U-M Precision Health
Annual Report 2021

Connecting Research with Results
Join the Discovery.
INSIDE

Letter from the co-directors

2021 at a glance

2021 by the numbers

Precision Health and U-M: A responsible data-sharing model

Taking the pulse of racial bias in health care

Webinar series aimed at clinicians attracted record attendance

The health impacts of environment and economics

Focus on diversity leads to innovative participant recruitment

Precision opioid prescribing use case

PROMPT Precision Health study

Grants program helps Precision Health research flourish

Investigators Awards fund seven collaborative projects in 2021

2021 graduates of Precision Health’s certificate program

Partnerships help Precision Health research thrive
Precision Health at U-M flourished in 2021. In a year where a “return to normal” eluded us, we were able to pick up our projects with a renewed focus. In a new, fluctuating work environment, we reached several milestones in precision health research, discoveries, and outcomes.

Data are the heart of Precision Health, so the nature and complexity of Precision Health’s Analytics Platform continues to grow and evolve. Last year, we added more than 700K chest X-ray images that are directly linked to coded (deidentified) clinical and health data. Researchers applied the platform’s resources in many ways, including uncovering racial bias and studying the impact of social determinants of health.

Our study Michigan and You: Partnering to Advance Research Together (MY PART) began using innovative remote recruitment methods to enroll a more diverse population to augment the Michigan Genomics Initiative (MGI) cohort—a vital resource that makes patient health information and other novel data available to researchers across campus. MY PART is the first study to recruit via the MyUofMHealth portal, and a newly designed dashboard helps recruiters pinpoint whom to approach. These and other efforts have allowed the MGI cohort to approach 100K participants, and more than 70K biosamples have been collected.

Implementation—bringing discoveries to the bedside and integrating them into clinical care—is the end goal of precision health research, and one of the most challenging. A multidisciplinary team enabled by Precision Health rapidly developed a prediction model using clinical and health data in the electronic medical record to identify hospitalized patients with COVID-19 who are at risk for deterioration. This work was then validated at a dozen external partnering hospitals and is now successfully integrated into a clinical workflow.

While we have broadened and deepened our resources, our community of Precision Health researchers continues to grow. Our Investigators Awards grants program, put on hold in 2020, funded seven projects totaling $1.4 million. Our cross-campus collaborators grew to 23 departments, initiatives, and programs, and we reached out to clinicians and health care staff with a seminar series exploring how precision health tools are changing clinical care. The National Academy of Medicine chose to highlight U-M as a case study in forward-thinking policies to share health data. We continue to be grateful to the Office of the Provost, College of Engineering, Michigan Medicine, and School of Public Health for support.

In the following pages you will find more details about the impact Precision Health has made in health prediction, research, and care.

We commend the guidance and efforts of our researchers and staff, who lead these innovations and demonstrate how Precision Health research can make a difference.
Data Resources and Data Sharing

• 750K chest X-ray images, collected from January 2019 to September 2021, are now available to researchers campuswide and can be analyzed alongside linked data from the electronic health record (EHR).

• Socioeconomic status (SES) data resources from the National Neighborhood Data Archive (NaNDA) are available and linkable to a Michigan Medicine patient’s EHR. These include:
  – historical and current geocoded addresses
  – urban/rural characteristics
  – number of eat/drink places, grocery stores, and stores selling liquor and tobacco products
  – health care services
  – land cover
  – neighborhood SES
  – number of parks and art/entertainment/recreation organizations

• A 2021 National Academy of Medicine publication on innovative approaches to improved data sharing chose U-M as a case study for its “range of synergistic and related innovations” that allow U-M “to move toward its overarching goals of advancing critical research and supporting precision health.”

Curation of large, rich, deidentified imaging datasets is time consuming and requires specialized expertise. These often represent insurmountable barriers to many investigators who would otherwise jump at the opportunity to include imaging data in their work. We have removed those barriers and hope to see investigators across the U-M campus actively incorporate imaging data into their analytics.

Jessica Fried, MD
Assistant Professor of Radiology and co-lead of chest X-ray repository project
Collaboration

Precision Health has developed meaningful partnerships with 23 schools, centers, and groups across campus:

- Alfred Taubman Medical Research Institute
- Advanced Genomics Core (AGC)
- Center for Statistical Genetics
- Central Biorepository
- Center for Healthcare Engineering and Patient Safety
- Data Office for Clinical & Translational Research
- Department of Clinical Pharmacy
- Department of Learning Health Sciences
- Department of Radiology
- Elizabeth Weiser Caswell Diabetes Institute
- Frances and Kenneth Eisenberg and Family Depression Center
- Health Information and Technology Services
- Information and Technology Services
- Institute for Healthcare Policy and Innovation
- Institute for Social Research
- Michigan Integrated Center for Health Analytics & Medical Prediction
- Michigan Medicine Institutional Review Board
- Michigan Institute for Clinical & Health Research
- Research Data Warehouse
- School of Dentistry
- School of Information
- School of Music, Theatre & Dance
- School of Nursing

Participant Recruitment

After success with its remote recruiting strategy in 2020, Precision Health’s MY PART study further innovated its approach to recruitment in 2021:

- On February 1, MY PART’s participant tracking dashboard went live. The dashboard can screen patients automatically and track recruitment efforts, patient contact logs, participant prescreening, and enrollments. It also has functionality to send automated emails to participants and to create profiles for non-Michigan Medicine patients to aid in external recruitment.

- Capitalizing on the shift to telehealth in the wake of COVID-19, and through collaboration with the MiChart team, MY PART became the first U-M study to use the MyUofMHealth portal for participant recruitment.

Educating Clinicians

In 2021, the focus of educational programming turned to helping clinicians understand the value and effect of precision health research. Attendance more than doubled. We offered the following webinars in 2021:

- “How Data Science, Learning Health Systems, and Precision Health Can Enhance Clinical Practice” (speakers: Gretchen Piatt and Rachel Richesson)
- “First Do No Harm: Understanding the ML/AI Behind Clinical Decision Alerts” (speakers: Karandeep Singh and Maggie Makar)
- “What Clinicians Need To Know when Using Artificial Intelligence and Machine Learning-Driven Technologies in Medical Decision Making” (speakers: Rada Mihalcea, Erkin Otles, Max Spadafore, Cornelius James)

Uncovering Bias

By making curated datasets available to researchers across campus, Precision Health does the work of
comprehensive data collection and enables them to focus on the research, potentially resulting in important scientific discoveries. Precision Health researcher Mike Sjoding and colleagues found that Black patients were three times as likely as white patients to have a seemingly healthy pulse oximetry reading that masked hypoxemia—a condition that can lead to serious health complications.

- They shared the findings in a *New England Journal of Medicine* (NEJM) Letter to the Editor.
- The findings got international attention, with stories in such media outlets as the *New York Times*, NPR, and the BBC.
- The NEJM letter was cited repeatedly in January 2021 correspondence to the FDA—signed by Senators Elizabeth Warren, Cory Booker, and Ron Wyden—which urged the agency to “quickly conduct a review of the accuracy of pulse oximeters across racially diverse patients and consumers.”

**Grants and Funding**

- More than $11 million of external funding has resulted from the ~$5 million of Precision Health funding distributed to Investigators in 2018 and 2019
- Funds have been distributed across eight schools/institutions on campus:
  - Medical School
  - College of Engineering
  - School of Public Health

**2021 Investigators**

After a hiatus in 2020, the Investigators Awards grant competition returned in 2021. Seven projects were each awarded a $200K grant over two years:

- “Using Artificial Intelligence to Broaden and Diversify Outdated Standards for the Determination of Skeletal Maturation in Growing Children”
- “Rapid Intraoperative Molecular Diagnosis of Diffuse Gliomas Using Stimulated Raman Histology and Deep Neural Networks”
- “Statistical and Computational Methods for Asymmetric Integration of Datasets from Different Cancers for the Identification of Cancer-related Genes and Biomarkers in Case-control Analyses”
- “Predicting Cardiac Surgery-Associated Acute Kidney Injury Using Federated Learning”
- “Assessing the Impact of Germline Pharmacogenetics (PGx) on Medication Outcomes and Clinician Prescribing Decisions in Patients with Cancer”
- “Deep Learning for Prediction of Mild Cognitive Impairment and Dementia of the Alzheimer’s Type”
- “Automated Harmonization of Multi-institutional Electronic Health Records Data”

**2021 Certificate Program Graduates**

Seven graduate students from schools and colleges across campus earned a Precision Health Graduate Certificate in 2021:

- Jacque Adams (School of Information)
- Hee Jae Choi (College of Pharmacy)
- Luke DeRoos (College of Engineering)
- Corinthia Gonzales (Medical School)
- Catherine Irwin (Medical School)
- Andrew McKeon (Medical School)
- Jowana Obeid (College of Literature, Science, and the Arts)

"Without that resource [RDW], there’s no way I could have gotten that research done!"

Mike Sjoding, MD, Assistant Professor of Internal Medicine-Pulmonary/Critical Care, co-author of “Racial Bias in Pulse Oximetry Measurement”
2021 by the numbers

222 PH members

101 joined in 2021

198 faculty members

70 full professors

14 schools, colleges & institutes

• Art & Design
• Biomedical Engineering
• Dentistry
• Engineering
• Information
• ISR
• LSA
• Medical School
• Nursing
• Pharmacy
• Public Health
• Public Policy
• UM–Flint
• UM–Dearborn

23 partnering groups

members received $11,403,192 in health-related grants

208 PH-related pubs

472 pub citations
A National Academy of Medicine special publication highlights U-M’s data-sharing approach, which prioritizes trust, transparency, and participant engagement.

Sharing health data during the COVID-19 pandemic has been critically important: for health care providers, public health officials, and society at large. And while the pandemic has illustrated how essential effective data sharing is, it also has magnified the preexisting barriers and inequities that render many data-sharing efforts ineffective.

Capitalizing on the attention to data collaboration that COVID-19 necessitated, the National Academy of Medicine (NAM), in consultation with the Patient-Centered Outcomes Research Institute (PCORI), followed up a pre-pandemic publication (Health Data Sharing to Support Better Health Outcomes: Building a Foundation of Stakeholder Trust) with a 2021 publication that looked in depth at a handful of innovative approaches to improved data sharing (Sharing Health Data: The Why, the Will, and the Way Forward). U-M was one of these case studies, with its “range of synergistic and related innovations” that “[allow] U-M to move toward its overarching goals of advancing critical research and supporting precision health.”

For the case study, the authors interviewed Precision Health member Kayte Spector-Bagdady, JD, M.Bioethics, chief of the research ethics service of the Center for Bioethics & Social Sciences in
Incorporating patient/participant views into its data-sharing policy is of primary importance to U-M. The study pointed to how the participant-engagement approach of the Michigan Genomics Initiative influenced both the “foundational work supporting U-M Precision Health” and institutional policy on data sharing (e.g., participants trusted U-M and acknowledged the importance of sharing data for research, but were not comfortable with data being shared with for-profit companies without explicit permission).

Research teams also looked at existing regulations and found that “current laws and regulations do not fully protect the myriad ways that data can be generated, shared, and used in the current age,” which underlined the importance of “participant trust and institutional responsibility,” and the need to go beyond “simply obtaining consent” to share data, to “a collective understanding of what it means to transparently, responsibly, and ethically steward data and specimens.”

The Medical School Human Data & Biospecimen Release Committee is one distinct way U-M ensures that individual-level data and biospecimens are adequately protected. The committee meets biweekly to consider data-sharing requests that involve commercial/non-academic entities, applying to each one a standard rubric that considers many aspects of the request. Also, the data-sharing policies in place at U-M “provide a roadmap for researchers to ensure compliance.”

Precision Health espouses these approaches to data sharing, but more than that, Precision Health resources, such as those available via the Analytics Platform, reinforce and perpetuate the careful and transparent sharing of data. The NAM reports state the importance of “continu[ing] to engage researchers who use the services of U-M Precision Health to ensure their data collection and sharing practices align with their use of the biobank. By doing so, these policies have the ability to influence the broader researcher communities across campus.”

“Precision Health tools, processes, and resources, available to researchers campuswide, are integral to promoting and sustaining U-M’s approach to data sharing,” says Co-Director Brahmajee Nallamothu.

Future direction listed in the use case involves “[expanding] research pursuits to include dialogue and participant engagement” and “reducing disparities created by demographic (especially race and ethnicity) biases in the recruitment and consent processes.” Such innovative recruitment approaches are at the core of Precision Health’s MY PART study (see page 16).

Since the most useful health data are fully representative of the population they serve, cultivating participant and community trust and engaging in diverse recruitment efforts are priorities for both Precision Health and U-M health research as a whole. “The trust and community building that form the foundation of data sharing at U-M are also essential to Precision Health’s goal of diverse and inclusive participant recruitment,” says Nallamothu.
Taking the pulse of racial bias in health care

How an ICU observation turned into a precision health investigation

A December 2020 Letter to the Editor in the New England Journal of Medicine (NEJM), which spoke of an unsettling research finding, created a ripple effect in 2021 that touched the media, the health care industry, and health policy and legislation. Although the study was simple, the results raised an alarm: a simple medical device, used for decades, was perpetuating bias and health disparities.

In 2020, when surging COVID-19 cases brought a larger, more diverse patient population to Michigan Medicine’s ICU, Precision Health researcher Michael Sjoding and his colleagues noticed regular discrepancies in two types of blood oxygen measurements. By using the data resources that Precision Health makes available campuswide, the team had quick access to the information they needed to solve the riddle. And by employing cross-disciplinary, Precision Health approaches to their research, they found an answer.
A vital measurement in COVID-19 cases is oxygen saturation in the blood. Saturation levels above 95% are healthy, while levels below 90% (hypoxemia) can lead to serious complications and require physician intervention. Readings between 88% and 96% are in a “crucial range, where small deviations [in accuracy] could really make a difference,” said Michael Sjoding, MD, an assistant professor of internal medicine—pulmonary/critical care.

Oxygen saturation is measured in one of two ways: using a pulse oximeter—a small device placed over the tip of the finger—or using arterial blood gas from a blood sample. While he was working in the COVID-19 ICU in 2020, Sjoding and his colleagues “didn’t actually know what to make of” the discrepancies they were seeing. Then he remembered a Boston Review article he’d read about how pulse oximeters deliver biased results when people have darker skin. So he looked to the data. Because of the readily available, reliable data from Michigan Medicine’s Research Data Warehouse (RDW), which includes records of 4M+ U-M patients, Sjoding could easily analyze the oximetry and arterial blood gas measurements of patients receiving supplemental oxygen from January through July 2020 and compare discrepancies according to whether patients identified as Black or white. “Without that resource,” Sjoding said, “there was no way I could’ve gotten research done” in such a timely manner.

What he and his team found was that in the U-M patient cohort, about 12% of Black patients with a pulse oximetry reading of 92% to 96% had an arterial oxygen saturation of less than 88%, compared with about 4% of white patients. Black patients were three times as likely to have a seemingly healthy oximetry reading that masked hypoxemia. The results were comparable in a cohort of critical care patients (the eICU Collaborative Research Database) from 178 hospitals from 2014 through 2015. “It’s just not acceptable,” Sjoding said.

The findings, which Sjoding and his colleagues (U-M’s Robert P. Dickson, MD; Theodore J. Iwashyna, MD, PhD; Steven E. Gay, MD; and Thomas S. Valley, MD) published in NEJM, rippled through both the scientific community and the general public, with stories in the New York Times and on NPR and the BBC, among other outlets. Since its publication, the letter has been cited in well over 100 research articles.

Policymakers also took note. The NEJM letter was cited repeatedly in January 2021 correspondence to then-Acting FDA Commissioner Janet Woodcock, which urged the FDA to “quickly conduct a review of the accuracy of pulse oximeters across racially diverse patients and consumers” and was signed by U.S. Senators Elizabeth Warren, Cory Booker, and Ron Wyden. They cited 2013 FDA guidance on pulse oximetry that recommends study volunteers that include “subjects with a range of skin pigmention, including at least 2 darkly pigmented subjects or 15% of your subject pool, whichever is larger.” This, in turn, prompted a February 2021 Safety Communication from the FDA on “Pulse Oximeter Accuracy and Limitations,” which also referenced Sjoding’s research and stated, “Pulse oximeters have limitations and a risk of inaccuracy under certain circumstances.”

In other words, there’s “still more work that needs to be done on the regulatory front,” said Sjoding, who met with FDA officials who were “well aware” of the oximeter’s inaccuracies. It’s at the testing level that biases need to be ferreted out, before a medical device goes to market, and before a machine-learning algorithm is implemented in a health care system. “Racial bias is entrenched in many things,” said Sjoding.

Uncovering this bias displays the “power of the data,” Sjoding said. “This important finding was in the data.” But the finding was also thanks to the precision health methodology the researchers employed: integrating clinical observations with data research to unmask bias, weighing a health care problem in the broader context of its social roots and implications, and considering the role health policy plays in its perpetuation.

“This important finding was in the data.”

Michael Sjoding, MD
Assistant Professor, Division of Pulmonary and Critical Care Medicine
Webinar series aimed at clinicians attracted record attendance

85% of participants would recommend the series to others
A key objective of Precision Health is to provide educational support to researchers and practitioners to enable and promote the expansion of precision health science.

The first two years of Precision Health’s educational programming were largely devoted to researchers. In 2021, the focus changed significantly, as Precision Health turned its sights on helping clinicians understand the value and effect of precision health research.

The series “Demystifying the Data, Processes, and Tools that Are Changing Clinical Care” was launched in 2021 with a focus on enhancing understanding about how precision health is affecting patient care. Whereas previous seminars and webinars drew audiences of 30 to 40 people, this series spurred a dramatic increase in attendance. The first three webinars (September, October, December) averaged more than 100 attendees each. Viewership of the recorded webinars grew substantially, too. To date, those three webinars have reached more than 1,700 viewers (including live and recorded views).

The series, which continued into 2022, uncovered an unmet need for patient-facing practitioners to gain a deeper understanding of artificial intelligence, machine learning, genetic data, and other precision health tools and resources available to support their work.

Of the webinar attendees who completed post-event surveys, 80% report that the programming is “excellent” and “delivers what was promised,” and 85% report that they would recommend the event to others.

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<th>SEMINAR:</th>
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<tr>
<td>“How Data Science, Learning Health Systems, and Precision Health Can Enhance Clinical Practice” featuring Gretchen Platt, MPH, PhD (Associate Professor, Learning Health Sciences) and Rachel Richesson, PhD, MPH, MS, FACMI (Clinical Professor, Learning Health Sciences)</td>
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<td>“First Do No Harm: Understanding the ML/AI Behind Clinical Decision Alerts” featuring Karandeep Singh, MD, MMSc (Assistant Professor, Learning Health Sciences, Internal Medicine, Urology, and Information) and Maggie Makar, PhD (Assistant Professor, Computer Science and Engineering)</td>
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<td>PANEL DISCUSSION: “What Clinicians Need To Know when Using Artificial Intelligence and Machine Learning-Driven Technologies in Medical Decision Making” featuring Rada Mihalcea, PhD (Professor, Electrical Engineering and Computer Science); Erkin Otles (Graduate Student Research Assistant, Industrial &amp; Operations Engineering); Max Spadafore, MD (House Officer, Emergency Medicine); and Cornelius James, MD (Assistant Professor, Internal Medicine and Pediatrics)</td>
<td>88</td>
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The health impacts of environment and economics

Working with the Institute for Social Research, Precision Health links neighborhood and socioeconomic data to electronic health record and genetic data, giving researchers the resources to examine social determinants of health.

Environment can impact not only access to health care, but health overall. The city you live in, its population, its nearby amenities—even what shape its sidewalks are in—are all factors that influence health. Precision Health collaborates with the Social Environment and Health program at U-M’s Institute for Social Research (ISR) to combine socioeconomic status (SES) data with electronic health record (EHR) information, to yield new insights into the health effects of factors seemingly unrelated to health care. Including linkable neighborhood data is a differentiating feature of Precision Health’s Analytics Platform resources, and marks a milestone in the development of Precision Health’s infrastructure.

The SES data resources on Precision Health’s DataDirect tool are accessible to researchers across campus. The resources link National Neighborhood Data Archive (NaNDA) data to a Michigan Medicine patient’s EHR. Patient addresses are also mapped to a U.S. Census block group and tract, which can then be linked to various data elements describing neighborhoods and geographies.

NaNDA—an open data repository offering nationwide measures of the physical and social environment—was established in 2019 by researchers in ISR’s Social Environment and Health program to streamline neighborhood measures. Professor Philippa Clarke, PhD, MSc, director of the Social Environment and Health program, and Megan Chenoweth, MS, the program’s data manager and curator, work with an interdisciplinary team to create nationwide measures of the physical and social environment. Using publicly available demographic data, they created an index representing neighborhood disadvantage; the index and all related documentation are available to any interested researcher.

“The reason we created NaNDA is that there has been so much duplication in the creation of neighborhood measures for different research projects. For instance, multiple R01s have created the same neighborhood measures for linkage to different study populations….Our goal is to reduce redundancy in research and to promote the use...
of common data elements in neighborhood research....We believe that these measures can promote more rigorous research on the importance of neighborhoods for health,” said Clarke. She and Chenoweth were instrumental in linking NaNDA data to health records, and making them accessible to researchers.

“I think it’s really exciting that Precision Health has taken the initiative to link neighborhood data to patient data,” Clarke said. “It’s very forward thinking to recognize the role of the neighborhood environment as an important social determinant of health. They are making it easier for researchers to investigate how neighborhood context shapes health outcomes and hospital readmissions. That opens up a whole new range of scientific inquiry, with the potential for new knowledge.”

Variables and datasets available to researchers include historical and current geocoded addresses, number of eat/drink places and grocery stores, health care services, land cover, neighborhood SES, and number of parks and recreation organizations.

Researchers are taking advantage of these resources.

**Social Determinants of Health and Clinical Ethics**

**Janice Firn**, PhD, MSW, HEC-C, is a clinical assistant professor in the Department of Learning Health Sciences and co-chief of education service at U-M’s Center for Bioethics and Social Sciences in Medicine. A clinical ethicist, Firn has drawn on Precision Health’s deidentified patient demographic, medical, and SES data in her research.

“There are no standards instructing clinical ethicists about how to implement fair and equitable ethics services,” Firn said. “Given the degree of bias toward specific sociodemographic groups, I was concerned [about] unintended impacts: specifically, that it could disproportionately impact certain sociodemographic groups and unintentionally perpetuate bias.

“To truly improve patient health care outcomes—the aim of precision health—consideration must also be given to social determinants of health, such as health care access, socioeconomic status, bias, etc.”
Focus on diversity leads to innovative participant recruitment

To broaden its participant cohorts to better represent state and national populations, Precision Health has diversified recruitment techniques and honed recruitment strategies.

Although the Michigan Genomics Initiative (MGI) cohort is a large and valuable study population, its participant makeup—primarily older, female Caucasian participants with preexisting comorbidities—is limited in genetic diversity. The goal of the Michigan and You: Partnering to Advance Research Together (MY PART) Study is to focus on diversifying the MGI population with underrepresented populations, as well as with younger and healthier participants.

Tracking Dashboard

To screen more efficiently and effectively, MY PART’s participant tracking dashboard—designed to search for diverse participants and flag them to be approached—went live in February. MY PART staff input criteria that prompt the dashboard to automatically label participants as “priority,” “approachable,” or “do not approach.” Those who are “priority” meet one or more criteria for increasing the diversity of the cohort (e.g., by age, race/ethnicity, or specific diseases/characteristics). The dashboard acts as a screening tool to increase recruiters’ ability to identify priority participants coming into the clinic, so that
they can approach these priority participants first, obviating the need for a recruiter to access MiChart electronic health records for screening.

The dashboard also tracks recruitment efforts, patient contact logs, participant prescreening and enrollments, and incentive payment records. Its other functions include sending automated emails to participants (cold emails, study welcome emails, task reminders, etc.) and creating profiles for non-Michigan Medicine patients, to aid in external recruitment. The high-tech and automated nature of the dashboard greatly cuts down on the human time and energy needed to identify priority participants.

“But with the launch of the MY PART Dashboard, recruiters can easily prioritize patients for enrollment in real time, allowing them to focus efforts on those who would enrich the diversity of our cohort;” said Jennifer Smith, PhD, MPH, an associate professor of epidemiology and associate director of the Cohort Development Workgroup.

The dashboard is already making a difference in the participant population: recently recruited participants are younger and of differing racial and ethnic backgrounds. A similar dashboard is in the works to help diversify recruitment in the MGI-Anesthesiology Collection Effort preoperative setting, increasing diversity overall.

“With the launch of the MY PART Dashboard, recruiters can easily prioritize patients for enrollment in real time, allowing them to focus efforts on those who would enrich the diversity of our cohort;” said Jennifer Smith, PhD, MPH, an associate professor of epidemiology and associate director of the Cohort Development Workgroup.

The recent shift toward telehealth means that a greater number of patients are using technology to connect with their clinicians electronically. Capitalizing on this shift, MY PART has begun recruiting participants through their patient portal, allowing us to better reach a more diverse set of participants who may not be as receptive to traditional recruitment methods.”

Jennifer Smith, PhD, MPH
Associate Professor, Epidemiology; Associate Director, Precision Health Cohort Development Workgroup

Patient Portal Recruitment

With the shift to telehealth in the wake of COVID-19, more patients are using their patient portal than ever before. In an effort to find new, innovative ways to connect with them, in September MY PART became the first study at U-M to use the MyUofMHealth patient portal to send recruitment invitations to Michigan Medicine patients. After many months of collaboration with Michigan Medicine’s MiChart Team, the result is a system to connect patients to many different research studies. The hope is that in 2022 Precision Health can continue to optimize the patient portal for recruitment.

To further diversify enrollment in the future, MY PART is looking into communication through texting, which is a preferred method of contact among participants. Precision Health is also interested in building relationships with partners outside Michigan Medicine and in underrepresented communities to further develop and expand the cohort.

For many years, health care has taken a one-size-fits-all approach, treating every patient as the “average” person. This research will allow the future of health care to treat every person on an individual level, tailoring care and treatment.
Precision opioid prescribing use case

Led by Chad Brummett, MD—professor and senior associate chair of anesthesiology—and Amy Bohnert, PhD, MHS—professor of anesthesiology and associate professor of psychiatry—this use case examines how improved prescribing guidelines for postsurgical pain management may lower rates of opioid misuse and dependence.

2021 Highlights

GUIDELINES AND EDUCATIONAL RESOURCES

- An Acute Care Opioid Prescribing Guide: a free comprehensive resource supporting the implementation of evidence-based acute care opioid prescribing
- New educational materials available for free co-branding (more than 3,500 downloads):
  - Managing Pain After Surgery
  - Non-Opioid Acute Pain Management Guide for Adults
  - Pediatrics: Non-Pharmacological Pain Management
  - Over the Counter - Surgical 1-Pager
- Ongoing work to develop opioid prescribing guidelines specific to pediatric surgeries, including tonsillectomies for patients under 11 years old and circumcision
- Completion of cast album of Painless: the Opioid Musical
USE CASE RESEARCH

• Preliminary genome-wide association studies, using MGI data, for new persistent opioid use, and the creation of a polygenic risk score

• Continuing validation of MAPS and Surescripts data of opioid prescriptions filled for MGI participants

• “Optimizing Post-Op Pain Management with CDS,” presented at an Epic EHR implementation conference in May 2021 by Brummett and Chris Zimmerman, PharmD, BCPS. Summarizing the results of the best practice advisory alarm set for hysterectomy procedures at Michigan Medicine, the presentation described how the clinical decision support tool provides opioid prescribing guidelines at the point of care, including amount and type of opioid to prescribe following a surgical procedure

• American Statistical Association Student/Young Researcher Paper Award for the manuscript “Individualized Risk Assessment of Preoperative Opioid Use by Interpretable Neural Network Regression” (authors: School of Public Health doctoral candidate Yuming Sun, Professor of Biostatistics Jian Kang, Yi Li, and Chad Brummett)

GRANT WORK

• Work supported by the 2020 Benter Foundation Grant
  – Manuscript – “Risk of Opioid Overdose Associated with Dental Opioid PrescriptionDispensing Among Patients and their Family Members”
  – Manuscript – “Risk of Persistent Opioid Use Associated with Dental Opioid Prescriptions Among Publicly and Privately Insured Patients”
  – Two analyses
    1) National profile of dental opioid prescribing in 2019
    2) Dispensing of opioid prescriptions using industry data and proportion of prescriptions that use a method of payment other than insurance

CONTINUING EDUCATION AND TRAINING

• Continuing education courses developed to address opioid overprescribing in the dental community, which are now required as part of licensure for dental students at the U-M School of Dentistry

Use case collaborators

Precision Health collaborates with other schools, departments, and initiatives to enrich use case resources and broaden the reach of prescribing guidelines. Collaborators include:

• The School of Dentistry and Romesh Nalliah, DDS, MHCM, associate dean for patient services and clinical professor of dentistry

• Karen A. Cooper, MD, clinical assistant professor of otolaryngology-head and neck surgery in the Pediatric Otolaryngology Clinic at C. S. Mott Children’s Hospital

• The School of Public Health and Yi Li, PhD, a professor of biostatistics and 2018 Precision Health Investigators Award recipient

• Precision Health Co-Director Jenna Wiens, PhD, associate professor of computer science and engineering

• The Michigan Genomics Initiative

• Poverty Solutions

• The Inter-university Consortium for Political and Social Research
Teaching through song

While the majority of research and educational resources for this use case seem directed at physicians and their prescribing practices, or at non-opioid pain management alternatives for adult patients, time and energy have also been spent on a creative way to reach another audience: teenagers and young adults.

Called Michigan High School Opioid Prevention Education (M-HOPE), the goal of this component of the use case is to develop creative content to educate teens and adolescents about the risks of opioids. So Precision Health, Michigan OPEN, and U-M’s School of Music, Theatre & Dance (SMTD) came together to collaborate on a project to communicate the dangers of opioid misuse to middle and high school students in a way that was more compelling than a pamphlet or a school assembly. Through the talents of then-undergrad Jacob Ryan Smith and other SMTD collaborators, Painless: The Opioid Musical was created. Inspired by true stories of opioid use disorder and recovery from members of Families Against Narcotics, Painless aims to educate youth about the prevalence and dangers of the opioid epidemic.

After three years in development, Painless was performed twice in December 2019. Subsequent planned performances were canceled due to COVID-19. Since performances in schools remained on pause in 2021, plans were made for a professional studio recording and downloadable cast album of Painless, with a Michigan Department of Health and Human Services (MDHHS) Injury Center grant supporting the work. Blue Cross Blue Shield of Michigan also awarded $15,000 toward the cost of making the album. By the end of 2021, seven tracks had been completely edited and mixed, with three more tracks to go. The album is expected to be completed in 2022.

Michigan OPEN is collaborating with MDHHS to add Painless to its Michigan Model for Health™ curriculum as a supplemental tool in the Opioid Misuse Prevention unit. With the help of MDHHS, the hope is that Painless can be performed at high schools across Michigan, followed by critical discussion and education, in 2022.
The PROviding Mental health Precision Treatment (PROMPT) Precision Health Study, recruiting since May 2020, uses mobile fitness devices such as FitBits and HealthKits (Apple Watch) to track both passive and patient-reported data—e.g., physical activity, weight, calories burned, heart rate, and sleep patterns—to learn how to get the most effective mental health treatment to patients as quickly as possible.

Led by co-investigators Amy Bohnert, PhD (professor of anesthesiology and associate professor of psychiatry), and Srijan Sen, MD, PhD (director of the Frances and Kenneth Eisenberg and Family Depression Center), PROMPT addresses two of the fundamental challenges in mental health care: long waits for appointments and the one-size-fits-all approach to care. By offering mobile treatment options, patients’ needs are addressed as soon as possible, often before they reach the clinic. And by examining patient-reported, environmental, and genetic data along with passive data collected from a mobile device, providers may more quickly establish an effective treatment approach.

**2021 Highlights**

On May 13, 2021, PROMPT celebrated its one-year anniversary of participant enrollment.

**RESEARCH GAINS**

- Secured IRB approval to allow for greater sharing of research-gathered data with a participant’s mental health care team, laying the groundwork for the creation of a provider-facing, research data dashboard
- Received IRB approval to conduct participant feedback interviews, allowing researchers to gather more specific information on patient experience and perceived value of participation, with a goal of refining and/or customizing future study-to-patient in-app messaging and laying the groundwork for collaboration between research and clinical care teams

“We hope to more effectively bring a precision approach to mental health and be able to predict beforehand which treatment will be most effective for a specific patient.”

Srijan Sen, MD, PhD
Director of the Frances and Kenneth Eisenberg and Family Depression Center
PROCESS IMPROVEMENT

- Standard recruitment, enrollment, and follow-up activity workflows codified to create internal knowledgebase resources, allowing for consistent team member training and staff onboarding as team expands
- CareEvolution development team updated PROMPT’s patient-facing study app to send a variety of real-time, automated, participant engagement-triggered, compliance-related in-app messages and emails:
  - reduced study team’s noncompliance communications by approximately half
  - reduced manual texting and emailing tasks
  - allowed team to focus on higher-stakes interactions (recruitment, cohort retention, comprehensive follow-ups)

PARTICIPANT INVOLVEMENT

- From May 2020 through the end of 2021:
  - 1,341 patients consented to PROMPT, and 522 (39%) completed one year of active participation
  - 320,037 automated daily mood surveys were delivered to participants, and 54.74% of those were completed

FUNDING

- ROI Grant proposal for PROMPT 2.0 submitted in July 2021 to
  - expand core project work
  - compare effectiveness of matching algorithm vs. random deployment of mobile health interventions on reducing symptom severity
  - identify characteristics that differentially predict reductions in symptom severity across different combinations of digital interventions
- Proposal submitted to Wellcome Leap Foundation in October 2021

COLLABORATORS

- Precision Health Data Analytics and IT Workgroup
  - create a platform making PROMPT data accessible for secondary users, including those without Michigan Medicine affiliations
  - provide datasets including patient-entered survey responses and biometric wearables data
- Behavioral Health Collaborative Care team
  - provide mental health assessments and referrals at select primary care centers
- University Health Service and Medicine Outpatient Psychiatry
  - continuous communication with research and clinical operations teams
  - attendance at weekly mental health clinic team meetings
  - monthly demographic and recruitment updates

"Genetic analysis combined with data gathered from mobile technology and environmental data may have the capacity to inform mental health treatment decisions and allow for comprehensive precision treatment."

Amy Bohnert, PhD
Professor of Anesthesiology; Associate Professor of Psychiatry
Mental health has been a priority area for Precision Health since its inception, but the PROMPT Study’s launch in February 2019 was prescient. Only a year later, day-to-day life as we knew it was completely upended. COVID-19 pushed the issue of mental health to center stage, and the challenges of acknowledging, and receiving the proper treatment for, mental health issues—challenges that had always existed—were suddenly in the spotlight. U-M acknowledged the significant toll the pandemic was taking on emotional well-being—employee programs and resources were more widely publicized, managers were encouraged to end meetings at 50 minutes to allow for 10 minutes of decompression, and stories on depression and mental health rose markedly on Michigan Medicine’s MHealthLab site. The pandemic also necessitated a rise in telehealth and remote treatment options, and many noted the advantages in such an approach, especially for those in rural areas, with mobility or transportation issues, or who otherwise had difficulty accessing in-person care.

The PROMPT Study is timely not only because it acknowledges the prevalence of mental health disorders and addresses longstanding obstacles to effective care, but also because it makes use of mobile technology to provide greater, more precise, and more “prompt” access to care. Its track record of high survey response rates, and the continued engagement of nearly 60% of its participants after 12 months, show that people are ready to take their mental health seriously and appreciate early mobile interventions during the sometimes long wait for an in-person appointment.

- BLOOM (Bipolar Longitudinal Outcomes Measures) team
  - discuss recruitment strategies
  - offer guidance in to expand BLOOM’s outreach efforts, particularly in contacting patients with MGI/MHB2/CRB engagement

- Ambulatory Psychiatry Psych Screening Video Visit assessment team
  - offer screening and participation to wider scope of waitlisted patients

- Ambulatory Psychiatry Sleep Clinic/MICH
  - develop prototype of a clinician dashboard to transfer study-collected novel (sleep) data to providers

PROMPT is right on time
Grants program helps Precision Health research flourish

When Precision Health launched in 2018, a key element of its charter was to sponsor campus research in the nascent field of precision health. How key? A full 20% of the initiative’s initial funding was dedicated to funding research through an internal grants program.

With enthusiastic support from its funding partners, Precision Health established two competitive grants programs: Investigators Awards (up to $300,000 each for established researchers) and Scholars Awards (up to $80,000 each for early-career researchers). This two-pronged approach was developed to encourage growth and engagement by researchers across campus—competition was open to ALL schools—at all career levels. The point was to draw early-career researchers to the field in addition to more seasoned researchers who were doing precision-health-adjacent work and to encourage development of a solid cohort of precision health researchers across disciplines.

Over three rounds of Investigators Awards (2018, 2019, 2021) and two rounds of Scholars Awards (2018 and 2019), Precision Health has distributed nearly $8 million in grant funding through the following:

- **24 Investigators Awards**
- **21 Scholars Awards**

Precision Health has distributed nearly $8 million since 2018.
Thanks to the multidisciplinary nature of the grants program, funds have been distributed across eight schools/colleges and programs on campus:

- Medical School
- College of Engineering
- School of Public Health
- Biomedical Engineering
- College of Pharmacy
- College of Literature, Science, and the Arts
- Office of the Vice President for Research
- School of Information

In grant funding through a competitive process that engaged expert reviewers on campus and beyond. In all, 24 Investigators Awards and 21 Scholars Awards projects have received funding. Even with the majority of Investigators Awards projects still underway, the overall grants program is starting to yield exciting results. In one important measure, researchers are beginning to publish their work.

More significantly, PH-funded Investigators projects (many still underway) have begun to spin off additional projects that have been funded externally. Of the approximately $5 million of funding distributed in the first two rounds of Investigators Awards, more than $11 million in external funding has resulted (see Figure 2).

The majority of Investigators Awards will be completed by the end of 2022, which means the productivity from Precision Health funding will only grow and multiply in the coming years. With a solid cohort of productive researchers from across campus, PH grants funding has successfully encouraged new and innovative projects and significantly increased the University of Michigan’s impressive portfolio of precision health research.
The Precision Health Investigators Awards, which support new, collaborative research projects rooted in precision health, were put on hold in 2020, but returned in 2021. The awards for 2021—each a $200K grant over two years—recognize seven thoroughly collaborative interdisciplinary research projects that explore topics such as surgery-associated kidney injury, point-of-care diagnosis for glioma genetic subtypes, and two projects focused on data integration: one involving electronic health records and the other aimed at pan-cancer analysis.

**PROJECT:**
“Using Artificial Intelligence to Broaden and Diversify Outdated Standards for the Determination of Skeletal Maturation in Growing Children”

**INVESTIGATORS:**
Anouck Girard, PhD, Professor of Aerospace Engineering
Josephine Kasa-Vubu, MD, Professor of Pediatrics
Michael DiPietro, MD, Professor Emeritus of Radiology

“Blending drone technology, traditional radiological imaging, and current-day pediatric endocrinology practice, this research challenges century-old dogmas about skeletal maturation in children. Interdisciplinary approaches have been a long tradition at Michigan, and few places would fathom the feasibility of associating aerospace engineering and pediatric medicine for groundbreaking research...only at Michigan!” —Josephine Kasa-Vubu

**PROJECT:**
“Rapid Intraoperative Molecular Diagnosis of Diffuse Gliomas Using Stimulated Raman Histology and Deep Neural Networks”

**INVESTIGATORS:**
Todd Hollon, MD, Assistant Professor of Neurosurgery
Honglak Lee, PhD, Associate Professor of Computer Science
Sandra Camelo-Piragua, MD, Associate Professor of Pathology

“Timely and efficient access to molecular diagnostic methods for diffuse gliomas remains difficult, causing a significant barrier to delivering molecularly targeted treatments. Our laboratory aims to develop an innovative point-of-care diagnostic screening method.” —Todd Hollon
PROJECT:
“Statistical and Computational Methods for Asymmetric Integration of Datasets from Different Cancers for the Identification of Cancer-related Genes and Biomarkers in Case–control Analyses”

INVESTIGATOR:
Hui Jiang, PhD, Associate Professor of Biostatistics

COLLABORATORS:
J. Chad Brenner, PhD, Associate Professor of Pharmacology and Otolaryngology–Head and Neck Surgery
Kevin (Zhi) He, PhD, Research Associate Professor of Biostatistics

“Pan-cancer analysis has the potential to identify common driver genes and biomarkers with greater statistical power and accuracy by taking advantage of the increased sample size when integrating datasets from different cancers. In this project, we will develop novel statistical and computational methods, as well as software tools, to analyze data collected from cancer patients and matched controls in the Michigan Genomics Initiative. Based on this dataset, we aim to find germline variants and related genes that are associated with increased risk of cancer, which can be further utilized for predictive modeling.” —Hui Jiang

PROJECT:
“Predicting Cardiac Surgery–Associated Acute Kidney Injury Using Federated Learning”

INVESTIGATOR:
Michael Mathis, MD, Assistant Professor of Anesthesiology

COLLABORATORS:
Karandeep Singh, MD, MMSc, Assistant Professor of Learning Health Sciences, Internal Medicine, Urology, and Information

“Developed for mobile technologies, federated learning enables the development of multi-hospital prediction models without the need to share data. Just as mobile apps such as Waze can crowdsource information on traffic conditions without sharing sensitive individual-level cellphone data, our approach to understanding kidney injury after cardiac surgery crowdsources information from multiple hospitals without compromising patient-level protected health information.” —Michael Mathis

PROJECT:
“Assessing the Impact of Germline Pharmacogenetics (PGx) on Medication Outcomes and Clinician Prescribing Decisions in Patients with Cancer”

INVESTIGATORS:
Amy Pasternak, PharmD, Clinical Assistant Professor of Pharmacy
Vaibhav Sahai, MBBS, MS, Associate Professor of Medical Oncology and Hematology

COLLABORATORS:
Daniel Hertz, PharmD, PhD, Assistant Professor of Pharmacy
Valerie Gunchick, MS, Clinical Research Project Manager

“Many patients with cancer experience side effects of their cancer treatment. With this award, we will investigate how pharmacogenetics could help to decrease the risk of a patient experiencing these side effects for different chemotherapies and for medications intended to help manage chemotherapy side effects.” —Amy Pasternak
PROJECT:
“Deep Learning for Prediction of Mild Cognitive Impairment and Dementia of the Alzheimer’s Type”

INVESTIGATORS:
Scott Peltier, PhD, Research Scientist of Biomedical Engineering/Functional MRI Laboratory
Zhongming Liu, PhD, Associate Professor of Biomedical Engineering and Electrical Engineering and Computer Science

COLLABORATORS:
Benjamin Hampstead, PhD, ABPP/CN, Professor of Psychology and Psychiatry
Jeffrey Fessler, PhD, Professor of Electrical Engineering and Computer Science
Douglas Noll, PhD, Professor of Biomedical Engineering

“This project will use functional MRI and machine learning methods to advance individualized diagnosis and treatment of Alzheimer’s disease. The unique collaborative environment at the University of Michigan, including the Functional MRI Laboratory, departments of Biomedical and Electrical Engineering, and the Michigan Alzheimer’s Disease Research Center, makes this research possible.” —Co-PIs Scott Peltier and Zhongming Liu

PROJECT:
“Automated Harmonization of Multi-institutional Electronic Health Records Data”

INVESTIGATOR:
Xu Shi, PhD, Assistant Professor of Biostatistics

COLLABORATOR:
V.G. Vinod Vydiswaran, PhD, Associate Professor of Learning Health Sciences and Information

“It is notorious that EHRs do not talk to each other. Such a lack of interoperability can decrease a model’s performance and lead to biases in biomedical research. Our team will adopt principles in how humans talk to each other to address the inherent heterogeneity in multi-institutional EHR data and implement the proposed methods to generate and transfer knowledge between the Michigan Genomics Initiative and UK Biobank.” —Xu Shi
2021 graduates of Precision Health’s Certificate Program

Precision Health’s Graduate Certificate Program attracts students from a range of disciplines. It is the first program at U-M to focus on the competencies of precision health, and the first of its kind among U.S. institutions.

**Jacque Adams** graduated from the School of Information in 2021 with an MS in Health Informatics and currently works as a Business Analyst at Blue Cross Blue Shield of Michigan.

**Hee Jae Choi** graduated from the College of Pharmacy in 2021 with a PharmD and is currently a Medical Fellow in Translational Medicine & Clinical Pharmacology at Boehringer Ingelheim.

**Luke DeRoos** is a PhD student in Industrial and Operations Engineering, studying under the guidance of Dr. Mariel Lavieri.

**Corinthia Gonzales** graduated from the Medical School in 2021 with an MS in Human Genetics.

**Catherine Irwin** graduated from the Medical School in 2021 with an MS in Health Infrastructures and Learning Systems. Vice president of marketing at NovoDynamics, she is also applying to the Health Infrastructures and Learning Systems PhD program.

**Andrew McKeon** graduated from the Medical School 2021 with an MS in Genetic Counseling. He is currently a Certified Genetic Counselor in the Clinical Cancer Genetics Program at MD Anderson Cancer Center.

**Jowana Obeid** graduated from Rackham Graduate School in 2021 with an MS in Molecular, Cellular and Developmental Biology. She is currently a PhD student in Molecular and Cell Biology at Stony Brook University.
Precision Health at U-M was created out of a desire to establish a central unit that could accelerate precision health research across campus, by providing the infrastructure to support precision health science across campus. At the time of Precision Health's formation, U-M hosted a plethora of precision medicine activities, but they were undertaken in silos: “islands of innovation” typically confined to a single school or academic department. Precision Health has since developed tools and infrastructure to support these islands of innovation and foster interactions among them, with the goal of creating collaborations that advance innovations in precision health. In pursuit of this goal, Precision Health has developed meaningful partnerships with 23 schools, centers, and groups across campus.

**ALFRED TAUBMAN MEDICAL RESEARCH INSTITUTE**

The Taubman Institute has partnered with Precision Health’s Investigators Awards program to fund a $300,000 research project led by Peter Todd, MD, PhD, associate professor of neurology (“Short Tandem Repeats in Precision Health and Human Disease”). Charles Burant, MD, PhD, director of the Taubman Institute, serves as a reviewer for the Precision Health grants program and participates in the leadership review and final selection process. Burant also leads the Taubman Institute Innovation Projects (TIIPs), which currently has four disease-specific Michigan Genomics Initiative (MGI) partner studies. These partnerships are helping to grow MGI’s number of DNA samples available for future research.
ADVANCED GENOMICS CORE (AGC)
AGC facilitates research in cutting-edge fields of genetics and genomics by offering sequencing and genotyping services to investigators. AGC collaborates with Precision Health by generating raw genotype data of MGI participant samples, which are banked in the U-M Central Biorepository (CBR). AGC provides technical support and issue remediation based on quality evaluation of the raw genotype data performed by the Precision Health CSG team.

CENTER FOR STATISTICAL GENETICS (CSG)
The Precision Health CSG team collaborates with MGI, Precision Health, and the CSG in the School of Public Health. As part of Precision Health’s goal to gain novel biomedical insights, MGI combines patient electronic health record (EHR) data with corresponding genetic data. The Precision Health CSG team performs rigorous preparation, quality evaluation, and quality control of MGI study participant genotype and genotype-derived data, which is shared with Precision Health investigators. The team further facilitates Precision Health research by offering investigators access to custom genetic analysis services and web-based genetic analysis tools. Since 2019, approximately 100 requests for MGI genetic data and genetic analysis have been fulfilled, and as of January 2022, 32 publications or preprints cite MGI data.

CENTRAL BIOREPOSITORY (CBR)
The partnership between the CBR and Precision Health has enabled
- Standardization of barcoded biospecimen collection kit production
- Participant enrollment
- Automated linkage of participant ID and sample IDs
- Secure, HIPAA-compliant linkage of biospecimens to the EHR
- Sample genealogy
- Automatic documentation of the biospecimen chain of custody

The CBR performs robotic DNA isolation from the whole blood or saliva of Precision Health participants.

DNA samples are quantified and subaliquoted for distribution to the AGC, where biospecimens are genotyped. CBR operations are conducted under a quality management system and accredited by the College of American Pathologists. The CBR offers quality control and assurance, which enables high-quality science and respects participants through the safekeeping of their biospecimens. A key component of this partnership is an understanding of the interplay among genetics, environmental and social variables, and medical phenotypes to develop and promote effective treatments and therapies.

CENTER FOR HEALTHCARE ENGINEERING AND PATIENT SAFETY (CHEPS)
CHEPS collaborates with Precision Health’s Data Analytics & IT (DA&IT) Workgroup to engage engineering students across various activities and projects related to the Precision Health Analytics Platform. Most notably, CHEPS students are involved with documentation projects, and with developing, seeding, and maintaining the PH GitLab code repository. Through these activities, CHEPS students deepen their understanding of EHR data while improving access and usability of PH data for U-M researchers. In 2020, 10 students from CHEPS engaged with PH. Prior to this, about 20 CHEPS students were involved in beta testing for PH DataDirect and the PH secure enclave.

DATA OFFICE FOR CLINICAL & TRANSLATIONAL RESEARCH (DOCTR)
Collaboration with DOCTR is critical to Precision Health’s success. DOCTR provides the data regulatory framework that PH deploys for all data and resources available through the Analytics Platform. The DA&IT Workgroup and DOCTR work synergistically to tackle emergent governance and technical issues related to new and existing datasets, data sources, linkages, and deidentification techniques, and the infrastructure to house newly acquired or curated datasets. In its first three years of operations, the PH DA&IT Workgroup had three staff members embedded in DOCTR, with additional partial effort of the clinical informaticist and Data Office director. Through this relationship, the DA&IT team has leveraged and further developed DOCTR expertise in validating datasets, developing and validating computed phenotypes, and certifying removal of protected health information from PH datasets.
DEPARTMENT OF CLINICAL PHARMACY
The Precision Health CSG team has partnered with pharmacogenetics researchers in the Department of Clinical Pharmacy (Amy Pasternak, Dan Hertz, and Kristen Ward) to automate the translation of MGI genetic data into processed star alleles and metabolic phenotypes. By making processed pharmacogenetics variables and phenotypes available to U-M researchers, PH has effectively removed one of the major bottlenecks for pharmacogenetics research. This is a brilliant example of how the CSG team (and the DA&IT team, more broadly) partners with groups of users to understand their needs and develop solutions to streamline and catalyze Precision Health research.

DEPARTMENT OF LEARNING HEALTH SCIENCES (DLHS)
DLHS partners with PH in multiple areas, most notably in administering and recruiting for the Precision Health Certificate Program. PH also works closely with DLHS in developing educational programming, leveraging content, and cross-promoting educational events. PH Education & Training Workgroup leaders Gretchen Piatt, MD, and Cornelius James, MD, both with appointments in DLHS, are deeply involved in supporting PH educational activities. Piatt oversees the Certificate Program; James helps develop educational programming for clinicians and medical students. Along with Karandeep Singh, MD, who is a PH Health Implementation Workgroup leader, James provides expertise in integrating Precision Health evidence-based research findings into clinical protocols. Additionally, DLHS partners with PH in an important collaboration involving a multi-phase (likely multi-year) Natural Language Processing (NLP) project, where DLHS faculty member Vinod Vydiswaran is working with the DA&IT Workgroup to deidentify and make available to researchers MM radiology reports, discharge summaries, and, ultimately, clinician and nursing notes.

ELIZABETH WEISER CASWELL DIABETES INSTITUTE (CDI)
Collaboration with what was previously known as the M-Diabetes team—now embedded in CDI—started in 2019. Synergy with the CDI team, led by Joyce Lee, MD, MPH, is a genuine opportunity for PH to play a key role in centralizing data acquisition and curation efforts for research as well as clinical care. This involves pulling data from various sources into the Research Data Warehouse (RDW) and building a diabetes registry, social worktables, flowsheets, and questionnaires. In 2020, CDI, PH, and RDW jointly hired a data analyst who is embedded in the PH/RDW technical team.

FRANCES AND KENNETH EISENBERG AND FAMILY DEPRESSION CENTER
In 2019, the Richard Tam Foundation provided a multimillion-dollar gift to benefit the U-M Depression Center. A part of that gift, in the amount of $500,000, was awarded to Precision Health, with the goal of establishing the Tam Precision Health Bipolar Collaboration Fund (“PH Fund”). Starting in 2022, and continuing for a period of five years, Precision Health leadership will use the PH Fund to provide expertise and staffing to the Heinz C. Prechter Bipolar Research Program data research team, to improve the accessibility of bipolar data by integrating them into the Precision Health platform and linking them to other novel datasets.

HEALTH INFORMATION AND TECHNOLOGY SERVICES (HITS)
Collaboration with various HITS units is critical for PH’s goal of developing and maintaining a flexible, robust, and secure analytics platform accessible to users campuswide. The PH DA&IT Workgroup has worked on many projects with the Information Assurance team, Academic IT, and HITS team liaison at Advanced Research Computing (ARC). The collaboration with HITS and ARC has been instrumental in ensuring the security of the PH computing environments and related data-transfer methods.

INFORMATION AND TECHNOLOGY SERVICES (ITS)
The collaboration between PH and ITS (in particular, ARC) has been and continues to be key to the design, development, maintenance, and updating of the PH Analytics Platform. PH funds one employee on the ARC team and has developed a robust relationship with ARC leadership. Since the rollout of PH DataDirect and connected computing environments and storage, our ARC partners have consistently supported PH users and have informed the strategy for the Analytics Platform infrastructure. ARC has also partnered with PH to build the first instance of the Amazon Web Services cloud at Michigan Medicine, which will make wearables data available to researchers.

PH and ARC have also collaborated to incorporate Encore—a self-serve, web-based analysis tool for running genome-wide association studies—into the PH suite of resources. In 2021, PH partnered with the MiDatabase team—another ITS team—to develop and maintain one of the Analytics Platform’s self-serve tools. Through this
collaboration, PH’s deidentified RDW—a partial copy of the enterprise RDW that offers direct access to database tables housing clinical structured data of 4M+ Michigan Medicine patients—became available to the U-M research community.

**INSTITUTE FOR HEALTHCARE POLICY AND INNOVATION (IHPI)**

PH has benefited from the leadership of multiple IHPI members, who have played key roles in leading the initiative. They include two of the three current co-directors—Brahmajee Nallamothu, MD, and Jenna Wiens, PhD—and one of the founding co-directors: Sachin Kheterpal, MD. IHPI Director John Ayanian is chair of the PH Faculty Advisory Committee.

PH also maintains important research collaborations with IHPI: PH’s two primary use cases, on opioid use and on mental health, are led by IHPI members. Additionally, the PH DA&IT Workgroup has engaged IHPI’s Data & Methods Hub in a productive conversation about linking claims data, available to IHPI members, to the deidentified EHR data on PH’s Analytics Platform. This would fulfill a distinctive need by facilitating research about health outcomes for patients who only have partial or episodic care at Michigan Medicine. With subsets of deidentified CMS (Medicare/Medicaid) claims data available on the Analytics Platform, researchers could link those data to deidentified EHR data and other PH datasets. In parallel, PH is partnering with the Michigan Value Collaborative team at IHPI, with the goal of supporting PH research linking deidentified BCBS claims data with the Analytics Platform’s EHR and health data.

**INSTITUTE FOR SOCIAL RESEARCH (ISR)**

Recognizing the role of the neighborhood environment as an important social determinant of health, PH has partnered with ISR’s Social Environment and Health program. Since 2019, PH’s collaboration with the ISR group—led by Philippa Clarke, PhD, MSc—has been key to acquiring and linking National Neighborhood Data Archive (NaNDa) Socioeconomic Status (SES) data to Michigan Medicine’s EHR, genetic data, and other health datasets. Adding (linkable) geocoded neighborhood data is one of the distinctive traits of the PH Analytics Platform and truly a key milestone Precision Health has reached to date.

**MICHIGAN INTEGRATED CENTER FOR HEALTH ANALYTICS & MEDICAL PREDICTION (MICHAMP)**

To build community around self-serve data tools and other analytics resources, PH partnered with MiCHAMP and its affiliated researchers to crowdsourced definitions and computed phenotypes/start populations to seed a GitLab code repository dedicated to PH/RDW resources. This is an ongoing effort primarily targeting users of the deidentified (and PHI) RDW.

**MICHIGAN MEDICINE INSTITUTIONAL REVIEW BOARD (IRBMED)**

PH has partnered with Michigan Medicine IRB leadership and the IRBMED analyst team to review and ensure alignment between the regulatory framework put in place by the IRBMED and the high-level governance principles espoused by PH leadership. This has led to a sustained process of communications and review between PH’s Research Scientific Facilitators and IRBMED staff.

**MICHIGAN INSTITUTE FOR CLINICAL & HEALTH RESEARCH (MICHR)**

Precision Health’s partnership with MICHR has led to a better understanding of research participants’ views on the studies in which they participate, and what researchers can do to improve the participant experience. Some changes implemented as a result of this partnership include explaining to participants why they were chosen for research and recognizing the continued need to diversify cohorts, as participants have said they want to advance health care and be “part of the missing puzzle pieces.” MICHR has also provided guidance with study materials to help PH reach out more effectively to potential participants.

**RADIOLOGY**

In 2020, PH initiated a partnership with Michigan Medicine’s radiology department, with the strategic goal of creating deidentified research repositories of various medical image modalities. Chair of Radiology Vikas Gulani, MD, PhD, endorsed PH’s effort in mid-2020, and since then, the PH technical team—in collaboration with the Radiology informatics team, Jessica Fried, MD, and Michael Sjoding, MD—has created and made available two repositories and, with guidance from DA&IT Workgroup leader Zhongming Liu, PhD, is currently working on a third (brain MRI) repository.
RESEARCH DATA WAREHOUSE (RDW)
The RDW technical team sits at the intersection of CAS (Clinical Applications Services), DOCTR, and PH. The team manages and maintains a research copy of the database housing the clinical structured data of 4M+ Michigan Medicine patients. The RDW is a critical resource to advance Michigan Medicine’s translational research by enabling secure access to clinical data from across multiple sources. Three PH programmers (with plans underway to add two more) sit on the PH/RDW technical team; PH also covers partial effort for additional RDW team members.

SCHOOL OF DENTISTRY
Precision Health and the Michigan Department of Health and Human Services have partnered with the School of Dentistry and College of Pharmacy to advance educational development related to opioids and pain management. The result is three distinct one-hour training modules, meeting Michigan’s licensure requirement for three hours of board-approved continuing education for pain and symptom management.

Dental School students assisted in conducting a nationwide survey of U.S. dental schools that will inform dental curriculum changes that account for opioid prescribing and patient education about safe drug storage and disposal. The School of Dentistry has incorporated “Pain Management in Dentistry” modules into the curriculum.

SCHOOL OF INFORMATION
Precision Health is partnering with the School of Information to offer BSI students a project capstone experience. In addition to creating visual data models of PH datasets, the student project team is analyzing data from past years to identify data trends. They will identify and duplicate missing data, and create a timeline of when new data have become available. Students will also create visualizations to present their findings, which PH staff will use to pinpoint areas for data quality improvement.

SCHOOL OF MUSIC, THEATRE & DANCE
In partnership with the Michigan Opioid Prescribing Engagement Network (Michigan OPEN) and the CDC, the School of Music, Theatre & Dance created Painless: The Opioid Musical, a fully orchestrated musical performance that has been added to the MDHHS’s Michigan Model of Health curriculum as a supplemental tool for the Opioid Misuse Prevention unit. With the help of MDHHS, Painless will be performed at 10 high schools across Michigan in the coming year.

SCHOOL OF NURSING
The Precision Health opioid use case team has worked with Michigan OPEN and the Michigan Emergency Department Improvement Collaborative (MEDIC) project to reduce opioid-related morbidity and mortality by:
• Increasing emergency department naloxone distribution to patients treated for opioid overdose and those at high risk of future overdose; and
• Facilitating hospital and community interprofessional provider networks to develop best practices for emergency-department-based opioid use disorder screening, naloxone distribution, and initiation of medication-assisted treatment.

Train-the-trainer methods developed within the School of Nursing have been implemented in 23 emergency departments across Michigan so far.
Precision Health workgroup leaders

**COHORT DEVELOPMENT**

Bhramar Mukherjee, PhD  
John D. Kalbfleisch Collegiate Professor and Chair, Biostatistics; Professor, Epidemiology and Global Public Health, School of Public Health

Jennifer Smith, PhD, MPH  
Associate Professor, Epidemiology, School of Public Health; Research Associate Professor, Survey Research Center, Institute for Social Research

**DATA ANALYTICS & IT**

Megan Haymart, MD  
Professor, Division of Metabolism, Endocrinology, and Diabetes and Department of Internal Medicine; Nancy Wigginton Endocrinology Research Professor in Thyroid Cancer, Medical School

Zhongming Liu, PhD  
Associate Professor, Biomedical Engineering and Electrical and Computer Engineering; Director, Engineering Preclinical Imaging Center, College of Engineering

**EDUCATION & TRAINING**

Xiang Zhou, PhD  
John G. Searle Assistant Professor, Biostatistics, School of Public Health

Vicki Ellingrod, PharmD, FCCP  
Senior Associate Dean; John Gideon Searle Professor, Pharmacy, College of Pharmacy; Professor, Psychiatry, Medical School

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