**Neonatal-Perinatal Medicine Fellowship Program Curriculum**

The NPM fellowship program consists of the following components as outlined by the Program Requirements for Education developed by the American Board of Pediatrics (ABP) and ACGME Resident Review Committee (RRC) for Neonatal-Perinatal Medicine. Please see [www.acgme.org/acWebsite/RRC_320/320_prIndex.asp](http://www.acgme.org/acWebsite/RRC_320/320_prIndex.asp). Fellows are assigned to these components in an educationally appropriate sequence over the usual 36 months of training.

**Overview of the Neonatal-Perinatal Medicine Fellowship**

The NPM fellowship program, accredited by the ACGME Residency Review Committee for Pediatrics, which includes the American Board of Pediatrics, is jointly sponsored by the University of Minnesota (UMN) and Children’s Hospitals and Clinics of Minnesota — St. Paul (CHCM-SP). The University NICU is located on the West Bank Campus in the University of Minnesota Masonic Children’s Hospital (UMMCH), and has ~750 annual admissions. CHCM-SP has ~925 annual admissions. Twenty-four neonatologists direct patient care and provide education at both institutions. Residents from the University of Minnesota Pediatric and Medicine-Pediatric Residency Program receive training in neonatology at both sites.

These hospitals serve a wide referral area geographically, with patients from all socioeconomic groups. The University NICU has a busy Level III+ service providing all aspects of neonatal intensive care. The NICU and Maternal-Fetal Medicine (MFM) service at UMMCH receives patient referrals from throughout Minnesota, as well as North Dakota, South Dakota and western Wisconsin. The MFM service covers all types of referrals and has a large fetal echocardiography program in conjunction with the UMN pediatric cardiologists. The NICU serves as a referral source for other NICUs in the area, receiving patients with cardiac and surgical problems from the four-state area. The NICU is also a national ECMO Center of Excellence, serving as a regional ECMO referral center, supporting 6-10 ECMO patients per year. Additionally, the University service is involved in many collaborative clinical research projects with a dozen active clinical protocols enrolling at present. Approximately 25-30% of the annual admissions are transported either by ground ambulance or via fixed-wing/helicopter air ambulance transport service. If interested, the neonatal-perinatal medicine fellows may participate in the transport service. The staff neonatologists are listed here: [http://www.peds.umn.edu/neonatology/faculty/index.htm](http://www.peds.umn.edu/neonatology/faculty/index.htm)

The NICU at Children’s Hospitals and Clinics of Minnesota—St. Paul serves the eastern metropolitan area and hospitals located in St. Paul, eastern Minnesota and western Wisconsin. Approximately 20 percent of the admissions are transported from these hospitals. The remaining 80 percent are born at United Hospital, located adjacent to CHCM-SP, an active perinatal referral center for Minnesota and western Wisconsin. This NICU is a referral source for infants requiring non-conventional ventilation and for
Clinical Curriculum

The clinical curriculum is based on providing PL-4 fellows (1st year) with a high degree of direct patient contact and responsibility on the NICU, and providing PL-4/5/6 fellows graded supervisory responsibility for the PL-1/2/3 residents, medical students and their patients. The first year consists of predominately clinical activities and the second two years are primarily for scholarly activity, combined with ongoing clinical work.

The fellowship requires 12-15 months of clinical rotations consisting of a minimum of 12 months assigned to the NICU critical service, one month on cardiology, one senior month on the UMMCH intermediate care service and additional elective time as desired. Five to six months of the first year are spent rotating between the two NICUs as a clinical fellow (functioning as a junior staff person in the supervision of the hour-to-hour care of critically ill newborn infants), along with the cardiology rotation. Fellows generally have the remaining six to seven months of critical clinical experience spread out during the second and third years. During the third year of clinical service, the fellow is expected to function fully as a junior attending neonatologist and will have the additional month on the UMMCH intermediate care service. Formal training in NRP, transport of the critically ill newborn infant and ECMO will be provided. Participation in the NICU Follow-up Clinic is required during all three years of the fellowship.

Participation in the Vermont Oxford Network is required for 6 months during the second year, with additional participation available on an elective basis. Elective clinical rotations include Maternal-Fetal Medicine, Pediatric Surgery and International rotations.

The Maternal-Fetal Medicine rotation is a month-long elective that many fellows take during the first year. Rotating with the UMMCH maternal-fetal medicine physicians provides exposure to and an appreciation of the prenatal diagnostic tests available, as well as the management of high-risk pregnancies and preterm labor. Fellows attend high-risk clinics and are involved in prenatal counseling of high-risk patients. They may also work with our prenatal palliative care and hospice team.

The Pediatric Surgery rotation is a month-long elective that fellows may choose to take at any time during their training. The primary goal of rotating with the UMMCH pediatric surgeons is to become proficient at the placement of central venous catheters, other than umbilical and PICC lines.

During the 2-week International rotation, a 2nd or 3rd year neonatal fellow has the opportunity to travel to Cuzco, Peru to work in the Neonatal Intensive Care Unit at Cuzco Regional Hospital. The goals of this rotation are to gain an understanding of neonatology in a developing country and to learn to provide education in this setting.
This NICU contains 7 critical care beds and up to 20 mild/moderate acuity beds and cares for premature infants requiring mechanical ventilation and also has pediatric surgical services. The hospital serves a very diverse population both from the city of Cuzco and also many outlying highland communities of the Andes Mountains. Primary fellow responsibilities during this rotation including attending daily work rounds, assisting with admissions of new infants, and assisting with daily patient care duties. Supervision during this rotation is primarily from an attending neonatologist from the University of Minnesota Masonic Children’s Hospital, with input from attending neonatologists at the Cuzco Regional Hospital. Fellows are expected to take part in educational and teaching opportunities with the NICU staff including teaching the AAP Neonatal Resuscitation Program Course. This rotation provides a unique opportunity to use advanced Spanish language skills in speaking and writing. It is an expectation that fellows are proficient in the Spanish language prior to travel. There is also an opportunity to collaborate with several general pediatricians from Minnesota doing outreach at several local Peruvian orphanages. Fellows are expected to perform at the level of junior attending. This rotation provides a great deal of flexibility for an individualized learning plan based on interest in different international health topics. Participation in and funding for this rotation is not guaranteed and must be approved by the NPM program director. For more information on Global Pediatrics please visit the following website: http://www.globalpeds.umn.edu/index.htm.

Scholarly Activity
The majority of the Neonatal-Perinatal Medicine Fellowship consists of 18-20 months of scholarly activity. As per the ABP, “all fellows will be expected to engage in projects in which they develop hypotheses or in projects of substantive scholarly exploration and analysis that require critical thinking. Areas in which scholarly activity may be pursued include, but are not limited to: basic, clinical or translational biomedicine; health services; quality improvement; bioethics; education; and public policy.” Traditional clinical/basic research or other scholarly activities, within neonatology, perinatology and developmental biology are facilitated by the mentors in neonatology or other related subspecialties. Neonatologists and subspecialists in other pediatric divisions supervise these studies and are instrumental in guiding the development of individual projects with appropriate specific curriculum (e.g., laboratory meetings, journal clubs, course work).

Once an area of interest is identified, fellows will work with the program director, in addition to their specific mentor and scholarship oversight committee, to develop an individualized learning plan (ILP) for scholarly activity. The goals and objectives will then be individualized to address the specific area of scholarly investigation.

Collaborative Research
The University of Minnesota and Children’s Hospitals and Clinics–St. Paul have been
involved in many national collaborative trials including studies on surfactant, inhaled nitric oxide, fluconazole and the STOP-ROP consortium. The primary venue for collaborative work has been through participation in the Center for Neurobehavioral Development (http://cnbd.umn.edu/). Dr. Michael Georgieff is the director of this unique multidisciplinary resource for training and research across disciplines.

Additional collaborative research is ongoing between division members and members of the Divisions of Cardiology (Lazaros Kochilas, M.D. and Jamie Lohr, M.D.) and Infectious Diseases (Mark Schleiss, M.D.) in the Department of Pediatrics; the Department of Laboratory Medicine and Pathology (Carol L. Wells, Ph.D.); the Institute of Child Development (Kathleen Thomas, M.D., and Megan Gunnar, Ph.D.); the Department of Neurosurgery & Neuroscience (Walter Low, PhD); the Center for Immunology (Marc Jenkins, PhD) and the Department of Veterinary Pathobiology (Mathur Kannan, Ph.D., and David R. Brown, Ph.D.). Several fellows have been supported on the Infectious Disease Training Grant and one completed a combined neonatal-infectious disease fellowship. Opportunities to work with researchers in other areas at the University of Minnesota are also available. The following link provides a way to search for experts in your specific area of interest: http://experts.umn.edu/index.pl

Graduate studies
Fellows also have the opportunity to participate in graduate-level coursework offered by The University and to obtain a Masters of Clinical Research, Masters of Public Health, Masters in Health Informatics or Masters in Bioethics. The specific curricula for these programs are listed at the respective websites (add general umn website link). Fellows have also obtained on-line certificate training in Quality Improvement and Pediatric Bioethics. The program is open to discussing options with each fellow for additional training. Participation and tuition payment cannot be guaranteed in advance and preapproval must be obtained from the program director.

Potential Mentors within the Division of Neonatology

Catherine M. Bendel, M.D.~ Dr. Bendel’s research has involved the pathogenesis of infections due to Candida albicans and other Candida species in neonates; as well as related multi-center clinical trials on the NICU. Her work is specifically oriented toward assessing yeast factors that account for adhesion, virulence and the host-microbe interaction. She is currently collaborating with Dr. Gale to look at the role of these factors in the development of the neonatal fungal microbiome. Dr. Bendel has also been involved in clinical trials regarding fluconazole prophylaxis in ELBW infants. She is currently involved in the SCAMP trial to evaluate antibiotic therapy for NEC and complex intra-abdominal infections. Her work is supported by funding from the NHLBI and NIH.

Mark Bergeron, M.D., MPH ~ Dr. Bergeron is on faculty at Children’s Hospitals and Clinics–St. Paul, and has a Master’s in Public Health in the area of Maternal and Child Health. Dr. Bergeron has a strong interest in clinical research, maternal and child health
health policy, and quality improvement initiatives, and has been actively involved in the Vermont Oxford Network NICQ Collaborative. Dr. Bergeron also serves as an adjunct faculty member for the School of Public Health.

Cheryl A. Gale, M.D.~ Dr. Gale is an established investigator in the molecular pathogenesis of *Candida albicans* infections. She has a joint appointment in the Department of Genetics, Cell Biology and Development, and is a faculty member of the University of Minnesota’s Molecular, Cellular, Developmental Biology, and Genetics Graduate Program. Dr. Gale’s research focus is in molecular mechanisms of *C. albicans* morphogenesis and how fungal morphogenesis proteins are involved in tissue invasion and destruction. In addition, she studies how fungal microbial communities in the infant gut are associated with health and disease. The NIH, March of Dimes, MN Vikings, Minnesota Medical Foundation and University of Minnesota Graduate School have supported her research programs.

Thomas George, M.D.~ Dr. George is Clinical Director of the UMACH NICU and Associate Program Director for the Pediatric Residency Program. He is involved in studies of graduate medical education, clinical research projects on the NICU, participates in our Vermont-Oxford Network team, administrative/program development, outreach, and neonatal CME activities.

Michael K. Georgieff, M.D.~ Dr. Georgieff is an established investigator in neonatal nutrition and metabolism and neurodevelopment. He has a joint appointment in Pediatrics and the Institute of Child Development and is a member of the Neuroscience Graduate Faculty. Dr. Georgieff is the chief of Neonatology and Co-Director of the Center for Neurobehavioral Development (CNBD) at the University of Minnesota. He also directs the Neonatal Nutrition Support Service and the NICU Follow-up Clinic at the University site. His research is on the impact of early nutrition on developmental outcome of infants, specifically studying the cellular and molecular mechanisms of placental iron transport and the neurologic sequelae of perinatal iron deficiency. He is supported by grants from the NIH (NICHD and NINDS). Dr. Georgieff is also the Vice Chair of the Department of Pediatrics.

Tate Gisslen, M.D.~ Dr. Gisslen joined the faculty in 2013 and is interested in the studying the effects of intrauterine inflammation/infection on neonatal outcomes – both short term and long-term neurodevelopmental outcomes.

Sixto F. Guiang, III, M.D.~ Dr. Guiang’s research focuses on clinical issues associated with ECMO.

Anne Hall, M.D.~ Dr. Hall's research interests include developmental origins of adult disease. Specifically, she uses a rodent model of intrauterine growth restriction to study fetal metabolic adaptations to poor intrauterine conditions and how this affects both short and long-term neurodevelopment. She utilizes high-field NMR spectroscopy under
the mentorship of Dr. Rao. She is a CHRC scholar and her research is funded by the Viking's Children's Fund and NIH CHRCDA K12.

Dana E. Johnson, M.D., Ph.D.~ Dr. Johnson investigates the short- and long-term medical and developmental effects of early childhood institutionalization and the outcome of children adopted internationally. Of particular interest is the relationship between stress and somatic/brain growth. His work is supported by the Minnesota Medical Foundation, the Viking Children’s Fund, the NIH, and Genentec. He is also a member of the CNBD.

Andrea Lampland, M.D.~ Dr. Lampland performs translational research regarding neonatal ventilation and short-term pulmonary physiology. She performs investigator-initiated local clinical studies in the NICU and utilizes a piglet model of RDS/ALI in her animal lab in the Infant Diagnostic and Research Center at CHCM-SP. Her work has been funded by industry and the Children’s Hospital Internal Research Grant Program.

Erin Osterholm, M.D.~ Dr. Osterholm's primary area of research includes the effects of stress on the developing brain, especially alterations in the hypothalamic-pituitary-adrenal axis. She works in collaboration with members of the Institute of Child Development and Center for Neurobehavioral Development on research examining the HPA axis and nutrition in small for gestational age infants. Dr. Osterholm also has an interest in neonatal resuscitation education and is a member of the NICU Simulation Core Team leading simulation based learning for residents and fellows.

Kathleen Pfister, M.D.~ Dr. Pfister joined the faculty in 2013. Her research interests are in studying neurodevelopmental outcomes of high-risk preterm and term infants, using ERP technology to evaluate memory function and speed of brain processing. She is continuing a project she started during fellowship looking at outcomes among term infants with HIE, including follow-up out to 1 year old.

Sara Ramel, M.D.~ Dr. Ramel is involved in several clinical research projects and is a faculty member in the Center for Neurobehavioral Development. Her research interests are in growth and nutrition of preterm infants and their impact on long-term developmental outcomes. Specifically, she is focused on early body composition changes and the effect of nutritional manipulations and illness on these changes, as well as the long-term effects of these changes on later body composition and cognition. She is currently funded by the March of Dimes.

Raghavendra Rao, M.D.~ Dr. Rao is a core faculty member and Chair of the Scientific Advisory Committee at the Center for Neurobehavioral Development and is a Senior Faculty in the Graduate Program in Neuroscience. His research focus is regional brain development under typical and adverse perinatal conditions. He is specifically interested in understanding the effects of hypoglycemia and hyperglycemia, iron deficiency, chronic hypoxia, acute hypoxia-ischemia on the developing brain regions in various
animal models. He utilizes high-field NMR spectroscopy, behavioral assessment, molecular analysis and histochemical analysis in his research, which is funded by the NICHD, and Viking Children’s Fund. He is the site-investigator for the multicenter Preterm Erythropoietin for Neuroprotection (PENUT) trial funded by the NINDS.

**Kari Roberts, M.D.** Dr Roberts is the Director of NICU Clinical Research. Her research area of interest is neonatal resuscitation and invasive procedures. She is currently Principle Investigator of a national, multi-center, randomized controlled trial investigating the use of the Laryngeal Mask Airway for Surfactant Administration in Neonates. Dr Roberts is also the Director of NICU Simulation Training and has developed neonatal simulation labs and advanced procedural skills workshops for residents, fellows and neonatal nurse practitioners.

**Tara Zamora, M.D.** Dr. Zamora's research interests include basic and translational research on the effects of anemia on the developing preterm brain and neurodevelopmental outcomes.