



**BERTHIAUME
INSTITUTE**
FOR PRECISION HEALTH

Annual Report

2022



UNIVERSITY OF
NOTRE DAME

| RESEARCH



About the Institute

The Berthiaume Institute for Precision Health (BIPH) at the University of Notre Dame seeks to prevent and treat disease, promote wellness, and reduce health disparities by developing new tools to understand human variability at the molecular and cellular levels.

The BIPH serves its community by fostering both discovery-based and hypothesis-driven research, educating and training students, and moving proven ideas out of the lab and into broader use.

To advance these goals, the Institute engages scientists, engineers, clinical practitioners, and industry partners in cross-cutting, multidisciplinary research themes. The BIPH also educates the public about the opportunities, challenges, and complexities inherent in health-related research.

BIPH researchers are investigating the factors underlying each person's health, particularly those in underserved populations, and they work to ensure new discoveries, data, and technologies benefit all populations.

The BIPH is a unit of Notre Dame Research.

Welcome

We are excited to issue this 2022 annual report for the Berthiaume Institute for Precision Health (BIPH) and to describe the wide-ranging impact we are having on research, training of students, and community engagement at Notre Dame. Our goal, of course, is to help people live healthier lives. We strive to accomplish this goal by supporting the investigations and discoveries of Notre Dame's passionate professors, students, postdocs, and staff. Progress toward our goal is illustrated in the following pages, much of which was made possible by the generous investment of the Berthiaume family and other benefactors.

A special highlight of the past year was the degree to which BIPH students took on leadership of important initiatives within the Institute. For the first time, graduate students organized our annual symposium. They chose the theme, attracted two of the country's leading researchers to campus, and selected a range of excellent student speakers to enhance and expand the day's discussions. Our students were also substantive contributors to the first meeting of the Institute's Advisory Board, and they were key players in a variety of projects we undertook with industry partners. These young scientists and engineers represent a vibrant present and an exciting glimpse of what the BIPH hopes to achieve in the years to come.

Of course, many challenges lie ahead. In this report you will see a renewed commitment to ensuring that research outcomes supported by the BIPH have significant societal value, especially for those who benefit less often from pioneering advances. You will also see our continuing efforts to expand the Institute's impact by building strategic partnerships with our colleagues in the academic, medical, governmental, and commercial sectors.

Thank you to all who, in so many ways, participated in and gave to the BIPH community in the past year. We look forward to continuing our important partnership in support of biomedical research at Notre Dame and beyond.

Sincerely,



Paul Bohn,
Paul Bohn, Director of the Berthiaume Institute for Precision Health, Arthur J. Schmitt Professor of Chemical and Biomolecular Engineering, and Professor of Chemistry and Biochemistry

4



THE BERTHIAUME INSTITUTE FOR PRECISION HEALTH

4

THE BERTHIAUME INSTITUTE FOR PRECISION HEALTH

- THE BERTHIAUME INSTITUTE FOR PRECISION HEALTH



2022 ANNUAL REPORT

2022 ANNUAL REPORT

- 2022 ANNUAL REPORT

5

5

5

5



5



Building relationships with external funders

One way that the BIPH assists affiliated faculty is through research development—that is, helping forge relationships with external funders, such as government agencies and private foundations. For example, last year BIPH director **Paul Bohn** joined other Notre Dame units in presenting current research activities to Admiral **Christopher W. Grady**, Vice Chairman of the Joint Chiefs of Staff.



Bohn (left) shows Admiral Christopher Grady, Vice Chairman of the Joint Chiefs of Staff (right), a prototype of a portable device, developed at Notre Dame, that could one day monitor the health of military personnel.

Supporting Students



Fellowships and research experiences

In 2022, the BIPH expanded the size of its graduate student summer research fellowship program. Selected for fellowships were:

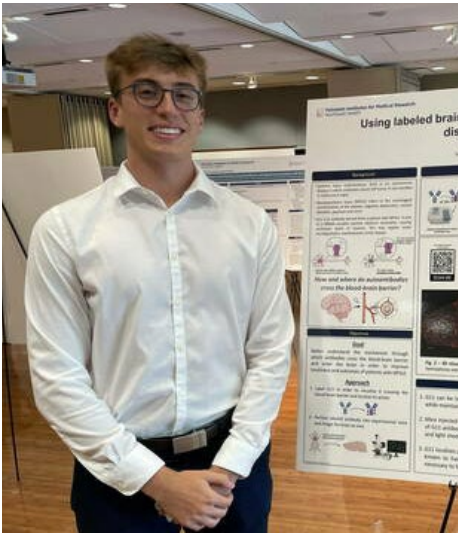
- Laura Alderfer, Bioengineering; advisor: Donny Hanjaya-Putra, assistant professor of Aerospace and Mechanical Engineering
- Kirk Atkinson, Chemistry & Biochemistry; advisor: Brad Smith, Emil T. Hofman Professor of Science in the Department of Chemistry & Biochemistry
- Nathan Dominique, Chemistry & Biochemistry; advisor: Jon Camden, professor of Chemistry & Biochemistry
- Harrison Hill, Chemistry & Biochemistry; advisor: Brandon Ashfeld, professor of Chemistry & Biochemistry
- Francisco Huizar, Bioengineering; advisor: Jeremiah Zartman, associate professor of Chemical and Biomolecular Engineering (also named the O'Brien Family Fellow)
- Tiffany Huwe, Biological Sciences; advisor: Cristian Koepfli, assistant professor of Biological Sciences
- Chinedu Madukoma, Civil and Environmental Engineering and Earth Sciences; advisor: Josh Shrout, professor of Civil and Environmental Engineering and Earth Sciences
- Alicia Wei, Bioengineering; advisor: Tom O'Sullivan, associate professor of Electrical Engineering (also named the Leiva Graduate Fellow in Precision Medicine)
- Sihan Yu, Chemical and Biomolecular Engineering; advisor: Matt Webber, Keating-Crawford Collegiate Professor of Engineering in the Department of Chemical & Biomolecular Engineering
- Yuting Zhang, Integrated Biomedical Sciences; advisor: Xin Lu, John M. and Mary Jo Boler Associate Professor in the Department of Biological Sciences

For the 10th year, the BIPH awarded Berry Family Foundation Graduate Fellowships, consisting of full-year graduate stipends, to two students doing outstanding research in an area of interest to the Institute:

- Caitlin Donahue, Chemistry and Biochemistry (advisor: Katharine White, Clare Boothe Luce Assistant Professor in the Department of Chemistry & Biochemistry) for her project: "Investigating increased intracellular pH in driving cancer cell behaviors and therapeutic relevance of decreased pH in limiting tumorigenic phenotypes"
- Bingxin Yang, Materials Science and Engineering-Chemical and Biomolecular Engineering (advisor: Nosang Myung) for his project: "Smart Insulin Leak Detector"



Please scan this QR code to watch the fellows explaining their research in their own words.



Christopher Aiello, 2022 BIPH Precision Medicine Research Fellow at the Feinstein Institute

Once again, the BIPH continued its long-standing partnership with the Feinstein Institute for Medical Research (FIMR), the research arm of Northwell Health in New York, by enabling Notre Dame students to gain valuable experience conducting research in a world-class clinical setting. In 2022, stipends, travel support, and housing support were provided to graduate student **Nilay Kumar** (Chemical and Biomolecular Engineering) and undergraduate students **Noor Behnam** (Chemical and Biomolecular Engineering), **Meng Chen** (Computer Science and Engineering), and **Christopher Aiello** (Neuroscience/Spanish) so they could spend the summer on Long Island working on projects led by FIMR researchers.

At the end of the summer, Aiello reflected, in part: “While the eight-week program did go extremely fast and I cannot believe I am done, when I look back I am so proud of all that I was able to accomplish and how much I grew as a scientist. I plan to use all that I learned this summer as a stepping stone. I will stay in touch with my mentor, with hopes of even publishing what develops out of the work I did this summer. Outside of Feinstein, I hope to bring my new skills to wherever I end up researching in the future.”



Please scan this QR code to read Christopher Aiello's full reflection.



BIPH grad student workshop on paper millifluidic devices with Marya Lieberman, professor in the Department of Chemistry and Biochemistry

In 2022, former BIPH graduate fellows continued to have an impact. For example:

- **Melinda Lake-Speers** (2015 Berry Fellow) completed a postdoc at Purdue University and became a new assistant professor in Mechanical and Aerospace Engineering at Case Western Reserve University.
- **Yide Zhang** (2017 Berry Fellow) published his first article as a postdoc at the California Institute of Technology (in Nature Communications: “Ultrafast and hypersensitive phase imaging of propagating internodal current flows in myelinated axons and electromagnetic pulses in dielectrics.”)
- **Maria Cristina Miranda Vergara** (2017 Leiva Fellow) returned to Mexico for a faculty position in cancer research at Universidad Popular Autónoma del Estado de Puebla.

BIPH Graduate Student Group (GSG)

In its second year, the Institute's graduate student group elected new leaders and launched several new activities to enhance the precision health community at Notre Dame. These included hands-on workshops to learn new fabrication and coding techniques in paper analytical devices and Raspberry Pi, and a career development discussion with a panel of speakers from Lilly, Merck, Pfizer, and Sterling Pharma.



Olatunde Awotunde
President, BIPH GSG



Faraj Al-Badani
VP, BIPH GSG



Alex Sinclair
VP, BIPH GSG



2022 BIPH Fellows

Notre Dame's McCourtney Hall has been home to the Berthiaume Institute for Precision Health since 2016.



Building Community

Annual Symposium

In March 2022, the BIPH hosted its annual symposium, which tackled the forward-looking topic, “Planning for the Next Pandemic: Precision Health Approaches.” Speakers included **Gaurav Sahay** from Oregon State University and **Erin Eckert** from RTI International. The keynote speaker was **Christa-Marie Singleton**, MD, from the Office of the Associate Director for Policy and Strategy, Centers for Disease Control and Prevention (CDC).



Dr. Christa-Marie Singleton from the CDC delivers the keynote address at the 2022 BIPH annual symposium

Advisory Board meeting

In November 2022, the BIPH hosted the first meeting of the Institute’s Advisory Board. This board of distinguished leaders in health and research have started a conversation with BIPH faculty and students that will help guide the Institute’s growth in the coming years.

The founding members of the BIPH Advisory Board are:

- **Nancy Allbritton**, Frank & Julie Jungers Dean of Engineering, University of Washington
- **Enid Gatimu**, associate director of Analytical Sciences, Novo Nordisk
- **John Meara**, Steven C. and Carmella R. Kletjian Professor of Global Health and Social Medicine and Professor of Surgery, Harvard Medical School
- **Jeffrey Moore**, Stanley O. Ikenberry Endowed Chair, Professor of Chemistry, and Howard Hughes Medical Institute Professor, University of Illinois
- **Steven Soper**, Foundation Distinguished Professor of Chemistry, University of Kansas
- **Christa-Marie Singleton**, Chief Medical Officer, Office of the Associate Director for Policy and Strategy, Centers for Disease Control and Prevention
- **Shuichi Takayama**, professor, GRA Eminent Scholar, Price Gilbert, Jr. Chair in Regenerative Engineering and Medicine, Georgia Institute of Technology
- **Rasmi Thomas**, chief, Laboratory of Integrative Multiomics, U.S. Military HIV Research Program at Walter Reed Army Institute of Research
- **Kevin Tracey**, president and CEO, Feinstein Institute for Medical Research, Northwell Health
- **Ann Weber**, senior vice president, Preclinical Development, Kallyope

Alicia Wei (right), 2022 BIPH Leiva Fellow, talks with the BIPH Advisory Board about the Institute’s strategic direction



(Above) BIPH Advisory Board members discuss students’ research at a poster session

Caitlin Kerr, (right) a graduate student advised by Matthew Champion, associate professor in the Department of Chemistry & Biochemistry, competed in the CBM 3-Minute Thesis competition between students from Purdue University, Indiana University, and Notre Dame



NSF Center for Bioanalytic Metrology

The Center for Bioanalytic Metrology, a Phase I National Science Foundation Industry-University Cooperative Research Center, is the Berthiaume Institute's primary mechanism for connecting and working with commercial partners. The BIPH leads and administers the Center on behalf of Notre Dame, Indiana University, and Purdue University.

In 2022, CBM welcomed two new dues-paying members to the Center, pharmaceutical company Moderna and specialty chemical company Evonik. This brought the total number of CBM members to 13:



Through the Center, these companies funded a wide range of research projects addressing their priorities, including two at Notre Dame:

- Smart miniature cell culture platform with PAT for suspension cells, led by **Yichun Wang** and **Nosang Myung**
- 3D molecular imaging of plant tissue by fluorescence lifetime imaging microscopy, led by **Scott Howard**, associate professor in the Department of Electrical Engineering

Another goal of CBM is to foster productive interactions between graduate students and company personnel, both to enhance the students' training and introduce the companies to potential new hires. In 2022, these interactions included a series of virtual workshops on life as a scientist working in industry and a 3-Minute Thesis competition that gave students the opportunity to introduce their research projects and hone their presentation skills.

Looking Ahead



BIPH leaders are pursuing many avenues to expand the Institute's impact in research, education, and translational science. Three near-term areas of emphasis are:

- 1 Health Disparities and Inequalities** – Improving the health of all populations, particularly those that are currently underserved, is core to the Institute's mission. New programs are being added that expand these efforts at a variety of scales.
- 2 Strategic Collaborations** – As strong as the BIPH is by itself, the work of Notre Dame researchers is amplified exponentially by working with others across campus and around the world. The Institute is forging collaborations with clinical partners, health-related companies, different agencies within the government, and other biomedical partners.
- 3 Enhanced Skills Training** – Despite the excellence of a Notre Dame education, not every student picks up the full range of specialized skills sought by industry in their classes and labs. To augment their training, the BIPH will work with commercial partners to offer targeted workshops and classes on specific types of instrumentation and processes.



BERTHIAUME INSTITUTE

FOR PRECISION HEALTH

B02 McCourtney Hall
Notre Dame, IN 46556 USA
1+(574) 631-7385
precisionhealth@nd.edu

precisionhealth.nd.edu