a spectrum of violations, such as incursions on human security, deprivation of basic needs and the denial of justice. Core to the Model is the Minnesota Human Rights Lab

[<https://www.law.umn.edu/human-rights-center/minnesota-human-rights-lab>], a venue for interdisciplinary discussions about pressing human rights issues and the research approaches best suited to understanding these issues.

Through the Minnesota Model, human rights practice and scholarship inform and inspire each other, facilitating cutting-edge research and effective human rights outcomes. World-leading faculty work in partnership with institutions, civil society and human rights defenders, while partner organizations bring their most pressing problems to the Human Rights Lab. As a signature contribution, the Minnesota Model identifies conceptual approaches and best practices for developing and sustaining collaborative relationships between scholars and practitioners. By engaging graduate students with leading faculty and innovative partner organizations, the Model also supports teaching the next generation of human rights leaders to generate solutions to complex challenges such as inequality, discrimination and violations of human rights. Through these partnerships, the Minnesota Model fills knowledge gaps in practice and brings knowledge back to the University to inform teaching and research.

## **Intersection of Enhancing Individual and Community Capacity for a Changing World and Feeding the World Sustainably**

**Developing Effective, Scalable Strategies to Address Hunger on Post-Secondary Campuses.** Co-PIs: Melissa Laska, Epidemiology & Community Health; Katherine Lust, Boynton Health; Carolyn Porta, Nursing; Michael Stebleton, Organizational Leadership, Policy & Development. Intersecting with *Fostering Just and Equitable Communities*. \$324,878 interdisciplinary team award.

**Extended Team—Members and Partners:** Dave Golden, Boynton Health; Rebecca Leighton, Boynton Health; Mikaela Robertson, Boynton Health; Darin Erickson, Epidemiology & Community Health; Caitlin Caspi, Family Medicine & Community Health; Marla Eisenberg, Pediatrics; Angela Fertig, Public Affairs; Marla Reicks, Food Science & Nutrition; Laura Perdue, Extension; Rachel Widome, Epidemiology & Community Health; Susan Mason, Epidemiology & Community Health; Jamie Stang, Epidemiology & Community Health; Tracey Deutsch, History; Jamie Randall, North Hennepin Community College; Becky Nordin, Minneapolis College; Mary Hearst, St. Catherine University; Tricia Leland, The Food Group; Jill Westfall, Hunger Solutions; Rebecca Mino, Second Harvest Heartland; Jenna Carter, Blue Cross Blue Shield MN; Louise Iverson, General Mills Foundation. A Student and Trainee Leadership Committee is also being convened through this work.

Food insecurity, or lack of reliable access to sufficient quantities of affordable, nutritious, and culturally appropriate food, has recently gained attention as a concern on college campuses. Early work suggests as many as one in every two to three college students may be food insecure, and thus also vulnerable to numerous adverse health and academic consequences as a result. Post-secondary institutions across the U.S. are struggling to understand the scope and nature of the rising campus food insecurity crisis and to identify solutions. Effective interventions will likely need to include numerous components, such as emergency food provision to students as well as upstream policy and systems approaches to prevent food insecurity.

Our team is deeply dedicated to the notion that no young person should have to choose between their pursuit of higher education and feeding themselves, and we are committed to identifying evidence-based, scalable strategies post-secondary institutions can employ to make this a reality. The aim of this project is to provide necessary formative research for developing

and implementing evidence-based interventions. Our team will leverage university expertise from public health, nutrition, nursing, education, medicine, public affairs, liberal arts, food and agriculture, as well as expertise from students and trainees from a range of backgrounds and a wide array of cross-sector partner organizations. Using a mixed methods approach we will address key research questions, including: Who is most affected by food insecurity on college campuses in Minnesota? How is student food insecurity associated with health, well-being, and educational achievement? How do institutional factors influence college officials in initiating campus hunger relief efforts? How can we build a multi-faceted network of stakeholders across campuses to collaborate on multi-level strategies that address the underlying causes of hunger? Overall, our long-term goal is to catalyze evidence-based, action-oriented research that will allow us to work with campuses to develop and evaluate systems-level strategies for effectively and sustainably alleviating campus food insecurity.

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*[More on the UMN Driving Tomorrow Research Initiatives >](#)*