Annual Report 2022



Bringing it all together

Join the Discovery.



INSIDE

Letter from the co-directors	1
2022 at a glance	2
2022 by the numbers	4
PH core resource celebrates 10 years	5
Precision Health partners with Michigan MENA population to diversify cohort	12
PH promotes use of imaging through MRI brain repository	14
Genetics and machine learning come together to uncover precision cancer treatment	15
Providing a pathway to implement artificial intelligence and machine learning in health care	16

Precision Health grant leads to	18
predictive model for opioid misuse	
More than 30 new postoperative opioid prescribing recommendations developed for adult and pediatric surgical procedures	20
Using the latest in wearable tech to address the mental health crisis	23
Precision Health focuses on membership to facilitate multidisciplinary collaboration	26
Precision Health's certificate program celebrates its 2022 graduates	28



Brahmajee Nallamothu, MD Co-Director

Professor of Cardiovascular Diseases and Internal Medicine **Medical School**



Jenna Wiens, PhD Co-Director

Associate Professor of Computer Science and Engineering **College of Engineering**



Sebastian Zöllner, PhD Co-Director

Professor of Biostatistics School of Public Health

Welcome.

If we needed examples of the far-reaching value of precision health research, we could look to 2022 and find them in abundance. COVID's grip continued to loosen and we turned our attention to long-term projects that had been maintaining their momentum in the background, helping them come to fruition. Precision Health's accomplishments over the last year have spanned innovations in Al/machine learning, with an emphasis on mental health and opioid misuse research.

Precision Health researchers working in mental health were awarded a <u>\$780K grant</u> from National Institute of Mental Health to expand the <u>PROviding</u> <u>Mental health Precision Treatment</u> (PROMPT) study. In March the first set of PROMPT wearables data became available on Precision Health's Analytics Platform. With respect to opioid misuse research, the <u>Michigan Opioid</u> <u>Prescribing Engagement Network (OPEN)</u> developed new, evidence-based opioid prescribing and counseling recommendations in 2022, including new recommendations for five general surgery procedures and three dozen new pediatric prescribing recommendations.

Addressing the opioid epidemic was also the subject of a risk prediction model developed by Precision Health researchers, which identifies those most at risk of persistent opioid use after surgery, allowing health care providers to intervene preoperatively. In another study, Precision Health researchers used a machine-learning algorithm to target and disable the metabolic pathways that sustain cancer cells.

2022 was also the 10th anniversary of the Michigan Genomics Initiative (MGI). Begun in 2012 by Goncalo Abecasis from the School of Public Health and Chad Brummett from Anesthesiology, MGI was a biobank founded with the novel objective of combining genetic data with EHR data. Today, MGI has a worldwide reputation as a rich resource of genetic and clinical information. More than 80,000 participants make up the cohort, with recruiting efforts underway to diversify the population (see story, page 6). Researchers from U-M have studied MGI data, sharing their discoveries in more than 450 publications.

Beyond MGI, Precision Health continues to expand data resources. Focusing efforts on imaging data, more than 750,000 chest X-rays, and more than 6,000 MRI brain studies are available to researchers and ready for machine learning applications.

With respect to impact at the bedside, Precision Health launched the Epic Genomics Indicators Module (EGIM) as part Michigan Medicine's EHR system and developed a pathway and resources to guide researchers from the beginning stages of a project—assembling a team and gathering data—to its culmination: implementation in the MiChart EHR.

The spirit of Precision Health at U-M is one of collaboration, and we would be remiss not to acknowledge that many schools, departments, offices, and programs make our work possible. We thank the work of the numerous individuals who support our research, as well as the Office of the Provost, College of Engineering, Michigan Medicine, and School of Public Health.

2022 at a glance

The year 2022 was one giant leap for Precision Health at U-M, as the success stories in this annual report demonstrate. From new ways to prevent opioid misuse to an innovative cancer treatment, Precision Health's collaborative, multidisciplinary research touched all aspects of health care. The availability of new data collections, including wearables data and brain imaging data, has expanded opportunities for researchers, as has the new Data to Implementation Pathway, which begins with helping researchers form a team and ends with a project's implementation into the EHR. And last but not least, the Michigan Genomics Initiative (MGI)—the catalyst for Precision Health at U-M-celebrated <u>its 10th anniversary.</u>

Happy Anniversary, MGI!

On May 29, 2012, the <u>Michigan Genomics Initiative</u> enrolled its first participant. After a decade in existence, this foundational Precision Health resource encompasses a cohort of 92,000-plus participants, and its data has been used or referenced in <u>more</u> <u>than 450 studies</u>. It has evolved considerably from its early days of encrypted spreadsheets and manual data entry. Now, automated processes span regional recruitment sites that go beyond U-M, further diversifying the cohort and providing ever-richer data for researchers.

Predicting Risk for Persistent Opioid Use

Research into opioid misuse prevention has been central to Precision Health since its inception. Using <u>MGL</u> data, Precision Health Investigator <u>Anne Fernandez</u> and her colleagues developed a predictive model to ascertain which patients would be most at risk for persistent opioid use (POU) after surgery. With this model, health care practitioners can identify those patients most at risk and take preoperative measures to prevent POU.

New Opioid Prescribing Recommendations for 30+ Surgical Procedures

For a significant number of people, opioid misuse disorder starts with a prescription for postoperative surgical pain. Updating current postoperative prescribing recommendations is one way to prevent misuse. <u>The Michigan Opioid Prescribing Engagement</u> <u>Network (OPEN)</u>, using patient-reported outcomes data has, to date, developed evidence-based opioid prescribing and counseling recommendations for more than 70 procedures. More than 30 of these recommendations were developed in 2022, including five new prescribing recommendations for general surgery procedures and three dozen new pediatric prescribing recommendations.

Advancing Cancer Treatment Using Machine Learning

As a Precision Health <u>Scholar</u> in 2018, Abhinav Achreja began a bioinformatics research project on tumor metabolic processes. Four years later, this research would help lead to a breakthrough treatment targeting ovarian cancer cells. In September 2022, Achreja, with a team of U-M and Indiana University colleagues, <u>published findings in Nature Metabolism</u> on CLIM— "collateral lethal genes identification via metabolic fluxes"—a machine learning, precision oncology platform that can target and disable cancer cells' metabolic pathways.

Precision Health Forges a Data to Implementation Pathway

In 2020, Precision Health announced the development of a roadmap to move predictive models through retrospective and prospective analyses, to the pilot phase, with the ultimate goal being clinical implementation of the model in the electronic health record (EHR). Since then, Precision Health has evolved in the areas of <u>Health Implementation</u> and <u>Data Analytics</u> & IT, strengthened collaborative ties, and developed more resources. The roadmap was transformed into a Data to Implementation Pathway, which can effectively guide and support researchers through every step of the process, from team formation to MiChart deployment.

Improving Genetic Data Access with the EPIC Genomic Indicators Module

Genetic testing and genomic data can be invaluable for treatment decisions and research, but often these data are not properly integrated into the digital health record and virtually inaccessible. As part of MiChart's <u>fall 2022 update</u>, the Epic Genomics Indicators Module (EGIM) became part of Michigan Medicine's EHR system. The data EGIM tracks and organizes have the potential to improve medication prescribing patterns and increase uptake of genetic testing referrals by PCPs, and its patient-facing elements allow researchers to study patient engagement.

Wearables Data Advances Mental Health Care

The PROviding Mental health Precision Treatment

(PROMPT) Precision Health Study marked several milestones in 2022: the number of study participants surpassed 2,000, the National Institute of Mental Health <u>awarded PROMPT a grant</u> to expand its research, and, in March, the first set of wearables data became available to qualified researchers on <u>Precision Health's</u> <u>Analytics Platform</u>.

PH Promotes use of imaging through MRI Brain Repository

One goal of Precision Health's <u>Data Analytics & IT</u> efforts is to collect and clean medical imaging data, which are abundant and hold valuable information, but are often stored separately and in a format distinct from other clinical data. In 2022, the Brain MRI Repository was designed and set up; it now houses more than 6,000 MRI brain studies that have been translated into a dataset preconfigured for machine learning applications.

Expanding Cohort Diversity

The main goal of the <u>Michigan and You: Partnering</u> to Advance Research Together (MY PART) study has been to diversify the MGI participant population. In 2022, MY PART established a partnership with the Arab Community Center for Economic and Social Services (ACCESS) in Dearborn, MI, to recruit participants from the Middle Eastern and North African (MENA) population, which has historically been underrepresented in medical and public health research studies.

Certificate Program Graduates

Precision Health's first-of-its-kind Graduate Certificate Program is going strong. In 2022, six students graduated from the program, hailing from the College of Engineering, School of Information, College of Pharmacy, and Medical School.

2022 by the numbers



PH Core Resource celebrates 10 years Vou could say MGI started it all...

Before "big data" and "biobank" became the buzzwords they are today, there was the Michigan Genomics Initiative (MGI). Created in 2012 as a collaborative research effort among physicians, researchers, and patients, MGI would build a participant cohort that combined patient electronic health record (EHR) data with genetic data. The brainchild of a biostatistician and an anesthesiologist, MGI distinguished itself as a registry that not only merged EHR and genetics, but also allowed researchers to recontact participants. MGI was ahead of its time in its use of a broad consent from participants, allowing their data to be used in future, as-yet-unknown studies. In addition, MGI's architects created a highly visual pamphlet as a simple and memorable way to explain the consent and data collection processes to participants. I mean, who would have thought 10 years ago we would have made all the strides we have? I don't know where it could go from here, but I think the possibilities are, dare I say, endless?... I'm just happy that Gonçalo walked into Chad's office that day and asked to do this, because here we are, 10 years later.

Kendall Dubois, MS MGI Project Manager

After a decade in existence, the MGI cohort contains 92,000-plus participants, and its data have been used or referenced in more than 450 studies. From the early days of encrypted Excel spreadsheets and manual data entry at U-M's University Hospital, to the current automated processes across regional recruitment sites, MGI has evolved into a rich resource for researchers at U-M and beyond.

A host of individuals across departments and functions play a part in MGI. Research assistants and coordinators, nurses, the Central Biorepository (CBR), the Data Office for Clinical and Translational Research (DOCTR), the Center for Statistical Genetics, programmers, research scientific facilitators, investigators who use MGI data, the participants who– through agreeing to share their data–make health discoveries possible…even this list is incomplete.

Beginning

On May 29, 2012, MGI enrolled its first participant. But it began before that, when Gonçalo Abecasis, D. Phil., a professor of biostatistics in the School of Public Health, approached anesthesiologist Chad Brummett, MD, a professor and senior associate chair for research who'd begun the Analgesics Outcomes Study (AOS) in 2010 with colleague Daniel Clauw, MD.

AOS was one of the first U-M studies in which participants consented to have their blood samples used in future studies; it didn't limit patient data use to one specific study or condition. This "broad consent," as it is known, allows researchers to use the same data in any number of studies. This flexibility was appealing to Abecasis. He approached Brummett and proposed building a biorepository. Based on a recent trial that had recruited 20,000 people in two years, they decided to aim for recruiting 10,000 patients per year for MGI.

Early days

"When we first started, MGI consent was 12 pages long, and there was a paper questionnaire that went with it that every patient filled out—clipboards, pens everywhere," said DeAnna Hanewald, a research area specialist senior with MGI since November 2012. Samples were reviewed and recorded manually, and all of the information on the five-page questionnaire was likewise manually entered. The team at the time was "consenting about 50 patients a day. That's a lot of manual work to manage," said Kendall Dubois, MGI's project manager.

Streamlining the process

An early challenge to tackle was finding a way to automate the sample collection and recording process." That's where the Central Biorepository, or CBR, came in.

The CBR began working with MGI in 2013. "MGI served as a use case for the implementation of a centralized infrastructure to support patient consent, biospecimen collection, processing, storage, and distribution," explained Victoria Blanc, PhD, the CBR's director.

The MGI team began using LabVantage, a laboratory information management system (LIMS) the CBR uses for all biorepository studies. LabVantage captures the full chain-of-custody of biospecimens and provides detailed freezer location management services, which was especially important given the number of biospecimens collected for MGI. The system also provides a conduit for annotating biospecimens, Blanc said, with sample metadata, genotype data, and secure, private linkage to the electronic health record. This technology enabled MGI to scale up recruitment and data acquisition.

The evolution of consent

One notable MGI creation is its innovative consent form: It went from being an unwieldy, sometimes redundant 12 pages to being a threepage consent form accompanied by an illustrated pamphlet. The shortened consent form's straightforward language and the pamphlet's colorful drawings make the consent process easier to understand, which is of primary importance. "We take a lot of time to train on informed consent, At a Precision Health Town Hall in December 2017, Abecasis described the efficacy of the informational pamphlet that accompanied the consent form:

We ended up with a pamphlet that's all on one sheet of paper; it looks almost like a cartoon. You might say, 'You're not being serious about it if you do it this way,' but the history of it was that we started off with the traditional consent form that had been designed by the



IRB—it was [12] pages-and participants ioined and signed. And then we called them back and said, 'We'd like to know a little bit more about you,' and they would say, 'What are you talking about?' ...If you get it down to one sheet of paper, you increase the chances that people actually read and pay attention and don't tune out. So when we follow up with participants, we get better results and get more consistent

because that's the most important part of our interaction with the patients," says MGI project manager Kendall Dubois. DeAnna Hanewald, a research area specialist senior who has been with MGI since November 2012, agrees that "informed consent, and making sure we're being very thorough and making sure our patients understand the concept" is something MGI prioritizes. [answers]. It's not completely out of the blue and unexpected.

"The team has really just done an incredible job of doing what I consider to be ethical, written informed consent, where we really explain the study well," says Chad Brummett, MD.

Most cited studies using MGI data

- 1,370 citations: <u>New Persistent Opioid</u> <u>Use After Minor and Major Surgical</u> <u>Procedures in US Adults</u> Brummett, Chad M., Waljee, Jennifer F., et al. JAMA Surgery, June 2017
- 2. 523 citations: <u>Mapping the human</u> <u>genetic architecture of COVID-19</u> COVID-19 Host Genetics Initiative Nature, July 2021
- 435 citations: <u>Exome-wide</u> <u>association study of plasma lipids in</u> <u>>300,000 individuals</u> Liu, Dajiang J., Peloso, Gina M., et al. Nature Genetics, October 2017
- 4. 432 citations: <u>Biobank-driven</u> <u>genomic discovery yields new insight</u> <u>into atrial fibrillation biology</u> Nielsen, Jonas B., Thorolfsdottir, Rosa B., et al. Nature Genetics, July 2018
- 156 citations: <u>The power of genetic</u> <u>diversity in genome-wide association</u> <u>studies of lipids</u> Graham, Sarah E., Clarke, Shoa L., et al. Nature, December 2021

For a complete list of MGI publications, visit: <u>precisionhealth.umich.edu/our-</u> research/michigangenomics/publications

 I
 University of Michigan

Today the process is even more efficient, with the incorporation of the MyDataHelps app. "Participants can enter their survey data electronically and easily fill out follow-up surveys," said Janet Houghtby, MS, currently the manager of Cohort Development for Precision Health, who has worked with MGI since its inception.

After processing a DNA sample, a portion ("aliquot") of the sample is delivered to the Advanced Genomics Core (AGC), where it is genotyped. Genomic data are then analyzed and processed at the School of Public Health, where researchers are tasked with data quality and the complexities of combining genetic data with EHR data.

Matt Zawistowski, PhD, a clinical associate professor of biostatistics who is a member of the MGI genetic data team, began working on MGI shortly after it started, when he was a research staff member in Abecasis's lab. "My role has largely been overcoming the logistical hurdles of linking together two complex data sources—whole genome genotype data and electronic health records—to make an accessible resource for broad use by university researchers," he said. "I've always been impressed with the implementation of MGI. It is a complex process to go from patient recruitment to high-quality dataset."

Lars Fritsche, PhD, an associate research scientist in biostatistics, was also working in the Abecasis lab when he started to run genotype quality control for MGI in 2013. "I established a semi-automated QC pipeline for MGI's weekly genotype batches that I used for the next five years," Fritsche said. "Ultimately, [we] were able to generate the first data freeze of high-quality genotypes that was ready for prime time."

Getting to prime time required expertise in several fields. "The initial MGI genetics startup team," said Fritsche, "included a small but dedicated group of people mainly coming from Biostatistics, Anesthesiology, the Central Biorepository, and the Advanced Genomics Core, that met regularly to resolve any challenges we encountered."

A true team effort

It takes a host of committed individuals to keep MGI going. "We've had a lot of incredible staff over the years," said Brummett. "If you think about it, going from zero participants to 47 people per day across six sites required a lot of thinking about mission, vision, ways that we work as a team and function as team, standard operating procedures."

Brummett also acknowledged the contributions of "our nursing colleagues, who have been helpful in drawing samples before surgery and have been part of that team from the beginning. Sometimes they really go out of their way to help us, and we appreciate it."



"We try to reiterate to our team all the time that what they do is extremely important. Sometimes the dayto-day can get in the way, and you don't see all the things that happen downstream after you consent that patient," said Dubois. "Vici Blanc and the team at CBR are [also] critical, as is the DOCTR office, and our statisticians."

"In the beginning, MGI leveraged the expertise of existing groups to handle individual parts of this process," Zawistowski said, "but each group was built and optimized to work individually. We each excelled at our own jobs, but for MGI to become a long-term success, we had to work more efficiently as a team. We had to understand how each group operated. As each side gained a better appreciation for the work of the others, we built a system that would work for MGI long term. It sounds easy, because it has generally worked out well, but there was a lot of hidden work that went into creating the current MGI data pipeline."

MGI's beginnings also benefited from anesthesiologist Sachin Kheterpal, MD, MBA, one of Precision Health's founding co-directors and associate dean for research information technology. "Sachin was part of the reason that starting [MGI] in anesthesiology was so powerful," said Brummett. "In his research administration role, even before Precision Health, he knew more about making meaningful clinical data out of the electronic health record than anyone else in the health system." With this knowledge, MGI leads could "develop phenotypes more rich than, say, a UK Biobank," Brummett added. MGI phenotypes included patientreported outcome measures, clinical data, and labs, and they "live over time, so you continue to get data from those participants."

As the main data resource of Precision Health, MGI continues to be enriched with new sources of information, such as prescription and imaging data, and geolocation and other social determinants of health. "I think it's important to recognize that it's not just genetics. It's about health and disease and people, and there's a lot of individual variance in people that is not necessarily explained by genetics. Precision Health now enables that, and MGI enables that," Brummett said.



The success of MGI has launched opportunities for expansion out of the perioperative space. The spectrum of conditions represented by our partner studies runs from mental health disorders and neurological conditions, to metabolic syndromes and autoimmune diseases.

Victoria Blanc, Ph.D. Director, Central Biorepository

The results

The availability of MGI data and the tools and support that Precision Health supplies have impacted how researchers approach their work. "I think it's pretty common for people to talk about cross-campus research, but it's less common for people to actually do it," said Brummett. "I think Precision Health is an example where you have researchers from multiple schools and colleges truly collaborating and truly working together for better."

Over the last decade, MGI data have formed the basis for significant discoveries in implementation science, polygenic risk scores, ophthalmology, pain research, diabetes, cardiology, and other areas. The number of publications using MGI data is just one measure of the impact MGI has made over the last 10 years.

"I use MGI as one of my key resources for scientific projects and collaborations," said Fritsche. "I have used MGI data in at least 14 papers, mainly around polygenic risk scores, genome-wide association studies, and new statistical genetics methods."

"The number of publications that come out of MGI is really incredible," said Brummett. "We've seen so many papers—in Nature, Nature Genetics, Nature Communication—high-impact, specialty journals—that come from MGI," he said, also pointing to national and international collaborations where U-M is now a key player because of MGI.

MGI and Precision Health at the University of Michigan contribute to each other's development. The work that Precision Health has done in advancing MGI "has galvanized researchers around the institution to try to use MGI as a resource and also think about Precision Health as bigger than MGI. The creation of Precision Health has been helpful in broadening the use of MGI," said Brummett.

Brummet credits Precision Health's founding co-directors—Kheterpal, Abecasis, and Eric Michielssen, PhD, professor of electrical engineering and computer science and associate dean for research—for promoting MGI and making its data more widely available. And he credits MGI participants for making it all possible. "Without people willing to give their samples and be part of something bigger, we really don't have anything," he said.

The future

"I was privileged to be there on day one of MGI, collecting that first sample in pre-op," said Houghtby. "I am excited to see what the future holds and how we can work to personalize medicine for everyone." For the future, the MGI team hopes to see greater diversity in participant recruitment, in the types of data collected, and in the kind of research Precision Health and MGI enable.

"We're really pushing for diversity of samples," said Dubois. Hanewald notes: "When MGI first started, it was only surgical patients, and now, with MY PART, we're able to recruit patients anywhere,", adding that moving outside of Michigan Medicine will help diversify the participant population. Houghtby agreed: "MGI has expanded outside of the preoperative area with 13 partner studies, each enrolling for disease-specific participants. We have also moved into the community, enrolling the first non-Michigan Medicine participant into MY PART. We want to collect samples that reflect the diversity of the United States across age, gender identity, race, and ethnicity."

MGI was a major catalyst for the creation of Precision Health and remains its backbone. Precision Health, in turn, will continue to grow and promote this invaluable data resource through the Cohort Development and Data Analytics & IT focus areas, its support of innovative health research, and an environment that champions cross-disciplinary collaboration.

MGI 10th anniversary symposium

On September 30, 2022, Precision Health held a symposium at the School of Public Health to commemorate MGI's 10th Anniversary. MGI cofounder and Precision Health founding co-director Goncalo Abecasis, D.Phil., delivered a keynote address, and MGI researchers from Public Health, Pharmacy, and Medicine shared findings made possible by MGI data.

Presentations:

- Gonçalo Abecasis, D.Phil.: Keynote: <u>"Biobanks</u> <u>& MGI: Discoveries & Serendipity to Improve</u> <u>Human Health"</u>
- Amy Pasternak, PharmD : <u>"Leveraging</u> <u>MGI for Pharmacogenetic Discovery and</u> <u>Implementation Across the Health System"</u>
- Nicholas Douville, MD, PhD: <u>"Precision Health for</u> <u>the Perioperative Period: Integrating MGI into the</u> <u>Operating Room</u>"
- Brett Vanderwerff, PhD: <u>"Combining Genetic</u> Data Collected on MGI Arrays"
- Matthew Zawistowski, PhD: <u>"CYP2D6 Deletion</u> Calls in MGI"
- Daniel Hertz, PharmD, PhD: <u>"Clinical-Translational</u> <u>Studies to Prevent Severe Fluoropyrimidine</u> <u>Toxicity in DPYD Carriers"</u>
- Jean Morrison, PhD: <u>"Investigating Selection Bias</u> in the Michigan Genomics Initiative"
- Jennifer A. Smith, PhD, MPH: <u>"Update on MGI</u> <u>Recruitment"</u>
- Matthew Zawistowski, PhD; Kristin Krach, MS; Snehal Patil, MS; Brett Vanderwerff, PhD: <u>"Precision Health Tools Workshop: Introduction to</u> <u>Pheweb & Encore"</u>



Enriching the diversity of study participants

Precision Health recruited its first participant into the Michigan and You: Partnering to Advance Research Together (MY PART) study in May 2020. Since its inception, MY PART's main goal has been to diversify the Michigan Genomics Initiative (MGI) participant population, to build a research cohort that more accurately reflects the diversity of the U.S. in health status, age, gender identity, race, ethnicity, and geography. It's been working. When presenting on MY PART recruitment at the MGI 10th Anniversary Symposium in September 2022, Cohort Development Associate Director Jennifer A. Smith, PhD, noted that one-third of the MY PART cohort identifies as nonwhite; compared to the MGI population, the MY PART cohort has twice the proportion of Hispanic participants; and the average MY PART participant is substantially younger than the average MGI participant.

To attract more diverse participants, and partly in response to COVID-19, Precision Health has used innovative recruitment and engagement methods for MY PART, including a participant tracking dashboard to help recruiters identify potential participants; remote, electronic recruitment through the MyDataHelps app; and collection of DNA samples via "spit kits" returned in the mail. MyDataHelps can also link to outside electronic health records, so that recruitment is not limited to Michigan Medicine patients.

In 2022, MY PART began an initiative to focus on recruiting participants from the Middle Eastern and North African (MENA) population, which has historically been dramatically underrepresented in medical and public health research studies. At the MGI 10th Anniversary Symposium, Smith, an associate professor of epidemiology, detailed these efforts. "In Metro Detroit, we have one of the largest, most visible, Arab and MENA communities in the U.S.," she noted, "so we wanted to really work with that community and make it a part of Precision Health."

To develop this recruitment initiative, the Cohort Development group worked with researchers at and outside U-M, including researcher Kristine J. Ajrouch, PhD—a professor at Eastern Michigan University and an adjunct research professor at U-M's Survey Research Center—whose work focuses on the Arab American population. The MY PART research team began by adding questions to the MY PART survey that were relevant to the MENA population. They then established a partnership with the Arab Community Center for Economic and Social Services (ACCESS) in Dearborn, with MY PART recruiters regularly onsite at the center.

Other efforts underway include:

- Engaging with Arab American and/or Public Health student groups at U-M Dearborn and other universities
- Partnering with health care professionals at U-M and other hospital systems and clinics
- Forging a new partnership with the Arab American Health Initiative (AAHI)
- Launching email and social media recruitment
 efforts
- Developing a grant proposal on cardiovascular disease in the MENA population

With the ongoing efforts listed above, the MY PART team hopes to cultivate "a great partnership with this population, which is so underrepresented in research," said Smith.

A MY PART recruiter at ACCESS

By Jacob Ortlieb, MY PART Clinical Research Coordinator

The MY PART Study is committed to Precision Health's goal to pursue health equity by better representing the diversity of the United States. For that to happen, every group needs representation.

In 2022, to broaden our reach, MY PART partnered with the Arab Community Center for Economic and Social Services (ACCESS) in Dearborn for our first-ever in-person recruitment. Dearborn, Michigan, has one of the United States' largest



Jacob Ortlieb at ACCESS in Dearborn populations of people of Middle Eastern or North African (MENA) descent, and ACCESS has loyally served the community for over 50 years.

ACCESS shares our vision for the future of health care, and we are excited about the opportunities this

opportunities this partnership has brought. Interested participants can sign up, answer the survey, provide a small saliva sample, and earn a \$25 gift card, all while

waiting for their ACCESS appointment.

We have met countless wonderful people and have made connections with ACCESS staff and clients alike. This experience has shown us, once again, that despite differences in our language or cultural backgrounds, we can collaborate toward achieving a shared goal. It has been an honor to work with this community to improve health equity.

PH promotes use of imaging through MRI brain repository

Early in 2021, Precision Health made chest-X-ray imaging data available to researchers on its Analytics Platform. By October of that year, the Chest X-Ray Repository contained more than 750k images, and imaging project leads Mike Sjoding, MD (Assistant Professor of Internal Medicine-Pulmonary/Critical Care), and Jessica Fried, MD (Clinical Assistant Professor of Radiology), mentioned that a library of brain MRI images was in the works.

A Brain MRI Repository was designed and set up in 2022, and now houses more than 6,000 MRI brain studies that have been deidentified and "translated" into a multimodal dataset preconfigured for machine learning (ML) applications.

Images in the Brain MRI Repository are pulled from the Michigan Medicine Radiology Picture Archiving and Communication System (PACS). All protected health information (PHI) and identifying attributes are removed, and relevant features for multimodal ML analysis are extracted. These features include grey matter surface/volume, white matter surface/ volume, cortical thickness/folding, and brain curvature characteristics. Each MRI study is stored in a NIFTI format.

Medical imaging data are abundant and hold valuable information but are often stored separately from other clinical data, in a distinct format, and with identifying information. One goal of Precision Health's Data Analytics & IT efforts is to collect and clean imaging data, save them in a deidentified and usable format, and house them in repositories. Ultimately, these repositories will link to other Precision Health datasets, such as genetic and wearables data and deidentified EHR data, broadening the scope of precision health research and fueling new discoveries.

Zhongming Liu, PhD, assistant director of Data Analytics & IT at Precision Health and associate professor of Biomedical Engineering and Electrical and Computer Engineering, led the development of the Brain MRI Repository. In developing the repository, Liu, who is also director of the Engineering Preclinical Imaging Center in the Department of Biomedical Engineering, collaborated with colleagues and subject matter experts from the Department of Psychology's Michigan Neuroimaging Initiative and the Functional MRI Laboratory, which is housed in the Office of the Vice President for Research.

"This brain MRI repository uses the standards and practices established by the brain imaging community," says Liu. "It enables the use of artificial intelligence and machine learning for precision health. The repository currently represents the first phase of 'big data' in clinical brain MRI. Its future expansion will create a valuable data resource and open opportunities for collaboration between medical and data scientists from different fields."

For those interested in learning more, the Precision Health Analytics Platform Documentation Site has information on how to access and use the repository, including access requirements, a GitHub site, and a Brain MRI Starting Population.

Genetics and machine learning come together to uncover precision cancer treatment

In 2018, Abhinav Achreja, PhD, received a Precision Health Scholars Award to fund the research project "Phenotype and metabotype analysis of cancer patient-specific metabolic vulnerabilities." Achreja then a research fellow in biomedical engineering working in the lab of Precision Health member Deepak Nagrath, PhD—focused his computational bioinformatics research on tumor metabolic processes and the tumor microenvironment. Four years later, his research on metabolic vulnerabilities would help lead to a breakthrough treatment targeting ovarian cancer cells.

In September 2022, Achreja, Nagrath (an associate professor of biomedical engineering), and their colleagues made news alongside researchers from Indiana University when they published findings in Nature Metabolism demonstrating the effectiveness of an approach that uses a machine-learning algorithm to target and disable cancer cells' metabolic pathways.

They call the approach "collateral lethal genes identification via metabolic fluxes," or CLIM: a machine learning, precision oncology platform that identifies collateral lethal metabolic targets. Tumor cells thrive by deleting sections of DNA meant to suppress their growth. With these deletions, however, comes collateral damage—genes necessary for metabolic processes are also lost. To remedy this, paralog, or backup, genes step in to perform the metabolic duties, and the tumor cell survives. The researchers saw an opportunity. "The theory is that vulnerabilities emerge in the metabolism of cancer cells due to specific genetic alterations," said Nagrath. By using CLIM, Achreja and Nagrath can predict which paralog will act as a collateral lethal gene and inactivate it, which deprives the cancer cell of an essential function. "Our platform actually makes predictions based on the modeling of the metabolism," Achreja explained to Fierce Biotech.

The team at Indiana University validated these findings in the lab—six out of the six mice they tested the treatment on showed complete remission.

"This could revolutionize the precision medicine field because the drug targeting will only affect and kill cancer cells and spare the normal cells," said Nagrath. "Most cancer drugs affect normal tissues and cells. However, our strategy allows specific targeting of cancer cells."

2022 Precision Health Annual Report | 15

Providing a pathway to implement artificial intelligence and machine learning in health care

In Precision Health's 2020 Annual Report, we announced the development of a roadmap researchers could follow to move predictive models through retrospective and prospective analyses, to the pilot phase, with the ultimate goal being clinical implementation of the model in the electronic health record (EHR). Developing the roadmap required enterprise-wide collaboration, with engineers, programmers, data analysts, clinicians, and administrators providing input.

This initial roadmap marked the first step in supporting integration of artificial intelligence (AI) and machine learning (ML) models developed at U-M into the EHR and into Michigan Medicine's operational workflows. Prior to the roadmap, no standardized process existed.

As researchers, clinical champions, and other stakeholders put the roadmap to the test, the landscape changed around how to govern and deploy prediction models. New challenges became apparent at the model deployment and implementation stages, and at the point where the two intersected. The roadmap needed to be redrawn to create a smoother route. This prompted the roadmap developers to consider the process from a researcher's point of view and determine the most helpful resources for researchers at each stage.

"The new pathway has been rewritten from a researcher perspective," explained Karandeep Singh, MD, MMSc, Precision Health's associate director of Health Implementation.

An implementation roadmap was transformed into a Data to Implementation Pathway, which can effectively guide and support researchers through every step of the process, from team formation to MiChart deployment.

"Precision Health can support researchers in so many ways. Our new pathway helps us figure out where researchers are on their data-to-implementation journey and guide them toward the resources we can offer to make sure their work is impactful," said Singh.

Since developing the original roadmap in 2020, Precision Health evolved in the areas of Health Implementation and Data Analytics & IT, strengthened collaborative ties, and developed more resources. The two groups joined forces to better address translational research needs.

"We realized that the process of building and implementing a prediction model, a common research use case we support, involves resources across Data Analytics & IT and Health Implementation," Singh said, adding, "the translation of a research idea from the data analysis phase to implementation is often one of the biggest challenges. Recognizing this challenge, our two groups worked together to highlight what each group can do to support researchers, including a focus on the critical point at which a data analysis becomes ready to implement."

The new pathway consists of a set of decision points, actions, and resource support, helping researchers identify clinical collaborators, gather and analyze data, develop models, and prospectively study novel predictive algorithms. Covering so many areas and connecting the dots between them required extensive collaboration not only within Precision Health, but between Precision Health and a host of other offices and programs.

"The pathway is informed by our conversations and collaborations with a number of research groups on campus," said Singh, "including researchers at the Max Harry Weil Institute for Critical Care Research and Innovation, the Michigan Program on Value Enhancement, and the Machine Learning for Data-Driven Decisions group [led by Precision Health Co-Director Jenna Wiens]." Precision Health also leveraged the expertise of collaborators in Engineering, the Michigan Medicine Clinical Intelligence Committee, MiCHAMP, the Office of Clinical Informatics, Learning Health Sciences, HITS, the Data Office for Clinical & Translational Research, and the Research Data Warehouse.

Precision Health's Data to Implementation Pathway aims to streamline and clarify a key process in health care improvement that is lengthy and cumbersome. "While new discoveries fueled by science are exciting, the delays from discovery to implementation that pervade science are troubling," said Singh. "While some delays may be warranted to make sure that findings are confirmed before being implemented, we want to remove the friction that can lead to unnecessary delays simply because there isn't a clear path for researchers to take discoveries from bench to bedside. I'm hoping that studying implementations of these discoveries, including those that leverage our electronic health record, become a part of our culture and lead to better care, faster."

Data to implementation pathway

Intake, Team formation, and Data acquisition

Data Analytics & IT

We can help you get data for your r<u>esearch.</u>

Email Research Facilitators at PHDataHelp@umich.edu to get started with data and analytical needs.

Have you formed a team?

We have research scientific facilitators who can help you connect with clinicians and/ or data scientists.

Does your team need access to patient data?

- <u>Deidentified health data</u> available through selfserve tools
- Data documentation
 (Level 1 VPN)

At the end of this phase, your team should be formed and have access to retrospective data needed to understand the clinical problem and/or build a model. Analysis, Model development, and Retrospective evaluation

Does your team need access to a secure computing environment?

- Precision Health Analytics <u>Platform</u>, a secure, flexible, and high-compute environment for your
- research.
- U-M Research Computing, available to U-M Principal Investigators and includes access to high-speed storage and computing resources. This resource is provided by U-M Information Technology Services.

At the end of this phase, analytics should be complete on this retrospective data, and if applicable, a model should be trained and retrospectively evaluated.

Does the analysis or model need to be prospectively evaluated?

Near Real-Time Research Data Warehouse (NRT-RDW) This service maps a near realtime data feed to data tables similar to DataDirect/RDW.

Stakeholder engagement

Health Implementation We can help you

implement your research.

Email us at PH-Implementation-Support@ umich.edu to get started with implementation needs.

Are there operational stakeholders that need to be involved?

Governance committees or key stakeholders may need to review and approve your research plan to enable you to conduct a research study that involves clinical end-users. **Precision Health** can help you navigate and connect with these committees.

Example committees and stakeholders:

- Nursing governance research and translation committee
- M-PLAN directors for inpatient units

At the end of this phase, any governance bodies and related stakeholders that need to review the research should be engaged

MiChart (Epic)

Implementation within

functionality do you need to integrate within MiChart? Best-Clinical prediction practice model alert Contact Place a the MiChart research Research request to Team the clinical michmed.org/ Intelligence <u>MiChart</u> Committee Research forms.office. com/r/ eywnKE47UC

For models to be technically integrated within MiChart, they will need to be packaged in a specific Python format to run in Epic's Cognitive Computing Platform.

Precision Health can help you package your model.

	At th shou MiCh	e ei Ild k nart	nd o be in ana	f thi tegi I visi	's ph rate ible	ase d wi to c	, an thin linic	alyti al	cs	
	end-	-use	ers.							
v d.										

Precision Health grant leads to predictive model for opioid misuse

Research into opioid misuse prevention has been central to Precision Health (PH) since its inception, when "Precision Opioid Prescribing" became the first PH use case. Co-investigators Chad Brummett, MD, and Amy Bohnert, PhD, MHS, have published studies related to the use case in the American Journal of Preventive Medicine, the New England Journal of Medicine, Annals of Surgery, and other journals.

Harnessing the power of data through machine learning applications such as predictive modeling is another foundational aim of Precision Health, with such research often relying on PH's data backbone: the Michigan Genomics Initiative (MGI) (see story, page 5). PH researchers have applied predictive modeling to acute kidney injury and cancer risk, among other areas. In a study published in Surgery in 2022, Anne Fernandez, PhD, and her colleagues combined these core focus areas of Precision Health. Using data from MGI, they developed a predictive model to ascertain which patients would be most at risk for persistent opioid use (POU) after surgery. With this model, health care practitioners could then take POU prevention measures before surgery.

Fernandez, an Assistant Professor of Psychiatry, was granted a 2018 Precision Health Investigators Award for her project "Precision Prevention of New Persistent Opioid Use Following Surgery: A machine learningbased treatment approach." The Surgery study grew out of this research.

"Opioid-based pain medications have an important therapeutic role in surgical recovery, but they also introduce risks of long-term use, physical dependence, and addiction. Many people use them for acute pain after surgery and stop without incident, but some do not," said Fernandez, corresponding author on the study. "This research could help identify surgical patients who are at risk of persistent opioid use and trigger prevention efforts to mitigate this risk before it happens."

More than 90% of the annual 100 million surgical patients in the U.S. currently receive a prescription for opioids. A significant number of these patients—9-13% of those who have not used opioids before, and an even higher percentage of those already taking them before surgery—will continue to use opioids long term, which exacerbates the already serious opioid epidemic.

Being able to offer preoperative opioid counseling to those at highest risk would contain the costs and resources involved in counseling to those who most need it.

Two aspects of this study differentiated it from similar previous research. First, the model's development incorporated more sources of information than just claims data. Researchers also considered patientreported measures of pain and stress, prescription drug monitoring data, and data from the electronic health record. "By integrating diverse data resources at the University of Michigan, we were able to develop the most accurate model for predicting POU published in the literature," Fernandez said, acknowledging MGI, Precision Health, and the Data Office for Clinical & Translational Research for their contributions, which made the work possible.

Second, unlike previous POU prediction models, this model was tested separately on two populations: opioid-naïve patients, and patients who had previously taken opioids. Intervention strategies for patients who had previously taken opioids would differ from opioid-naïve patient counseling, so researchers tested model performance in each group individually, which was a first.

One predictor not included in the restricted model, however, was race, which the researchers carefully considered. "MGI data and Michigan Medicine data in general are fairly homogenous, with a very high proportion of White, Non-Hispanic individuals," Fernandez explained (read about how MY PART is taking steps to change this, page xx). "Dr. [Karandeep] Singh and I are working with Dr. Rahul Ladhania on a funded MIDAS grant" ("Equitable Models for Persistent Opioid Use Prediction and Personalization") to increase the sample size for subgroups and "evaluate the equitability of this model and several other persistent opioid use prediction models across diverse groups."

Fernandez credited her Investigators Award with enabling the research. "The development of this model was the cumulative goal of my funded Precision Health Investigators Award," she said. "That grant was integral in this work, as was the connection it facilitated with the Precision Health data team and resources. I am very grateful for their investment in this line of research."

•	•	•	•	•	•	•	•							•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•							•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•		•	•	•
•	•	•	•	•	•	•	•							•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•							•	•
•	•		•	•	•	•	•								•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•							•	•
•	•	•	•	•	•	•	•							•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•							•	•
•	•	•	•		•	•	•								•	•	•	•	•	•	•	•	•	•		•	•	•	•		•	•	•	•	•								•
•	•	•	•	•	•	•	•							•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•							•	•
																													2	022	2 Pre	ecis	sior	ר He	ealt	th A	nn	ual	Re	por	τļ	19	
÷.,	•			•		•	•		•	•		•	•	•	•	•	•	•	÷.,	•	•	•	•	•		÷.,	•	•				•	•	•	•		•	•	•	•		•	•
		•					•	•	1	•	•	•	•	•	•	•	•	•	•	•		•	•	•						•					•		•	•	•	•	•	•	•

More than 30 new postoperative opioid prescribing recommendations developed for adult and pediatric surgical procedures

New opioid prescribing recommendations were developed in 2022 for the following medical procedures:

Pediatric:	Shortening Femur/Tibia	Hydrocelectomy								
Dental Extraction	Percutaneous Pinning - Wrist, Elbow,	Hypospadias Repair								
Appendectomy	Humerus	Orchiopexy								
Inguinal Hernia	Orthopaedic Tendon / Soft Tissue Procedure	Penile Surgery – Chordee Release, Meatoplasty or Meatotomy								
Umbilical Hernia	Trigger Finger Release	Testicular Torsion Repair								
LeFort and/or Sagittal Split Osteotomy	Adenoidectomy	Ureteral Reimplant								
Oral-Maxillofacial Bone Cyst	Mastoidectomy	Soft Tissue Procedure								
Removal	Neck Surgery	Conoral Surgery								
Epiphysiodesis	Otoplasty	Centeral Surgery.								
Hand Surgery	Tonsillectomy (11 years old and	Gastrorrhaphy								
Knee Surgery – Arthroscopic, Open,	younger)	Pancreatectority								
Ankle Antroscopy	Tonsillectomy (12 years old and	Laparoscopic enterolysis								
ORIF – Elbow, Humerus, Radius, Ulna	greater)	Transanal excision of rectal tumor								
	Tympanoplasty	Laparoscopic closure of								
	Alveolar Cleft Bone Graft	enterostomy								
Orthongodia Rona Lasian Romaval	Cleft Lip									
Orthopdedic Bone Lesion Removal	Palatoplasty and Pharyngoplasty									
Orthopaeaic Haraware Removal	Circumcision									
Osteotomy - Rotation Femur/Tibia,										

On September 14, 2022, Precision Health held a virtual research update for study participants, and Chad Brummett, MD, gave a presentation on reducing opioid misuse. Co-investigator of the Precision Opioid Prescribing Use Case, Brummett summed up the severity of the current opioid epidemic in his opening remarks: "It's common, it happens, and it crosses all demographics. It is something that hits our whole country."

For a significant number of people with opioid misuse disorder, it starts after surgery, when they are prescribed opioid pain medication for the first time. And surgeons do not necessarily base their prescriptions on the latest research. "We recognized that surgeons were determining the number of opioids based on what they were taught as senior residents over evidence or direct data," said Brummett, who is a co-director of the Michigan Opioid Prescribing Engagement Network (OPEN). Other OPEN co-directors are Jennifer Waljee, MD, MPH, MS; Mark Bicket, MD, PhD; and Michael Englesbe, MD. "This is an opportunity to fill a critical gap," Brummett noted. In addition to educating providers, patients, and communities, the goals of OPEN are to reduce opioid use and eliminate unnecessary opioid exposures.

An effective way to prevent opioid misuse before it begins is by updating current postoperative prescribing recommendations. These recommendations use patient-reported outcomes (PROs) to determine the minimum number of opioids needed to effectively mitigate pain for a given procedure. OPEN is also looking at behavioral, lifestyle, and even genetic factors that might predispose someone to persistent opioid use, to identify those individuals who would most benefit from preoperative counseling or nonopioid forms of pain management.

Explained Heidi Aslesen, OPEN's grant program manager: "The goal is to custom fit prescribing to consumption, so we are still meeting the mark for pain management using opioids when they are appropriate, as well as encouraging nonopioid medications like Tylenol® (acetaminophen) and Motrin® (ibuprofen), and non-medication tools like meditation." To date, there are evidence-based opioid prescribing and counseling recommendations for more than 70 procedures, which cover general and specialized surgeries, dental extractions, and pediatric procedures.

More than 30 of these recommendations were developed in 2022, including five new prescribing recommendations for general surgery procedures and all the pediatric prescribing recommendations, which Karen Cooper, MD, helped the OPEN co-directors develop. "Our goal is to talk about how we can together safely and effectively manage acute pain after surgery, so children and adolescents can heal and recover as well as possible without long-term consequences. We have concrete recommendations now that can really make a difference as the work continues to evolve," Cooper said.

Existing OPEN recommendations were also reviewed in 2022, based on new prescribing patterns and PRO data: 10 recommendations were revised (decreased from previous recommendations), and nine recommendations stayed the same.

"These are evidence-based prescribing recommendations; they're based on patient-reported use," Brummett emphasized in his September presentation. "Pain isn't getting worse, and satisfaction isn't decreasing" with these new recommendations, which are "getting down to around 10 pills" for some procedures whose original recommendations "were in the 40 to 50 pill-per-surgery range," he said. "We see many patients using zero pills and doing very very well."

"When opioids were first used, people didn't know the potential risks," said OPEN research assistant Holli Sharples. "Now, with the technology we have, we can look back and see where we can move forward and how we can provide better care management to our communities. We can see where the problems were, and we can work toward fixing them. We can't stop now."



Using the latest in wearable tech to address the mental health crisis

RHR: 61

Launched in 2019, the PROviding Mental health Precision Treatment (PROMPT) Precision Health Study optimizes wearables and mobile data to develop responsive precision mental health treatment, and 2022 marked a culmination of the study's innovative efforts: the number of study participants surpassed 2,000, the first set of wearables data became available to researchers on Precision Health's Analytics Platform, and the National Institute of Mental Health (NIMH) awarded PROMPT a \$780K grant to expand on the study's work.

MAH-

That there is a growing mental health crisis in the U.S. is acknowledged by the media, the government, and the public at large. What exacerbates an already serious problem is the lack of resources to adequately care for the growing population of people with mental health conditions. In designing PROMPT, Co-Investigators Amy Bohnert, PhD, MHS, and Srijan Sen, MD, PhD, wanted to address this care gap and the frustrating wait times that result from it. Getting an initial appointment can take months, during which an individual's mental health could deteriorate, or they could simply give up on the process. Once someone finally sees a mental health provider, a largely trial-and-error approach to the most effective treatment also takes valuable time; with PROMPT, Sen and Bohnert wanted to develop a more targeted, less time-consuming treatment approach.

Wearable sensor measures provide an objective, real-time method to gauge treatment response. When treatment efficacy is tracked and adjusted in real time, patients are less likely to drop a treatment program because it's not working.

The mental health sector, as in other health care fields, has been looking to wearable and mobile data to offer fresh insights and potential solutions to existing health care problems. There is a public health burden to lessen the gap between the number of people with mental health conditions and the capacity to provide them treatment. Digital interventions are one means to close this gap. The use of wearable technology can help expand the treatment capacity of health care systems. PROMPT relies on mobile interventions to start

R01 grant will expand PROMPT's core work:

On the topic "Technology and the Future of Mental Health Treatment," the National Institute of Mental Health (NIMH) states that "mobile mental health support can be very simple but effective," but allows that, in spite of the proliferation of mental health apps on the market, there remains "very little information on app effectiveness." The main concern with using digital interventions in mental health care is "obtaining scientific evidence that they work and that they work as well as traditional methods." Other concerns include privacy, regulation, and whether apps are equally effective for all people and all mental health conditions. The NIMH has identified research on digital health technology's effects on mental health care as "a high-priority area."

In September 2022, Sen and Bohnert were awarded an R01 grant from the NIMH for the project "Mobile Technology to Optimize Depression Treatment," which will continue and expand on PROMPT's work. In their project description, they note "the absence of objective, real-time methods to effectively predict and assess treatment response," which would enable tailoring mental health treatments to individuals, and see a solution in the "passive, continuous, and objective measures" that smartphones and wearables collect. Bohnert and Sen aim to identify factors that could predict which treatment could work for which patients, and to identify which passive digital measures indicate a patient is responding to treatment. "The project is designed to lead directly to an organization-level intervention that matches patients to treatments and continuously monitors their response to treatment," they say-an approach that "has the potential to greatly accelerate recovery.

"If successful," they continue, "the proposed research will result in improved mental health care by expanding the capacity of our health care system and by tailoring treatment to the needs of specific patients, using technology that can be readily adopted by health care systems and payers." mental health treatment before the first office visit and uses both passive and self-reported mobile and wearable device data to expedite an appropriate treatment plan for a patient.

Participant engagement in PROMPT has been impressive. Of the 2,100+ study participants, 90.3% have completed their six-week follow-up assessment, 78.1% have completed an 18-week follow-up survey, and 67% have completed their final, 12-month survey.

But gathering information from participants and their wearable and mobile devices is only a first step. To truly have value and influence future treatment approaches, these data need to be integrated into a clinical context, incorporated into workflows, and securely made available to researchers.

In March 2022, the first set of PROMPT data became available to qualified researchers; it includes readings from mobile fitness devices, FitBits, and HealthKits (Apple Watch), and information about physical activity, weight, calories burned, heart rate, sleep patterns, and more.

PROMPT data available via the Precision Health Analytics Platform include:

- Sensor data
 - activity level (steps, active minutes, sedentary minutes)
 - sleep data
 - heart rate
- Daily mood ratings
- Usage minutes of app-based mental health interventions Headspace (Mindfulness) and Silvercloud (Cognitive Behavioral Therapy)
- Genomic & environmental data
- A range of psychological assessment scales and measures

In addition to wearables and sensors, data are obtained from the electronic health record, DNA collection via saliva sample, and participant self-report surveys and mental health symptom assessments collected via the MyDataHelps app.

In 2022, the Precision Health Analytics

 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1
 1

Prompt data collection



Platform received 870 queries pertaining to PROMPT data.

Instructors may also access the data for use in their classes, so students can get hands-on experience with data analytics processes. Walter Dempsey, PhD, an assistant professor of biostatistics, explained how his students applied the data in the Biostatistics 629 course he teaches: "The students identified a scientific goal and developed their own analytic strategy. They then proceeded through the data analytic pipeline, from data cleaning/ modification, to applying advanced data analytic techniques to the cleaned PROMPT data."

Dempsey said working with these data was fundamental to the course, as it introduced students to the real-world skills required to analyze data and allowed them to practice statistical and machine learning techniques. Now that PROMPT data is accessible to researchers across campus, "We're looking for people who want to run with it," said Bohnert, who, along with the study team, meets regularly with researchers to discuss the study's framework and possible hypotheses for further analysis, "we don't see it as just our study."

Precision Health focuses on membership to facilitate multidisciplinary collaboration

Since its inception, U-M Precision Health has identified multidisciplinary research as an essential component of precision health science. To facilitate multidisciplinary collaborations, PH sponsors a membership program that connects hundreds of researchers across a full range of disciplines and from most schools on campus. This research community supports rich collaboration and eschewing of departmental and subject matter silos.

Seeking to deepen this community, in 2022, Precision Health brought on a team member devoted to member engagement and events. This allows us to have a dedicated focus on the member experience, from recruitment to application, from welcoming and onboarding to long-term membership.

New membership efforts included refreshing our existing membership application process, adding optional demographic questions to our membership application, e.g., on race & gender. This allows us to ensure we are reaching out to a diverse audience of potential members, and that our membership reflects/ exceeds the rich faculty diversity at U-M.

In addition, we began targeted outreach to Precision Health data users who might not yet have completed the application process, encouraging them to fully plug in to the membership opportunities available to them.

A big part of increasing member engagement involved connecting with members on social media and strengthening our social presence to amplify member research & accomplishments and communicate to our stakeholders. This included establishing a Precision Health at University of Michigan LinkedIn page which quickly took off, ending the year with 270 followers. On Twitter, we worked to put the #UMPrecisionHealth hashtag into use, using it to post weekly member highlights & draw attention to/ connect with our members.

We took a comprehensive look at which schools and departments were currently represented in our Precision Health membership, and identify where we were missing voices and perspectives. With intention, we reached out to health science schools, working to develop/strengthen relationships with those schools/ colleges and units Because of this outreach, we grew from 220 members in 2021 to 276 members in 2022, with membership increases in Engineering, Nursing, Public Health, Pharmacy, Medicine, LSA, Information, and ISR.

In the future, we're looking to further expand our footprint in underrepresented schools and colleges such as Social Work, Dentistry, Nursing, and others. We're working to support members as they build connections with each other, find research partners, and enjoy being in community.



Our research has benefited greatly from Precision Health at the University of Michigan. We have accessed data from the Michigan Genomics Initiative [MGI] to incorporate into our genetic studies, and have a well-established pipeline for this work. We have worked with Precision Health investigators to coordinate our case sample genotyping, deployment of new methods for our research, and dissemination of results of the research. It is truly a fantastic resource.

Santhi K. Ganesh, MD

Precision Health's certificate program celebrates its 2022 graduates

Precision Health's first-of-a-kind Graduate Certificate Program continues to attract students from a range of disciplines who graduate from the program and join organizations around the country.



Elissa Hult, PhD, completed the Precision Health Certificate program in winter 2022 while pursuing her PhD in Molecular and Integrative Physiology at the University of Michigan Medical School. Hult successfully defended her dissertation in April 2022 and now

works as a Postdoctoral Fellow in Worldwide Medical at Biogen in Cambridge, MA.



Logan Smith, PharmD, completed the Precision Health Certificate program in winter 2022. Smith is currently pursuing his PhD in Clinical Pharmacy and Translational Science at U-M's College of Pharmacy, and is a Postdoctoral Fellow in Clinical

Pharmacy Translational Science at U-M in Precision Health member Haojie Zhu's Lab.



Jake DeMeulemeester, MS, completed the Precision Health Certificate program in winter 2022 while pursuing his MS. He graduated from the University of Michigan's College of Engineering in spring 2023 with a MS in Biomedical Engineering.

DeMeulemeester currently works for the VA Ann Arbor Healthcare System as a research assistant.



Shuhan Liu, MS, completed the Precision Health Certificate program in winter 2022 and is pursuing her PhD in Clinical Pharmacy and Translational Sciences at the University of Michigan College of Pharmacy. Liu is currently a Research Assistant in the

Pharmacokinetics & Mass Spectrometry Laboratory at U-M.



Jana Muhic, MS, completed the Precision Health Certificate program in winter 2022. Muhic graduated from the University of Michigan in May 2022 with an MS in Health Informatics from the School of Information.



Brittany MacIntyre, MS, completed the Precision Health Certificate program in winter 2022. Muhic graduated from the University of Michigan's College of Engineering in May 2022 with an MS in Biomedical Engineering and is currently a

Research and Development Engineer at Akadeum Life Sciences, Inc.

Precision Health workgroup leaders

COHORT DEVELOPMENT

Salim Hayek, MD

Associate Professor of Internal Medicine, Department of Internal Medicine, Medical School

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

Precision Health executive committee

F. DuBois Bowman, PhD

Dean and Professor of Biostatistics, School of Public Health

Alec Gallimore, PhD

Robert J. Vlasic Dean of Engineering, Richard F. and Eleanor A. Towner Professor, Arthur F. Thurnau Professor, Aerospace Engineering, College of Engineering

Xiang Zhou, PhD

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

HEALTH IMPLEMENTATION

Karandeep Singh, MD, MMSc

Assistant Professor, Learning Health Sciences, Internal Medicine, and Urology, Medical School; Assistant Professor, Information, School of Information

Paul J. Grant, MD, FACP, SFHM

Clinical Associate Professor, Internal Medicine, Medical School; Hospitalist, Division of Hospital Medicine, Michigan Medicine

Lori Pierce, MD, FASCO, FASTRO

Vice Provost for Academic and Faculty Affairs Professor of Radiation Oncology

Marschall S. Runge, MD, PhD Dean, U-M Medical School and Executive Vice President for Medical Affairs

Precision Health staff

Rachel Dawson, JD Managing Director

Lori Robertson Administrative Specialist

Arika Lycan, LMSW Member Engagement Manager

Jessica Virzi, MSN, CSSBB Clinical Informaticist

Cinzia Villanucci Smothers, M. Bioethics Manager, Data Analytics & IT

Janet Houghtby, MS Manager, Cohort Development

Henry Robertson Clinical Research Technician Kristen Perkins, MSA, PMP Senior IT Project Manager

Jacob Ortlieb Clinical Research Coordinator

Gaspare Leone Clinical Research Assistant

Karee Lesko Clinical Research Technician

Susan Hollar, MSI

Sean R. Meyer, MBA, PhD Lead Data Scientist

Emily Bertucci-Richter, PhD Genetic Data Analyst

Qihua Zhao Senior Application Systems Analyst / Programmer Brett Vanderwerff, PhD Research Area Specialist

Snehal Patil, MS Application Programmer/Analyst Senior

Adrian Weyhing Lead Application Programmer

Giovanni Siciliano Application Programmer/Analyst Senior

Justin Ortwine Database Analyst/Programmer, Intermediate

Matt Milligan Research Cloud Administrator



precisionhealth.umich.edu

(734) 615-1493 | precisionhealth@umich.edu

Regents of the University of Michigan: Jordan B. Acker, Michael J. Behm, Mark J. Bernstein, Paul W. Brown, Sarah Hubbard, Denise Ilitch, Ron Weiser, Katherine E. White, Santa J. Ono, *ex officio*

NONDISCRIMINATION POLICY STATEMENT

The University of Michigan, as an equal opportunity/affirmative action employer, complies with all applicable federal and state laws regarding nondiscrimination and affirmative action. The University of Michigan is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, national origin, age, marital status, sex, sexual orientation, gender identity, gender expression, disability, religion, height, weight, or veteran status in employment, educational programs and activities, and admissions. Inquiries or complaints may be addressed to the Office for Institutional Equity, and Title IX/Section 504/ADA Coordinator, Office for Institutional Equity, 2072 Administrative Services Building, Ann Arbor, Michigan 48109–1432, 734–763–0235, TTY 734– 647–1388, institutional.equity@umich.edu. For other University of Michigan information call 734–764–1817.

© 2023 Regents of the University of Michigan • • •

PRODUCED BY MICHIGAN CREATIVE, A UNIT OF THE OFFICE OF THE VICE PRESIDENT FOR COMMUNICATIONS | MC230318