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On the cover:
Keith Stewart, MB, ChB, Director of the Mayo Clinic Center for Individualized Medicine, welcomes the audience at the 2015 IM Conference. Photo courtesy Mayo Clinic.

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Regardless of discipline or department, academia or industry, data truly fuels research. W. Edward Deming said, “In God we trust; all others must bring data.” However, being data rich, as well as having the tools and ability to process and translate the right data into actual information, are two different things.

In case you missed it, on May 26, the National Institutes of Health (NIH) awarded the Mayo Clinic $142 million over five years to establish the world’s largest research-cohort biobank for the Precision Medicine Initiative’s (PMI) Cohort Program. The goal: to support the collection, storage, and distribution of biospecimens for research from one million U.S. participants. Lab analysis of the biospecimens, including chemical and genetic tests, will be a key component of the core data sets. And the data sets generated will help researchers study individual differences in health and disease. Processing and translating the projected 35 million pieces of biological data is a massive undertaking. Interestingly, for several years Mayo Clinic and Illinois Alliance collaborators have worked with the large biomedical data sets from the Mayo Clinic’s own biobank of fifty thousand participants. The current biobank has served as a research resource for numerous projects relating to pre-term birth, certain types of cancer, and more. Together, Illinois has the computing bandwidth and know-how, and Mayo Clinic has the clinical expertise and infrastructure to properly handle the eventual influx of data.

As you’ll read in this issue of Interactions, the UI’s brightest and most accomplished students and researchers are already teamed up with clinicians at the Mayo Clinic Center for Individualized Medicine in many areas of personalized medicine, including bioinformatics. Check out the abstracts of recent publications about technology being developed through collaborations within the Alliance.

We congratulate the Mayo Clinic on being awarded the home of the Precision Medicine Initiative’s Biobank, and look forward to continued interactions surrounding Big Data. Without a doubt, even bigger achievements are on the horizon for the Mayo Clinic and Illinois Alliance for Technology-Based Healthcare.

Bryan White
Director, Mayo Clinic and Illinois Alliance for Technology-Based Healthcare

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KBase: Coming to Illinois

The University of Illinois and Mayo Clinic have partnered to support the installation of an instance of the Department of Energy (DOE) Systems Biology Knowledgebase, or “KBase” on the Illinois campus.

KBase is an open source software and data platform that integrates data, tools, and their associated interfaces into one unified environment rather than forcing users to access various sources and learn multiple systems—it’s basically a one-stop shop for all things systems biology. KBase enables researchers to collaboratively generate, test, and share new hypotheses about gene and protein functions; perform large-scale analyses on scalable computing infrastructure; and model interactions in microbes, plants, and their communities. KBase employs a Narrative Interface as its graphical user interface, which keeps a record of the computational analyses that are designed and carried out by the researcher. These records, called Narratives, can be kept private or they can be shared and published. Shared Narratives enable collaborators or other researchers in the community to follow the steps and thought processes that were used in the analysis for anyone who might wish to repeat the experiment or to change the parameters and/or inputs to generate different or enhanced results.

KBase is not completely new to Illinois or Mayo Clinic researchers—many are already using the DOE instance. However, the instance of KBase deployed by the DOE is limited in that it only handles data from projects that are within the scope of the DOE’s mission (e.g., related to energy and the environment). The instance of KBase at Illinois will not have the same limitations on the type of data allowed, which will make KBase an excellent resource for researchers working with health-related microbiome data. Researchers should note, however, that KBase is not HIPAA compliant and the version at Illinois will maintain the DOE’s restrictions for human subject data. In other words, uploading of human data or personally identifiable information will be prohibited.

Due to the impact that KBase is anticipated to have as a resource for health-focused research, Illinois and Mayo Clinic have both invested equally in the installation of KBase on the Illinois campus. This includes both the purchasing of new hardware and support for personnel to perform the software installation. Various colleges and units at Illinois have helped to support the installation, including the Office of the Vice Chancellor for Research, the Mayo Clinic and Illinois Alliance for Technology-Based Healthcare, and the Colleges of ACES, Engineering, Liberal Arts and Sciences, Applied Health Sciences and Veterinary Medicine.

The KBase system is housed at the Carl R. Woese Institute for Genomic Biology (IGB). System maintenance and user support will be provided by the HPCBio group in the Roy J. Carver Biotechnology Center and the Computer and Network Resource Group (CNRG) at IGB.

KBase is free to use for Illinois and Mayo Clinic researchers until July 1, 2018. After 2018, fees for use may be applied in order to keep the system up to date and replace hardware as needed. As of this article, the IGB CNRG staff is working on installation of specific modules. The software should be ready to use by the fall 2016 semester. Stay tuned for updates from the Mayo Clinic and Illinois Alliance on utilizing this exciting new research tool. ✨
What is KBase?

Predictive Biology
KBase integrates data, tools, and results to accelerate the scientific advancements needed to predict behavior and ultimately design microbes, plants, and their communities to perform desired functions.

Knowledge Sharing and Multiplication
Analyze across publicly shared data and experiments to rapidly propagate new results and compare similar approaches for quality control. These “meta-analyses,” performed by both users and the KBase system, will enable predictions across the tree of life.

Open-Source Analysis Tools
Combine sophisticated analytical methods in one environment backed by DOE high-performance computing without having to learn separate systems.

Integration
Benefit from KBases data model, which links diverse data, allowing comparisons between data types and interoperability with tools.

Data
Work with thousands of public plant and microbial datasets accessible within KBase or upload your own.

Easy Access
Use KBase tools and data via a web browser; no extra software needed.

Infographic usage courtesy of U.S. Department of Energy Office of Science
Dose-Dependent Response of Personal Glucose Meters to Nicotinamide Coenzymes: Applications to Point-of-Care Diagnostics of Many Non Glucose Targets in a Single Step

Jingjing Zhang, Yu Xiang, Miao Wang, Ananda Basu, and Yi Lu

Point-of-care (POC) devices that allow rapid, on-site, and affordable detection and monitoring of health biomarkers are becoming increasingly popular. However, few are commercially available due to the high cost of development and limited number of targets detected by many of the current devices.

To overcome these limitations, researchers are adapting current POC devices, such as personal glucose meters (PGMs), to measure a wider range of targets. The present study reports on a discovery that PGMs can give a dose-dependent response to nicotinamide coenzymes, such as the reduced form of nicotinamide adenine dinucleotide (NADH).

The research team has developed methods based on this discovery to perform one-step homogeneous assays of many non-glucose targets that are difficult to recognize by DNAzymes, aptamers, or antibodies, and without the need for conjugation and multiple steps of sample dilution, separation, or fluid manipulation. The methods are based on the target-induced consumption or production of NADH through cascade enzymatic reactions. The current method was tested by simultaneously monitoring glucose and L-lactate levels in human plasma from diabetes patients, and produced results that were comparable to current standard test methods. Since a large number of commercially available enzymatic assay kits utilize NADH in their detection, this discovery will allow the transformation of almost all of these clinical lab tests into POC tests that use a PGM.

Computational Discovery of Transcription Factors Associated With Drug Response

Casey Hanson, Junmei Cairns, Liewei Wang, and Saurabh Sinha

Pharmacogenetics, which aims to understand the relationship between individual variation at the genetic level and variation in cellular and physiological response to a drug, has expanded to the genome-wide level due to emerging genomic technologies. This growing field of pharmacogenomics has the potential to revolutionize healthcare by guiding personalized care for patients through genome sequencing. The current study presents a novel methodology, called GENMi (Gene Expression in the Middle), that integrates gene expression, genotype and drug response data in lymphoblastoid cell lines with transcription factor (TF)-binding sites from ENCODE (Encyclopedia of Genomic Elements) to reveal regulatory contexts associated with cytotoxicity. GENMi postulates that single-nucleotide polymorphisms within TF-binding sites putatively modulate its regulatory activity, and the resulting variation in gene expression leads to variation in drug response.

Analysis of 161 TFs and 24 treatments revealed 334 significantly associated TF–treatment pairs. Investigation of 20 selected pairs yielded literature support for 13 of these associations, often from studies where perturbation of the TF expression changes drug response. Experimental validation of significant GENMi associations in taxanes and anthracyclines across two triple-negative breast cancer cell lines corroborates our findings. The method is shown to be more sensitive than an alternative, genome-wide association study-based approach that does not use gene expression. These results demonstrate the utility of GENMi in identifying TFs that influence drug response and provides a number of candidates for further testing.
Nucleic acids serve as biomarkers of diseases, such as cancer, so it is highly desirable to develop approaches to extract a small number of such genomic extracts from human bodily fluids. Magnetic particles-based nucleic acid extraction is widely used for concentration of low-volume samples and is followed by DNA amplification in specific assays. However, approaches to integrate such magnetic particles-based capture with micro- and nanofluidic-based assays are still lacking.

In this report, the researchers demonstrate a magnetophoretic-based approach for target-specific DNA extraction and concentration within a microfluidic device. This device features a large chamber for reducing flow velocity and an array of μ-magnets for enhancing magnetic flux density. With this strategy, the device is able to collect up to 95% of the magnetic particles from the fluidic flow and concentrate these magnetic particles in a collection region. An enzymatic reaction is then used to detach the DNA from the magnetic particles within the microfluidic device, making the DNA available for subsequent analyses, such as methylation assays that use protein labeling.

This strategy for DNA extraction and concentration can bridge the gap between detection of low-concentration analytes from clinical samples and a range of micro- and nanofluidic sensors and devices including nanopores, nanocantilevers, and nanowires.

References:


Fifty thousand. That’s how many people have enrolled in the Mayo Clinic Biobank, a collection of samples and health information donated by Mayo Clinic patients for use in ongoing biomedical research. Multiply that number by 180,000, or the number of exons — regions of DNA that direct the human body to make essential proteins — contained in a single human genome, and you get nine billion. Through statistical analysis, researchers and physicians at the Mayo Clinic’s Center for Individualized Medicine (CIM) are using those nine billion data points to translate genomic medicine into clinical practice.

But they can’t do it with just pencil and paper. Crunching this much data requires high-performance computers and people who can run them — like Arjun Athreya. A PhD candidate in electrical and computer engineering at the University of Illinois at Urbana-Champaign, Arjun is supporting pharmacogenomics research at CIM through an institutional partnership that brings together top thinkers in technology and medicine — the Mayo Clinic and Illinois Alliance.

For young statisticians, computer scientists and engineers intrigued by the growing possibilities for big data in healthcare, the chance to collaborate on cutting-edge research at Mayo Clinic holds obvious appeal. “You can’t be working on medical data and not know what people at Mayo are doing, or miss an opportunity to work with their clinical experts,” says Athreya, who has a Master’s degree in electrical and computer engineering from Carnegie Mellon University and is advised by Prof. Ravishankar Iyer, PhD, of Illinois’ Coordinated Science Lab.

Likewise, Mayo Clinic researchers need the informatics infrastructure and powerful minds at Illinois, a world leader in engineering and computational sciences. Without this technology expertise, says Athreya, teasing out biological patterns from the chaos of numbers would be daunting.

“When you look at analyzing these data, a lot of these experiments can take hours to days to complete,” he says. “Today it might seem trivial when we say something takes hours to run for one patient, but if every hospital and every clinic starts to do this for every patient that comes in, the scale becomes pretty messy very quickly.”

If engineers can write more sophisticated software programs and make them run on the right kind of hardware, they can reduce the entire computation time needed for data analysis in experiments, Athreya explains. Millions or billions of unintelligible data points can quickly assume meaning. That makes research in individualized medicine more efficient, which ultimately translates into clinical care that better meets the patient’s needs.

For a glimpse at the Alliance’s integrated approach to research, consider Athreya’s contributions to cancer treatment studies in CIM’s Pharmacogenomics Program, which is led by Richard Weinshilboum, MD, and Liewei Wang, MD, PhD. To understand why standard drugs work effectively in some cancer patients but not in others, CIM investigators are collaborating with Illinois researchers like Athreya to study how variations in genes affect patients’ response to medications.

Within the Pharmacogenomics Program, Athreya is working with Mayo Clinic researcher Krishna Kalari, PhD, to develop and apply computational models to statistically analyze the impact of metformin, a drug used to manage Type 2 diabetes that also shows promise in treatment of certain breast cancers. Their models are helping CIM researchers identify genetic mutations in tumors that affect a patient’s response to metformin. The goal, says Athreya, is to “narrow down the impact of the drug to specific genetic biomarkers. Then we will know which patients would respond to this drug.”

Though the CIM research on metformin will continue after he returns to the University of Illinois, Athreya says his IT and Bioinformatics summer internship at Mayo Clinic has given him a lasting gift: greater appreciation for how his analytical skills can harmonize with the knowledge of healthcare experts.

“There were times when from our engineering perspective, we generated some results that made no sense to us,” he says. “And then the physicians and biologists looked at it and they said, ‘We know exactly what this is saying, and we can narrow down our research base.’ Those moments when we put up some results and there is a huge biological story behind what they see, those moments are pretty exciting.”

In those moments, he says, he sees the power of data to transform medicine.
Alliance Builds IT and Bioinformatics Internship Pipeline

By Meghan Olin

Biomedical informatics, or bioinformatics, is an umbrella term for all the biological studies that utilize computer programming as part of their methodology. It combines computer science, statistics, mathematics, and engineering to interpret biological data. Typically, bioinformatics is seen in the fields of genetics and genomics, where it aids in sequencing genomes and observing mutations. It is a rapidly growing field, due to advances in technology and computing. Bioinformatics has contributed largely to knowledge gains in personalized medicine. However, there is still much to learn about what bioinformatics can provide to clinical questions, which Mayo Clinic and UI interns are working to answer.

Over the past few summers, Illinois graduate students in statistics, computer science, and computer engineering have been expressly recruited to work with Mayo Clinic researchers and IT specialists as IT and Biomedical Informatics interns. The program, headed by Mathieu Wiepert of Mayo Clinic’s Center for Individualized Medicine and Illinois’ Saurabh Sinha, gives these students the chance to be part of hands-on, cutting-edge, real-time research.

Rochester, Minnesota may not be Silicon Valley, but it doesn’t seem to faze Illinois graduate students—some of whom have spent repeat summers at the top-tier clinical research campus.

One of these students, Zach Stephens, spent three summers as an IT and biomedical informatics intern, to make more connections between his education in bioinformatics and the real world data sets presented at Mayo Clinic. His main project in during the summer of 2015 was developing a tool that detects and validates complex structural variation by scoring combinations of breakpoints and untangling the genome areas by making rearrangements.

“One thing that made the project exciting was that it became an ongoing collaboration with my Mayo Clinic mentors when I returned back to UI,” said Stephens.

Likewise, Arjun Athreya will be spending an additional summer in 2016 at Mayo Clinic to continue his work in biomedical informatics to support pharmacogenomics research.

Illinois engineering professor Dr. Ravishankar Iyer is faculty advisor to both Stephens and Athreya. Iyer has worked hard to make sure the connection between his students and their mentors at Mayo Clinic continues when the summer ends. Iyer attributes his grad students’ interdisciplinary knowledge of both computing and biology to their exposure at Mayo. He says the opportunity his students are given is transformational.

“Mayo has the patient, clinical, and biological insight. We bring our strengths in engineering and computing. Combining the two, the results are remarkable,” explains Iyer.
The Mayo Clinic’s Summer Undergraduate Research Fellowship (SURF) program gives students from across the nation the opportunity to do clinical research for 10 weeks, while being mentored by top-notch physicians and graduate students. The Mayo Clinic and Illinois Alliance provides support for five program participants, selected after an application process. Get to know these exceptional students and read what they have to say about their unique experience.

Stephanie Youssef
Molecular and Cellular Biology, Class of 2016

Stephanie has a great interest in health and medicine. She currently conducts basic research on the Urbana campus, but was looking for an opportunity to research a topic that was more translational. The SURF program provided the perfect opportunity to better connect her love of research with patient care.

While at the Mayo Clinic, Stephanie worked closely with Dr. Megan Weivoda in the Cell Biology of Bone Laboratory led by Merry Jo Oursler, PhD. Stephanie’s SURF project involved using data from osteoclast specific knockouts in transgenic mice, RT-PCR, and MicroCT to support the hypothesis that TGF-B1 (a growth factor stored in the bone matrix that enhances migration of osteoblastic precursors to sites of bone remodeling) enhances osteoblast differentiation through osteoclast secretion of Wnt1, a protein crucial to normal bone formation.

Though Stephanie will not be continuing with this research at Illinois, she will be returning to the same lab at the Mayo Clinic after graduation to continue working on the research project she started during the SURF program.

As part of the Mayo Clinic and Illinois Alliance, Stephanie and other Illinois SURFs were able to attend specific meetings with Mayo personnel where they discussed their research. Stephanie identified these meetings as a particularly notable experience during her time at the Mayo Clinic. She said, “Being able to contribute to the successful relationship between the university and the Mayo Clinic and share our impact at these meetings was definitely remarkable.”

Stephanie’s advice for future SURF students is, “Seek benefits from every opportunity you have at the Mayo Clinic. Beyond the research project, I had the opportunity to learn research techniques other labs were performing, shadow clinicians at the Mayo Clinic, and attend lectures given by researchers and physicians from all over the world. Being at the Mayo Clinic is an unparalleled learning opportunity, take advantage of it.”

Anuj Chokshi
Neuroscience; Business Minor, Class of 2017

Anuj was drawn to the SURF program because Mayo Clinic offered a unique connection into both the clinical aspects of medicine and the research behind it. As an aspiring physician, Anuj wanted to get a better understanding of the process of research and be able to tackle major questions. Anuj is driven to understand the “why” behind things, so a research program built around medicine was a perfect fit.

Anuj spent his time at the Mayo Clinic working in Dr. Michael J. Ackerman’s sudden death genomics laboratory in the Molecular Pharmacology and Experimental Therapeutics (MPET) Department. Day to day, he worked alongside Jamie Kapplinger, a Mayo Clinic MD/PhD student. Anuj’s project revolved around elucidating the mechanism of disease for cardiac arrhythmias, and more specifically Jervell and Lange-Nielsen Syndrome. There is a generally accepted understanding of how this rare disease manifests, but a specific case from a recent protocol did not fit this criteria: that is, there was a genotype-phenotype misclassification along the way. Anuj is currently working on a manuscript with his mentor in the Ackerman lab to publish the results from his project.

In addition to working on his research project, Anuj had the unique opportunity to shadow his PI, Dr. Ackerman, in a clinical setting. Outside of the lab, Dr. Ackerman is a practicing physician and world leader in long QT syndrome, and accordingly, one of the most sought out cardiologists in the nation. This experience allowed Anuj to observe Dr. Ackerman’s bedside manner. Anuj felt it was a wonderful opportunity to connect the clinical aspects of medicine and see how they translate back to the lab, which, in turn, comes back to the bedside.

Anuj’s advice to future SURF students is, “Make the most out of it! This internship was pivotal to both my career development and understanding what I want to do in the future. There are hundreds of Mayo physicians and scientists eager to speak with you. No doubt put the work into your lab and project, but also branch out. I attended probably 25 seminars open to the entire Mayo community over the summer, and learned an incredible amount of information. At the end of the day, the program ends up being what you make of it!”

Vivian Chu
Bioengineering, Class of 2016

Vivian applied to the SURF program because she was interested in pursuing research and networking with the masterminds on the frontier of exciting research. As an added bonus, her family lives in the Twin Cities, which are about an hour and a half from Rochester, MN.
Gabriel Manning  
Animal Sciences, Class of 2016

Gabriel learned about the SURF program from his faculty mentor at Illinois. He was motivated to apply after realizing that traveling away from home and participating in a fully-immersive research experience, like the one offered through the SURF program, was a once in a lifetime opportunity. He also recognizes the difficulty and extreme importance of translating research findings into treatments. Gabriel believes that working full-time in a patient-oriented environment like that found at the Mayo Clinic, one unlike any other in the world, has better prepared him to contribute to the medical community in the future.

Gabriel was mentored by Dr. Nicholas Chia, whose lab is part of the Center for Individualized Medicine’s Microbiome Program at the Mayo Clinic. Gabriel also worked very closely with Charlie Seto, a graduate student from the University of Minnesota. With a focus directed towards the human colon microbiota, Gabriel learned to utilize bioinformatics techniques and worked to generate a replicable workflow for constructing a derivation of a reference database, a phylogenetic framework, and a set of in silico-validated DNA primers for microbial hydrogenase genes. This work at the Mayo Clinic was part of a much larger project that Dr. Rex Gaskins, Gabriel’s research mentor at Illinois, and Dr. Gaskins’ collaborators at the Mayo Clinic have been involved with for some time. Gabriel has continued to contribute to this research upon his return to Illinois.

Among Gabriel’s favorite memories from the summer are those that he made while experiencing Minnesota’s natural beauty on weekend trips with his lab mates, fellow SURFs, and the nursing students he met during the 10-week program. He says, “Although I wasn’t able to see all 10,000 lakes, water-skiing, wakeboarding, and swimming in Lake Superior are all incredible memories that I will always cherish. Among other things, our program included cookouts, weekly seminars, a minor league baseball game, and an end-of-the-summer volleyball tournament that capped off what is undoubtedly one of the most influential experiences of my life.”

Gabriel’s advice to future SURF students is, “Take full advantage of the opportunities that being in Rochester, Minnesota presents to you. The Mayo Clinic has amazing seminars every day. Try to go to as many as you can. Minnesota is the state of “10,000 lakes”—make sure to visit at least one of them. The Mayo Clinic’s reputation and mission has made Rochester home to physicians, nurses, and patients from all over the world. Meet the people that make Mayo Clinic the amazing medical center that it is; you’ll be all the better for it.

Vivian worked in Dr. Daniel Tschumperlin’s lab under Dr. Andrew Haak. The Tschumperlin lab focuses on the respiratory system and how the structure, function, and mechanics of the lungs are regulated in health and disease. Dr. Tschumperlin previously performed a siRNA screen on genes that impacted tissue fibrosis and found the protein STAT3 to be a hit. With Dr. Haak, Vivian further explored the mechanism of STAT3 on a fibrotic phenotype and brought in her previous experience in ECM analysis to this project. Using STAT3 inhibitors, they saw a fibrosis-resistant effect, indicating that STAT3 could be a potential target for new anti-fibrotic drug development. One of Vivian’s favorite experiences was simply going on walks with her mentor and PI. Their lab is on the St. Mary’s campus, about a mile away from the main Mayo Clinic campus downtown, and she was able to spend that time picking their brains for advice regarding her future. Vivian said, “They played huge roles in showing me that graduate school is an excellent choice for me and pointing me towards faculty members at universities across the nation that were involved in the things I was interested in.”

Vivian advises future SURF students, “Eat lunch with your lab mates. Don’t sit alone. Rather, reach out to these people and learn about the various paths they took to get to where they are. There are a lot of things to glean from them so don’t treat the summer as a time to focus solely on your project. Learn about others to learn about yourself.”

Kelly Twohig  
Chemistry, Class of 2017

Kelly applied to the SURF program because one of her friends participated in the program two summers in a row and had nothing but positive things to say about it. Kelly had already worked in a research lab at the university and really enjoyed it, so working extensively on a project for ten weeks in a very stimulating environment was very appealing to her.

While at the Mayo Clinic, Kelly worked in the Windland Smith Rice Sudden Death Genomics Laboratory under the supervision of Dr. Michael Ackerman. Her project aim was to determine the spectrum and prevalence of variants in the promoter regions of KCNQ1 and KCNH2 in patients with genetically elusive Long QT Syndrome. She used PCR to amplify the promoter regions of 37 genotype-negative/phenotype-positive LQTS patients, sequenced them, and analyzed them for variants. One novel duplication was found in a patient’s 5’UTR of KCNH2, but further functional studies need to be done to determine pathogenicity. In addition to her research project, Kelly valued her time spent shadowing Dr. Ackerman in his role outside the lab as a practicing cardiologist.

Kelly advises future SURF students to, “Shadow the physicians at Mayo as much as possible! After spending hours in the lab, I would often choose to relax during my free time, but I really wish that I used that time to take advantage of being surrounded by some of the best doctors in the world.”
Alliance Introduces New Graduate Fellowship Program

This spring, the Mayo Clinic and Illinois Alliance launched a new graduate fellowship program. The Fellowships for Technology-Based Healthcare Research will provide a unique opportunity for PhD students to work on a collaborative project between Mayo Clinic and Illinois with one year of the fellowship spent on the Mayo Clinic campus.

The fellowships are aimed at promoting collaborative translational research through development of new technologies and clinical tools that advance individualized medicine. The requirement to spend a total of one year’s worth of time on the Mayo Clinic campus, working closely with a Mayo Clinic advisor, will allow the students to get up close and personal with the real-world challenges associated with bringing individualized medicine technologies into the clinic.

Residence on the Mayo Clinic campus will also allow the students to gain access to secure data they would not otherwise be able to access at Illinois. The Mayo Clinic has identified a number of potential projects and project areas, most of which have a computation or bioinformatics focus. Current projects include large-scale community metabolic modeling, next-generation sequencing pipeline automation, and advanced analytics for prevention and prediction of complications.

Other areas of interest include, but are not limited to, point-of-care diagnostics, genomics, and tissue engineering.

Three Illinois departments—computer science, electrical and computer engineering, and bioengineering—have signed on to sponsor one year of the fellowship program for a student from each department. The CompGen Initiative, a collaborative effort at Illinois between the Coordinated Science Lab and Carl R. Woese Institute for Genomic Biology that focuses on development of new technologies to process and manage genomic data, is also sponsoring one year of the fellowships through this program.

Detailed information on how to apply for one of the fellowships can be found in the UI Graduate College Fellowship Opportunities Database or at mayoillinois.org. Applications for the first cohort of students, slated to start in the fall 2016 semester, are now under review. However, applications for the fellowship program will be accepted year-round.

Email info-mayo@mayoillinois.org with any questions.

Generous Gifts Support Unparalleled Student Opportunities

Several activities the Mayo Clinic and Illinois Alliance coordinates are possible because of donations to the Mayo Clinic in support of education and training. We recognize the contributions of Mrs. Phyllis Welsh Hallene to the Mayo Clinic in support of Summer Undergraduate Research Fellows from the University of Illinois at Urbana-Champaign. Without Mrs. Hallene’s gift, and similar financial support, Illinois students would not reach the same heights of learning and labor in their journey to solve global health challenges.
Meet Margret Berg Miller, Mayo Clinic & Illinois Alliance Co-Coordinator

By Meghan Olin

The Mayo Clinic and Illinois Alliance sets out to advance clinical and translational research and technology innovation in healthcare. Since the Alliance’s official start in 2010, the Mayo Clinic and University of Illinois have also teamed up to create unique educational programs, ultimately helping each institution reach its full potential. Margret (Maggie) Berg Miller, IHSI research development specialist, is the main contact on the Illinois end of the collaboration. She co-coordinates the Alliance along with Chris Schad, the Mayo Clinic program contact, to ensure all aspects of the Alliance are running smoothly and effectively.

If you have been involved with the Alliance in any way, no doubt you have interacted with Maggie on some level. Here’s a bit of insight into Maggie’s background and how she supports Alliance students and researchers in the clinical research space.

Before your start at IHSI and the Alliance, you were a U of I student. What does your educational background look like?

My scientific background is in microbiology. Technically, my degrees are in animal sciences, but I did microbiology research while I was a student. I came to U of I as an undergraduate, went to graduate school here, then stayed on for a post doc, all with Bryan White. I moved into the health space when I started my post doc because I was more focused on human microbiology projects. I was a year or two into my postdoc research when I was presented with the opportunity to co-coordinate the Mayo Alliance. Since I had been looking for a change from bench work and lab research, I basically jumped at the chance. I began work to get programs moving, helped Bryan (who was named director of the Alliance in 2012) organize the steering committee, and tackled various administrative duties.

Describe what you do within the Alliance, and give us an idea of your day-to-day role.

My role is to be the person who implements programs and ideas from UI faculty and makes sure faculty are interfacing with Mayo Clinic clinician researchers. For instance, I coordinate all the administrative components of the Computational Genomics Course the Alliance hosts each summer. I don’t create the course curriculum, but I handle everything from meeting room logistics, participant registration, advertising the course, updating online resources and tools, and participant follow up. It’s a lot of operational, behind the scenes work.

I’m the point person for students involved in any of the educational areas of the Alliance. The Alliance has also provided seed funding for research project collaborations between UI faculty and Mayo Clinic researchers, so I support those projects. I’m the first point of contact for any Illinois faculty looking to start a new collaboration with a Mayo Clinic researcher through the Alliance. The Alliance holds focused workshops for its researchers, and much of my time is spent organizing those events as well.

What can you say about the Summer Undergrad Research Fellowship (SURF) Program?

This 10-week summer program was created by and is completely run by Mayo Clinic, and is open to undergraduate students across the nation. But because of the University of Illinois’ ties to Mayo Clinic through the Alliance, a certain number of spots are reserved specifically for UI students. This year, seven SURF spots were allotted and the Alliance ran a pre-selection application process from a pool of UI students. Any students not chosen in the SURF pre-selection process were encouraged to apply throughout the nationwide, general Mayo Clinic advertisement, because they could also be chosen. But the Alliance’s pre-selection process is a great opportunity for students because they’re competing with a much smaller pool of applicants. Over the years we’ve had excellent feedback from staff at Mayo Clinic about the quality of our undergraduate students’ knowledge and work.

What do you think the Alliance means for Illinois and why do you believe it has been successful?

For Illinois researchers invested in health-related work, having a strong connection to a clinical institution like Mayo Clinic is a huge advantage. The opportunities for collaboration with Mayo Clinic researchers are nearly endless. And conversely, people at Mayo Clinic want to work with UI faculty and research staff because they’re dealing with some of the best minds in science and technology, who can access resources not widely available, like Blue Waters (supercomputing). The Alliance provides students with educational opportunities not found otherwise, too. There are not many undergraduate students who can say they spent a summer at a world-class research center, for instance.

What do you see in the future for the Alliance? Is there anything new and exciting on the horizon?

Specifically, I think there will be opportunities coming up in cancer research. Illinois has yet to work extensively with the Mayo Clinic’s cancer center, and we are very excited to begin. There was a workshop in March to outline grand challenges, with upcoming seed funding available. In general, I want to see the Alliance grow into clinical areas beyond precision medicine. I want to keep doing what we’re doing well, and move forward to create more partnered opportunities for students and researchers alike.
Since its inception, the University of Illinois at Urbana-Champaign has been a collaborating partner and joint sponsor of the Individualizing Medicine Conference. Each year, the conference continues to develop and grow. Clinicians and scientists from around the world travel to Rochester, Minnesota, to learn the latest advances in personalized medicine.

These photos of the 2015 Conference highlight and showcase Illinois’ involvement in the three-day event.

Cathy Wurzer of Minnesota Public Radio served as moderator for the conference’s main sessions, posing the audience’s questions and comments to each speaker. The lineup of speakers was impressive, ranging from MDs like Gianrico Farrugia, CEO of Mayo Clinic Florida, to PhDs like J. Craig Venter, CEO of Human Longevity, Inc., to academic researchers like Patricia LoRusso, DO, professor of medicine at Yale University Cancer Center.

New for 2015, the IM Conference featured a Patient and Public Symposium. Geared to be interactive and engage the general public in conversations about individualized medicine, the symposium attracted 212 attendees. University of Illinois graduate students and researchers involved in the Computing Genomes for Reproductive Health theme (led by Professor Derek Wildman at the Carl R. Woese Institute of Genomic Biology) organized stations for people to explore basic genomic science.
UI graduate students’ research posters were selected to be displayed at the conference. Additionally, the afternoon concurrent session called, “Beyond the Exome in Many Directions” featured Illinois’ Jun Song, PhD, and Stephen Boppart, MD/PhD, as speakers and was moderated by Derek Wildman, PhD.

The conference gave industry exhibitors an opportunity to give talks about their products and companies, and the number of corporate exhibitors more than doubled over 2014.
What Is the Mayo Clinic & Illinois Alliance?
The Mayo Clinic and Illinois Alliance for Technology-Based Healthcare is a group of faculty researchers, scientists, physicians, and students at Mayo Clinic and the University of Illinois at Urbana-Champaign who collaborate in a broad spectrum of health-related research. Established in 2010, the Alliance combines the strengths of both institutions to facilitate unique educational programs and advance clinical and translational research and technology innovation.

The Mayo Clinic & Illinois Alliance Purpose
The Alliance advances the promise of individualized medicine. Precision (or, individualized) medicine is uniquely informed by an individual’s genomic make up, environment, and lifestyle. The promises of precision medicine include better diagnoses, earlier interventions, customized treatment plans, and more-efficient drug therapies. Combining expertise in genomics, computing, and nanotechnology, the Alliance pushes precision medicine forward.

Disease and Health Conditions Focus
Mayo Clinic and Illinois Alliance research and technology development teams are focusing on advances in myriad health areas. These are current research areas, though the list is continually expanding.

- **Cancer**—glioblastoma, prostate, colorectal, and breast cancers
- **Autoimmune Diseases**—multiple sclerosis, rheumatoid arthritis, and celiac
- **General Health Conditions**—reproductive health, obesity, aging, and heart failure

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