

Pharmaceutical Research and
Manufacturers of America Foundation



ANNUAL REPORT 2013

Supporting innovative science for 48 years



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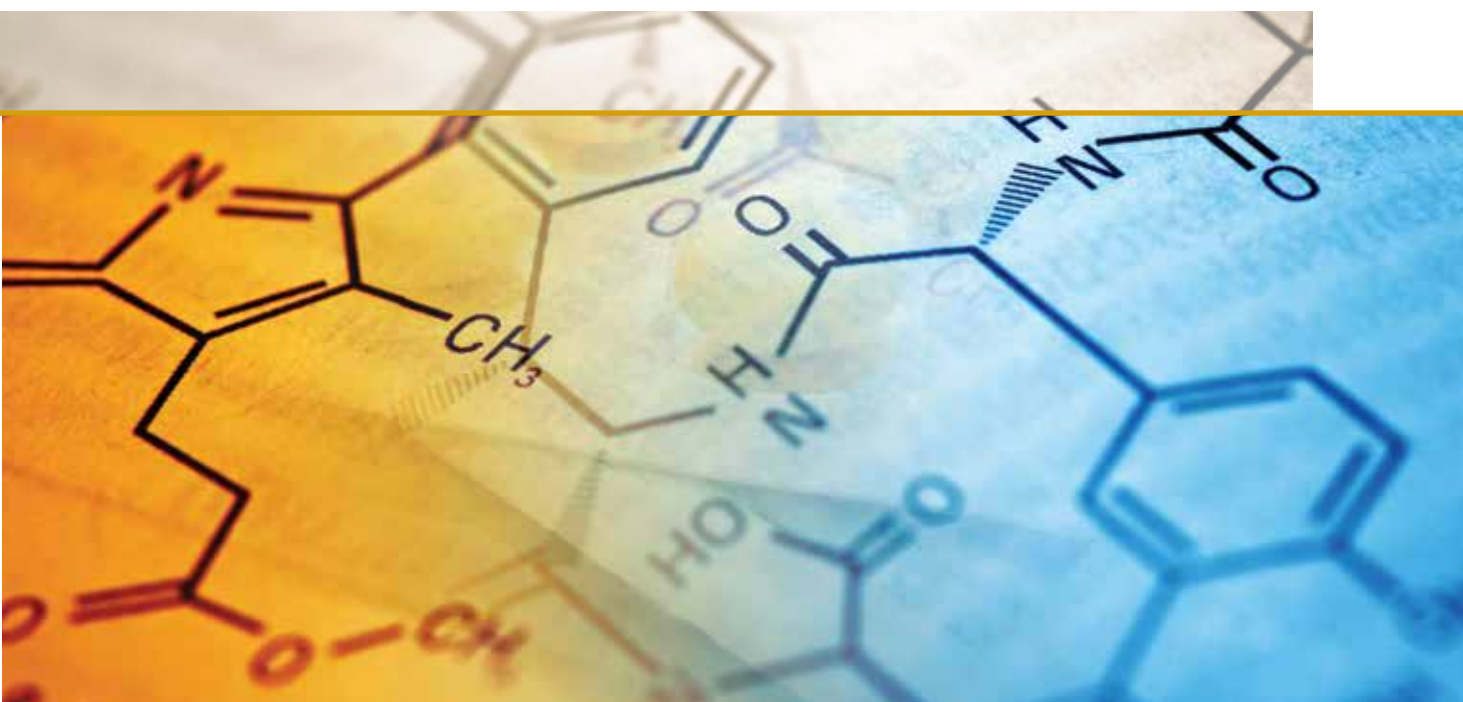
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MISSION Statement

The mission of the PhRMA Foundation is to **support young scientists** in disciplines important to the pharmaceutical industry by awarding them **competitive research fellowships and grants** at a critical decision point at the outset of their careers. The aim is to encourage young scientists who will be the leaders of tomorrow to **pursue careers in research and education** related to drug discovery.

The program will help to build a larger pool of highly-trained, top-quality scientists to help meet the growing needs of scientific and academic institutions, government, and the research-intensive pharmaceutical industry.

The Foundation's program is of particular benefit to the pharmaceutical industry in serving its purpose of **developing new life-saving, cost-effective medicines for patients** all around the world.





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MESSAGE from the Chairman

For nearly 50 years, the PhRMA Foundation's mission has been to initiate and implement dynamic, innovative programs that elevate science as well as promote expansion of skills, research and expertise that are essential to the continued success of the modern biopharmaceutical research sector. As Chairman of the PhRMA Foundation's Board of Directors, I am proud of the Foundation's past and notable successes. I am prouder still of the Foundation's continuing commitment to directly and creatively addressing the scientific challenges and talent development needs confronting our industry today.

Throughout its long history, the Foundation's objectives have been guided by the changing science, technologies and skills we need to discover and develop new medicines for patients. Within the past year, the Foundation's work has started to focus on addressing some of the challenges identified by PhRMA's new Biomedical Advisory Council (BMAC).

Practically, this means that the Foundation today is investing in people, programs and partnerships. The goal is to promote professional development, enhance scientific training, foster research and support educational initiatives important to innovation and growth. The value of these efforts is manifest in such successful and acclaimed programs as our Comparative Effectiveness Research Initiative and our fellowship and grant programs in Translational Medicine and Therapeutics designed to address current and future work force needs.

As part of the Foundation's continuing effort to elevate science, we are now working closely



with the BMAC, leveraging our experience and our well-earned reputation among our partners in industry, academia and government to explore programs that can support and advance Regulatory Science. Such efforts may include convening of experts to define curricular guidelines to improve training in this critical area.

Also, over the past two years, the Foundation worked closely with PhRMA and its partners in academia and government

to initiate programming specifically designed to help improve adherence—an essential element of better health. It is also critical to improving clinical effectiveness and lowering long-term healthcare costs. To help address this challenge, the Foundation inaugurated the PhRMA Foundation Young Investigator Grant Program to support promising research focused on improving adherence. Relevant research goals include development or evaluation of policies, the design of interventions and the creation of tools and programs that can successfully improve patient adherence.

In this and all that we do, PhRMA's and its member companies' science and regulatory leadership guide the Foundation. Our charge and our commitment remains: elevating the value of science, promoting the value of innovation and, most importantly, improving patient health. To further this great work, we will continue building partnerships and cooperation among biopharmaceutical research sector stakeholders and help ensure that America's biopharmaceutical research industry remains innovative, dynamic and capable of meeting the needs of patients.

A handwritten signature in black ink, appearing to read 'Elias Zerhouni'. The signature is fluid and stylized, with a long horizontal line extending from the end.

ELIAS ZERHOUNI, M.D.

MESSAGE from the President

From its beginning, a critical part of the PhRMA Foundation's mission is to increase public and health care stakeholder understanding of the benefit to patients and our economy of a strong, growing and innovative biopharmaceutical research sector. This commitment is underscored by recent Foundation initiatives, such as the effort to advance Patient Centered Comparative Effectiveness Research, our Adherence Improvement fellowship program, and a program involving NIH and medical schools to train future doctors in safe and effective prescribing. Importantly, these and other successful Foundation programs over the years focus on the value of research that improves patient health. Further, in this era of quickly evolving science and technology, the Foundation helps ensure that the biopharmaceutical research industry, academia and government have the skills, experience and expertise needed to keep the new medicine pipeline flowing.

We are proud of the Foundation's many accomplishments over its long history and, in particular, those of the past year. The Foundation strives to take a long-view and anticipate and help meet emerging patient and industry needs by creating programs designed to find solutions. But we are proudest of the growing role that the Foundation is playing as a critical strategic partner and convener able to bring a wide range of biopharmaceutical research sector stakeholders



together to listen, cooperate and act.

The Foundation's credibility, the trust it has earned and its growing reputation as an innovative seeker of solutions is a phenomenal asset. We have carefully and strategically leveraged this asset to build long-lasting, productive relationships with key players in the biopharmaceutical research eco-system. They include the Agency for Healthcare Research and Quality (AHRQ), the Patient Centered Outcomes Research

Institute (PCORI), the National Institutes of Health (NIH), the Foundation for the National Institutes of Health (FNIH) and the Reagan-Udall Foundation. We also work closely with prominent national scientific trade and professional associations such as ASCPT, AAPS, ISPOR, ASPET, AACP and ISCB. And, of course, we have long-standing relationships with universities across the nation.

Our success in building these critical and strategic partnerships has born important results in CER, adherence, safe and effective prescribing and translational medicine. Our newest effort will be in regulatory science education. Finding solutions, forging relationships, encouraging cooperation and sponsoring research that will help patients to live longer, healthier lives is the ultimate measure of the Foundation's work and its value.

A stylized, handwritten signature in black ink, appearing to read 'Del Persinger'.

DEL PERSINGER

COMPARATIVE Effectiveness Research

Helping Comparative Effectiveness Research Education to Flourish

For nearly 50 years, the PhRMA Foundation played a significant and distinctive role in fostering biopharmaceutical innovation. Through various efforts—such as grant-giving and initiating collaborative partnerships across the field—the Foundation has become a respected facilitator and dedicated ally recognized for its ability to advance the fields of research and education.

The Foundation's grants helped fund the pioneering research of young scientists in clinical pharmacology, toxicology, health outcomes, informatics, and pharmaceuticals—disciplines that are critical to the development of life-saving and live-improving medicines.

As a result of this honored history, the PhRMA Foundation has emerged as a leading source of early-career research funding. This funding has provided invaluable support for many renowned industry, academia, and government scientists. By focusing on advancing critical scientific disciplines, skills, and training, the Foundation is not only helping to ensure patients will continue to benefit from innovative new medicines, but also growing and improving America's biopharmaceutical research sector.

The PhRMA Foundation is also a well-respected national leader in building crucial partnerships among industry, government, academia, patients, and other healthcare stakeholders. With the proven ability to connect so many key contributors, the Foundation is uniquely positioned to serve as a trusted convener of field leaders and to promote cooperative efforts for identifying and solving sector-wide challenges.

For example, the Foundation's multi-year effort to promote excellence in Comparative Effectiveness Research (CER) has been a growing success. The initiative was launched in 2009, prior to passage of the Affordable Care Act, as the result of growing understanding that CER and PCOR (Patient Centered Outcomes Research) play an important role in improving health care. It was also an important concept that advanced the education of a new discipline that is vital to the pharmaceutical industry.

The Foundation's Health Outcomes Advisory Committee (HOAC) noted that although CER and PCOR were rapidly expanding, few formal education programs existed in U.S. colleges and universities. The group set out to address the lack of formal structures and consensus curricula that could limit the use and acceptance of CER.

The first step was an exploratory meeting that organized and used an interdisciplinary expert panel comprised mostly of professionals with pharmaceutical interests to develop a graduate education CER curriculum. The HOAC commissioned Daniel Mullins, PhD, of the University of Maryland School of Pharmacy, to determine how many and which types of CER education programs were available. Additionally, the HOAC asked Dr. Mullins and his colleagues to examine the few existing CER courses being offered, and to identify which courses should be required in an ideal CER degree program.

The panel met in December 2009 to discuss the findings and results of the literature search and





survey responses. They used them to identify the required and elective CER courses that should be taught to future researchers and applied users in CER masters' and doctoral programs. Using work groups to address different content areas, the panel developed a model CER curriculum entitled, "Curricular Considerations for Pharmaceutical Comparative Effectiveness Research," which was written by Michael D. Murray, PharmD, MPH, Purdue University, and edited by panel members. It was subsequently published in *Pharmacoepidemiology and Drug Safety* in 2011.¹

Taking this important preliminary work to the next level, the Foundation began the process of developing and offering CER curriculum development grants. The grants were specifically designed to support the creation of high-quality CER certificate and graduate level educational programs.

In 2012, the Foundation's Comparative Effective Research Initiative (CERI) emerged as an important vehicle for expanding and formalizing CER norms and cultivating a cadre of skilled CER and Patient-Centered Outcomes Research (PCOR) experts. The Foundation implemented its CER Educational Development Grant Program in 2012, awarding inaugural grants for the creation of Centers of

Excellence to Johns Hopkins University and the University of Washington.

The following year, grants were awarded to the Harvard School of Public Health, Division of Pharmacoepidemiology and Pharmacoeconomics and the University of Utah, Department of Pediatrics and Pharmacotherapy. A fifth Center of Excellence was created through a 2014 grant to the University of Maryland.

To further advance an initiative of fostering CER excellence, the Foundation utilized its position as a trusted partner and convener to implement several key efforts—all of which lead to a highly successful national plenary meeting on the subject of CER curriculum development. The Foundation together with the Agency for Healthcare Research & Quality (AHRQ) and the Patient-Centered Health Outcomes Research Institute (PCORI) agreed to convene the first national meeting, "Curricular Advances for Patient CER," in January 2014 at the Pew Conference Center in Washington, D.C.

¹Michael D. Murray, Curricular Considerations for Pharmaceutical Comparative Effectiveness Research, *Pharmacoepidemiology and Drug Safety* (2011) Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/pds.2100



conference, a central part of the Foundation's goal to promote a high-quality and multidisciplinary curriculum for university CER education and training programs, represented a major step forward in efforts to bring together CER and PCOR stakeholders. It was a significant—and highly successful—representation of many efforts over the past five years that were shifting from concept to reality.

The conference provided a needed forum for leaders from PCORI, AHRQ, the Food and Drug Administration, and the Centers for Medicare & Medicaid Services—as well as for representatives from industry and academia—to share and engage in a broad spectrum of issues both inhibiting and propelling CER forward. It was highly successful, with more than 120 academics and 50 institutions and representatives from the life sciences industry, government, and healthcare professional organizations in attendance. Keynote speakers Gail Wilensky, Ph.D., and Mark McClellan, M.D., Ph.D., spoke about incorporating CER into policymaking and the future of CER. The conference closed with a

discussion of curricular needs in the field.

Coming together in general sessions and small groups, participants explored what is working well in CER and PCOR training programs, existing training and support gaps, and what needs to be done to close those gaps. Conference participants examined current competencies, compared university CER training programs, and defined the scope of CER/PCOR and academic approaches to training. Finally, they explored the need for educational programs to standardize competencies structures. The full conference report can be found on the PhRMA Foundation website.

The discussions and interaction among attendees led to greater recognition that CER and PCOR are increasingly a “team science” that requires more emphasis on multidisciplinary training. In particular, participants concluded that scientists conducting CER and PCOR must possess a breadth of knowledge as well as substantial skill in one or more areas of expertise. Finally, attendees agreed there still are deficiencies in CER training, including how to better ensure patient engagement, disseminate and implement core curricula, and how to use decision science tools and big data.

The PhRMA Foundation's efforts to enhance CER and PCOR training speak to its mission to support young scientists who are pursuing careers important for patient health outcomes and the future of the pharmaceutical industry. At the same time, the Foundation continues to support programming designed to promote high-quality training and skill development to meet the future needs of industry, academia, and government.

As the PhRMA Foundation approaches its 50th year in service to science and medicine, it has never been more dedicated to fostering new research in crucial areas, as well as cooperation and collaboration among scientists, companies, academia, and government. In this spirit of innovation, growth, and working together, the Foundation will continue to support the truly dynamic field of drug development.

COMPARATIVE Effectiveness Awards

Training Program in Comparative Effectiveness Research

**Sonia Hernandez-Diaz,
M.D., Dr. PH**

*Harvard School of
Public Health*



The “Center of Excellence for Comparative Effectiveness Research (CER) Educational Program” at Harvard provides an integrated training, including specialized curriculum with core and elective coursework, supervised research experience with multiple faculty at the Harvard School of Public Health and the Division of Pharmacoepidemiology and Pharmacoeconomics at Brigham and Women’s Hospital (BWH), and personalized career development plans. The goal is to equip scholars with the knowledge and expertise they need to evaluate the comparative effectiveness and safety of drugs, vaccines, and medical devices. During the past year, the Program offered courses specifically developed to teach cutting-edge methodology for CER: “Methods for CER”, “Seminars in CER and Drug Safety” and “Medical device comparative effectiveness”. The Health Services course was expanded to include more CER aspects. These courses cover a wide range of practical issues pertaining to CER and drug safety research, from specific methodological aspects to policy implications. In some of them, the material is presented in an innovative case-based teaching methodology, an active learning approach. Moreover, students can take advanced courses on related areas such as causal inference, decision science, clinical trials or Pharmacoepidemiology. In addition to the courses there are year-around

seminar series offered by several Departments in the Harvard system. These public forums and lectures promote awareness and discussion of topical CER issues, and involve presentations from faculty, students, and guests. This year the center will continue the monthly webinars previously organized by the BWH DEcIDE Center for Comparative Effectiveness Research. Through these seminars a wider audience can be reached. In 2013, the center hosted a successful CER workshop focused on statistical, analytical and design methods for CER

with an emphasis on evaluating the comparative effectiveness of therapeutic interventions. In 2014, it has organized a Comparative Effectiveness Research in Public Health Symposium.

The Program emphasizes the practical implementation of advanced methods to important health problems via publishable research projects, typically using multiple healthcare databases. The objective is to mentor students to become independent professionals. The generous support by PhRMA has allowed us to support two doctoral students during 2013. One of them has developed a claims-based targeted healthcare safety monitoring system with application to three empirical examples. The other has studied the comparative effectiveness and safety of various immunosuppressive agents, traditional and biologic disease-modifying anti-rheumatic drugs (DMARDs), in patients with Rheumatoid Arthritis. Results have been presented at scientific meetings and will soon be published. The Program is attracting talented trainees into CER. This year the center received applications

from 41 highly qualified candidates. Another two scholars will benefit from this training opportunity during 2014.

In 2013, the center submitted a proposal to the Agency for Healthcare Research on a Career Development Program in Core Methods for Patient Centered Outcomes Research to establish a pipeline of researchers and scientific leaders who will investigate the most pressing healthcare

challenges in the United States, and who will innovate and advance the application of CER methods to patient-centered outcomes research. The center is developing a new course on “PCOR-Principles and Stakeholder Engagement” that cover rationale, strategies, and methods (e.g., focus group facilitation) for patient and other stakeholder involvement as partners in the research process.

Technology-Oriented Comparative Effectiveness Research Program

**Michael G. Spigarelli,
M.D., Ph.D.**

The University of Utah

The Technology-Oriented Comparative Effectiveness Research Educational Program (TOCER) at the University of Utah was established to further the ability to train and allow individuals the first hand opportunities to participate in supervised research to improve the quantity and quality of CER research conducted involving pharmaceutical agents, diagnostics, biomarkers and devices. This has been accomplished through the recruitment of highly talented and motivated TOCER predoctoral trainees coupled with expansion of existing programs designed to teach fundamentals of CER and introduction of new course offerings that expand and enhance the trainee experience as part of a CER Emphasis to their PhD and MS degrees offered at the University of Utah. We have successfully recruited three outstanding students as our first cohort of TOCER scholars. Two of them are second year PhD students in the Pharmacotherapy and Outcomes Research Program and the third is a first year PhD student in the



Pharmacotherapy Program. They have a multidisciplinary mentorship team that provides ongoing direction and encouragement in their development and future career plans. The scholars have begun the program in terms of core and elective coursework as well as dedicated CER research opportunities. We have begun recruiting recruitment for the second cohort of scholars and are excited by the diversity of applications and strength of the candidates.

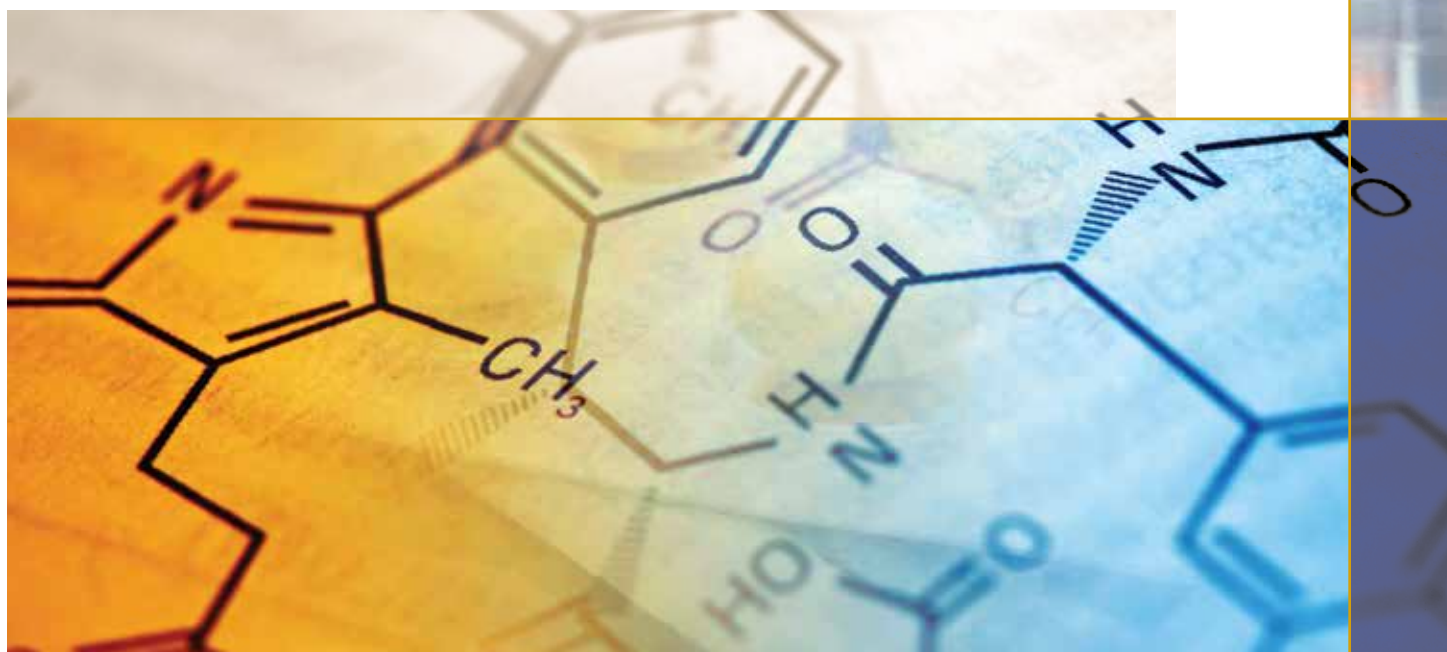
Over the course of the past year, we have improved and augmented our educational curriculum in a strongly positive manner. This included the development of two new courses: Implementation of Clinical Trials and Cost Effectiveness Analysis as well as enhancing the previously offered Methods in Comparative Effectiveness Research. Each course was designed to be an interactive, real world approach taught by experienced and knowledgeable instructors. These are the first curricular enhancements of the planned improvements across the spectrum of CER/Patient Centered Outcomes Research and we have two additional courses including Healthcare Data

Analytics and Decision Analysis currently being developed for implementation in the curriculum next year.

In addition, we augmented existing infrastructure to bring the goals and methodology of CER to a wide array of individuals across the spectrum of their careers. This has allowed us to partner within the existing Center for Clinical and Translational Science (CCTS) framework at the University of Utah including the provision of modules and courses offered through the CCTS including the Personalized Medicine Curriculum certificate program, the Masters of Science in Clinical Investigation (MSCI) Program, and the Graduate Certificate in Patient Centered Outcomes Research/Comparative Effectiveness Research. We have also partnered with the American Association of Pharmaceutical Scientists through our regional chapter the Rocky Mountain Discussion Group to feature CER at the annual meeting to be held in Missoula, MT in August 2014, and are in the initial phases of planning a Rocky Mountain CER Training Program in Collaboration with the CCTS core for Patient Centered Outcomes Research. These types of outreach have allowed growth across a spectrum

of disciplines to improve the reach and impact of comparative effectiveness research.

The TOCER Program, through the generous support provided by the PhRMA Foundation was created to foster a rich training environment that would produce a diverse cadre of investigators including pre-doctoral and practicing health professional scholars, to conduct and evaluate CER studies and publicize research results. We feel it is crucial that information is relevant to stakeholders, aligned with national priorities aimed towards improved health care delivery and health outcomes. This year we submitted an Agency for Healthcare Research and Quality (AHRQ) proposal, in conjunction with researchers from the University of Arizona to further the work begun as a result of our current funding and will continue to seek other opportunities from AHRQ, PCORI and NIH to help increase the number of researchers and quality of CER research. In addition, we have partnered with Lucy Savitz to further evolve the CER certificate program that she directs towards expanding its reach to larger audiences across the Rocky Mountain Region.



AWARDS in Excellence

Great science begins with innovative ideas transformed by dedicated researchers into new solutions for tackling old problems and meeting new challenges. The PhRMA Foundation's grants are given specifically to help young, innovative bioscience researchers at the start of their careers in order to help ignite potentially great ideas and move them from the laboratory white board to a laboratory bench.

The PhRMA Foundation's annual Awards in Excellence honors past grant recipients whose academic and scientific achievements distinguish them as leaders in their field. As young scientists deciding on areas of specialization, each honoree received a PhRMA Foundation grant in a discipline important to the research based biopharmaceutical industry. Today, these honorees exemplify the difference that PhRMA Foundation grants are making in filling critical scientific needs and by providing timely support to young researchers to support and advance their careers.

PhRMA's 2013 Awards in Excellence honor three leading academics and biopharmaceutical researchers for their research, their contribution to advancing our understanding of science and health, their dedication to students and mentoring and their commitment to the future. Each honoree embodies the very best in their chosen fields of Pharmacology/Toxicology, Clinical Pharmacology, and Pharmaceutics.

"One of the more gratifying aspects of the award was the recognition for a body of work done by many talented students, postdoctoral fellows, and research associates over many years." —BRYAN L. ROTH, M.D., Ph.D.,

MICHAEL HOOKER DISTINGUISHED PROFESSOR, UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL, 2011 AWARD IN EXCELLENCE IN PHARMACOLOGY/TOXICOLOGY RECIPIENT

2013 AWARD IN EXCELLENCE IN PHARMACOLOGY/TOXICOLOGY

William. B. Campbell, Ph.D.

*1976 Research Starter Grant in Pharmacology/Toxicology
Professor and Chairman of
Pharmacology and Toxicology
Medical College of Wisconsin*

William Campbell's interest in finding new and better ways to manage and regulate blood pressure as a means to both fight and prevent disease goes way back to his days as a young medical student in Texas. Today, he is Chairman of the Department of Pharmacology and Toxicology at the Medical College of Wisconsin, and still working to understand the regulation of blood pressure by endogenous mediators—hormones that operate locally in blood vessels and which act to constrict



the flow of blood.

By better understanding how endogenous mediators function and controlling those functions, Dr. Campbell hopes to create better tools for doctors to use helping patients in the on-going battle against a host of diseases and chronic conditions such as hypertension, heart disease and stroke. Dr. Campbell and fellow researchers know that if they can find new, more effective ways to regulate blood vessel constriction they can improve how medicines are delivered to targets. How quickly, effectively

and efficiently this is accomplished, in the case of a patient suffering from hypertension or heart disease, could literally be a matter of life or death.

"What we're shooting for in our research" says Dr. Campbell "is better treating for hypertension and low-grade inflammatory disease. The more we learn

about inflammation, the more interesting it becomes and controlling it more important. If we can better control inflammation, we can get to new and better treatments.”

The possibilities are tantalizing. Dr. Campbell has high hopes that the research of his and other laboratories can lead “to new innovative therapeutic approaches to how we deal with potential damage to blood vessels and the kidneys.”

The work is both challenging and rewarding, it is also full of promise. Over the next four years, working both with patients and pharmaceutical research companies, Dr. Campbell hopes to initiate human trials of potential new medicines and, specifically, better analogs capable of reaching a larger human population.

A Texas native, transplanted to the Medical College of Wisconsin in Milwaukee, Dr. Campbell earned his Bachelors in Pharmacy from the University of Texas in 1970 and his Ph.D. at the University of Texas Health Sciences Center in Dallas, Texas in 1974.

As a young assistant professor, Dr. Campbell faced the challenge of how to fund his research. Support soon came in the form of a grant from the American Heart Association and the PhRMA Foundation Research Starter Grant.

“It was a jump start,” he recalls. “The PhRMA Foundation grants help to start careers. It helps start researchers down the path to more and larger funding. It all allows you to set up a lab, get needed equipment and actually begin research. That, in turn, allows a young researcher to create and build that data needed to publish, get more attention and more support.”

The work he began with early support from the PhRMA Foundation lead to data and initial publications that then lead to larger, continuous support for his work from the National Institutes of Health.

“That was really important to my research” recalls Dr. Campbell, “and it is even more important today. These grants have a multiplier effect. Today, I know that local support grants help to leverage \$20 dollars of value to every \$1 of grant funding.

Early grants like PhRMA are like that. I suspect that PhRMA Foundation grants have lead to multiple millions of funding being invested in research from sources like the NIH.”

Dr. Campbell, the author of more than 320 research articles and book chapters, also focuses his attention on the graduate students he works with to train them to meet today’s medical, research and funding challenges.

“Every year, I work with one to two grad students. I like to give them direct attention and mentoring to help them make their careers. I believe that is the most important way to train students.”

Today, former students work in both industry and academia with many holding positions at PhRMA member companies

Dr. Campbell has received well-earned professional acclaim for his work. In 2013, he was honored by the Medical College of Wisconsin with its Distinguished Service Award for his work and contribution to the school. His scientific work has been honored with the 2006 Novartis Award from the American Heart Association Council for High Blood Pressure Research and the 2010 Paul M. Vanhoutte Award in Vascular Pharmacology from the American Society for Pharmacology and Experimental Therapeutics (ASPET).

But it is the future that Dr. Campbell is keeping his eye on. Like other leaders in the field of pharmacology and toxicology, he worries that we’re not doing enough to sustain the science and leverage the technology. “I’m concerned about the ability of researchers to take new compounds into clinical trials and not being able to find needed funding from NIH and other sources. That’s unfortunate. We talk about the importance of translational research—bench to bedside—but we’re falling short in making it into reality. Money is tight and so much critical work is left unfunded.”

That is what makes the support of the PhRMA Foundation’s grants so important: “These grants ensure that these projects go forward. That’s why we need the private sector—like the PhRMA Foundation so often has—to step in and be supportive.”

2013 AWARD IN EXCELLENCE IN CLINICAL PHARMACOLOGY

Juan J.L. Lertora, M.D., Ph.D

*Director, Clinical Pharmacology
Program
NIH Clinical Center*



Like all of those honored with the PhRMA Foundations Award in Excellence over the last 15 years, Dr. Juan Lertora understands the critical importance of mentoring the next generation of researchers, clinicians and scientists. "From my perspective," he says, "the field of clinical pharmacology is becoming increasingly multidisciplinary and we're seeing a decline in the number of young physicians choosing it as a research career path. We need to bring more clinical researchers into the field by stressing dual pathways such as combining, for example, nephrology with clinical pharmacology for physician trainees."

Dr. Lertora believes that equipping the next generation of researchers with a solid foundation in clinical pharmacology is critically important because: "Clinical Pharmacology is at the center of the drug development process. Our ability to evaluate the safety and efficacy of potential new medicines is enhanced by applying the principles of clinical pharmacology to clinical trials."

As the Director of the National Institutes of Health Clinical Center Clinical Pharmacology program since 2006, Dr. Lertora has been able to teach the fundamentals of clinical pharmacology to a broad audience nationally and internationally, while also contributing to the training of medical and pharmacy students, resident physicians, and postdoctoral fellows.

Dr. Lertora began his career graduating with honors from the Faculty of Medicine at the National University of the Northeast in Argentina. He went on to earn a doctorate from the Tulane University's Department of Pharmacology. While at Tulane, Dr. Lertora received a Merck Sharp & Dohme International Fellowship in Clinical Pharmacology and completed his training in Internal medicine at the University of Connecticut and a fellowship in Clinical Pharmacology at the University of Iowa.

In 1978, Dr. Lertora was awarded a PhRMA Foundation Faculty Award in Clinical Pharmacology. A grant that allowed for protected time and helped him initiate his research both as a laboratory scientist and as a clinical investigator at

Northwestern University. He credits the grant with helping to solidify his commitment to the field: "The PhRMA Foundation does a great job supporting young scientists and their training in the field of clinical pharmacology."

Dr. Lertora takes great pride in pointing-out that he is the second of three "generations" of researchers to benefit from a PhRMA Foundation grant. While at Northwestern, Dr. Lertora's mentor was Dr. Arthur Atkinson, Jr., an early recipient of a

PhRMA Foundation grant. In turn, while teaching at Tulane, Dr. Lertora mentored Dr. Albert W. Dreisbach, III, who would apply for and receive another PhRMA Foundation grant.

The Foundation grants are so important for young researchers, Dr. Lertora emphasizes, because young researchers need funding to be successful. "When, for example, you come into a Department of Internal Medicines as a young researcher, you are expected to be productive in both research and clinical practice. It is very demanding and starting a new research project is expensive. Finding support is essential. NIH, for example, is a great source of research funding, but you've got to be pretty well established to receive NIH support."

"The PhRMA Foundation Grant helps do two important things early in a career. First it helps promote important fields like clinical pharmacology. Second, it allows researchers to focus on research and development and their professional training."

Underscoring his interest in training and mentoring, Dr. Lertora was recruited to run NIH's Principles in Clinical Pharmacology Course in 2006. The course, begun by Dr. Arthur J. Atkinson, Jr. in 1998, was designed for NIH trainees, staff scientists and national and international distance learning partners. Today, with over 1,000 registrants, the course is reaching a diverse and international audience of medical doctors, Ph.D.s, pharmacists, including NIH staff and trainees.

The course's value as a tool for helping to keep clinical pharmacologists and clinical investigators current on the principles of drug development is one reason Dr. Lertora was honored with the NIH Clinical Director's Award for Teaching and Training and the Ruth L. Kirschstein Mentoring Award from the NIH Director in 2010.

2013 AWARD IN EXCELLENCE IN PHARMACEUTICS

Raj Suryanarayanan, Ph.D.

1994 Undergraduate Research Fellowship in Pharmaceutics
Professor and William and Mildred Peters Endowed Chair
Department of Pharmaceutics
College of Pharmacy, University of Minnesota



Dr. Raj Suryanarayanan's (Sury) interest in pharmaceutics started over 40 years ago while he earned a Bachelor's Degree in Pharmaceutics at Banaras Hindu University in his native India. Like every pharmacy student, Dr. Sury studied chemistry, drug synthesis, pharmacology and pharmacognosy.

"Understanding how a variety of arenas such as physical chemistry, material sciences, physics, math, biology can each be applied to solve a biological problem is what attracted me to the field of Pharmaceutics."

This was the start of a long scientific, academic and research career that took Dr. Sury from India to a Ph.D. in Pharmaceutics at the University of British Columbia and on to a distinguished 30 plus year career at the University of Minnesota. Today, he is the William and Mildred Peters Endowed Chair in the Department of Pharmacology at the University of Minnesota's School of Pharmacy.

Dr. Sury's achievements have brought him recognition as an outstanding teacher and contributor to pharmaceutical technology, including such prestigious professional recognition as:

The 2010 American Association of Pharmaceutical Scientists (AAPS) Outstanding Educator Award, recognizing excellence in education in the technologies related to pharmaceutics;

- The 2007 Distinguished Alumnus Award, presented by Banaras Hindu University's Department of Pharmaceutics, Institute of Technology; the 2006 award of the William and Mildred Peters Endowed Chair in the Department of Pharmaceutics at the University of Minnesota's College of Pharmacy;
- Election as a fellow of the American Association of Pharmaceutical Scientists in 2002; and
- Induction into the University of Minnesota's Academy of Distinguished teachers in 1999.

In addition, he is also the author of over 110 peer-reviewed publications and book chapters and in, high demand at scientific meetings.

Dr. Sury's contributions and success both reflect

the value of his research and his passion for science and teaching. But getting started, Dr. Sury recalls, is the real challenge every young scientist faces at the outset of a career. He credits the critical role a 1994 PhRMA Foundation grant played in helping to initiate his research as a big part in launching his career: "The foundation grant was so important because it came at a critical time and helped to really get my research going."

"Sink or swim is traditionally the way things work at the start of a career. Early support is essential and that's what PhRMA Foundation grants do: support early stage research and researchers early in their careers. It helps train people. It helps to secure a base of people with a strong foundation in science who can then apply that knowledge to the difficult problems we face—whether in industry, government or academia."

Dr. Sury's research has helped to advance the science of pharmaceutics and helped launch numerous scientific careers as his students, graduate students and fellows have taken their skills to industry, academia and government.

According to Dr. Sury: "One of the great joys of the job is to train students who go on to do things and do science that is far-beyond what they learned here in my laboratory." We must be willing to learn new things and apply them to the problems we are facing. We simply can't do things the way we did five or ten years ago."

In particular, Dr. Sury is understandably proud that he and his students and fellows over the years have been so successful in developing new analytical techniques that have helped to advance our understanding of complex understanding of pharmaceutical systems.

But, he also worries about the future and whether we are doing enough to support the next generation of researchers. "It never feels like we're doing enough," he says. "New things, new challenges come up all the time and we have to be prepared to learn and change. For example, because of the work I do, I now find myself enmeshed in numerous intellectual property (IP) issues. I've had to learn about IP law in order to further my research and be useful to the community. So, it isn't just the science that is important now, it is the intersection of science and law, science and management and science and regulation that must be understood."

"You have to keep up and if you have the right mindset," Dr. Sury concludes, "you will probably survive and also thrive."

FELLOWSHIPS and Grants

Informatics

Pre Doctoral Fellowship in Informatics

At universities throughout the country, students are researching new avenues to find, process, and translate information about human health and disease. Their work stands to advance the state of the art in informatics, improving pharmaceutical research and patient care. To support these bright young scientists as they integrate information technology with biological, chemical, and pharmacological sciences, the Foundation provides an annual stipend for up to two years.

“I was extremely grateful for this support from the PhRMA Foundation. Personally, it gave me great satisfaction to reduce the financial investment of my primary mentor and institution, and the application process was excellent practice for learning how to craft compelling, yet succinct grant proposals for future funding. Professionally, it was particularly gratifying to include predoctoral funding support from the PhRMA [Foundation] on my CV, and I’m sure that, combined with my computational experience, your support helped me secure a postdoc position in my field of machine learning immediately after graduation.” —KAREN G. DOWELL, UNIVERSITY OF MAINE, 2011 PRE DOCTORAL FELLOWSHIP IN INFORMATICS RECIPIENT

“The PhRMA Pre Doctoral Fellowship in Informatics helped jump-start my career in bioinformatics and genomic medicine. It gave me the flexibility and creative autonomy to pursue the projects I was most passionate about as a young investigator.” —JASON RIZZO, STATE UNIVERSITY OF NEW YORK AT BUFFALO, 2010 PRE DOCTORAL FELLOWSHIP IN INFORMATICS RECIPIENT

2013 Pre Doctoral Fellowships in Informatics

Micah Chambers

University of California, Los Angeles
“Connectivity Based Machine Learning in Bipolar Disorder”



Micah Chambers

Bipolar disorder is an extremely debilitating mood disorder that exacts a heavy personal and economic toll. Properly diagnosed and treated, bipolar patients can lead normal lives; however, overlapping symptoms with other mental disorders complicates diagnosis, and large variation in how the disease responds to medication makes normalization of

patients’ mood difficult. Correlation of optimal treatment with—and identification of—biomarkers could provide a much needed decrease in the average time to stabilize the patient’s mood. Group-wise studies, followed by the development of an automatic classifier capable of diagnosing bipolar disorder are the first two steps in this process. This work will make use of Diffusion Weighted Magnetic Resonance Imaging (DWMRI) and resting state functional MRI (fMRI) to develop connectivity models which will then be correlated with disease state by leveraging supervised machine learning methods. These methods are capable of identifying patterns from the large datasets provided by these imaging modalities (DWMRI/fMRI). This research will provide software that processes MRI images and ultimately produces a probability of bipolar disorder within novel patients regardless of whether they are currently experiencing mania or depression.

Henry Lin

University of California, San Francisco
“Ligand-based Methods to Relate and Reorganize Proteins”



Henry Lin

Traditionally, we relate proteins using biological information, such as function, pathway, sequence or structural similarity. But ligand recognition—a key characteristic of proteins—does not always respect such metrics. For instance, acetylcholine, and serotonin signal both through G-Protein Coupled Receptors (GPCRs) and ion channels, which are unrelated by sequence or structure. The reagents that modulate these

targets show similar disregard for bioinformatics boundaries and drug pharmacology often reflects actions across target families separated by apparently unbridgeable molecular gulfs. This project aims to invert the classic molecular biology view—that one moves from protein sequence to structure to ligands—by using the similarities among the protein’s ligands to relate the proteins themselves. New protein organizations and relationships will be created using this pharmacological approach with ligands as representations of proteins. The results will provide guidelines for which proteins need to be tested against, ensuring specificity for a particular drug discovery target that goes beyond sequence-related targets in which a much broader range of targets are likely implicated. More generally, the analysis *may* suggest a teleological basis for the recognition of ligands across major protein families and the analysis will point towards examples where the structural basis of ligand recognition by both targets should be further explored.

Post Doctoral Fellowship in Informatics

The PhRMA Foundation supports postdoctoral research activities that will enhance the expertise of informatics specialists and bridge experimental and computational approaches in genomic and biochemical studies. With this funding, many recipients have been able to secure their careers in informatics and establish independent labs.

“The Post Doctoral Fellowship in Informatics was critical to the success of my postdoctoral research. Without the generous support of the PhRMA Foundation, I doubt I would have a tenure-track faculty position today.”

—JOHN A. CAPRA, Ph.D., UNIVERSITY OF CALIFORNIA, SAN FRANCISCO, 2011 POST DOCTORAL FELLOWSHIP IN INFORMATICS RECIPIENT

“My Post Doctoral Fellowship in Informatics from the PhRMA Foundation allowed me to pursue extensive cross-training in two top-notch labs focusing on computational and experimental genomics. This resulted in a highly innovative project on the fundamental mechanisms of Pol II transcription and regulation that was not otherwise supported by either lab. The comprehensive training and intellectual freedom has allowed me to rapidly establish my independence. As a result, I will be starting my own lab at Cornell next year!”

—CHARLES DANKO, Ph.D., CORNELL UNIVERSITY, 2010 POST DOCTORAL FELLOWSHIP IN INFORMATICS RECIPIENT

2013 Post Doctoral Fellowships in Informatics

Andreja Jovic, Ph.D.

Columbia University

“Uncovering Feedback and Crosstalk Mechanisms Promoting Drug Resistance in Melanoma”



Andreja Jovic, Ph.D.

Cancer behaves differently in every patient, rendering development of therapeutic drugs a tremendous challenge. This heterogeneity in cancer arises in part from genetic mutations, which can alter how cells process exogenous and endogenous signals; these signals are processed through molecular networks. In some cases, these various mutations alter networks, thereby arming cancer cells with the ability to resist drug treatments. Therefore, in order to develop effective, personalized therapeutic drugs, approaches are needed that determine how mutations alter cells' signaling networks, leading to drug resistance. While current approaches are adept at identifying the mutations that can lead to drug resistance, there is a paucity of approaches that uncover the mechanisms by which these mutations cause resistance. Through a multidisciplinary approach, this project proposes to develop comprehensive signaling network models to understand these mechanisms. The project will employ cutting-edge genomic technologies to measure drug responses of a large panel of melanoma tumors with various genetic mutations. From this data, the project will develop computational models to analyze cell signaling networks, to understand the molecular mechanisms of drug resistance. With these models, it will be possible to decipher patterns in tumor drug responses, and thereby determine which parts of signaling networks are best to target to overcome drug resistance on a tumor-specific basis. The results of this study will eventually enable effective development of drugs for thwarting drug resistance in malignant melanoma on a patient-specific basis. This study believes the proposed approach is broad enough to enable development of efficacious therapeutics for all cancer patients.

Jarrett Camp, Ph.D.

Stanford University

“Comparative and Functional Genomics of Placenta Morphology”



Jarrett Camp, Ph.D.

The placenta is the baby's lifeline to the outside world during pregnancy. Vital nutrients are transported across the placenta to the baby and toxic waste products are returned back to the mother. Humans share the genes necessary to build a placenta with all placental mammals, however, the placenta has evolved dramatically different forms throughout the mammalian kingdom. Variations in placental size, shape, and maternal attachments reflect different reproductive strategies and nutrition needs amongst mammals. Problems in the formation of the human placenta can lead to pathologies such as preeclampsia, which often result in premature birth and long-term consequences on the health of the human being. Advances in methods using high-throughput DNA sequencing have dramatically expanded the understanding of mammalian genomes by identifying active genes and the regulatory DNA that governs gene expression. This project will use these new methods to test the hypothesis that changes in gene regulation have impacted the evolution and development of the human placenta. Placentas from multiple mammalian species will be acquired and assayed for genomic activity. This data will be combined with genome sequences from over 50 mammalian species in which detailed knowledge of placenta morphology has been described. Computational tools will be developed to compare genomic information from mammals with diverse placenta structures with genomic information from human placentas. This comparison will help identify the genetic mechanisms that distinguish the particular features of human placenta morphology. This work will be significant because it will help genotype at-risk mothers during early pregnancy, enable physicians to better predict and prevent pathologies associated with premature birth, and initiate future efforts to use often-discarded placenta tissue to understand *in utero* life events experienced by the baby while inside of the mother's womb.

Research Starter Grant in Informatics

At the PhRMA Foundation, we aim to help early-career researchers navigate their current paths, especially in teaching and training. The Research Starter Grant offers support to beginning faculty members launching independent research careers. This funding provides assistance to informatics scientists who have no other financial backing. We see it as a way to encourage and sustain the good work of young investigators who are stepping out at their colleges and institutions.

“The PhRMA Foundation Starter Grant allowed me to hire an additional programmer, which in turn allowed us to pursue more ambitious projects and get the results of these projects published more rapidly. Our current projects would not be possible without this early funding boost.” —MICHELLE MEYER, Ph.D., BOSTON

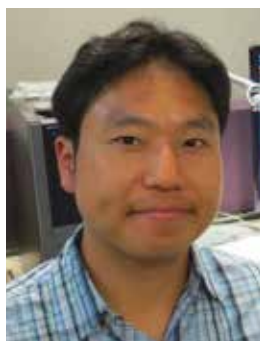
COLLEGE, 2012 RESEARCH STARTER GRANT IN INFORMATICS RECIPIENT

2013 Research Starter Grants in Informatics

Kyoung-Jae Won, Ph.D.

University of Pennsylvania

“An Integrative Approach to Construct a Regulatory Network of Thiazolidinediones”



Kyoung-Jae Won, Ph.D.

Obesity, caused by excess calories stored as fat in white adipose tissue over time, is a major risk factor for metabolic disorders including type 2 diabetes. Thiazolidinediones (TZDs) have been used as a treatment for diabetes because of their effect of increasing insulin sensitivity. However, clinical use of TZDs has been limited because of serious safety concerns such as potential cardiovascular risks.

Therefore, it is important to understand the mechanism of the browning effect on WAT by TZDs for therapeutic purposes. TZDs act by activating PPAR γ (peroxisome proliferator-activated receptor γ). However, our understanding about the targets of PPAR γ , as well as its interacting transcription factors (TFs), is still limited. This is mainly because interactions between distal binding TFs and their target genes are difficult to measure. The goal of the project is to identify direct target genes of PPAR γ and other TFs. The result will enhance our understanding about the transcriptional mechanism of TZDs and further be used to design low-risk drug targets for type 2 diabetes.

Joel T. Dudley, Ph.D.

Mount Sinai School of Medicine

“Computational drug repurposing for Rare Disease”



Joel T. Dudley, Ph.D.

Niemann-Pick C (NPC) is an autosomal recessive lysosomal storage disease characterized by accumulation of lipids within the early endosomes and lysosomes. Symptom onset usually occurs in childhood, and is generally reflective of progressive neurodegeneration. What begins initially as behavioral disturbances and clumsiness, unfortunately progressing to seizures, dementia and immobility, with eventual death

in the second to third decade of life. Currently, there are no disease modifying treatments available for patients with NPC, partly reflecting the challenges of drug development for an orphan disease, and in particular, one with prominent CNS features, which render approaches like enzyme replacement therapy unfeasible. Computational approaches to drug repositioning are well equipped to address unmet needs for rare diseases. Our group develops and applies integrative informatics methodologies to systematically integrate large compendia of molecular data on drugs and disease. We analyze and compare high-dimensional molecular patterns of system-wide perturbations induced by drugs and disease states to infer novel drug repurposing opportunities. This study will leverage genomic information gathered from patients with NPC, as well as the animal and cell-based systems used to study the disease, to define a set of representative NPC signatures. These disease signatures will then be

mapped to a large library of drug-induced signatures to identify the drugs most likely to affect NPC physiology. We have started exploring approaches to building representative NPC disease signatures, which can then be used to build connections with drugs. For example, we have used NPC-cell gene expression to build a network of NPC gene interactions, and used this network to predict drugs that target neighborhoods that are altered in NPC. Initial cell-based screening of compounds identified by our approach demonstrate encouraging reduction in the lipid dysfunction hallmarks of cellular pathology in NPC, and suggest further testing as novel candidate treatments for NPC.

Raluca Gordon, Ph.D.

Duke University

“Understanding the Complex Interplay Among Members of a Transcription Factor Family”



Raluca Gordon, Ph.D.

Transcription factors (TFs) regulate gene expression by binding to specific, short DNA sites across the genome. Most TFs are members of protein families that share a common DNA binding domain and thus have very similar DNA binding preferences. However, individual TFs often function in a non-redundant manner and control different regulatory programs in the cell.

Furthermore, members of certain TF families can bind DNA either as homodimers or heterodimers with other family members, leading to complex TF-TF interaction networks where the factors compete and cooperate to bind their specific targets across the genome. The long-term goal of my research is to understand the interplay among closely related TFs as they perform their unique regulatory functions, and to understand how this regulatory activity gets disrupted in diseased cells. The proposed research focuses on the interplay among proteins in the Myc/Max/Mad network, which play essential roles in cell proliferation, differentiation, and death. Myc proteins are transcriptional activators that promote cell growth and proliferation, while proteins of the Mad family act as transcriptional repressors, inhibiting cell proliferation. To exert their biological roles, both Myc and Mad proteins must heterodimerize with transcription factor Max. As a consequence, Mad antagonizes Myc by competing for binding to Max and to putative DNA binding sites across the genome. However, despite the critical biological roles of Myc proteins and their Max/Mad competitors, few quantitative data are available regarding the Myc/Max/Mad protein-DNA interactions. The proposed research combines high-throughput protein-DNA binding assays with state-of-the-art machine learning methods to generate quantitative models for the competition between Myc proteins and their Max/Mad antagonists for binding to their target sites across the human genome.

Pharmacology/Toxicology

Pre Doctoral Fellowship in Pharmacology/Toxicology

Since the program's initiation in 1978, more than 370 Pre Doctoral Pharmacology and Toxicology Fellowships have helped expand the nation's pool of highly-trained pharmaceutical researchers. The PhRMA Foundation provides awardees with a two-year stipend as they move toward completion of their research for pharmacology and toxicology doctoral dissertations.

“To succeed as an early career investigator, you must to be able to demonstrate that you and your research are highly fundable. The award I received from the PhRMA Foundation as a graduate student shows just that, and I believe it was a huge benefit to me when applying for postdoctoral fellowships. In fact, I applied for three postdoctoral positions and was offered all of them!”—JENNIFER LAMBERTS, UNIVERSITY OF MICHIGAN, 2012 PRE DOCTORAL FELLOWSHIP IN PHARMACOLOGY/TOXICOLOGY RECIPIENT

2013 Pre Doctoral Fellowships in Pharmacology/Toxicology

Larisa Kruger

University of Michigan

"Comparison of Mouse Models of Childhood Epilepsy Expressing Mutations in the Sodium Channel Gene SCN1B"



Larisa Kruger

Some forms of childhood epilepsy are caused by inherited gene mutations. Our work focuses on mutations in the gene *SCN1B* that cause Genetic Epilepsy with Febrile Seizures Plus, or GEFS+. *SCN1B* encodes the Beta1 subunit of voltage-gated sodium channels, molecules that are essential for firing of neurons in the brain. Mutations in this gene cause neurons to fire too frequently, resulting in

seizures. This project compares two different mouse models of *SCN1B*-linked GEFS+ to investigate the mechanism of how these mutations cause seizures. The project also uses a novel technique to study human neurons made from stem cells generated from a GEFS+ patient's skin biopsy. Our results will lend new insights into how seizures occur in childhood and may lead to the development of new therapies to treat this devastating disease.

Emily Moser

University of Virginia

"Control of Inflammation and Restoration of Pulmonary Function During the Host Response to Influenza Virus: The Contribution of Co-stimulation"



Emily Moser

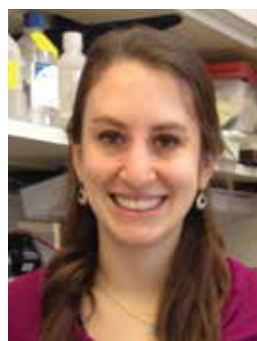
Influenza A virus (IAV) infection can produce severe lung inflammation and injury. The host immune response to infection mediates virus clearance but also contributes to inflammation and injury of the respiratory tract, marking the immune response as a potential therapeutic target after severe infections. Host factors coordinating IAV clearance and pulmonary inflammation are well-studied, however, factors controlling

recovery from disease following IAV clearance are ill-defined. The costimulatory ligand CD86 mediates interactions between immune cells via its receptors CD28 and CTLA-4. Preliminary data suggests that in infected mice, blockade of CD86 signaling *in vivo* after IAV clearance delays recovery and promotes accumulation of neutrophils in the respiratory tract. Furthermore, CD86 blockade reduces both the T cell growth factor IL-2 and T regulatory cells (Treg) in the lungs. Independent depletion of Tregs after IAV clearance also delays recovery and leads to neutrophil accumulation in the lungs. These data suggest that Tregs may play a crucial role in regulating pulmonary inflammation after IAV infection and are in turn dependent on CD86 ligand engagement. Studies are under way to explore the role of CD86 in recovery and resolution of inflammation after IAV infection, with the long-term goal of exploring the therapeutic potential of optimizing CD86 signaling to promote Treg function in recovery from infection.

Tara Gelb

Georgetown University

"The Role of Metabotropic Glutamate Receptor 1 in Human Melanoma"



Tara Gelb

Melanoma is the most dangerous form of skin cancer. This disease accounts for a minority (4%) of skin cancers, but is responsible for the majority of skin cancer fatalities. This cancer is characterized by an abnormal growth of melanocytes, the pigment producing cells of the skin. The incidence of melanoma has increased over the past thirty years, although its mortality rate has leveled off. The life expectancy

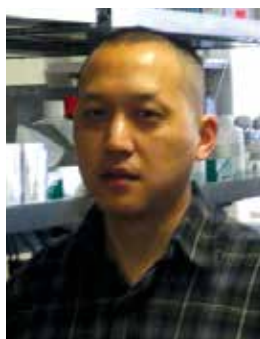
for people with distant metastatic melanoma is less than one year. The ineffectiveness of current therapies used to treat melanoma requires the development of novel treatments, which will selectively target and inhibit melanoma cell growth and metastasis. One target for the treatment of melanoma is metabotropic glutamate 1 (mGlu1) receptor. This project has shown that *in vitro* melanoma cell growth is fully inhibited by blockade of this receptor using non-competitive mGlu1 receptor antagonists. Others have shown that transfection of mGlu1 receptors into healthy melanocytes causes transformation to melanoma cells. *In vivo*, these transformed melanoma cells grow and metastasize, and knockdown of mGlu1 receptors inhibits this melanoma growth. Although mGlu1 receptor antagonists are successfully used in behavioral studies, they have

never been tested as a treatment for melanoma *in vivo*. Understanding the signaling downstream of mGlu1 receptors will identify additional, novel targets for melanoma therapeutics. Classical mGlu1 receptor signaling is characterized by transient G protein-mediated stimulation of phospholipase C (PLC) and phosphoinositide (PI) hydrolysis. The research has identified an additional pathway: glutamate activation of mGlu1 receptors causing β -arrestin-1-dependent internalization of the receptor and formation of a signaling complex that scaffolds and facilitates long-term ERK phosphorylation. Determination of the pathway(s) that regulate melanoma cell growth will identify a new set of potential protein targets for the treatment of melanoma. The overall purpose of this study is to take the initial steps in developing novel, more efficacious metastatic melanoma treatments.

Gilbert Kim

Thomas Jefferson University

“Targeting GUCY2C for Anti-obesity Pharmacotherapy”



Gilbert Kim

Obesity is a global pandemic affecting adults and children of both genders, with ominous trends in obesity-related morbidities, mortalities, and medical expenditures. The current tools in the physician's armamentarium to help obese patients achieve better health have proven limited in efficacy or burdened with ongoing safety concerns. In the context of this unmet clinical need for more effective and safe

anti-obesity therapies, the recent discovery of a new gut-brain endocrine axis regulating appetite and metabolism is a welcome opportunity for advancing translational medicine and clinical care. The transmembrane receptor guanylyl cyclase C (GUCY2C) has been well characterized as a key intestinal regulator of vital homeostatic mechanisms, notably antitumorigenesis, upon activation by its cognate paracrine hormones. The recent discovery of GUCY2C expression and function in the hypothalamus extends GUCY2C signaling to the central nervous system in an endocrine regulatory circuit mediating satiety. This GUCY2C-mediated physiologic satiety reflex represents a prime target for investigating the pharmacotherapeutic potential of GUCY2C hormone supplementation to drive appetite suppression and reverse obesity. Targeting GCC signaling to modulate energy intake is particularly advantageous because it leverages an endogenous mechanism mediating energy homeostasis. Further, preliminary

studies suggest that obesity-related suppression of GCC hormone expression in the intestine may contribute to dysregulation of central appetite control. Thus, GCC hormone supplementation that rescues obesity-related hormone suppression could restore one key mechanism of appetite regulation contributing to pathophysiology. Hormone replacement to reconstitute GUCY2C signaling has been an active area of translational and clinical research, producing FDA- and EMA-approved oral drugs to treat constipation, which affects millions of patients worldwide. Thus, GCC hormone supplementation may offer the efficacy and safety in practice that has eluded nearly all other candidates that have failed in this important therapeutic area. Equally promising is the concept of colorectal cancer prevention and treatment via GUCY2C hormone administration. The well characterized role of GUCY2C signaling in intestinal homeostasis and tumor suppression makes the pharmacotherapeutic promotion of GUCY2C signaling potentially transformative in its clinical impact. Moreover, the coincident regulation of these vital homeostatic mechanisms of energy balance and tumor suppression by one receptor hormone system, and the intriguing possibility of treating both obesity and colorectal cancer with hormone administration, suggests the potential discovery of one mechanism underlying the established link between obesity and colorectal cancer, which has been heretofore unknown. The substantial implications for translation of these studies into improvements in patient care underscore the importance of defining the mechanisms regulating GCC signaling in appetite control, the ability of obesity to corrupt the GCC signaling axis, and the pharmacotherapeutic potential of GCC ligand supplementation in preventing and treating obesity.

Kristen Andersen

University of Wisconsin-Madison

“Developing Chemical Tools to Study Complex Biological Processes”



Kristen Anderson

This research focuses on the application of novel chemical tools to address complex biological problems, both at the molecular and cellular level. At the protein level, the project is working to develop a method to produce ubiquitin chains with a high degree of control using a combination of cutting edge molecular biology techniques and highly selective chemistry. Cellular signaling through ubiquitin modifications can

promote many different responses, including protein destruction or creation. The ubiquitin signal itself is complex, as the small ubiquitin protein may link through any of seven positions on the ubiquitin molecule, forming a multitude of complex structures. Only a few of the fates encoded by these various combinations are understood. This ligation method has the potential to be performed iteratively with the modified protein building blocks to produce any ubiquitin chain with a high degree of control. Ultimately, this method will provide a powerful tool for studying this multifaceted signaling pathway by placing any ubiquitin chain within reach. At the cellular level, the project is working to extend the toolbox of specialized sugar building blocks that can be used to monitor glycan trafficking. The current understanding of glycan biosynthesis remains elusive due to the complexity of the number of precursors as well as the heterogeneity of polysaccharide products. In recent years, the incorporation of unnatural functional groups into the monomeric sugar building blocks has elucidated many aspects of glycan biosynthesis. The goal is to develop unique reaction pairs that will be used to monitor multiple sugars throughout metabolism simultaneously in living cells to expand the knowledge of glycan biosynthesis. The elucidation of these complex sugar metabolism pathways will aid in our understanding of normal cell processes, as well as aberrant glycan regulation in disease states.

Amanda Croasdell

University of Rochester

"Specialized Proresolving Mediators Attenuate Cigarette Smoke-induced Inflammation in Macrophages"



Amanda Croasdell

Cigarette smoke (CS) is currently the leading cause of preventable death in the United States, accounting for 1 in 5 deaths. Despite the extensive amount of cigarette smoke research done in the last fifty years, treatments for many smoking related diseases, including chronic obstructive pulmonary disease (COPD) and an increased susceptibility to bacterial infections, are still limited and focus on short term

relief of symptoms. Underlying many of these cigarette smoke-associated disease states is chronic inflammation. Cells respond to inflammatory stimuli such as cigarette smoke by producing pro-inflammatory cytokines and recruiting and activating inflammatory cells such as macrophages and neutrophils. Acute inflammation is a necessary process by which the body responds to outside

stimuli. A prolonged immune response, though, can lead to chronic inflammation, resulting in tissue damage, cell death, scarring, and loss of organ function. Previously, the resolution of inflammation was thought to be a passive process. Recently, endogenous, lipid-derived, specialized proresolving mediators (SPMs) have been discovered; these mediators play a critical role in the active resolution of inflammation by suppressing pro-inflammatory actions and promoting alternative resolution pathways. SPMs can dampen uncontrolled inflammation through a number of mechanisms, including decreasing inflammatory mediator production and altering neutrophil trafficking. SPMs act through several immune cell types in the lung, including macrophages, which play a central role in pulmonary inflammation. Chronic macrophage activation has also been implicated in the pathogenesis of diseases associated with smoking, such as COPD. This research project will determine the efficacy of SPMs in attenuating cigarette smoke-induced inflammatory mediator production by human macrophages and the mechanism(s) of SPM signaling. It will additionally investigate the effects of cigarette smoke on identified SPM receptors. Macrophages can also be polarized to pro-inflammatory or proresolution phenotypes, and the ability of SPMs to alter this polarization will be investigated. This research will be the first step in investigating the role of SPMs in resolving inflammation associated with smoke exposure and will provide the groundwork for further investigation and eventual translation of SPMs into a clinical setting.

Jameson Dahlin

Mayo Clinic College of Medicine

"Small-molecule Inhibitors of Rtt109-catalyzed Histone Acetylation as Potential Aspergillus Fumigatus Therapeutics"



Jameson Dahlin

Deadly fungal infections have risen significantly due to increased numbers of patients with weakened immune systems, such as individuals infected with HIV, organ transplant patients and cancer patients undergoing chemotherapy including pediatric populations. The mortality rate from these infections often exceeds 50%. Many fungal genes are also found in humans, making it difficult to

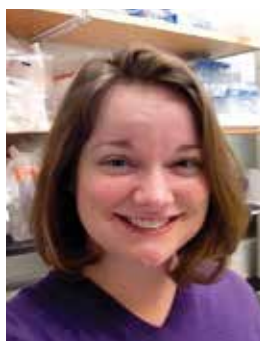
identify fungal-specific therapeutic targets. In fungal and human cells, for example, DNA and proteins in the nucleus are assembled into chromatin, which is needed to package DNA into a comparatively small cell nucleus. The

basic repeating unit of chromatin is the nucleosome, which consists of DNA wrapped around proteins called histones, analogous to string being wrapped around a ball. These histone proteins are subject to complex regulation by processes such as acetylation, and are important in regulating cell proliferation and differentiation. Numerous histone-modifying enzymes have been implicated in disease conditions such as cancer. The lysine acetyltransferase (KAT) Rtt109 is an enzyme that is highly conserved in fungal species and exhibits no obvious sequence homology to mammalian KATs. Rtt109 is critical for yeast cells to resist damage to its DNA, and deletion of the Rtt109 gene in the pathogenic fungi *Candida albicans* reduces fungal infection in mouse models.

The objective of this proposal is to use biological and chemical approaches to validate Rtt109 as a target for treating fungal infections, with an emphasis on the clinically relevant species *Aspergillus fumigatus*. The project's hypothesis is that potent and selective inhibitors of Rtt109 will function as useful anti-fungal agents against *A. fumigatus*, and these inhibitors will exhibit minimal side effects in human cells. This proposal will help the trainee gain expertise in medicinal chemistry, molecular pharmacology, toxicology and mouse models of human diseases. This multidisciplinary and collaborative proposal will integrate basic biochemical and cellular mechanistic studies and *in vivo* studies in fungi and mice. Information obtained from this proposal may also benefit other groups pursuing epigenetic targets and one of the "high-hanging fruits" in drug discovery, protein-protein interactions.

Amber Frick, Pharm.D.

University of North Carolina at Chapel Hill
"Cellular Genetics Approaches to Defining Toxicity Pathways"



Amber Frick, Pharm.D.

Non-Hodgkin lymphoma (NHL) is the seventh most common cancer, contributing to significant morbidity and mortality. Diffuse large B-cell lymphoma, a subtype of NHL of particular interest, represents the most common type of malignant lymphoma, with a five-year overall survival of only forty-six percent. Although anthracyclines are commonly used as anti-lymphoma chemotherapy, notable adverse effects limit

dosing. To improve the use of anti-lymphoma chemotherapeutics, a thorough understanding of their cytotoxic effects is needed. In addition, normal immune cell function, which may be adversely affected by

chemotherapeutic administration, may enhance lymphoma therapeutic outcomes. Thus to elucidate the mechanisms underlying dose-limiting adverse drug reactions on normal immune cells (*i.e.*, B-cells, T-cells, monocytes, and granulocytes), This project will investigate how these chemotherapeutics exert cytotoxic effects by analyzing various phenotypes in α panel of primary cell lines from well-defined recombinant inbred mouse strains. Furthermore, genes and genetic pathways underlying the variable toxicity responses of normal immune function cells to anti-lymphoma agents will be identified via genome-wide association analysis. Identification of genetic components of toxicity may lead to the discovery of biomarkers potentially translatable to human studies. For this approach, classes of compounds (dual PI3K/mTOR inhibitors and MEK inhibitors) that are currently in clinical development for hematological cancers will be tested and compared with the traditional standard of care anticancer agents (*e.g.*, the Janus-faced anthracyclines). Ultimately, The project may clinically impact individualized therapy for the treatment of NHL and additional cancers. These findings may lead to improvements in patient safety and reduction in healthcare costs.

Alyssa Verano

Weill Cornell Graduate School of Medical Sciences
"Synthesis and Biological Evaluation of Acortatarins as Inhibitors of Oxidative Stress"



Alyssa Verano

Acortatarins A and B are naturally occurring spiroketal compounds that were isolated from the roots of the *Acorus tatarinowii* plant. *Acorus tatarinowii* root is used as traditional Chinese medicine for the treatment of central nervous system disorders. Acortatarin A was also isolated from the fruit *Capparis spinosa* (capers) and from bee-collected pollen from the plant *Brassica campestris*, both of which are used as tradi-

tional Chinese medicines to combat disease. Acortatarins A and B exhibit significant antioxidant activity in renal cells and decreased levels of reactive oxygen species (ROS). Because these compounds demonstrate promising biological activity, a structurally diverse library of acortatarin analogues will be synthesized and tested for biological activity in order to examine structure-activity relationships. Due to increasing evidence that antioxidants have beneficial properties in cancer prevention and therapy, the acortatarin library will also be directed toward anti-cancer screens in the future. In addition, the antioxidative

properties of these natural products will be investigated in order to elucidate their mechanism of action and cellular targets. These studies will provide a basis for the

discovery of new antioxidant compounds and could lead to identification of key pharmacophores and novel drugs aimed at cancer and disease prevention.

Post Doctoral Fellowship in Pharmacology/Toxicology

The Post Doctoral Fellowship in Pharmacology/Toxicology provides a two-year stipend to scientists who seek to gain new skills in pharmacologically relevant areas. Eligible candidates are actively pursuing a multidisciplinary research training program to enhance their expertise and education, or embarking on a research project that aims to integrate information on a drug's molecular or cellular mechanisms of action with the agent's effects on the intact organism.

“The PhRMA Foundation Postdoctoral Fellowship has provided me the necessary support needed to continue my research and professional training in oncology and toxicology. This award has strengthened my resolve and confidence as a postdoctoral researcher, which is a driving force for future success.” —TARYN JAMES, Ph.D.

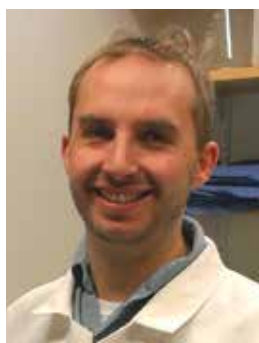
UNIVERSITY OF WISCONSIN AT MADISON, 2013 POST DOCTORAL FELLOWSHIP IN PHARMACOLOGY/
TOXICOLOGY RECIPIENT

2013 Post Doctoral Fellowships in Pharmacology/Toxicology

Adam Walker, Ph.D.

Vanderbilt University

“Regulation of Hippocampal Function by Allosteric Modulators of mGlu3”



Adam Walker, Ph.D.

The metabotropic glutamate receptors (mGlu) are implicated as therapeutic targets in multiple neurological and psychiatric conditions. The group II mGlu (mGlu2 and mGlu3) are typically inhibitory serving to presynaptically attenuate glutamatergic tone at excitatory synapses and have been implicated as novel targets for antipsychotic, anxiolytic, and antidepressant medications. Although activa-

tion of group II mGlu inhibits transmission at many synapses, they are not inhibitory at the Schaffer Collateral-CA1 (SC-CA1) synapse in the hippocampus. Instead, this study and others have discovered they are involved in form of glial-neuronal communication. Synergistic activation β -adrenergic (β AR) and group II mGlu increase

cyclic-AMP accumulation in glia and results in release of adenosine that in turn activates presynaptic A_1 receptors to decrease glutamate release and depress excitatory transmission. These results imply that group II mGlu may function to prevent neuronal damage during periods of high glutamate and noradrenergic tone that may occur in periods of prolonged and intense stress. Based on immunohistochemical evidence, it is hypothesized that mGlu3 is the receptor subtype involved in this effect, but until recently, compounds have not been able to distinguish between mGlu2 and mGlu3. Our lab has recently discovered a compound that is a selective allosteric antagonist of mGlu3 *in vitro* and synthesized analogs. The goal of this research project is to rigorously characterize these new compounds using cell-based pharmacology. Furthermore, these compounds will be used in electrophysiology experiments to test the hypothesis that mGlu3 is the group II subtype mediating a form of communication between glial-cells and neurons in the hippocampus. Finally, this project will test the hypothesis that mGlu3 activation can regulate the effects of β AR activation on hippocampal network function by attenuating a form of synaptic plasticity mediated by β ARs. Overall, these results will provide insight into how mGlu3 can regulate β AR activity and may have implications for disorders involving cognitive impairment. These studies represent major advances in mGlu pharmacology, understanding their physiological functions in the central nervous system, and elucidating their therapeutic potential.

Byron Neil Roberts, Ph.D.

University of California, Davis

"Predicting Antiarrhythmic Drug Effects in Ischemic Tissue."



Byron Neil Roberts, Ph.D.

About 80% of sudden cardiac deaths occur in patients with ischemic heart disease, and the overwhelming majority of these events involve ventricular arrhythmias. Many patients rely upon pharmacologic therapy, including antiarrhythmic drugs, for primary prevention of sudden cardiac death. However, there is currently no reliable way to predict which antiarrhythmic drugs will reduce a patient's arrhythmia risk, posing a

fundamental barrier to effective clinical treatment of arrhythmias. During ischemia, pathological changes occur to myocyte physiology that alter cell electrical properties and set the stage for arrhythmias. Importantly, pH changes that occur during ischemia can alter how antiarrhythmic drugs interact with ion channels. Given the strong relationships between sudden cardiac death, ventricular arrhythmias and ischemia, and given the fact that antiarrhythmics are often administered in the setting of ischemia, it is imperative to understand how these drugs behave during ischemia. The aim of this project is to build a computationally based framework, taking into account off-target and pH-dependent factors, to predict the effects of antiarrhythmic drugs in the setting of ischemia.

Taryn James, Ph.D.

University of Wisconsin-Madison

"Mechanisms and Molecular Targets of Phytoestrogens in Breast Cancer In Vivo"



Taryn James, Ph.D.

The biological effects of estrogens include guiding the development of breast, uterus, ovaries, and bone and are mediated by two subtypes of estrogen receptors (ER), ER alpha (α) and ER beta (β), which function in pairs (i.e. 2 ER α , 2 ER β and 1 ER α and 1 ER β). The two receptors have opposing functions in breast i.e. ER α promotes while ER β inhibits breast tissue growth. Therefore the ratio of ER α : ER β increase

during cancer. Although ER α is the main target for breast cancer therapy, ER β is neither a prognosis marker nor a therapeutic target. Because the current ER targeting drugs (e.g. fulvestrant) non-selectively inhibit both forms of ERs, better strategies are needed to utilize the anti-growth effects of ER β . This project aims to take advantage of the negative effects of ER beta on breast tissue growth for breast cancer treatment by developing an assay that would select compounds that can induce the normal function of ER β receptors in breast. Previous research on this project using a similar assay has shown that an interaction of 2 ER β receptors or 1 ER β and 1 ER α receptors induced by certain phytoestrogens can decrease the growth of breast cancer cells. Therefore compounds that induced ER β containing pairs may be useful for cancer treatment. The new assay that will be developed in this project will uniquely allow us to detect compounds that can stimulate ER beta receptor pairs in tumors. Additionally, this assay will also be used to screen environmental compounds for their ability to be a causative agent for breast cancer. The hypothesis is that phytoestrogens identified in this project *will* inhibit the progression of breast cancers in animals. Therefore this assay will be a necessary tool for discovery of natural compounds, which may be developed as alternative treatments for breast cancers that failed conventional treatment.

Research Starter Grant in Pharmacology/Toxicology

For faculty members without sufficient sources of funding, the PhRMA Foundation offers the Research Starter Grant: a one-year award to help launch independent research careers. This grant aims to assist academic scientists in pursuing studies that shed light on individualized drug therapy and optimal therapeutic options.

“It is difficult for new investigators to obtain funding in topics of research without proven expertise. My non-traditional career path of skipping postdoctoral training to work in industry and then moving to Drexel University to start an academic career as an assistant professor made my task of obtaining funding even more daunting. The Research Starter Grant in Pharmacology/Toxicology from the PhRMA Foundation has enabled me to explore alterations in DNA methylation in pain. The studies conducted [and continuing] will serve as the basis for my research for years to come and have made a significant impact in expanding my horizon of research. Better understanding of the molecular mechanisms underlying DNA methylation could potentially be rewarding from the basic research and patient-care standpoints and can lead to better strategies for treating pain.”—

SEENA AJIT, Ph.D., DREXEL UNIVERSITY COLLEGE OF MEDICINE, 2012 RESEARCH STARTER GRANT IN PHARMACOLOGY/TOXICOLOGY RECIPIENT

2013 Research Starter Grants in Pharmacology and Toxicology

Michy Kelly, Ph.D.

University of South Carolina School of Medicine
“Compartmentalization of Cyclic Nucleotides in the Ventral Hippocampus”



Michy Kelly, Ph.D.

Schizophrenia affects 1% of people, and no medicines currently treat the negative or cognitive symptoms that impair patients' ability to function in everyday life. Thus, new therapeutic targets must be identified. Phosphodiesterase 11A (PDE11A), an enzyme that breaks down both cAMP and cGMP, may be one such target. Preliminary Studies show that adult PDE11A knockout (KO) mice exhibit phenotypes related

to the negative and cognitive symptoms of schizophrenia. Interestingly, PDE11A is almost exclusively localized to CA1 and subiculum of the ventral hippocampal formation (VHIPP; a.k.a. anterior HIPP in primates, AHIPP), with only limited expression observed in the dorsal HIPP. AHIPP deficits have been repeatedly observed in patients with schizophrenia and lesions to the rodent VHIPP recapitulate

many aspects of schizophrenia. Thus, the project hypothesizes that PDE11A regulates brain functioning primarily through its ability to compartmentalize cyclic nucleotides in the VHIPP/AHIPP. This project will combine pharmacological, genetic, behavioral, biochemical, and molecular techniques in mice to determine how PDE11A activity during development versus adulthood shapes VHIPP function and how negative social experiences sculpt the brain by modifying PDE11A compartmentalization. PDE11A may offer a unique therapeutic opportunity to selectively restore cyclic nucleotide signaling in a specific brain region impacted by disease, without affecting signaling in normal brain regions or the periphery. In so doing, it is hoped that a PDE11A-targeted drug would provide symptom relief without causing unwanted side effects.

Phillip Kopf, Ph.D.

Midwestern University
“The Role of 12-Lipoxygenase in Aldosterone Secretion”

Elevated circulating aldosterone levels are associated with hypertension, thrombosis formation, cardiac hypertrophy, and congestive heart failure. Aldosterone secretion is regulated by angiotensin II (Ang II), potassium, and adrenocorticotrophic hormone (ACTH). Ang II stimulation of aldosterone secretion is mediated by angiotensin type 1 receptors and phospholipase C-calcium downstream signaling. Additional evidence exists for an essential role of the 12-lipoxygenase (12-LO) pathway in Ang



Phillip Kopf, Ph.D.

II-stimulated aldosterone secretion. However, the identity of 12-LO metabolites, as well as the mechanism and extent by which these metabolites contribute to Ang II-stimulation of aldosterone secretion remains unknown. The long-term goal of these studies is to understand the role of 12-LO in the regulation of aldosterone secretion. The objective of this proposal is to identify the 12-LO metabolites that contribute to Ang II-

stimulated aldosterone secretion and to characterize the receptor that mediates the action of these active metabolites. The central hypothesis is that arachidonic acid and/or adrenic acid 12-LO metabolites mediate Ang II-stimulated aldosterone secretion by activation of a guanine nucleotide binding protein (G-protein) coupled receptor (GPCR). The rationale for the proposed research is that identification of the 12-LO metabolites and their receptor that mediates aldosterone secretion would provide a novel pharmacological target for the remediation of circulating aldosterone levels. Such a novel target has the potential to ameliorate morbidity and mortality in patients with cardiovascular disease associated with hyperaldosteronism.

Health Outcomes

Pre Doctoral Fellowship in Health Outcomes

With a focus on healthcare and its effects on the well-being of patients and populations, outcomes research provides crucial information to doctors, patients, policymakers, and clinicians. The PhRMA Foundation's Pre Doctoral Fellowships in Health Outcomes seeks to increase the number of trained investigators studying all aspects of drug therapies by providing a stipend to students two years away from completing doctoral dissertations.

"As a recipient of the PhRMA Foundation's Pre Doctoral Fellowship in Health Outcomes, I have been able to focus on my dissertation methods and research while not having to also work as a graduate assistant. The experience of planning, writing, applying for, and being awarded this Fellowship has solidified my belief in the importance of my research, and helped me collaborate with researchers outside of my field."—EMILY REESE,

UNIVERSITY OF MARYLAND, 2012 PRE DOCTORAL FELLOWSHIP IN HEALTH OUTCOMES RECIPIENT

2013 Pre Doctoral Fellowships in Health Outcomes

Angie Mae Rodday

Tufts University

"Utilizing Patient-Reported Outcomes to Assess the Impact of Complex Medical Disorders in Children"

Approximately 8,000 US children are dependent on home-based mechanical ventilation because of various underlying conditions, including neuromuscular diseases or spinal cord injuries. Compared with healthy children, those requiring respiratory assistance are more likely to experience unscheduled healthcare utilization. In addition, families and children may experience negative effects on family functioning and health-related quality of life (HRQL).



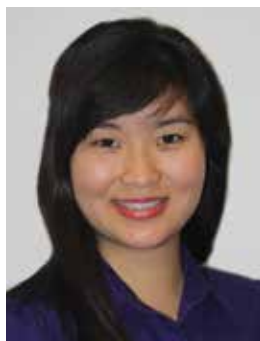
Angie Mae Rodday

Using a sample of children with ventilator dependence and their families, This project aims to: (1) determine which factors relating to the family, child, and disease impact the family, (2) assess the association between HRQL and healthcare utilization, and (3) explore better measures of physical functioning in those at risk for lower functioning. Results will enable the identification of factors that impact the family and affect HRQL and healthcare utilization, which can be used to develop interventions to improve outcomes.

Dawn Kim-Romo, MS

University of Texas at Austin

“The Treatment of Unipolar Major Depression with Psychotic Features Using Combination Therapy versus Monotherapy: A Study on Adherence, Persistence, and Health Care Utilization and Expenditures”



Dawn Kim-Romo, MS

Major depressive disorder with psychotic features (MD-Psy) is a documented public health problem associated with considerable morbidity and mortality. Epidemiological studies report that 14.7% to 25.3% of patients diagnosed with major depression have psychotic features, and this proportion is estimated to be much higher in the geriatric population at 44.7%. Compared to patients with nonpsychotic

depression, patients with MD-Psy experience more severe depression, higher psychosocial impairment, worse psychomotor agitation, and higher frequencies of insomnia. These patients are also more likely to have worse health outcomes related to longer persisting depression, as well as increased risk of relapse, hospitalizations, suicide, and financial dependency. While this disorder is associated with high rates of relapse and suffering, the treatment of MD-Psy has not been sufficiently studied. Currently, there is no clear consensus regarding the treatment strategy for MD-Psy, and there is considerable debate about which pharmacological treatment is best. The primary purpose of the proposed study is to assess medication therapy for patients with unipolar MD-Psy in relation to improved safety, medication adherence and persistence, and reduced suicide attempts, health care utilization, and health care costs using real-world data. The proposed study also aims to provide enhanced understanding of this severe subset of major depressive disorder and to provide information to fill the gaps in knowledge that clinicians and decision-makers may use when considering treatment options for unipolar MD-Psy.

Post Doctoral Fellowship in Health Outcomes

Post Doctoral Fellowships in Health Outcomes support scientists launching research projects that represent the promising field of health outcomes at schools of pharmacy, medicine, and public health. Scientists beginning careers in this area are eligible to receive an annual stipend for up to two years.

“The PhRMA Foundation Post Doctoral Fellowship has had a great impact on my professional career. Through this award, I was not only able to complete the work I had started, but dive further into my research question. As a result, I have taken leadership on a spin-off project, which has yielded additional poster presentations and a forthcoming manuscript. This award has served as an excellent jump start to my career as an independent outcomes researcher!”—DOMINIQUE COMER, PHARM.D., THOMAS JEFFERSON UNIVERSITY, 2012 POST DOCTORAL FELLOWSHIP IN HEALTH OUTCOMES RECIPIENT

2013 Post Doctoral Fellowships in Health Outcomes

Robert McQueen, Ph.D.

University of Colorado

“Development and Application of a Multiple Sclerosis Policy Model”

Multiple sclerosis (MS) is a chronic and debilitating inflammatory autoimmune disorder of the central nervous system with a U.S. prevalence of 400,000. Because MS patients have increased healthcare utilization and



Robert McQueen, Ph.D.

typically have a long life span, MS imposes a significant and long-term burden. Disease modifying therapies (DMTs) have an ultimate treatment goal to delay or prevent the long-term disability of relapsing-remitting MS (RRMS) while minimizing DMT-related risks. The trial-based efficacy of DMTs as compared to placebo or standard of care are relatively well known over short-term

1-2 year time horizons in the RRMS population. Using evidence from short-term randomized controlled trials (RCTs), decision-analytic models are commonly employed to project the risks and benefits of DMTs for MS. Such trial-informed models however, lack the breadth needed to generalize to policy relevant hypotheses outside of the realm of the clinical trial due to limitations such as: lack of real-world DMT treatment patterns such as switching between DMTs or discontinuing them, limited head-to-head comparisons among DMTs, and lack of effectiveness and safety-driven endpoints.

There are no consensus statements on DMT treatment that are supported by neurology societies in the RRMS population. Policy decision makers as well as clinicians are left to make critical treatment judgments based on expert opinion and experience. Given the

significant and long-term burden of MS as well as the costly investment in DMTs there is a critical need to provide a framework that includes best available evidence to guide this decision making process and lay the foundation for creating consensus guidelines in DMT use for the management of MS. The objective of this study is to develop an MS policy model to estimate and compare the long-term clinical benefits, risks, and costs of DMTs for RRMS. Using evidence from RCTs, the literature, and claims data, this policy model will incorporate real-world treatment patterns including switching to alternative DMTs or discontinuing initial DMTs. The results from this policy model will inform evidence-based DMT decision making, and generate additional hypotheses relating to the lifetime costs and outcomes of MS.

Research Starter Grant in Health Outcomes

Scientists beginning independent research careers at the faculty level are eligible to receive funding for one year to study patient-centered outcomes, data, systems, and technologies for improving the effectiveness of pharmaceutical interventions.

“The PhRMA Foundation Research Starter Grant was key in my ability to establish a research agenda focusing on the benefits of pharmacist–physician collaboration in the safe and effective use of insulin and other medicines to treat type 2 diabetes. Funding to support this research allowed me to develop a network of collaborators and generate pilot data that facilitated my efforts in securing additional funding to expand this research. Ultimately, the value of this funding will be to patients as we build upon the pilot study and provide further evidence that effective collaborative drug therapy management programs improve treatment outcomes for patients with type 2 diabetes.”—CARRIE MCADAM-MARX, R.PH., Ph.D., UNIVERSITY OF UTAH, 2011

RESEARCH STARTER GRANT IN HEALTH OUTCOMES RECIPIENT

2013 Research Starter Grants in Health Outcomes

Sarah Tom, Ph.D., MPH

University of Maryland, Baltimore

“Insomnia Medication Use, Physical Function, and Mortality in Older Women”

In general, medications to treat insomnia should be used with caution in older adults because of psychomotor problems, cognitive impairment, and daytime somnolence risks, among other adverse events. Despite these concerns, prescriptions of non-benzo-diazepine sedative hypnotics have increased nearly nine-fold among Americans aged ≥ 65 years from 1993–2007. The influence of these medications on physical function and mortality has not been well-characterized. These relationships are particularly relevant to the health of older



Sarah Tom, Ph.D., MPH

women, as women are more likely to report insomnia and in general to use medication than older men. This research will evaluate the associations between longitudinal use of insomnia medication, self-reported and measured physical function, and mortality during up to 19 years of follow-up in the Women’s Health Initiative, a longitudinal study of nearly 162,000 postmenopausal American women age 50–79 years at baseline. These results will assist medical care providers and older women in making informed decisions about insomnia medication use to optimize insomnia management and subsequent physical health.

Milena Anatchkova, Ph.D.

University of Massachusetts Medical School
“Estimating Patient Reported Labor Market Outcomes from Health Variables”



Milena Anatchkova, Ph.D.

Return to work and related labor market outcomes (LMO, e.g, work productivity, presenteeism, occupational functioning) are important from both patient and societal perspectives. The indirect costs of disease in terms of diminished work productivity and missed days of work must be better understood to fully appreciate the cost-benefit of treatment. Nevertheless, measures of LMO are not

readily available in many clinical studies. The overall goal of the project is to develop and evaluate approaches for

estimating LMO scores from available patient-reported health data, with the long-term goal of applying them to model LMO in studies where this information is not available. The study will use available data from 2 NIH-sponsored research efforts with 3 independent samples. These studies provide the necessary information that allow for the development of the algorithms and the independent testing of their validity. The specific aims are to develop methods for estimating impact of health problems on LMO from patient-reported health status data; and evaluate the performance of the LMO estimation methods in independent samples. The successful completion of the project will result in practical low cost approaches to estimating productivity outcomes in studies with good patient-reported health measures but no direct assessments of LMO. These methodological advances will help fill gaps in existing data and allow for tests of LMO hypotheses, which otherwise would be impossible. Results will also allow the translation of health status and work limitation scores in productivity cost estimates in sets where data on individual earnings is available.

Pharmaceutics

Pre Doctoral Fellowship in Pharmaceutics

As one of the Foundation's longest-standing programs, the Pre Doctoral Fellowship in Pharmaceutics assists students engaged in dissertation research on relationships among drug delivery systems, gene therapy, and clinical applications. A stipend is provided when coursework has been completed and Ph.D. candidates begin their final research project.

“I am very thankful to the PhRMA Foundation for believing in me and awarding me with the Pre Doctoral Fellowship. The award did not just help me financially, but also helped me be a better contributor to the scientific community by motivating and boosting my scientific interests and efforts. I feel so proud and honored to receive the PhRMA Foundation Fellowship and am sure this title will go a long way in my professional career. Thank you, PhRMA Foundation, for stimulating and encouraging the scientists of tomorrow.”—SWETA MODI, UNIVERSITY OF KENTUCKY, 2012 PRE DOCTORAL FELLOWSHIP IN PHARMACEUTICS

2013 Pre Doctoral Fellowships in Pharmaceuticals

Matthew Jackson

Purdue University

“Investigating the Phase Behavior of Supersaturated Solutions of Poorly Water Soluble Drugs”



Matthew Jackson

Currently poor solubility continues to be a major hurdle in the formulation of new drugs. Amorphous solid dispersions have been shown to be a favorable solubility enhancement technique, leading to an apparent increase in solubility needed to increase overall bioavailability. These formulations create a supersaturated solution which will eventually return to equilibrium through crystallization of the drug.

However, evidence suggests that the formation of a new colloidal drug-rich phase through liquid-liquid phase separation (LLPS) may supersede crystallization in certain systems. LLPS has been observed in specific systems but the mechanisms and overall effect on drug dissolution and absorption are not well understood. This research is focused on developing and validating novel analytical methods to characterize the behavior of drugs in supersaturated solutions, such as those that result from the dissolution of amorphous solid dispersions. The model drugs selected for this study exhibit phase behavior which is very influential toward LLPS. Additionally, if a relationship between the apparent amorphous solubility and LLPS can be established, then this could greatly impact the formulation of amorphous solid dispersions. Using polymeric inhibitors and analytical techniques such as ultraviolet spectroscopy, fluorescence, second harmonic generation, and dynamic light scattering, we can manipulate a variety of variables to analyze LLPS relative to the apparent amorphous solubility. Better understanding the phase behavior of these drugs and the consequences of creating highly supersaturated drug solutions should enable the utilization of amorphous solid dispersions as a robust oral dosage form.

James Byrne

University of North Carolina at Chapel Hill

“The Local Iontophoretic Delivery of FOLFIRINOX for the Treatment of Pancreatic Cancer”



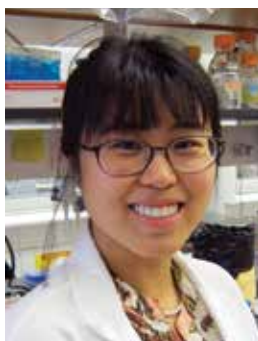
James Byrne

With an incidence rate approximately equivalent to the death rate, pancreatic cancer is the fourth leading cause of cancer death in the United States. The poor prognosis is in part attributed to the ineffective delivery of chemotherapeutics. Poor tissue perfusion plays a substantial role in preventing adequate drug accumulation in primary pancreatic tumors. In an attempt to address the lack of effectiveness of systemically

administered chemotherapy and associated toxicity, the project proposes to develop a minimally invasive, iontophoretic device approach adapted to locally deliver cytotoxic chemotherapies directly to pancreatic tumors. One tremendous advantage of the iontophoretic device is for the delivery of agents that are limited by systemic toxicity. FOLFIRINOX is a promising cytotoxic cocktail (leucovorin, 5-fluorouracil, irinotecan, and oxaliplatin) but with only limited utility in patients due to its increased systemic toxicity. Therefore, device delivery of FOLFIRINOX would have the potential to substantially improve the resectability and local control rate in patients with locally advanced and unresectable pancreatic cancer. The proposed work involves developing and testing the iontophoretic delivery of FOLFIRINOX by establishing the transport characteristics of the FOLFIRINOX chemotherapies under applied electric potential gradients, determining the safety and pharmacokinetic profiles of the iontophoretic delivery of FOLFIRINOX at different treatment parameters, and evaluating the efficacy of the iontophoretic delivery of FOLFIRINOX in state-of-the-art mouse models for pancreatic cancer. This device therapy has potential paradigm shifting implications for the treatment of pancreatic cancer.

Qi Yang

University of North Carolina at Chapel Hill
“Engineering Immune-Inert Nanoparticles for Targeted Cancer Therapy”



Qi Yang

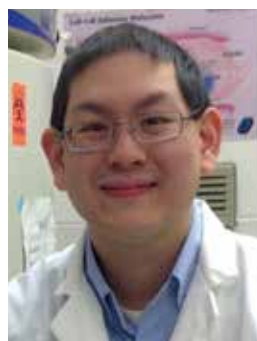
Polyethylene glycol (PEG) coatings are routinely used to minimize the interaction of nanoparticles with biological environments, particularly with that of the mononuclear phagocyte system, allowing the nanoparticles to avoid clearance and persist in the systemic and/or lymphatic circulation. However, due to technical hurdles in quantifying the extent of PEG grafting and in generating dense PEG

coatings, few studies have rigorously explored the precise PEG grafting density necessary to achieve these desirable “stealth” properties. Similarly, nanoparticle targeting of cancer cells typically relies on the presence of ligands conjugated onto the nanoparticle surface, but the effects of ligand density on target cell uptake and non-specific cell uptake remain poorly understood. This project aims to engineer nanoparticles that are able to optimally bind to target cells while avoiding immune cell uptake, enabling the effective targeted delivery of diagnostic and therapeutic agents to cancer cells. A model nanoparticle with precisely tunable surface chemistry will be modified with PEG of varying density and molecular weight and with varying amounts of small molecule targeting ligands specific for B cell lymphomas. The effect of the PEG coating and ligand density conditions on clearance by phagocytic cells and on uptake by target lymphoma cells will be evaluated both *in vitro* and *in vivo*. The results of these studies will provide valuable quantitative insights into the interaction of targeted, PEGylated nanoparticles with biological environments.

Bryant Yung

The Ohio State University
“Small Peptide Lipid Nanoparticles for the Delivery of Anti-miRNA in Breast Cancer”

RNA interference (RNAi) is an emerging therapeutic modality for cancer, but is limited due to critical barriers in safety, efficacy, and delivery. Viral and nonviral vectors have been developed to overcome these challenges, but have been met with limited success. Viral vectors are efficient delivery vehicles, but trigger unwanted cytotoxicity and immunogenicity. Nonviral vectors are less toxic,



Bryant Yung

but do not yield high transfection efficiencies. Striking a balance between safety and efficacy is essential to promoting RNAi as a therapy. To this end, a novel delivery vehicle, small peptide lipid nanoparticles containing gramicidin (SPLN-G) have recently been developed by our laboratory to overcome barriers in delivery. Gramicidin, when combined with lipids at appropriate concentration is a potent promoter of transfection. SPLN-G has shown superior transfection activity relative to traditional cationic liposomes and commercially available transfection agents, however, the mechanism of action is not well understood. Physical characterization of SPLN-G in conjunction with *in vitro* and *in vivo* testing will allow for optimization of the formulation and a better understanding of the underlying pathways of activity. MicroRNA (miR) mimics are short nucleotide chains that inhibit gene expression through translational suppression of a messenger RNA (mRNA) target. miR-221 has been reported to be a critical factor in the progression of triple negative breast cancer (TNBC). TNBC is resistant to hormonal therapies due to the lack of targetable receptors on the cell surface. Recent findings have reported miR inhibitor, anti-miR-221 (AM-221), as a viable option for targeting and suppressing the activity of miR-221. AM-221 induces estrogen receptor α (ER α) expression in TNBC cell lines, thereby facilitating a strategy for sensitization to chemotherapeutics targeting ER α -positive cells such as tamoxifen. Combination of SPLN-G with AM-221 (SPLN-G/AM-221) and co-administration with tamoxifen may open new doors for the treatment of TNBC.

Sharadvi Thati

University of Kansas
“Soluble Antigen Arrays (SAGAs) Mitigate Experimental Autoimmune Encephalomyelitis (EAE)”



Sharadvi Thati

Multiple sclerosis (MS) is an autoimmune disorder that attacks the myelin sheath of neurons. Soluble Antigen Arrays (SAGA) are composed of a hyaluronic acid backbone, with grafted LABL (an ICAM-1 ligand) and grafted PLP (proteolipid protein). PLP is a part of the protein that makes up the myelin sheath and is an auto-antigen in MS. SAGA have

been effective in the mouse experimental autoimmune encephalomyelitis (EAE) model. Different routes of administration and dosing schedules showed little to no difference in disease outcomes. Results suggested a single subcutaneous dose approaches the clinical efficacy of three doses (200 nMol PLP). Decreasing the injection volume from 100 uL to 20 uL slightly reduced efficacy. According to R. O. Weller, et al., MS is initially thought to

be a systemic disease, but in later stages, is localized in the lymph nodes in the superior half of the body. Since hyaluronic acid can be varied in size, SAgA can be designed to drain to local lymph nodes after a subcutaneous injection. The next steps will be to correlate the size of the SAgA, densities of peptides, and ratio of the two peptides (LABL:PLP) to compare local (i.e. lymph node) versus systemic administration (i.e. absorption into blood).

Research Starter Grant in Pharmaceuticals

A grant can do more than facilitate research. It can also motivate scientists who have no other viable funding sources and lay the groundwork for successful academic careers. The Research Starter Grant in Pharmaceuticals supports scientists who are beginning their academic research careers at the faculty level, and ensures the promising work of these researchers continues.

“This prestigious award significantly increased interest in my work among researchers in academic and industrial environments and helped me establish productive collaborations in the field of nanomedicine. Moreover, the PhRMA Foundation award increased my reputation as a young professor among students and helped me recruit talented and research-oriented scholars to work in my laboratory. It allowed me to achieve my initial research goals, publish my first independent papers, and collect the important preliminary data to strengthen my applications for major funding sources. Thank you so much, PhRMA Foundation! ”

—OLEH TARATULA, Ph.D., OREGON STATE UNIVERSITY, 2012 RESEARCH STARTER GRANT IN PHARMACEUTICS RECIPIENT

2013 Research Starter Grants in Pharmaceuticals

Christopher Jewell, Ph.D.

University of Maryland

“Lymph Node Delivery of Immunomodulatory Biomaterial Depots for Therapeutic Vaccination”



Christopher Jewell, Ph.D.

Vaccines have generated one of the largest impacts on human health in history, but a fundamental challenge now facing the field is how to meet the rising need for vaccines that allow control over the specific nature of immune response. The idea of tuning response is termed “immunomodulation”. The research funded under this award is based on direct lymph node delivery of biomaterial vaccine depots that control the local release of vaccine components in lymph nodes.

Lymph nodes are the immunological “command centers” that coordinate immune response, and the ability to control the concentrations and kinetics of antigens and drugs in these tissues could dramatically improve the generation of immune responses tailored for specific diseases. One strategy that would particularly benefit from this approach is therapeutic vaccination for patients with cancer or autoimmune disorders. Therapeutic vaccines are in contrast to traditional preventative vaccines which protect healthy individuals. The initial studies for this project demonstrate that lymph node deposition of vaccine depots loaded with antigen and different combinations of small molecule drugs can be used to generate immune populations with either immunostimulatory or regulatory abilities. One research aim will test if depots loaded with a self-antigen (myelin) linked to multiple sclerosis (MS) can be used to combat disease in a mouse model of MS by generating self-antigen specific regulatory T cells that control inflammation and autoimmune reactions. A parallel aim will test if depots loaded with tumor associated antigens and small molecules known to induce central memory T cells can contribute to breaking tumor tolerance during mouse challenge studies. The

unique strategy of directly controlling the lymph node microenvironment with controlled release depots could ultimately lead to new therapeutic vaccines that generate tolerizing immune responses for autoimmune disorders or

potent immune responses for cancer immunotherapy, depending on the dose and combination of drugs loaded in the vaccine depots.

Clinical Pharmacology

Paul Calabresi Medical Student Fellowship

Named in honor of Dr. Paul Calabresi, who served the PhRMA Foundation as committee chairman and member for 25 years, the Paul Calabresi Medical Student Fellowship gives students an opportunity to spend up to two full years conducting an investigative project in pharmacology. By engaging scientists involved in important research projects at a point when their professional interests may lead them in different directions, the program aims to pave the path for research and teaching careers in clinical pharmacology.

“The research performed under this award was motivated by my interest in therapeutic strategies for psychiatric disorders. The Fellowship [provided] resources to forge a new collaboration between the departments of pharmacology, chemistry, structural biology, and computational biology in order to design new drugs targeting receptors that play an important role in the glutamate hypothesis for schizophrenia. The funding provided money that may not have been otherwise available for lab materials that enabled testing of predictions made by my computational models. This research has increased my knowledge and skills in computation and experimental methods, taught me how to form fruitful collaborations across fields of study, and provided leadership opportunities in directing the progress of this project.”—ELIZABETH NGUYEN

DONG, VANDERBILT UNIVERSITY, 2011 PAUL CALABRESI MEDICAL STUDENT FELLOWSHIP RECIPIENT

2013 Paul Calabresi Medical Student Fellowships

Maria Boboila

Weill Cornell Medical College

“Mitoprotective Agent SS-31 as a Potential Treatment for Neuropsychiatric Disorders”



Maria Boboila

Autism spectrum disorders and schizophrenia are highly prevalent neuropsychiatric disorders which share many common features. However, to date, treatment strategies remain largely ineffective. Mitochondrial dysfunction and increased oxidative stress in neurons has been suggested to play a role in both autism and schizophrenia. Proper

functioning of mitochondria is needed to generate the high levels of energy that neurons require, and mitochondrial dysfunction can lead to impaired neuronal function, which may contribute to the symptoms seen in autistic and schizophrenic patients. The goal of the research is to test the hypothesis that improving mitochondrial function will alleviate the aberrant behaviors seen in both autism and schizophrenia. A genetic mutant mouse model of autism, in which the mutated gene *cacna1c* (coding for the Cav1.2 calcium channel subunit) results in autistic-like behaviors such as increased anxiety and decreased sociability, will be used to evaluate whether a novel mitoprotective agent called SS-31 can improve abnormal autism- and schizophrenia-related behaviors. The effects of SS-31 at the cellular level will also be examined, to determine whether improved mitochondrial function can rescue a defect that has been identified in the survival of newborn neurons in the hippocampus of adult Cav1.2 mutant mice, a mechanism in the brain believed to regulate emotional behavior. Finally, this project is interested in the effect of

boosting mitochondrial activity on the survival and function of a subset of neurons in the brain, the parvalbumin-expressing fast-spiking GABAergic interneurons, which have been strongly implicated in autism and schizophrenia. The overall goal of the project is to explore new therapeutic strategies for patients suffering from neuropsychiatric disorders such as autism and schizophrenia.

Isha Gupta

University of Utah School of Medicine

“Defining the mechanism of COMP-Angiopoietin-1 activity in the diabetic retina”

Diabetic retinopathy (DR) is the leading cause of blindness in the working-age population and its prevalence is projected to increase 50% by 2030. Currently, the treatments for DR do not target the underlying hyperpermeability or ischemia found in DR, and are only indicated in the advanced stages of the disease where visual acuity may be irreversibly lost. Hyperglycemia-induced loss of retinal endothelial cells due to vascular dysfunction is



Isha Gupta

a primary pathophysiologic mechanism of DR. During prolonged hyperglycemia, blood vessels become hyperpermeable, inducing inflammatory cytokine production and leukocyte adhesion resulting in retinal inflammation, hypoxia and endothelial cell apoptosis. A key pericyte-derived trophic signal that is lost in DR is Angiopoietin-1 (Ang1), which has been shown to promote vascular maturation and

quiescence by binding the endothelial surface receptor Tie2. In our preliminary data, this project has found that COMP-Ang1, a soluble Ang1 analogue, normalizes the retinal vasculature in diabetes. The proposed studies will test constitutive retinal expression of COMP-Ang1 and its ability to prevent endothelial apoptosis and inflammation in the diabetic retina.

Faculty Development Award in Clinical Pharmacology

Established by the PhRMA Foundation in 1966, the Faculty Development Award in Clinical Pharmacology recognizes the many challenges of drug investigation, particularly those related to ensuring a highly trained and competent workforce. This program stimulates clinical pharmacology teaching, training, and research by providing annual awards to medical schools in support of full-time junior faculty members. The ultimate goal is to maximize the research potential of clinical pharmacologists during the years immediately following formal training programs.

“The PhRMA Foundation Faculty Development Award provided me with the resources necessary to secure professional time devoted entirely to research and other scholarly activities. It also allowed me to establish new collaboration with senior investigators in my field and obtain additional expertise to foster a translational approach to my current research. This award has contributed tremendously toward my development as an independent investigator.”—CYNDYA A. SHIBAO, M.D., VANDERBILT UNIVERSITY, 2012 FACULTY DEVELOPMENT AWARD IN CLINICAL PHARMACOLOGY RECIPIENT

“This award was granted to me just as I was starting my first faculty position. The funds that supported my salary ensured I had sufficient protected time to devote to the development of my research program. The data that were generated during this award period allowed me to secure additional funding from sources such as the National Institutes of Health and American Society of Hematology, thus establishing myself as an independent investigator. It has been very gratifying to know I have the support of some of this country’s most distinguished clinical pharmacologists. It is becoming increasingly challenging to secure funding for one’s research in these difficult financial times and I cannot emphasize enough how significant a role programs such as the PhRMA Foundation Faculty Development Award in Clinical Pharmacology play in an individual’s career.”

—SARAH A. HOLSTEIN, M.D., Ph.D., UNIVERSITY OF IOWA, 2010 FACULTY DEVELOPMENT AWARD IN CLINICAL PHARMACOLOGY RECIPIENT

2013 Faculty Development Award in Clinical Pharmacology

Sara Lynn Van Driest, M.D., Ph.D.

Vanderbilt University

“Pharmacogenomics of Fentanyl and Dexmedetomidine in Children”



Sara Lynn Van Driest,
M.D., Ph.D.

Despite advances in pharmacogenomics, there is little data derived from children to guide pediatric clinicians. In this vulnerable population, drug response variability leads to treatment failures and adverse events. Fentanyl and dexmedetomidine (DM), both used in the pediatric inpatients, show wide inter-individual variability. Understanding the molecular etiologies for variability can

enable personalized dosing. The project aims are to test the hypothesis that in children treated with fentanyl and/or DM, genetic variants in genes encoding known drug transporters and metabolic enzymes are associated with variable drug concentrations and test the hypothesis that variation in candidate genes regulating drug response are associated with atypical response to fentanyl and/or DM in children.

Methods used will be drug concentrations will be measured in remnant serum samples from pediatric cardiac surgery patients using a novel, high-throughput, LC-MS/MS assay, and individuals will be characterized with respect to pharmacokinetics. Candidate genes in drug disposition and response pathways will be genotyped for tests of association. This research will develop clinically implementable, evidence-based prediction models for two frequently used medications in inpatient pediatrics. The broader vision is to develop a generalizable approach to integrate drug concentrations from remnant blood with genomics and informatics to optimize drug therapy for the full spectrum of pediatric therapeutics.

Translational Medicine and Therapeutics

Post Doctoral Fellowship in Translational Medicine and Therapeutics

The PhRMA Foundation Post Doctoral Program in Translational Medicine and Therapeutics provides stipend support for individuals engaged in multidisciplinary/collaborative research training programs that will create or extend their credentials in this evolving area. The intent of this program is to support postdoctoral career development activities of individuals preparing to engage in research that will bridge the gap between discoveries using experimental and computational technologies and in the research laboratory and their application in clinical research and the clinic. A key component of postdoctoral training in this area involves collaborative programs that span the non-clinical and clinical domains, potentially involving multiple laboratories, advisers and/or institutions. The post-doctoral award consists of a \$60,000 annual stipend for up to two years. The second year of this award is contingent upon a progress report approved by the Foundation and submission of a financial report. The award is intended solely as a stipend and may not be used otherwise. The first Translational Medicine and Therapeutics awards were awarded in 2013.

“The PhRMA Foundation Postdoctoral Fellowship in Translational Medicine and Therapeutics has provided me with the resources and protected time I need to focus all of my research efforts on better understanding the genetic architecture of Alzheimer’s disease. It has enabled me to build collaborations with outstanding researchers in the field and establish a strong foundation from which I will be fully prepared to transition into an independent research position.”—TIMOTHY J HOHMAN, PhD, VANDERBILT UNIVERSITY MEDICAL CENTER, 2013 POST DOCTORAL FELLOWSHIP IN TRANSLATIONAL MEDICINE AND THERAPEUTICS RECIPIENT

2013 Post Doctoral Fellowships in Translational Medicine and Therapeutics

Stefanie Sowinski, Ph.D.

The J. David Gladstone Institutes
“Investigating How CD4 T Cells Die in HIV-1 Infected Patients”



Stefanie Sowinski, Ph.D.

This study seeks to understand a fundamental problem in HIV/AIDS, namely how the virus causes the progressive depletion of CD4 T cells. Despite 25 years of study, the precise mechanisms underlying the demise of CD4 T cells during HIV-1 infection remains poorly understood. Previously, it was found that a death pathway called pyroptosis is activated in

resting CD4 T cells from lymphoid tissues that are abortively infected with the virus. Pyroptosis is an intensely inflammatory form of programmed cell death. This cell death pathway, originally designed to protect the host, spins out of control when more CD4 T cells are attracted to the zone of inflammation where they undergo repeated rounds of abortive infection, CD4 T cell death and inflammation. This study will test whether the same death pathway also occurs in HIV infected people. If this assumption is confirmed, inhibitors of this death pathway, which are already in the clinic, could be repurposed preserving CD4 T cells and inhibiting inflammation thereby blocking HIV-induced disease progression. This novel therapy could form a bridge therapy for the millions of people who cannot yet access antiretroviral therapy or alternatively be used in conjunction with antiviral therapy. These inhibitors might be particularly valuable in patients who have failed multiple antiviral drug regimens or who display rapidly progressive disease.

Tarsheen Sethi, MBBS, M.D.

University of Louisville

“Tumor Associated Macrophage Imaging using Ferumoxytol-Enhanced MRI in Pediatric Sarcomas”



Tarsheen Sethi, MBBS, M.D.

The post-treatment 5-year survival rate of pediatric sarcomas is abysmal and has not changed in several years. Thus there is a need for additional prognostic biomarkers as targets for new therapies and improved outcomes. Presence of tumor associated macrophages (TAM) in the stroma of sarcomas is associated with poor prognosis. Moreover, TAMs are a potential target for immunotherapy and

novel TAM-targeted anti-inflammatory drugs are being developed. The goal of this project is to develop and implement an immediately available imaging test for selective detection and quantification of TAM in pediatric sarcomas. The project will propose to use a FDA-approved iron oxide nanoparticle compound ferumoxytol (Feraheme™), which is phagocytosed by TAM and can be detected with MR imaging. The overall hypothesis is that ferumoxytol selectively detects presence of TAM and that the degree of nanoparticle-induced tumor enhancement on MR images correlates with tumor grade on histopathology. If successful, our new TAM imaging test will help individualize therapeutic options based on tumor aggressiveness, develop and monitor new anti-inflammatory therapies and ultimately, improve long term outcomes.

Timothy Hohman, Ph.D.

Vanderbilt University Medical Center

“Epistatic Genetic Risk Factors and Neuroimaging Biomarkers of Alzheimer’s Disease”



Timothy Hohman, Ph.D.

Alzheimer’s Disease (AD) is a debilitating neurodegenerative disease with two distinct pathologic features: beta-amyloid plaques and neurofibrillary tau tangles. Ongoing research on biomarkers of AD has led to well validated *in vivo* measures of amyloid deposition using a variety of novel techniques. These measurements provide an opportunity to identify genetic factors that are related to clinical outcomes in individuals

currently harboring AD pathology. The project goal is to identify genetic markers that confer risk and resilience to amyloid plaques, and to the downstream neurodegenerative cascade in response to this damaging neuropathology. The project will accomplish this goal using data from the Alzheimer’s Disease Neuroimaging Initiative. First, the study will look at genetic interactions that predict amyloid pathology. Next, it will identify genes related to disease progression in individuals with amyloid pathology. Finally, the project will identify genetic markers of disease progression in a population at high risk for amyloid pathology (Down Syndrome). These three complimentary approaches will highlight genetic variants that predict resilience from the amyloid cascade, and ultimately result in novel targets for clinical intervention aimed at activating innate compensatory mechanisms that might stave off the clinical manifestation of AD.

Research Starter Grant in Translational Medicine and Therapeutics

The purpose of the PhRMA Foundation Research Starter Grant is to offer financial support to individuals beginning their independent research careers at the faculty level. The program provides a research grant of \$100,000 for one year. The program is not offered as a means to augment a significantly funded ongoing research effort. The Research Starter Grant Program in Translational Medicine and Therapeutics aims to support individuals beginning independent research careers in academia or research institutions and where long term training of students and/or scientists is an expected outcome in conjunction with their research. This program focuses on supporting the career development of scientists engaged in bridging research and discoveries using experimental and computational technologies to their application in clinical research and the clinic. The program is not focused on supporting the application of standard technologies to experimental biology or medicine but specifically to explore innovative and collaborative projects that bridge the non-clinical:clinical interface.

“This PhRMA Translational Medicine Starter Grant has provided me with the support necessary to transition my strong basic science research program into the clinical direction, establishing me as a true translational researcher. As a PhD scientist in a clinical department, having received this award will certainly be a boost to my career and will establish solid and productive clinical partnerships, ensuring my future success.” —

MICHELLE E. KIMPLE, Ph.D., UNIVERSITY OF WISCONSIN-MADISON, 2013 RESEARCH STARTER GRANT IN TRANSLATIONAL MEDICINE AND THERAPEUTICS RECIPIENT

2013 Research Starter Grants in Translational Medicine and Therapeutics

Radojka Savic, Ph.D.

University of California, San Francisco

“Systems Pharmacology Translational Platform for Tuberculosis”



Radojka Savic, Ph.D.

Although frequently considered a disease of the past, 1.4 million people die from tuberculosis every year. Combination drug regimens are essential for diseases like tuberculosis, since lack of efficacy is also accompanied by development of resistance. Modeling approaches that integrate disease, pharmacokinetic and pharmacodynamics data are necessary to inform optimal choice of drug combinations,

dosages and regimens for treatment of tuberculosis. Given the complexity of tuberculosis disease, drug treatment and lack of good clinical endpoints, we believe

that a system pharmacology translational platform that integrates *in silico* models of TB disease progression, immune and drug response driven by preclinical and clinical data is ultimately needed to inform TB treatment optimization and drug development. Here we propose to make a first pioneering step towards establishment of such a platform, where we want to establish a link between system biology *in silico* representation of tissue granuloma model with preclinical and clinical pharmacokinetic-pharmacodynamics models. This effort will be driven by large preclinical and clinical databases from 2 distinct TB regimens. We hope to establish an unique platform which will be able to separate between system- and drug- related parameters and will allow us to identify regimens with highest probability of cure.

Michelle Kimple, Ph.D.

University of Wisconsin-Madison

“Validating a Novel Biomarker for Type 2 Diabetes Therapeutic Response”

Type 2 diabetes (T2D) is a costly and complex chronic illness and a serious public health problem. In recent years, T2D has impacted over 8% of the US adult population, with a full 35% of adults being pre-diabetic. T2D is the leading cause of kidney failure, non-traumatic lower limb amputations, and new cases of blindness; a



Michelle Kimple, Ph.D.

major factor in heart disease and stroke; and the seventh leading cause of death. Soberingly, these US trends for diabetes prevalence and impact mirror those observed world-wide. Therefore, developing new methods for identifying and properly treating diabetic individuals is very timely and critically important. Prostaglandin E2 (PGE2) is a well-known mediator of inflammation that has been

previously linked with type 1 diabetes, where the immune system destroys the beta-cells of the pancreas, the body's sole producers of the hormone that controls blood sugar, insulin. PGE2 activates a family of receptors on the beta-cell, some members of which reduce insulin production. Signaling through these PGE2 receptors antagonizes

the effects of signaling through another class of hormone receptors stimulatory towards insulin production. This phenomenon could explain why drugs that target these stimulatory receptors fail in 20-30% of T2D individuals. As PGE2 is produced in many body cells, the levels of PGE2 in the plasma might serve as a convenient biomarker for the actual amount of PGE2 being produced by the beta-cells themselves, predicting whether a T2D patient would respond to certain drug therapies. The goal of this project is to determine whether the levels of PGE2 in diabetic patients' blood correlates with the responsiveness of their diabetes to treatment; in particular, with those drugs that work through the stimulatory receptors mentioned above. Being able to classify an individual as a putative "non-responder" to certain T2D drugs would decrease the amount of time spent on determining what the optimal treatment regimen for this patient would be. Doing so would certainly improve the care, treatment, and healthy lifespan of T2D individuals.

Young Investigator Award in Adherence Improvement Program

Post Doctoral Fellowship in Adherence Improvement

This fellowship provides stipend support for career development activities of individuals prepared to engage in research that is aimed at improving medication adherence. Relevant research goals include the development or evaluation of policies, interventions, or tools that are potentially successful in improving medication adherence. Support is provided for a one-year period to selected individuals who are beginning careers in adherence improvement research and who give promise of outstanding development as researchers. The award consists of a \$50,000 annual stipend.

"The PhRMA Foundation Young Investigator Post-doctoral fellowship award enables me to devote full-time efforts toward improving the quality of treatment for youth with Attention Deficit-Hyperactivity Disorder (ADHD) in community settings. This award has provided me with the opportunity of developing my career in Pharmacoepidemiology and Outcomes Research."—THIYAGU RAJAKANNAN, Ph.D.,

UNIVERSITY OF MARYLAND, 2013 POST DOCTORAL FELLOWSHIP IN ADHERENCE IMPROVEMENT POST DOCTORAL FELLOWSHIP IN ADHERENCE IMPROVEMENT RECIPIENT

2013 Post Doctoral Fellowship in Adherence Improvement

Thiyagu Rajakanna, M.Pharm, Ph.D.

University of Maryland, Baltimore

“Patient-Centered Monitoring Tools for Improving Medication Adherence in Pediatric Attention-Deficit/Hyperactivity Disorder”



Thiyagu Rajakanna,
M.Pharm, Ph.D.

Attention-deficit/hyperactivity disorder (ADHD) is a very common psychiatric disorder that typically begins in childhood. Studies indicate that the benefits of medication treatment for ADHD can be improved if children stay in treatment, but population-based data show significant non-adherence. The goal of this feasibility study is to

assess the role of patient-centered monitoring (PCM) in improving adherence with ADHD medication therapy in community mental healthcare settings. PCM will be implemented by using brief family reports to assess effectiveness and safety from a toolbox of rating forms created by the American Academy of Child and Adolescent Psychiatry (AACAP), which are simple and user friendly. A cohort (N=36) of 7-10 year olds newly diagnosed with ADHD with prescribed medication will be followed prospectively for up to 6 months in community mental health settings in Boston, MA, Brooklyn, NY, Baltimore, MD and Gainesville, FL. Feasibility will be measured in terms of physician/staff satisfaction with the PCM program, 6-month treatment completion rates and outcomes. Adherence will be measured by parent report of symptoms, functioning and adverse drug events as well as in terms of median adherence days. To assess the impact of the intervention on adherence, the study cohort will be compared with matched controls at each site.

Research Starter Grant in Adherence Improvement

The purpose of the PhRMA Foundation Research Starter Grant is to offer financial support to individuals beginning independent research careers in academia who do not have other substantial sources of funding. Relevant research goals include the development or evaluation of policies, interventions, or tools that are potentially successful in improving medication adherence. This program provides a research grant of \$50,000 for one year.

“The funding and support from the PhRMA Foundation has helped my team and I to efficiently address some of the unanswered questions about the comparative effectiveness of medication adherence interventions for cardiovascular disease. This study also provides groundwork for what I hope will be future funded projects to develop approaches to successfully improve adherence to medications.”—TODD RUPPAR, PhD, RN, GCNS-BC, UNIVERSITY OF MISSOURI SINCLAIR SCHOOL OF NURSING, 2013 RESEARCH STARTER GRANT IN ADHERENCE IMPROVEMENT RECIPIENT

2013 Research Starter Grants in Adherence Improvement

Todd Ruppap, Ph.D., RN, GCNS-BC

University of Missouri

“Comparative Effectiveness of Heart Failure Medication Adherence Intervention”



Todd Ruppap, Ph.D. RN

Heart failure leads to diminished quality of life and early mortality, in addition to increased costs and health care utilization to manage symptoms and exacerbations. Improving medication adherence is a key strategy to improve heart failure outcomes, but heart failure patients' adherence to medications remains low. The development of effective adherence interventions is hampered by a lack of comparative effectiveness

research comparing existing adherence interventions. This program of research will use meta-analysis to quantitatively integrate scientific knowledge about medication adherence interventions for heart failure patients, leading to development of effective interventions to test in clinical practice settings to achieve improved clinical outcomes. Meta-analysis is a recognized method for synthesizing and comparing the effectiveness of interventions designed to change the same clinical outcome. Moderator analyses will compare intervention components (e.g., packaging, cues, self-monitoring, dose modification) as well as sample differences such as gender, age, minority status, and disease severity. The findings from this comparative effectiveness research will have an immediate impact on future research and clinical practice by identifying adherence intervention characteristics associated with the best adherence and heart failure outcomes. This study will also identify new unanswered questions for future research on the behavioral management of heart failure.

Mathew Jon Gregoski, Ph.D., MS

Medical University of South Carolina

“Towards Personalized Medicine: Wireless Medication Adherence Among Hypertensive African Americans in the Real-world Setting”



Mathew Jon Gregoski,
Ph.D. MS

Essential hypertension (EH) is a primary risk factor for cerebrovascular, renal, and cardiovascular disease and is a leading cause of mortality (~33.6). Two major factors for uncontrolled EH are medication non-adherence, and clinical inertia (i.e. failure for clinicians to intensify/modify regimens). While case-managers, and reminder strategies have shown to improve BP control, they only reach ~45% of patients during trials and the effects typically only last as long as the trial duration. The 2014 Eighth Joint National Committee notes that African Americans are at highest risk for all complications of hypertension and, despite this risk, are historically undertreated. The purpose of this project is to complete focus groups demonstrating dimensions/features of all currently available medication reminder devices with wireless data transmission among African Americans that have EH and live in the underserved New York City metro area. From focus group patient-preference data we will select the device patients will use for a 12-week medication reminder intervention. We will determine whether currently available medication reminder devices with wireless data transmission have the potential to improve medication adherence and reduce clinical inertia when implemented in real-life environments. If successful, this research could greatly improve our healthcare model; the cost of medication non-adherence among hospitals currently exceeds \$100 billion per year.



The Foundation was honored to present its 2013 awards at our distinguished scientific annual meetings throughout the county.



Our thanks to the following organizations:

The American Association of Pharmaceutical Scientists (AAPS)

San Antonio, Texas presented on November 10, 2013

by Marilyn E. Morris, Ph.D., AAPS President

The American Society for Clinical Pharmacology and Therapeutics (ASCPT)

Indianapolis, Indiana presented on March 6, 2013

by Darrell R. Abernethy, M.D., Ph.D., Chairman of the Clinical Pharmacology Advisory Committee

The American Society for Pharmacology and Experimental Therapeutics (ASPET)

Boston, Massachusetts presented on April 20, 2013

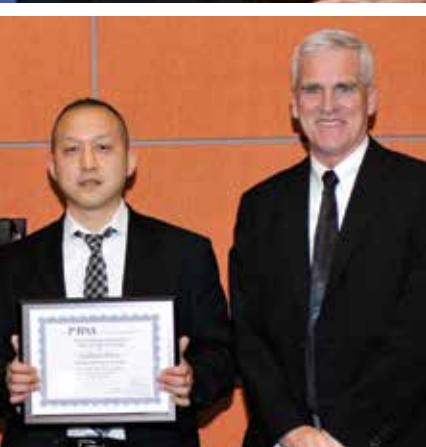
by Terry L. Bowlin, Ph.D., Chairman of the Basic Pharmacology Advisory Committee



The International Society for Pharmacoeconomics and Outcomes Research (ISPOR)

New Orleans, Louisiana presented on May 22, 2013

by Jean Paul Gagnon, Ph.D. Chairman of the Health Outcomes and CER Advisory Committees



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TREASURER'S Report

The PhRMA Foundation ended 2013 in solid financial shape despite another drop in contributions from member companies. Member contributions were \$2.4 million -- down from \$2.5 million in 2012 and \$2.8 million in 2011. These contributions are the sole support for the Foundation's core program of grants and newer strategic partnerships on CER, Translational Science and Safe and Effective Prescribing. Beyond these programs, the Foundation has also implemented programs designed as part of PhRMA's priorities and funded from PhRMA's budget. In 2013 PhRMA contributed \$710,000 for these programs, including Investigators Adherence Improvement and Assessing the Benefit of Treating Cancer. Including the PhRMA-funded programs, total contributions to the Foundation were \$3.1 million in 2013.

We awarded over \$2.53 million in grants, an increase of 11.7% over the previous year. We held down non-grant program and administrative expenses and stayed within budget. Total expenditures were \$3.1 million. Net assets at



December 31 were \$21.3 million, a 15% increase from the prior year. The increase in net assets is attributable to investment earnings of \$2.7 million. Financial details are shown in the accompanying Statement of Income and Expenditures.

On behalf of the Board and staff, I give special thanks for the continuing support of our generous contributors, who are listed in this report. We urge all PhRMA members to become full contributors, so that we may continue the important strategic

initiatives of the Foundation. Our programs represent our industry's commitment to innovation in research, the incorporation of sound science in medical training and practice, and development of the young investigators of tomorrow.

The Foundation's financial position as of December 31, 2013, has been audited by the accounting firm of Tate and Tryon of Washington, D.C. A full report can be obtained by contacting the Foundation.

A handwritten signature in dark ink, appearing to read 'Mikael Dolsten'.

MIKAEL DOLSTEN, M.D., Ph.D.

STATEMENT of Income & Expenditures

INCOME	
Contributions ¹	\$ 3,107,125
Contributions - in kind from PhRMA	\$ 45,962
Interest and Dividends	\$ 439,124
(Realized and Unrealized) Gains in Securities	\$ 2,223,632
Other Income	\$ 76,960
TOTAL INCOME	\$ 5,892,803
EXPENDITURES	
Programs	
Awards in Excellence	\$ 22,500
Adherence Improvement	\$ 157,500
Clinical Pharmacology Program	\$ 237,000
Comparative Effectiveness Program	\$ 333,328
Health Outcomes Program	\$ 347,875
Informatics Program	\$ 325,000
Pharmaceutics Program	\$ 310,000
Pharmacology Programs	\$ 595,000
Translational Medicine and Therapeutics	\$ 125,000
AFPE Fellowship Award	\$ 7,500
Other Grants	\$ 69,808
Subtotal – Grants	\$ 2,530,511
Other	
Committee Meetings, Travel and Honoraria	\$ 120,106
Publications and Special Projects	\$ 22,585
Subtotal – Other	\$ 142,691
PROGRAM TOTAL	\$ 2,673,202
Administrative	
Staff, Taxes, Depreciation & Insurance	\$ 333,716
Rent & PhRMA Accounting Services ²	\$ 45,962
Professional Services and Investment Expenses	\$ 65,972
Office Expenses	\$ 3,602
Subtotal – Administrative	\$ 449,252
TOTAL EXPENDITURES	\$3,122,454

¹Includes contributions from PhRMA for Adherence Program

²Rent and Accounting Services are donated by PhRMA

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(CTI)
Pfizer Inc.
Boston, Massachusetts

PhRMA Foundation Programs for 2014

Number of Awards Name of Program/ Year of First Awards	Budgeted Yearly/ Length of Award	Program Budget	Deadline Announcement Date Starting Time
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Adherence Improvement

Pre Doctoral Fellowships in Adherence Improvement (2013)	2 awarded/ 1 year	\$50,000 total \$25,000 per award per year	October 1, 2013 December 15, 2013 January 1, 2014
Post Doctoral Fellowship in Adherence Improvement (2013)	1 awarded/ 1 year	\$50,000 total \$50,000 per award per year	October 1, 2013 December 15, 2013 January 1, 2014
Research Starter Grants in Adherence Improvement (2013)	1 awarded/ 1 year	\$50,000 total \$50,000 per award per year	October 1, 2013 December 15, 2013 January 1, 2014

Basic Pharmacology Advisory Committee

Pre Doctoral Fellowships in Pharmacology/Toxicology (1978)	9 awarded/ up to 2 years	\$340,000 total \$20,000 per award per year	September 1, 2013 December 15, 2013 January–August
Post Doctoral Fellowship in Pharmacology/Toxicology (2002)	2 awarded/ 2 years	\$160,000 total \$40,000 per award per year	September 1, 2013 December 15, 2013 July–December
Sabbatical Fellowship in Pharmacology/Toxicology (2002)	0 awarded/ 1 year	\$0 total \$40,000 per award per year	September 1, 2013 December 15, 2013 January–December
Research Starter Grants in Pharmacology/Toxicology (1972)	2 awarded/ 1 year	\$200,000 total \$100,000 per award per year	September 1, 2013 December 15, 2013 January 1, 2014

continued on page 50

ETHICAL CONSIDERATIONS: The Scientific Advisory Committee as well as the program advisory committees of the PhRMA Foundation are dedicated to ensuring the appropriate use of animals and humans in research. In their deliberations, they consider all aspects of a proposal and may deny support for many reasons. Careful consideration is given to ensure the humane use and care of animal subjects. For human and animal research, the project review committee requires, in writing, a statement of adherence to prevailing standards of ethical research practices. Institutional Review Board approval is required before any research project may be initiated. In addition, informed consent is required before any person can participate in a research project.

Programs for 2014, continued

Number of Awards Name of Program/ Year of First Awards	Budgeted Yearly/ Length of Award	Program Budget	Deadline Announcement Date Starting Time
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Clinical Pharmacology Advisory Committee

Paul Calabresi Medical Student Research Fellowships (1974)	2 awarded/ 6 months up to 2 years	\$36,000 total \$18,000 per award	February 1, 2014 April 15, 2014 July 1, 2014
Faculty Development Award in Clinical Pharmacology (1966)	1 awarded/ 2 years	\$240,000 total \$120,000 per award	February 1, 2014 April 15, 2014

Comparative Effectiveness Advisory Committee

Center of Excellence Award	1 awarded 3 years	\$250,000 total \$83,333 per award per year	September 15, 2013 December 15, 2013 January 1, 2014
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Health Outcomes Advisory Committee

Pre Doctoral Fellowships in Health Outcomes (2002)	2 awarded/ 1 - 2 years	\$100,000 total \$25,000 per award per year	February 1, 2014 April 15, 2014 July–December
Post Doctoral Fellowship in Health Outcomes (2002)	1 awarded/ 2 years	\$110,000 total \$55,000 per award per year	February 1, 2014 April 15, 2014 July–December
Research Starter Grants in Health Outcomes (2002)	2 awarded/ 1 year	\$200,000 total \$100,000 per award per year	February 1, 2014 April 15, 2014 July 1, 2014

Informatics Advisory Committee

Pre Doctoral Fellowships in Informatics (2009)	1 awarded/ 2 years	\$40 000 total \$20,000 per award per year	September 1, 2013 December 15, 2013 January–August
Post Doctoral Fellowships in Informatics (2002)	3 awarded/ 2 years	\$240,000 total \$40,000 per award per year	September 1, 2013 December 15, 2013 January–December

Number of Awards	Name of Program/ Year of First Awards	Budgeted Yearly/ Length of Award	Program Budget	Deadline Announcement Date Starting Time
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Informatics, continued

Research Starter Grants in Informatics (2002)	2 awarded/ 1 year	\$200,000 total \$100,000 per award per year	September 1, 2013 December 15, 2013 January 1, 2014
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Pharmaceutics Advisory Committee

Pre Doctoral Fellowships in Pharmaceutics (1987)	3 awarded/ 2 years	\$120,000 total \$20,000 per award per year	September 1, 2013 December 15, 2013 January–August
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Post Doctoral Fellowships in Pharmaceutics	1 awarded 2 years	\$80,000 total \$40,000 per award per year	September 1, 2013 December 15, 2013 January–December
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Sabbatical Fellowship in Pharmaceutics (2002)	1 awarded/ 1 year	\$40,000 total \$40,000 per award per year	September 1, 2013 December 15, 2013 January–December
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Research Starter Grants in Pharmaceutics (1972)	2 awarded/ 1 year	\$200,000 total \$100,000 per award per year	September 1, 2013 December 15, 2013 January 1, 2014
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Translational Medicine Advisory Committee

Post Doctoral Fellowships in Translational Medicine (2013)	2 awarded/ 2 years	\$240,000 total \$60,000 per award per year	February 1, 2014 April 15, 2014 July–December
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Research Starter Grants in Translational Medicine (2013)	3 awarded/ 1 year	\$300,000 total \$100,000 per award per year	February 1, 2014 April 15, 2014 July–December
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All of the above programs will accept applications for research on drugs for rare diseases

PhRMA Foundation Staff



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