

Indispensable News MinneCeutics

University of Minnesota

Fall 2014

Department of Pharmaceutics

Dear Friends,

It is a pleasure for me to greet you again this year. The department remains active in all facets of the academic mission, including our teaching, service and of course, our scholarly and research efforts.

We have been an integral part of the College's efforts to revise the professional program curriculum, incorporating our innovative teaching techniques and our dedication to the fundamentals of pharmaceutical sciences. The new Pharm.D. curriculum is almost in full swing, with both the first- and second-year students getting significantly revised courses from the department. As part of the new initiative in teaching, the College has created discipline-related teaching assistant (TA) groups. These TA pools should allow the assignment of an appropriately skilled graduate student to specific courses across the new curriculum. This effort will be carefully evaluated and improved upon over the next few years. Pharmaceutics courses continue to rely on the support of the talented pharmaceutics graduate students to help with our teaching.



Our scholarly activity and research continues to be at the leading edge of innovation. The department, although relatively small in faculty number, leads the College in various per capita funding metrics that are important measures of research success. Another critical measure of success is the placement of our students and the number of national awards they routinely win, as exemplified by fellowships, and awards from the AAPS (see student section in this newsletter). Three of our students won University-wide dissertation fellowships, an unprecedented accomplishment for a College of Pharmacy program. Our students are highly recruited, especially by the pharmaceutical industry, and have been very successful upon graduation. We firmly believe this is in part due to the rigorous graduate program in pharmaceutics we maintain at Minnesota.

We are saddened by the loss of our longtime friend and colleague, Professor Yueh-Erh (Jady) Rahman. Dr. Rahman passed away peacefully on September 16, 2014 and will be remembered for many things, including her many years as a successful researcher and department head of pharmaceutics.

I personally would like to thank all of you, our friends and alumni, who have supported our graduate student fellowships and initiatives, and helped the department in many ways by being strong ambassadors of good will and through helping us with your time and talent. This has been both a rewarding and challenging year. Best wishes to all for a safe and productive year ahead.

With kind regards,

William F. Elmquist, Pharm.D., Ph.D.

Professor and Head, Dept. of Pharmaceutics

PHARMACEUTICS FACULTY — William F. Elmquist, Carolyn A. Fairbanks, Karunya K. Kandimalla, Jayanth Panyam, Swayam Prabha, Ronald J. Sawchuk (Emeritus), Henning Schroeder, Ronald A. Siegel, Changquan Calvin Sun, Raj G. Suryanarayanan, Timothy S. Wiedmann, Cheryl L. Zimmerman

AFFILIATE FACULTY — Walid M. Awni, AbbVie. Richard C. Brundage, Dept. of Experimental and Clinical Pharmacology, University of Minnesota. Lester R. Drewes, Dept. of Biochemistry and Molecular Biology, University of Minnesota-Duluth. Michael D. Karol, Synta Pharmaceuticals. David A. Largaespada, Dept. of Genetics, Cell Biology and Development, University of Minnesota. Z. Jane Li, Boehringer Ingelheim Pharmaceuticals, Inc. Theresa M. Reineke, Dept. of Chemistry, University of Minnesota. Jann N. Sarkaria, Dept. of Radiation Oncology, Mayo Clinic. Evgenyi Y. Shalaev, Allergan, Inc. Chun Wang, Dept. of Biomedical Engineering, University of Minnesota. Joseph A. Zasadzinski, Dept. of Chemical Engineering and Materials Science, University of Minnesota.

Alekha Dash, Ph.D. [1990], professor and chair at Creighton University's School of Pharmacy, was appointed as the associate dean for research for the School beginning October 1, 2014.

Purnanand D. Sarma, Ph.D. [1993], President & CEO of TARIS Biomedical of Lexington, MA, announced that Allergan had acquired the rights to TARIS's LiRIS(R). LiRIS(R) is currently in Phase 2 trials for the treatment of interstitial cystitis/bladder pain syndrome. TARIS developed the proprietary technology for continuous delivery of lidocaine to the bladder over an extended period to relieve painful and often debilitating symptoms. TARIS is a clinical-stage specialty pharmaceutical company focused on developing a pipeline of innovative treatments for bladder diseases.

Richard C. Brundage, Ph.D. [1996] was selected as a Fellow of the International Society of Pharmacometrics.

Alex Yuandong Gu, Ph.D. [2003] has moved to Singapore where he is the director of the Institute of Microelectronics at ASTAR (Agency for Science, Technology and Research). His Energy Harvester Team was awarded the 2014 "Prestigious Engineering Achievement Award" from the Institution of Engineers, Singapore. Alex is also an adjunct associate professor in the Electrical and Computer Engineering Department of the National University of Singapore.

Nagdeep Giri, Ph.D. [2008] and wife Marta welcomed their first child, son Johan Arav, on March 31, 2014.

According to our records, several Pharmaceutics alumni earned both Masters and Ph.D. degrees in Pharmaceutics at the U of M:

- ★ **Morris D. Faiman**, M.S. 1961, Ph.D. 1965
- ★ **Sue-Chih Hsieh Lee**, M.S. 1982, Ph.D. 1982
- ★ **Zhihong Li**, M.S. 2003, Ph.D. 2007
- ★ **Kuchibotla Suryanarayana Murthy**, M.S. 1966, Ph.D. 1968
- ★ **Maturu Krishna Pramoda**, M.S. 1966, Ph.D. 1969
- ★ **Lilian Esmat Riad**, M.S. 1985, Ph.D. 1989
- ★ **Hsueh-Ling Shelley Su Wu**, M.S. 1983, Ph.D. 1986

Isha Koonar, Ph.D. [2014] recently accepted a position at GlaxoSmithKline near Philadelphia. She and Dr. Prakarsh Singh were married last December in Chandigarh, India.

Khushboo Kothari, Ph.D. [2014] accepted a position as a formulation scientist at Takeda Pharmaceuticals in Boston, MA.

Tanmoy Sadhukha, Ph.D. [2013], and his family welcomed the arrival of a second daughter, Keeva, in 2014. Tanmoy received an honorable mention for the 2014 Best Dissertation Award at the University of Minnesota. He is currently a postdoctoral associate in Dr. Swayam Prabha's research group.

Dear Alumni and Friends,

Remember your graduate school days? The lab, exams, Dinkytown, The Big Ten, The Improper Fraction, Appleby Hall, snowstorms, summers and traditions with your grad school friends?

We want to build a history of Pharmaceutics students, especially the early M.S. and Ph.D. graduates, before the stories are gone. We will print your story in the next newsletter. If you will include a photo of a place in and around the U of M campus we will match it with a current photo.

Send your story and photo to mcder002@umn.edu or mail to: Dept. of Pharmaceutics, University of Minnesota, 308 Harvard Street SE, Room 9-177 WDH, Minneapolis, MN 55455.

We look forward to hearing from you!



From the Director of Graduate Studies

Dear Alumni, Students, Colleagues and Friends,

As you know, our program contains faculty who are rising stars. At the same time, several of the faculty are old and we may be even older than we look! Thus, in the coming decade you can expect a changing of the guard. As a prelude to this transition, we have begun to re-shape our graduate program for the future. In this process, we have been mindful of the foundation on which student learning was achieved, which, when coupled with their hard work, has yielded many distinguished alumni. However, the world continues to change rapidly and we cannot believe that the approaches of the past will remain cutting edge any more than lectures delivered with a piece of chalk on a blackboard.

Integration of physical pharmacy and pharmacokinetics for the development and optimization of drug delivery will remain the cornerstone of pharmaceuticals. Nevertheless, we want to improve the facility of students to identify, master and apply fundamental concepts in conducting research. Moreover, it has become rare to access a textbook for information because we rely on the internet and our ability to critically evaluate the available plethora of information. For these primary reasons, we have made significant changes in our coursework requirements and the Preliminary Written Exam.

I, and probably many alumni, view coursework as the most valued experience of graduate school. We can readily recall an effective professor laying out the key theme that embodies the subject. However, we must also recall the inefficiency and maybe frustration in sitting through the many hours of a class while awaiting critical content. In our present careers, we no longer attend classes unless they're sufficiently compact (i.e., a short course), but rely instead on 45-minute plenary lectures at meetings to glean the essence of a subject. To reflect this paradigm, our program no longer requires physical chemistry, statistics, or pharmacokinetics in 13 credits of classes, but instead have introduced four required "modules". These are a focused series of presentations given by our faculty that efficiently deliver (equivalent to 4 credits) the foundation of pharmaceuticals embodied in the subject areas of physical pharmacy, pharmacokinetics, mathematics and statistics, and drug delivery. It then becomes the responsibility of the student to understand the concepts and demonstrate competency in a final exam at the conclusion of each module.

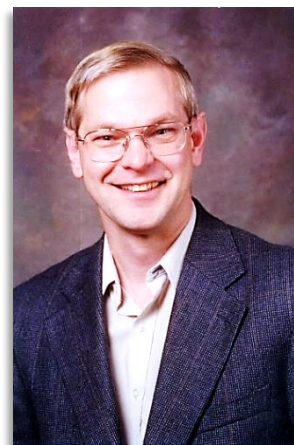
While subject mastery in pharmaceuticals is essential, it remains as yet another step in the ability to use foundation concepts to advance science. This form of higher-order learning is difficult to achieve in lecture-based classrooms and written exams. It is better approached through group meetings, seminars, readings and, importantly, the Preliminary Written and Oral Examinations. Because we are satisfied that the use of modules will ensure subject mastery, we have converted the Preliminary Written Examination into a research proposal. In this exercise, the student is expected to develop a written research hypothesis or objective and use higher-order thinking to (1) identify the underlying concepts, (2) master the concepts if needed, (3) lay out a sound, logical sequence of studies that will allow testing of the hypothesis, and (4) provide a clear, unequivocal approach to data interpretation leading to conclusions that advance science. The faculty on a student's thesis committee will challenge the student to assess their acquisition of advanced learning. Because of the demanding nature of this undertaking, we have limited the requirements of "other coursework" to just 8 credits fulfilled by no less than three courses.

As we embark on this new venture, we would be very interested in hearing the opinions of our alumni. Do attend the breakfast in San Diego and let us know what you think.

With kind regards,

Timothy S. Wiedmann, Ph.D.

Professor and Director of Graduate Studies



Degrees Earned

Karen Grinnen, M.S. [2014] Thesis: *Effect of a Novel Polymer Vaccine on the Anti-Tumor Immune Response and Survival in a Mouse Model of Glioma*. Advisor: Prof. Timothy Wiedmann

Isha Koonar, Ph.D. [2014] Thesis: *Hydrogels Based on Dual Responsive Triblock Polymers*. Advisor: Prof. Ronald Siegel

Khushboo Kothari, Ph.D. [2014] Thesis: *The Role of Molecular Mobility and Hydrogen Bonding Interactions on the Physical Stability of Amorphous Pharmaceuticals*. Advisor: Prof. Raj Suryanarayanan

Lin Niu, Ph.D. [2014] Thesis: *Formulation and Delivery of Polymeric Nanoparticle-Assisted Vaccine Against Melanoma*. Advisor: Prof. Jayanth Panyam

Rajneet Kaur Oberoi, Ph.D. [2014] Thesis: *Influence of Active Efflux Transport on the Distribution of Targeted Agents to Brain Tumors*. Advisor: Prof. William Elmquist

2014-2015 Graduate Fellowship Recipients

AFPE Pre-Doctoral Fellowships are awarded to outstanding pre-doctoral graduate students. **Karen Parrish** is this year's recipient. (Advisor: Dr. William Elmquist)

The University of Minnesota Graduate School awards the **Doctoral Dissertation Fellowship** to top graduate students in their final year as they are preparing to defend their Ph.D. theses. This year Pharmaceutics students received an unprecedented number of these highly competitive fellowships. They are **Ameya Kirtane** (Advisor: Dr. Jayanth Panyam), **Mehak Mehta** (Advisor: Dr. Raj Suryanarayanan), and **Frederick Osei-Yeboah** (Advisor: Dr. Calvin Sun).

The **David J.W. Grant and Marilyn J. Grant Fellowship in Physical Pharmacy** is awarded to students whose research is focused in physical pharmacy. **Pinal Mistry** is this year's recipient. (Advisor: Dr. R. Suryanarayanan)

The **Edward G. Rippie Fellowship in Pharmaceutics** is awarded to students with a consistent and outstanding academic record. It has been awarded to **Karen Parrish**. (Advisor: Dr. W. Elmquist)

The **Ronald J. Sawchuk Fellowship in Pharmacokinetics** is awarded to a graduate student whose research is focused in pharmacokinetics. **Karen Parrish** received this year's award. (Advisor: Dr. W. Elmquist)

Pharmaceutics welcomed new students in fall 2014

Mr. Kweku Amponsah-Efah— B.Pharm. in Pharmacy; M.B.A. in Strategic Management/Consulting, Kwame Nkrumah University of Science and Technology, Ghana

Mr. Jiangnan Dun— B.S. in Pharmacy, Peking University, China; M.S. in Chemistry, New York University

Mr. Gautham Gampa— B.Pharm. in Pharmacy, Jawaharlal Nehru Tech University, India; M.Pharm. in Pharmaceutics, Birla Institute of Technology, India

Ms. Shenye Hu— B.S. in Pharmacy, Shanghai Jiaotong University; M.S. in Pharmaceutical Sciences, St. John's University, New York

Ms. Vidhi Khanna— B.Pharm., Institute of Chemical Technology, India

Ms. Minjee Kim— B.S. in Life Science and Biotechnology, Korea University; M.S. in Biochemistry and Molecular Genetics, University of Illinois-Chicago

Ms. Janice Laramy— B.A. in Chemistry, University of Minnesota-Morris; Pharm.D., University of Minnesota-Minneapolis

Mr. Shail Panchamia— B.Tech. in Pharmaceutical Sciences, Institute of Chemical Technology, India

Mr. Saif Rahman— B.A. in Physiology, University of Minnesota

Ms. Drishti Sehgal— B.Tech. in Biotechnology, Padmashree Dr. D.Y. Patil University, India



(L to R) Kweku Amponsah-Efah, Jiangnan Dun, Minjee Kim, Janice Laramy, Shenye Hu, Drishti Sehgal, Gautham Gampa, Vidhi Khanna, Shail Panchamia, Saif Rahman.

Graduate Student Activities

Ameya Kirtane received the Best Podium Award in Drug Delivery at the June 2014 PGSRM for *Effect of Particle Size and Drug Release Rate on the Therapeutic Index of Nanoparticles: A Pharmacokinetic Modeling Approach* (University of Illinois at Chicago) and the 2014 AAPS Graduate Student Award in Biotechnology to be awarded at the November annual meeting (San Diego, CA).

Ameya gave a podium presentation on *Surface Functionalization of Nanoparticles to Improve Their Intratumoral Penetration* at the May 2014 IPRIME Conference (Minneapolis, MN). He also gave two poster presentations during the July 2014 Controlled Release Society meeting in Chicago, IL: *A Pharmacokinetic Model for Quantifying the Effect of Vascular Physiology on the Choice of Drug Carrier: A Framework for Personalized Nanomedicine*, and *Reverse-Engineering Fibrinolytic Enzymes on the Nanoparticle Surface to Improve Tumor Penetration of Nanoparticles*.

Garvey Liu gave two poster presentations on *Chemoprevention by Curcumin: A Prodrug Hypothesis*, one at the June 2014 Pharmaceutics Graduate Student Research Meeting (PGSRM) in Chicago, IL, and also at the August 2014 Globalization of Pharmaceutics Education Network (GPEN) in Helsinki, Finland.

Mehak Mehta received the 2014 AAPS Graduate Student Symposium Award in Physical Pharmacy and Biopharmaceutics and will give a podium presentation about *Influence of Polymer Properties on the Molecular Mobility in the Glassy State* at the November AAPS Annual Meeting in San Diego, CA. She also received the AAPS Best Poster Award in Analysis and Pharmaceutical Quality (APQ) for her upcoming poster presentation *Dielectric Spectroscopy: A Technique to Measure Structural Relaxation in Glassy Pharmaceuticals*.

Mehak received a Thesis Research Travel Grant from U Minnesota in support of travel for her dissertation work. She is also chairing the 2015 Preclinical Form and Formulation in Drug Discovery Gordon Research Seminar, to be held June 6-7, 2015 at the Waterville Valley Resort in New Hampshire. Earlier this summer, Mehak participated in a summer internship at Genentech, South San Francisco, CA under the guidance of Dr. Chen Mao. Her research project involved investigating the influence of excipients on the chemical stability of amorphous solid dispersions.

Pinal Mistry was selected to receive 2014 IPEC Foundation Graduate Student Scholarship Award. This award identifies significant contributions to formulation science and technology through innovative research with excipients. She has also received a 2014 Graduate Student Research in Analysis and Pharmaceutical Quality (APQ) Award that recognizes

excellence in graduate education in the fields of pharmaceuticals, bioanalytical chemistry, and pharmaceutical analysis. She will give a podium presentation at AAPS on *Role of the Strength of Drug-Polymer Interactions on the Molecular Mobility and Physical Stability of Amorphous Solid Dispersions*.

Pinal and other group members in Dr. Raj Suryanarayanan's lab made two visits to the Synchrotron X-ray research facility at Argonne National Labs, IL. The high intensity X-ray radiation at the beam line, coupled with the two-dimensional detector, provides enhanced sensitivity as compared to the laboratory source to detect the earliest evidence of crystallization in amorphous pharmaceuticals, enabling development of predictive models for crystallization during the shelf-life.

Lin Niu received the 2014 AAPS Innovation in Biotechnology Award sponsored by Genentech. He gave a poster talk at the AAPS National Biotechnology Conference on the topic of *Intradermal Delivery of High Volume Polymeric Nanoparticle Based Vaccine Formulation Using a Hollow Microneedle System*.

Frederick Osei-Yeboah recently received a poster award at the Compaction Simulation Forum, a 2014 IPEC Foundation Graduate Student Scholarship Award, and the 2014 Graduate Student Research Award in MSE from AAPS.

Karen Parrish participated in a summer internship at Genentech in South San Francisco, CA where she worked to characterize a non-specific P450 inhibitor under the direction of Matthew Wright and Jialin Mao in the Drug Metabolism and Pharmacokinetics Division. Karen is the recipient of a Ted Rowell Graduate Fellowship, and has received the 2014 AAPS Graduate Student Research Award in PPDM/CPTR.

Nidhi Sharda participated in an internship at Genentech, South San Francisco in Drug Metabolism and Kinetics. Her project was looking at brain slice method to estimate fraction unbound of drugs in brain.

GPEN – Globalization of Pharmaceutics Education Network

The 2014 GPEN meeting was held in August in Helsinki, Finland. Representing our program at the meeting were graduate students **Garvey Liu** and **Karen Parrish**. Garvey gave a poster presentation on *Chemoprevention by Curcumin: A Prodrug Hypothesis*, and Karen gave a podium presentation on *Palbociclib Efficacy in Glioblastoma is Limited by Efflux Pump Activity at the Blood-Brain Barrier*.



Graduate Student Organizations

2014-2015 Pharmaceutics Graduate Student Representatives

Hyunjoon Kim and Sampada Koranne



2014-2015 AAPS Student Chapter Officers

Chair — Karen Parrish (Pharmaceutics)

Chair-Elect — Youssef Roman (Experimental & Clinical Pharmacology)

Secretary — Sampada Koranne (Pharmaceutics)

Treasurer — Malek Okour (Experimental & Clinical Pharmacology)

Student Outreach Officer — Nidhi Sharda (Pharmaceutics)

Web Coordinator — Saif Rahman (Pharmaceutics)

The AAPS Student Chapter organized several educational and social activities last year. The chapter held career development workshops on developing leadership skills, delivering effective presentations, preparing for a career in academia, and preparing for a job interview. In August 2014 the Chapter hosted **Dr. Sunny Bhardwaj, Ph.D.**, a senior scientist in the Discovery Pharmaceutical Sciences division at Merck & Co., for a short course on *Amorphous State I: Basic Concepts, Molecular Dynamics and Role of Dielectric Spectroscopy*. He also presented a seminar on pharmaceutical sciences in drug discovery. Dr. Bhardwaj is a 2012 graduate of the program.

In addition, the chapter continued the tradition of Bowling Night and added an ice skating event to help make the cold winter more bearable. In September 2014 they welcomed the new students to the chapter with an annual kickoff meeting and elected officers for the coming year. The newly elected executive committee is excited to plan another year of great workshops and social events!



2014 Fall Picnic Hosted by Pharmaceutics Graduate Student Representatives (2013-2014) Nidhi Sharda and Michelle Fung

(photos courtesy of Sampada Koranne)

Students prepared beautiful food for the entire Pharmaceutics Dept. and their families on the banks of the Mississippi River near the medical science buildings. Grills and tables were set up and games were provided for children and adults. Thank you for a fun gathering, and thanks to Mr. and Mrs. Fung in food preparation on their vacation!



People

Dr. Xingchu Gong from Zhejiang University, China, joined Dr. Calvin Sun's research group as a visiting professor.

Danielle Johansson joined Pharmaceutics as Dr. Raj Suryanarayanan's assistant in the Peters Endowed Chair office. She also works with Dr. Tom Larson, Associate Dean for Clinical Affairs, College of Pharmacy.

Mamta Kapoor Bhushan, Ph.D., a postdoc in Prof. Ron Siegel's lab, has been invited to present her research in a talk titled *Platform Technology Based on Prodrug/Enzyme Systems for Epilepsy Treatment* at the November 2014 Annual International Federation of Pharmaceutical Manufacturers and Associations (IFPMA) conference in New York. She is one of the four young innovators invited internationally to speak at the Young Innovators in the Spotlight section at this conference. In addition to her scientific achievements, Mamta and her husband, Himanshu Bhushan, gave birth to a son, Vihaan. Mamta has accepted a position at the FDA starting in November.



Sani H. Kizilbash, M.B.B.S., joined Dr. William Elmquist's group as a visiting scientist. Dr. Kizilbash is a medical oncologist at Mayo Clinic (Rochester, MN) and he sub-specializes in treating patients with primary brain malignancies. His research interests include early drug development for brain malignancies and drug delivery across the blood brain barrier. He is from Karachi, Pakistan and earned his M.B.B.S. degree in 2003 from Aga Khan University (Karachi, Pakistan). He later acquired an M.P.H degree from Emory University (Atlanta, GA) and completed his fellowship training in hematology and medical oncology at Mayo Clinic (Rochester, MN) in 2014. He and his wife, Sarah J. Kizilbash, have two sons, Zain and Zayan.

Buddhadev Layek, Ph.D., joined Dr. Swayam Prabha's research group in 2014. He earned his Ph.D. degree in March from North Dakota State University. He and his wife, Mayna, have a son, Nil. Bud is from West Bengal, India.

Heelim Lee, a 2014 B.S. materials science graduate from the U of M, has been working in Prof. Ron Siegel's laboratory on glucose-sensitive hydrogels and hydrogels that can change shape reversibly.

Dr. Benyong Lou recently returned to Minjiang University in Fuzhou, China after spending a year in Dr. Calvin Sun's lab as a visiting professor.

Rajendar Mittapalli, Ph.D. and wife, Sindhu, welcomed a son, Dhruvan, this year. Raj was a postdoctoral associate in Dr. William Elmquist's lab before joining Abbvie in 2013.

Siddharthya Mujumdar, Ph.D., a biomedical engineering graduate of Dr. Ron Siegel's lab, is moving from Novartis to Roche Process R&D, both in Switzerland, in November.

Rajesh S. Omtri, Ph.D., was selected to receive a travelship from the Clinical Pharmacology and Translational Research (CPTR) Section of AAPS to attend the November 2014 AAPS Annual Meeting in San Diego, CA. He is a scientist in Dr. Karunya Kandimalla's lab.

Shubhajit Paul, Ph.D., joined Dr. Calvin Sun's lab as a post-doctoral associate. He earned his Ph.D. in pharmaceutics in 2013 from the National University of Singapore under the supervision of Prof. Paul Heng. He is from India and was recently married to Susmita.

Vishard Ragoonanan, Ph.D., joined Allergan, Inc. in Irvine, CA in September as a scientist in the small molecule product development group. He is currently working in inhalation development on a drug device combination product. He was a research associate in Dr. Raj Suryanarayanan's lab.

Limin Shi, Ph.D., recently accepted a position at Upsher-Smith Pharmaceuticals in the Twin Cities. Prior to that he was a postdoctoral associate and later a scientist in Dr. Calvin Sun's research group.

Suresh Kumar Swaminathan, Ph.D., gave a presentation on *Insulin and Amyloid Abeta Peptide Trafficking Across the Blood-Brain Barrier: Quid Pro Quo?* at the Neurovascular Unit/Blood-Brain Barrier Mini-Symposium in October 2013. The meeting was sponsored by the Brain Barriers Research Center and the U of M Academic Health Center-Duluth. He was also selected to receive a travelship from the Clinical Pharmacology and Translational Research (CPTR) Section of AAPS to attend the November 2014 AAPS Annual Meeting in San Diego, CA. His abstract is entitled *Insulin Signaling Modulates Trafficking of the Beta-Amyloid Peptides at the Blood-Brain Barrier*. He is a research associate in Dr. Karunya Kandimalla's lab.

Naveen Thakral, Ph.D., received a renewal of his Eli Lilly Innovation Fellowship Award; he is an Eli Lilly Postdoctoral Scientist in the lab of Dr. Raj Suryanarayanan. Naveen presented two posters at the 2014 Denver X-ray Conference in Big Sky Resort, Montana on *Profiling Spatial Distribution of Drug Crystallization in Tablets by 2D-XRD*, and *Effect of Compression on the Crystallization of Amorphous Indomethacin in Tablets*.

Jody Tracy joined the Pharmaceutics departmental office in June. She is nationally certified in massage therapy and bodywork, and enjoys reading and learning about health care and health promotion. She also makes jewelry from precious metals and semi-precious gemstones. Jody is pursuing a B.S. in

Applied Studies online through the University of Minnesota, Crookston. She lives in Minneapolis with her husband, P.J., and cat, McKenna.

Majeed Ullah, a visiting Ph.D. student from Comsats University of Science and Technology in Pakistan, spent January through July 2014 in Dr. Calvin Sun's lab.

Shuangling Zhang, Ph.D., joined Prof. William Elmquist's lab in January 2014 as a postdoctoral associate after graduating from Texas Tech University in Amarillo, TX. Her current work is to investigate the influence of anti-angiogenic therapy on drug delivery to brain tumors, in collaboration with Dr. Jann Sarkaria, M.D. of Mayo Clinic.

Faculty News and Activities

In Memoriam



Professor Emerita Yueh-Erh (Jady) Rahman, M.D., passed away on September 16, 2014 in La Jolla, California. She joined Pharmaceutics in 1985 as a tenured faculty member, and served as director of graduate studies from 1989-1992 and dept. head from 1991 until her retirement in 1998.

Professor Timothy Wiedmann believed that Jady was most recognized for her work with liposomes. "While she explored many applications, her work with iron chelation and treating iron toxicity was very significant. The insightful aspect was that liposomes accumulate in the reticuloendothelial system (spleen, liver) which are also the organs that accumulate iron. In essence, she took advantage of a shortcoming of liposomes to develop an effective treatment strategy."

Professor Wiedmann is grateful for the support she provided to him as a junior faculty member. "She was extremely generous in opening up her lab and allowing use of her equipment. But perhaps her greatest gift was being a humanitarian. On a global scale, she predicted the implications for the U.S. when AIDS first occurred, and she actively studied the consequences of the accident in Chernobyl. Jady was also a kind and caring colleague." Professor Wiedmann fondly remembered the time she treated his wife and him to fine dining, just before the birth of their first child. "She knew it would be a long time before we could again enjoy a quiet dinner in a nice restaurant."

Dr. Rahman was a world traveler and wrote about her life in *A Journey With No Boundary Conditions*. She was preceded in death by husband Aneesur, a professor of physics at the University of Minnesota, in 1987. She is survived by daughter Aneesa Baker and husband Dewain, grandchildren Elias and Zoe Scandalis, nieces, nephews, colleagues and friends. A memorial service is scheduled in California on October 25, 2014.

PROFESSOR WILLIAM F. ELMQUIST was invited to give the following talks this year:

- *Pharmacology of Intrathecal Drug Delivery to the Spinal Cord*. North American Neuromodulation Meeting, December 2013, Las Vegas, Nevada.
- *Transporters in ADME – "Targeted Bioavailability"*. APA Biotransformation Short Course, Ahmedabad, India, February 2014.
- *Impact of BBB Transporters on Delivery and Efficacy of Molecularly-Targeted Agents in Brain Tumors*. Plenary Talk, APA Annual Meeting, Ahmedabad, India, February 2014.

- *Impact of BBB Transporters on Delivery and Efficacy of Molecularly-Targeted Agents in Brain Tumors*. 6th International Symposium, NIPER – S.A.S. Nagar, Chandigarh, India, February 2014.
- *Methods for Assessing BBB Drug Transporters and Approaches to Overcome the Function of Drug Efflux Transporters*. Pharmaceutical Sciences World Congress, Transporters in Drug Disposition, Melbourne, Australia, April 2014.
- *Regulatory Mechanisms Influencing Drug Transport Across the Blood-Brain Barrier*. Pharmaceutical Sciences World Congress, Transporters in Drug Disposition, Melbourne, Australia, April 2014.

- *How CNS Barriers to Drug Delivery May Influence the Treatment of Primary and Secondary Brain Tumors*. Genentech, South San Francisco, CA, May 2014.
- *Factors Influencing Treatment of Primary and Secondary Brain Tumors*. Dept. of Pharmacology & Systems Therapeutics, Mt. Sinai Icahn School of Medicine, New York, NY, May 2014.
- *Pharmacology of Intrathecal Drug Delivery to the Spinal Cord*. Jazz Pharmaceuticals Advisory Board Meeting, San Diego, California, June 2014.

PROFESSOR CAROLYN A. FAIRBANKS and her research team continue to contribute their expertise in intrathecal and epidural drug delivery for translational research collaborations with industry and other academic groups (e.g. the University of Minnesota Center for Translational Medicine). Her research interests focus on targeted delivery of gene therapeutics to specific CNS neuronal subpopulations. She and her team contributed two articles to the review journal *Frontiers in Neuroanatomy*. They also continue to investigate mechanisms underlying the development of addiction under conditions of chronic pain; an article summarizing these findings was published in *PLoS One* (Wade et al., 2013). She has recently completed a special volume on this topic that she envisioned and edited, entitled *Neurobiological Studies of Addiction in Chronic Pain*; the volume will be published Springer's Clinical Neurosciences series in 2015. Her lab also continues to research endogenous mechanisms of spinal analgesia. Her research is supported in part by the National Center of Complementary and Alternative Medicine (NCCAM) to investigate endogenous mechanisms of electroacupuncture-induced analgesia and by the National Institute on Drug Abuse to study endogenous inhibition of opioid analgesic tolerance.

Dr. Fairbanks is also co-leading the College of Pharmacy syllabus development for the neuropharmacology area of the core curriculum; this new content will be first offered in fall of 2015. 2014 marks the tenth anniversary of Dr. Fairbanks's signature interdisciplinary course, *Advanced Neuropharmacology*, which she envisioned upon her appointment in 2002. The sixth iteration of the course is underway, with students enrolled from the Graduate Programs in Pharmaceutics, Experimental and Clinical Pharmacology, Neuroscience, and Biomedical Engineering.

Dr. Fairbanks continues to work with the new Vice President of Research, Dr. Brian Herman, as U Minnesota IACUC Vice Chair for Biomedical Science with the unwavering goal of improving the research environment at the U. She is leading the search for a new institutional veterinarian to replace the current director of the animal care team who will retire after twenty years in leadership. In October Dr. Fairbanks gave a presentation on *Gene Therapy for CNS Disorders* at Texas State University.

PROFESSOR KARUNYA KANDIMALLA and his research group are investigating pathophysiological mechanisms that mediate toxic amyloid accumulation and cognitive decline in

Alzheimer's disease (AD) brain. They continue to collaborate with investigators at the Mayo Clinic College of Medicine (Rochester, MN), the National High Magnetic Field Laboratory (Tallahassee, FL), and Center for Magnetic Resonance Research (University of Minnesota) to develop multimodal nanoprobe for the diagnosis of cerebral amyloid angiopathy and cerebrovascular inflammation. The Kandimalla group is also developing novel drug delivery systems to disrupt microbial biofilms and inhibit quorum-sensing circuitry, which promotes antibiotic resistance in bacterial biofilms. In collaboration with the Microbiome Group at the Mayo Clinic (Rochester, MN), the Kandimalla lab is investigating the impact of human microbiota on oral drug absorption and metabolism.

Dr. Kandimalla is the author of *Engineering Theranostic Nanovehicles to Target Cerebrovascular Amyloid Deposits*, which was selected as the top 40 best research reports by the National High Magnetic Field Laboratory and was published in the MagLab Report's 2014 Highlights Issue. He has a patent pending for his work on *Nanoparticles/Theranostic Vehicles for the Diagnosis and Treatment of Cerebral Amyloid Angiopathy*.

Dr. Kandimalla was invited to present *Two Sides of the Coin: Impaired Amyloid Clearance and Cognitive Decline in Alzheimer's Disease Brain at the Neurovascular Unit and Blood Brain Barrier Symposium*, Academic Health Center, University of Minnesota, Duluth. October 2013. He has received a U Minnesota Seed Grant from the Academic Health Center for *Nanoparticle-Mediated Photodynamic Therapy to Disrupt Bacterial Biofilms*, and is a co-investigator on the grant *ApoJ/Clustering Peptide as a Novel Therapeutic Agent for Alzheimer's Disease* funded by the Alzheimer's Drug Discovery Foundation.

PROFESSOR JAYANTH PANYAM received a grant from the U Minnesota Office of Discovery and Translation to study *A Novel Marker for Isolation and Characterization of Circulating Tumor Cells from Patients with Metastatic Breast Cancer*. He is a co-Principal Investigator on a grant funded by the Randy Shaver Cancer Research Fund to study an advanced vaccine for treating bladder cancer. He also reports two patents:

- Hudson AP, Panyam J., Whittum-Hudson J. *Nanoparticles for imaging and treating chlamydial infection*. US #8,647,673; Issued 2/11/14.
- Kalscheuer S, Panyam J. (2014) *Antibody fragments for detecting cancer and methods of use*. Provisional patent application, Pending.

Dr. Panyam was invited to give presentations on *PLGA-induced Inflammation is a Double-edged Sword* by the University of Iowa College of Pharmacy in Iowa City (March 2014) and by the University of Nebraska Medical Center's Department of Pharmaceutical Sciences in Omaha (April 2014). He was elected to the Editorial Advisory Board of the Journal of Pharmaceutical Sciences, and to the inaugural cohort of the Academic Research Fellows Program of the American Association of Colleges of Pharmacy.

Dr. Panyam and his research group mentored local high school and college students, helping them gain research experience: PRIYANKA NARAYAN (Wayzata High School, 2012-2014)

Surfactant-polymer nanoparticles for oral drug delivery.

Priyanka was accepted into Harvard University.

AKSHAY SHEKAWAT (Wayzata High School, 2014-present)

Rotational magnetic fields as external stimulus for triggered tumor cell kill.

SAYALI DESHMUKH (Wayzata High School, 2014-present)

Intracellular trafficking of polymeric nanoparticles.

KATHRYN MORRIS (U Minnesota Directed Study student; 2013-2014) *Chemosensitization of cancer stem cells.* Kathryn is currently working toward her B.S. in Biological Sciences.

PROFESSOR SWAYAM PRABHA received a Grant-in-Aid of Research, Artistry, and Scholarship from the U of M Office of the Vice President for Research her work on *Nano-engineered Mesenchymal Stem Cells as Therapeutic Drug Carriers*. She also received the 2014 College of Pharmacy/College of Veterinary Medicine collaborative research award for her research on *Targeting Solid Tumors Using Nano-engineered Mesenchymal Stem Cells*. Dr. Prabha and her team were invited by AAPS PharmSciTech to publish their research entitled *Translational Application of Nano Delivery Systems: Emerging Cancer Therapy* in a special theme issue.

Dr. Prabha continues in her role as Co-Director of the Center for Translational Drug Delivery at the U of M. CTDD established a research partnership with City University of New York (CUNY) for the development of organometallic compounds as cancer therapeutics.

PROFESSOR RONALD A. SIEGEL has received two grants from the American Epilepsy Society and the Epilepsy Foundation to study intranasal prodrug/enzyme systems for rapid delivery of benzodiazepines in treating epileptic seizure emergencies. This work is in close collaboration with researchers in the Department of Medicinal Chemistry and the Department of Experimental and Clinical Pharmacology.

Prof. Siegel continues to direct the Biomaterials and Pharmaceutical Materials program for IPRIME (Industrial Partners for Research in Interfacial and Materials Engineering) at the U. He is also on the International Board of Advisors for SuMo, a consortium of Swedish universities and companies, funded by the Swedish government, that focuses its research on biomaterials and other soft materials.

PROFESSOR CHANGQUAN CALVIN SUN received a 2014 PhRMA Foundation Sabbatical Fellowship. He is currently on a research sabbatical in Denmark. In addition to serving as chair of the 2nd David Grant Symposium in May 2014 and chair of the Compaction Simulation Forum in July 2014 at the University of Copenhagen, Denmark, he also served as co-chair of the 2014 MSE Short Course on *Fixed Dose Combination Tablets: Materials Science and Modeling Approaches for Robust Design*. He was active in AAPS, serving

as member of the 2014 Award Committee and the 2014 Foundation Committee on Grants and Fellowships.

Dr. Sun was invited to give several presentations this year:

- *Material Sparing Approaches for Optimizing API Powder Properties Critical to Successful Tablet Manufacture*. AAPS Symposium: Design and Control of API Powder Properties to Optimize Drug Product Manufacture (November 2014)
- *Interfacial Adhesion in Bilayer Tablets*. AAPS Short Course: Fixed Dose Combination Tablets: Materials Science and Modeling Approaches for Robust Design (November 2014)
- *Recent Progress in Pharmaceutical Crystal Engineering*. University of Bradford, West Yorkshire, UK (October 2014)
- *A Formulation Strategy for Solving the Overgranulation Problem in High Shear Wet Granulation*. Particulate Processes in the Pharmaceutical Industry IV Conference, Potsdam, Germany (September 2014)
- *Speedy Development of High Quality Tablet Products Through Compaction Simulation*. Zoetis (August 2014)
- *Pharmaceutical Materials Science – Past, Present, and Future*. University of Copenhagen, Denmark (August 2014)
- *Challenges and Opportunities in Pharmaceutical Powder Compaction*. Compaction Simulation Forum 2014, Philadelphia, PA (June 2014)
- *Expanding Solid-State Landscape of Drugs Through Controlled Crystallization*. 2nd David Grant Symposium, University of Minnesota, Minneapolis, MN (May 2014)
- *Solving Pharmaceutical Manufacturing Problems Through Integrated Crystal and Particle Engineering*. College of Pharmacy and Health Sciences, Campbell University, Buies Creek, NC (April 2014)
- *Factors Impacting Interfacial Bonding Strength of Bilayer Tablets*. ExcipientFest Americas, Marriott Raleigh City Center, Raleigh, NC (April 2014)
- *Tablet Product Development Enabled by Integrated Crystal and Particle Engineering*. Peck Symposium, Purdue University, West Lafayette, IN (March 2014)
- *High Dose Tablet Product Development Enabled by Crystal and Particle Engineering*. FMC Health and Nutrition, Shanghai, China (January 2014)

PROFESSOR RAJ G. SURYANARAYANAN was co-chair of the Gordon Research Conference's *Preclinical Form and Formulation for Drug Discovery*, Waterville Valley, NH, June 2013. He was discussion leader for *Analytical Tools to Probe Form and Formulation - First Gordon Conference*.

Dr. Suryanarayanan was invited to give the following presentations:

- *Materials Science of Pharmaceuticals: Drug-Excipient Interplay*. 2013 AAPS Annual Meeting, David J. Grant Research Award Presentation, San Antonio, TX, November 2013.
- *Academic Perspective on Collaborations With Industry (and FDA)*. 2013 AAPS FDD Open Forum on "Strategic alliances with universities, spin-offs, start-ups and research institutions for



co-creation of enabling technologies throughout the drug-development value chain,” San Antonio, TX, November 2013.

- *Applications of XRD in Preformulation and Formulation Studies* as part of the UK-India Education and Research Initiative, University of Hyderabad, Hyderabad, India, January 2014.
- *Challenges with Amorphous Pharmaceuticals* at the seminar on “Green Processing Technologies for Poorly Soluble Drugs” organized by UK-India Education and Research Initiative at the Institute of Chemical Technology, Mumbai, India, January 9, 2014.
- *Predicting the Physical Stability of Amorphous Systems from Molecular Mobility*. 2nd Dr. David J.W. Grant Symposium on Solid-State Pharmaceutics, University of Minnesota, Minneapolis, May 2014.
- *Advanced X-ray Diffractometric Techniques to Characterize Multicomponent Pharmaceutical System*. Cocrystals and Multicomponent Systems Session (II), AMPTEC 2014 Conference, University of Lille 1, Villeneuve d’Ascq, France, July 2014.
- *Applications of XRD in Preformulation and Formulation Studies*. 2014 IUCr 23rd Congress and General Assembly, Montreal, Quebec, Canada, August 2014.
- *Understanding Material Properties to Design Robust Pharmaceutical Dosage Forms*. Agents of Change Research Symposium: The Global Impact of UBC Pharmaceutical Sciences Alumni, Vancouver, British Columbia, Canada, September 2014.
- *The Role of Annealing in Controlling the Physical Form During Freeze-Drying*. Freeze Drying of Pharmaceuticals & Biologicals Short Course and Conference, Garmisch-Partenkirchen, Germany, September 2014.

PROFESSOR TIMOTHY WIEDMANN received an NIH/NCI grant to study interactions between tobacco smoke constituents in rodents. He continues in his role with the

AeroCore Inhalation Testing Research Facility, supporting research in aerosol delivery (Dr. Frank Ondrey’s PREVENT grant for cancer chemoprevention) and in vapor exposures (Dr. Lisa Peterson’s NIH/NCI grant to evaluate cancer incidence in tobacco constituent mixtures). In addition, AeroCore is supporting the measurement of heating rates of magnetic nanoparticles for treatment of brain cancer.

Dr. Wiedmann presented an overview of graduate education to a delegation from Shenyang Pharmaceutical University in China, who visited the College of Pharmacy in February 2014. He also participated in a reception for a delegation of scientists from China Pharmaceutical University, Nanjing in March 2014.

PROFESSOR CHERYL L. ZIMMERMAN was selected Professor of the Semester (Fall 2013) by the Pharm.D. Class of 2016 for her course in pharmacokinetics.

Dr. Zimmerman again accompanied Pharm.D. students, two nurses and a physician on a medical mission to Haiti in March 2014. Dr. Zimmerman and another pharmacist functioned as the pharmacy preceptors in a rural primary care and immunization clinic, which the group set up in a church on the site of an elementary school. The team worked with Haitian physicians to treat the students, parents and people from the surrounding countryside. The four-day clinic treated almost 400 patients and dispensed approximately 1,000 prescriptions. The student-run organization, CARE For Haiti (Clinics and Relief Efforts For Haiti) is planning annual medical missions and will continue to treat the community of Chabin for acute conditions. The next trip is planned for March 2015, and Dr. Zimmerman will again accompany the team. Please see their Facebook page for more information and photos. (www.facebook.com/CareForHaitiClinicsAndReliefEfforts)

The 2nd David Grant Symposium was held on the Twin Cities campus of the University of Minnesota on May 22-24, 2014. Eighty active researchers and leaders from academia and industry gathered to discuss cutting-edge research in the field of solid-state pharmaceuticals. Similar to the first symposium, participants gave overwhelmingly positive feedback to this event. Marilyn and Gillian Grant were the honored guests at the reception and opening ceremony. Prof. Lian Yu delivered the keynote speech, and Prof. Changquan Calvin Sun served as Chair.

The symposium is held in honor of late Professor David J.W. Grant, a leader who helped to define solid-state science for drug product development.

Recent Publications

- Agyare EK, Jaruszewski KM, Curran GL, Rosenberg JT, Grant SC, Lowe VJ, Ramakrishnan S, Paravastu AK, Poduslo JF and Kandimalla KK. Engineering theranostic nanovehicles capable of targeting cerebrovascular amyloid deposits. *J. Control. Release* (2014) Jul 10; 185:121-9. PMID: 24735640.
- Arora S, Swaminathan S, Kirtane AR, Panyam J and Singh A (2014) Synthesis, characterization and evaluation of Poly (D, L-lactide-co-glycolide)-based nanoformulation of miRNA-150: potential implications for pancreatic cancer therapy. *Int. J. Nanomed.* 18(9): 2933-42.
- Bhattacharya S, Bhardwaj SP and Suryanarayanan R. Molecular motions in sucrose-PVP and sucrose-sorbitol dispersions-II. Implications of annealing on secondary relaxations. *Pharm. Res.* May 3 [Epub ahead of print] (2014). PMID: 24792829.
- Chattoraj S, Bhugra C, Li ZJ and Sun CC. Effect of heating rate and kinetic model selection on activation energy of nonisothermal crystallization of amorphous felodipine. *J. Pharm. Sci.* accepted (2014)
- Chattoraj S, Shi L, Chen M, Alhalaweh A, Velaga S and Sun CC, Origin of deteriorated saccharin crystal plasticity by cocrystallization with piroxicam. *Cryst. Growth Des.* 14: 3864–3874 (2014)
- Cheng KW, Wong CC, Alston NM, Gerardo G, Huang L, Ouyang N, Xie G, Wiedmann T and Rigas B (2013) Aerosol administration of phospho-sulindac inhibits lung tumorigenesis. *Mol. Canc. Therap.* 12(8): 1417-1428.
- Chow SF, Shi L, Ng WW, Leung KHY, Nagapudi K, Sun CC and Chow AHL. Kinetic entrapment of a hidden curcumin cocrystal with phloroglucinol, *Cryst. Growth Des.* 14: 5079–5089 (2014)
- Chow SF, Sun CC and Chow AHL. Assessment of the relative performance of a confined impinging jet mixer and a multi-inlet vortex mixer for curcumin nanoparticle production. *Eur. J. Pharm. Biopharm.* DOI: 10.1016/j.ejpb.2014.07.004 (2014)
- Grill A, Koniar B and Panyam J (2014) Co-delivery of natural metabolic inhibitors in a self-microemulsifying drug delivery system for improved oral bioavailability of curcumin. *Drug Del. Transl. Res.* 4(4): 344-352.
- Jaruszewski KM, Curran GL, Swaminathan SK, Rosenberg JT, Grant SC, Ramakrishnan S, Lowe VJ, Poduslo JF and Kandimalla KK. Multimodal nanoprobe to target cerebrovascular amyloid in Alzheimer's disease brain. *Biomaterials* (2014) Feb; 35(6): 1967-76. PMID: 24331706
- Kapoor M and Siegel RA. Prodrug/Enzyme based acceleration of absorption of hydrophobic drugs: An in vitro study. *Mol. Pharm.* 10: 3519-3524 (2013). DOI: 10.1021/mp400272m. PMID: 23937162 in process.
- Kapoor M, Winter T, Lis L, Georg GJ and Siegel RA. Rapid delivery of diazepam from supersaturated solutions prepared using prodrug-enzyme mixtures: Toward intranasal treatment of seizure emergencies. *AAPS J.* 16: 577-585 (2014). DOI: 10.1208/s12248-014-9596-5. PMID: 24700272 in process.
- Kim A, Mujumdar SK and Siegel RA. Swelling properties of hydrogels containing phenylboronic acids. *Chemosensors* 2: 1-12 (2014). DOI:10.3390/chemosensors2010001.
- Kirtane A, Kalscheuer S and Panyam J (2013) Exploiting nanotechnology to overcome tumor drug resistance: challenges and opportunities. *Adv. Drug Del. Rev.* 65(13-14): 1731-47.
- Kirtane AR and Panyam J (2013) Polymer nanoparticles: Weighing up gene delivery. *Nature Nanotechnol.* 8(11): 805-6 (Invited editorial).
- Kothari K, Ragoonanan V and Suryanarayanan R. Dielectric spectroscopy of small molecule pharmaceuticals – Effect of sample configuration. *J. Pharm. Sci.* (2014)
- Kothari K, Ragoonanan V and Suryanarayanan R. Influence of molecular mobility on the physical stability of amorphous pharmaceuticals in the supercooled and glassy states. *Mol. Pharmaceutics* Aug 8 [Epub ahead of print]. PMID: 25105216. (2014).
- Medarametla V, Festin S, Sugarragchaa C, Eng A, Naqwi A, Wiedmann T and Zisman LS (2014) PK10453, a nonselective platelet-derived growth factor receptor inhibitor, prevents the progression of pulmonary arterial hypertension. *Pulm. Circ.* 4: 82-102.
- Modi SR, Perumalla SR, Dantuluri A, Sun CC and Bansal AK. Effect of crystal habit on intrinsic dissolution behavior of celecoxib due to differential wettability, *Cryst Growth Des.*, DOI: 10.1021/cg501084a (2014)
- Osei-Yeboah F, Feng Y and Sun CC. Evolution of structure and properties of granules containing microcrystalline cellulose and polyvinyl pyrrolidone during high shear wet granulation. *J. Pharm. Sci.* 103: 207-215 (2014)
- Osei-Yeboah F, Zhang M, Feng Y and Sun CC. A formulation strategy for solving the overgranulation problem in high shear wet granulation. *J. Pharm. Sci.* 103: 2434–2440 (2014)
- Perumalla SR and Sun CC. Enabling tablet product development of 5-fluorocytosine through integrated crystal and particle engineering. *J. Pharm. Sci.* 103: 1126-1132 (2014). **Selected for inclusion in the JPS July 2014 virtual issue "Most Original and Most Significant Scientific Findings."**
- Perumalla SR and Sun CC. Design and preparation of a 4:1 lamivudine - oxalic acid CAB cocrystal for improving lamivudine purification process, *Cryst. Growth Des.* 14: 3990–3995 (2014)
- Pustulka K, Wohl AR, Han J, McCormick A, Macosko CW, Panyam J and Hoye TR (2013) Flash nanoprecipitation: Particle structure and stability. *Mol. Pharmaceutics* 10(11): 4367-4377.

Ragoonanan V and Suryanarayanan R. Ultrasonication as a potential tool to predict solute crystallization in freeze-concentrates. *Pharm. Res.* 31(6): 1512-1524 (2014).

Sadhukha T, O'Brien T and Prabha S (2014) Nano-engineered mesenchymal stem cells as targeted therapeutic carriers. *J. Controlled Release* (in press).

Sadhukha T and Prabha S (2014) Encapsulation in nanoparticles improves anti-cancer efficacy of carboplatin. *AAPS PharmSciTech* 15(4): 1029-1038.

Sadhukha T, Wiedmann TS and Panyam J (2014) Enhancing therapeutic efficacy through designed aggregation of nanoparticles. *Biomaterials* 35(27): 7860-9.

Siegel RA. Stimuli sensitive polymers and self regulated drug delivery systems: A very partial review. *J. Control. Rel.* 190: 337-351 (2014). NIHMS609764. DOI:10.1016/j.jconrel.2014.06.035.

Song SH, Park JH, Chitnis G, Siegel RA and Ziaie B. A wireless chemical sensor with iron oxide nanoparticles Embedded hydrogel. *Sens. Act. B* 193: 925-930 (2014). DOI:10.1016/j.snb.2013.12.012

Sundaramurthi P and Suryanarayanan R. Azithromycin hydrates – Implications of processing-induced phase transformations. *J. Pharm. Sci.* Aug 19 [Epub ahead of print]. Doi: 10.1002/jps.24084. PMID: 25139082 (2014)

Usacheva M, Swaminathan S, Kirtane AR and Panyam J (2014) Encapsulation of methylene blue in nanoparticles enhances PDT efficacy under hypoxia. *Mol. Pharmaceutics* [Epub ahead of print].

Usacheva M, Swaminathan SK, Kirtane AR and Panyam J. Enhanced photodynamic therapy and effective elimination fo cancer stem cells using surfactant-polymer nanoparticles. *Mol. Pharm.* 11(9): 3186-3195.

Vaidhyanathan S, Mittapalli RK, Sarkaria JN and Elmquist WF. Factors influencing the CNS distribution of a novel MEK-1/2 inhibitor: Implications for combination therapy for melanoma brain metastases. *Drug Metab. Dispos.* Aug; 42(8): 1292-1300, 2014.

Wohl AR, Kalscheuer S, Lee HS, Han J, McCormick A, Macosko CW, Panyam J and Hoye TR (2014) A silicate ester prodrug strategy for improving the therapeutic index of paclitaxel. *J. Med. Chem.* 57(6): 2368-79.

AeroCore

www.pharmacy.umn.edu/aerocore

At the new AeroCore Center, College of Pharmacy researchers have partnered with colleagues from the U's Masonic Cancer Center, College of Science and Engineering, and Medical School to develop and test aerosol drug delivery for lung diseases such as lung cancer, cystic fibrosis, tuberculosis and more.

AeroCore brings together U of M experts in drug delivery, aerosol generation and testing, lung science and health, and cancer to:

- develop aerosol drug delivery systems
- administer the drug in a controlled environment
- test for toxicity
- measure the amount of drug delivered to the lungs.

AeroCore researchers are currently working on a better way to eradicate dangerous lung cancer cells through inhalation of nanoparticles and the use of hyperthermia, or the process of raising heat levels to a point that threatens cell survival, for help in killing cancerous cells that have formed in the lungs. By heating iron oxide nanoparticles to temperatures higher than 98.6 degrees Fahrenheit, researchers have been able to effectively kill cancer cells in preliminary mouse-model trials. This new drug delivery method also delivers the chemotherapeutic drugs directly to the lungs while reducing the harmful effects to other parts of the body.

Co-Director, Jayanth Panyam, Ph.D.
Dept. of Pharmaceutics, College of Pharmacy

Professor Jayanth Panyam has interests in the research and development of polymeric-based drug delivery systems for targeted treatments of disease.

Co-Director, Frank G. Ondrey, M.D., Ph.D., FACS
Dept. of Otolaryngology, School of Medicine

Professor Frank Ondrey, a practicing physician, is actively involved in the prevention and treatment of respiratory and head and neck cancers. As part of his focus on translational medicine, he has specific expertise in the identification and validation of biomarkers.

Laboratory Manager, Timothy S. Wiedmann, Ph.D.
Dept. of Pharmaceutics, College of Pharmacy
612-624-5457 or wiedm001@umn.edu

Professor Timothy Wiedmann has over 20 years of experience in providing technical support for the inhalation delivery of drugs, chemicals and particulate systems to rodent animal models using a wide array of aerosol generation devices.

AeroCore is positioned strictly as a service facility, but the close connection to the academic-rich environment of the University with faculty in the College of Pharmacy, Cancer Center, Particle Technology Laboratory, and the Center for Lung Science and Health allow for independent, supportive research consultation and collaboration.



❖ Center For Translational Drug Delivery

The Center for Translational Drug Delivery is uniquely positioned to assist pharmaceutical companies with all aspects of drug delivery and complex development challenges. "Our colleagues in Pharmaceutics deal with all aspects of drug delivery," said Dr. Raj Suryanarayanan. "As a group, we can provide significant service to the community."

Now in its second year, CTDD provides services that include preformulation, formulation development, preclinical biological testing and analytical services. To date, CTDD's services have focused primarily on the pharmaceutical industry. There have also been interactions with University colleagues, and CTDD is open to opportunities for collaboration. As part of the University's Academic Health Center, it is well positioned with clinical groups, particularly physicians, who want to take drug delivery one step further. Their work will help others, including scientists and engineers, take their compound one step closer to the patient.

Projects thus far have been primarily driven by the reputation and expertise of the faculty in the Department of Pharmaceutics as researchers who regularly publish high-quality scientific papers and have significant experience working with pharmaceutical companies, the FDA and the United States Pharmacopeia. This level of expertise has uniquely positioned the center for growth.

DIRECTOR – Raj Suryanarayanan, Ph.D.

Professor of Pharmaceutics and William & Mildred Peters Endowed Chair, University of Minnesota

Research interests in the broad area of pharmaceutical materials science. Current research projects: • characterization and stabilization of amorphous pharmaceuticals • evaluating influence of molecular mobility on stability of amorphous drugs and dispersions • understanding the role of processing and storage induced phase transitions on properties of pharmaceutical dosage forms • developing novel applications of powder X-ray diffractometry for characterizing pharmaceutical dosage forms.

ASSOCIATE DIRECTOR – Swayam Prabha, Ph.D., MBA

Assistant Professor of Pharmaceutics and Associate Director of Center for Translational Drug Delivery, College of Pharmacy, University of Minnesota

Over 10 years of pharmaceutical and biotech industrial experience. Prior to joining the University of Minnesota in 2012, Prabha served as senior manager for Formulation and Process Development, Valeant Pharmaceuticals. Primary expertise in dosage form design, formulation and process development, technical operations and technology transfer.

www.pharmacy.umn.edu/ctdd

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Monday, November 3, 2014

7:00-8:30 a.m.

Marriott Marquis, San Diego Marina

Rancho Santa Fe Room

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AAPS Annual Meeting and Exposition

San Diego, California

November 2-6, 2014

