

2014 Research Annual Report

Nephrology and Hypertension



Division Summary

RESEARCH AND TRAINING DETAILS

Number of Faculty	14
Number of Joint Appointment Faculty	1
Number of Research Students	7
Number of Support Personnel	10
Direct Annual Grant Support	\$2,259,578
Direct Annual Industry Support	\$471,967
Peer Reviewed Publications	45

CLINICAL ACTIVITIES AND TRAINING

Number of Clinical Staff	18
Number of Clinical Fellows	6
Inpatient Encounters	3,580
Outpatient Encounters	4,580

Division Photo



Row 1: D Claes, M Avedt, E Jackson, S Goldstein, E Erkan, K Drake
Row 2: T Pleasant, J Goebel, M Bennett, R Bignall, P Devarajan
Row 3: B Siroky, B Dixon, G Hamdani, R VanDeVoorde, D Hooper, O Volovelsky

Significant Accomplishments

New Test Panel Revolutionizes Diagnosis of Thrombotic Microangiopathy

A transformative advancement in diagnostic testing has further elevated the profile of Cincinnati Children's. Thrombotic microangiopathies are a group of disorders that cause damage to small blood vessels throughout the body, leading to organ damage and possibly death if not treated promptly. In the past, the required blood tests were available only piecemeal at different institutions. Through the efforts of **Bradley Dixon, MD**, in the Division of Nephrology and Hypertension, and his collaborators in the Cancer and Blood Diseases Institute and the Division of Human Genetics, all of these tests were brought under one roof at Cincinnati Children's. This platform of tests was made available for clinical use in September 2013, and has revolutionized the diagnostic testing of individuals with thrombotic microangiopathies. In recognition, Dr. Dixon received the Entrepreneurial Achievement Faculty Award in February.

Multidisciplinary Stone Center Launched to Meet Soaring Demand

More than 625 children were treated last year for kidney and urinary tract stones at Cincinnati Children's, double the number from five years ago and more than triple the figure over the last decade. In response to this growing epidemic, the Stone Center was launched. The Center's multidisciplinary team includes physicians, nurses, dietitians, genetic counselors, and social workers from seven specialties. Under the direction of **Prasad Devarajan, MD**, Nephrology Division Director, the Center provides families of children with kidney stones coordinated care, education, treatment, prevention and research. Children are seen by a nephrologist, urologist, dietitian, and genetics counselor. Research in stone disease includes a data base, evaluation of the

two-day versus one-day metabolic stone profile, stone risk before and after bariatric surgery, and development of a genetic chip to detect the common hereditary stone forming conditions. We are also one of the Coordinating Centers within the NIH-funded Rare Kidney Stone Consortium to test novel therapies for kidney stones.

Our Kidney Transplant Program Busiest in the Country

Our Kidney Transplant Program, spearheaded by nephrologists **Jens Goebel, MD**, and **David Hooper, MD, MS**, is one of the most experienced in the country at treating complex diseases of the kidney and urinary tract. We have excellent outcomes, with 100 percent one-year post-transplant patient and graft survival rates. Last year, we performed 34 kidney transplants, more than any other center in the U.S. In recognition of the achievements of the kidney transplant program, Hooper received the Clinical Care Achievement Faculty Award in February.

Research Highlights

Prasad Devarajan, MD

Dr. Devarajan has continued with a wide spectrum of approaches to kidney health and disease processes, spanning from molecular, genomic and proteomic approaches to human observational and clinical trials. Dr. Devarajan is the director of the NIH-funded P50 Center of Excellence in Nephrology, a unique multi-disciplinary research program designed to support basic, translational, and clinical research on critical pediatric kidney diseases that have major unmet needs. The proposal includes three primary research projects in the areas of acute kidney injury, proteinuric kidney disease, and lupus nephritis, with participation from recognized teams of investigators from multiple disciplines. Also included are high-resource gene expression, proteomics, and biomarker cores with core leaders of international repute to support the study of the three focus areas. In addition, six to eight pilot and feasibility projects will be funded in the three areas of research focus. Dr. Devarajan is the center PI and/or nephrology lead investigator for several NIH-funded prospective clinical studies. He has established a Kidney Biomarker Laboratory which now performs more than 40 distinct assays for acute and chronic kidney disease biomarkers. Dr. Devarajan's ground-breaking research on biomarkers and new therapeutic targets in kidney diseases has yielded over 20 publications and several patent applications during the last fiscal year.

Stuart L. Goldstein, MD

Dr. Goldstein is the director of the Center for Acute Care Nephrology (CACN), and has had a very productive research year, with achievements that spanned the scope of the Center's research missions. The nephrotoxic medication acute kidney injury (AKI) reduction project, NINJA, which was associated with a 42% reduction in AKI, had four related publications this year. The CACN received pilot funding to spread NINJA to nine other US pediatric centers. The CACN also is coordinating the largest prospective pediatric AKI study ever undertaken: "Assessment of Worldwide AKI, Renal angina and Epidemiology in Children (AWARE)". The CACN published two landmark papers validating the Renal Angina risk stratification concept, with incorporation of urinary biomarkers. These demonstrate the utility of a simple risk stratification system to aid in directing biomarker measurement and guide therapies to support patients with AKI. In addition, the CACN coordinates the international pediatric contribution to the DIRECT study, which is a genome wide association study for nephrotoxic medication associated AKI; currently 15 pediatric centers have signed on to this project. The CACN is also coordinating the NICHD sponsored Pediatric Opportunistic Pharmacokinetic Study arm of the Pediatric Trials Network at Cincinnati Children's with two protocols that are active currently.

Elizabeth C. Jackson, MD

Dr. Jackson is the director of the Healthy Bladder Clinic, and continues her active research program in optimizing the management of nocturnal enuresis. She is completing a randomized prospective trial comparing the effectiveness of the voice recordable alarm with the buzzer alarm for nocturnal enuresis. Preliminary results suggest that the voice alarm may lead to a lower dropout rate, and have been presented at national scientific meetings. Dr. Jackson is also evaluating the two day versus the one day metabolic stone profile in children. Preliminary findings suggest that more than half the children with a 48 hour urine collection have a significant abnormality that would have been missed if only 24 hours of urine had been tested.

Bradley Dixon, MD

Dr. Dixon's laboratory studies the effect of high concentrations of salt and urea, known as hyperosmolality, on the ability of cells in the kidneys and urinary tract to protect themselves from these hostile conditions and carry out normal biological processes such as cell division and metabolism under such stress. Dr. Dixon's research currently focuses on how kidney cells can detect hyperosmolality in the environment around them in order to switch on vital cellular programs to withstand these conditions. He, and his collaborators both at Cincinnati Children's and the UC College of Medicine, are investigating how primary cilia act as sensors of hyperosmolality in kidney cells. Dr. Dixon is also involved in translational research focusing on the diagnostic evaluation of patients with thrombotic microangiopathies, a group of disorders which cause blood vessel inflammation and clotting leading to organ damage, through his work in the Nephrology Clinical Laboratory. Dr. Dixon is particularly interested in making clinical testing for the major forms of thrombotic microangiopathy more efficient and meaningful as well as investigating new tests for these disease processes.

Mark Mitsnefes, MD MS

Dr. Mitsnefes' research interest has been to define biologic targets for interventions to prevent progression of cardiovascular disease in children with chronic kidney disease, through epidemiological and translational studies. Dr. Mitsnefes is a co-investigator and co-chair of the cardiovascular subcommittee in the multicenter NIH funded study of chronic kidney disease in children, the CKiD study. In one published study, the CKiD investigators examined the effect of blood pressure control on frequency of left ventricular hypertrophy (LVH). This study indicated that better BP control over time was associated with regression of LVH. Another published CKiD study analyzed sphingolipid levels. This is the first study indicating that ceramide levels are increased in children with CKD. One of the ceramides, lactosylceramide was identified as an independent predictor of lower systolic function in these children.

Edward Nehus, MD MS

Dr. Nehus' research interest is in comparative effectiveness research with special emphasis on long-term outcomes of pediatric kidney transplant recipients. This past year, he completed a nationwide study of focal and segmental glomerulosclerosis (FSGS), the second leading cause of kidney failure in children. This study investigated national trends in FSGS leading to kidney transplant and analyzed risk factors for recurrence of disease. Dr. Nehus' research demonstrated that FSGS as a cause of pediatric kidney failure is on the rise, and that recurrence risk is highest in young, white children. He also has ongoing research efforts in many other areas, including steroid use in pediatric kidney transplant, chronic kidney disease in obesity, and pharmacokinetic alterations that occur in children receiving continuous renal replacement therapy.

Michael Bennett, PhD

Dr. Bennett is the director of the Cincinnati Children's Biomarker Laboratory and co-director of the Center of Excellence in Pediatric Nephrology Proteomics Core. His primary research interests include biomarkers and mechanisms of nephrotic syndrome and lupus nephritis. An exciting ongoing project that has continued this past year is the validation and addition of new candidates to an investigational panel of biomarkers that can

distinguish steroid sensitive from steroid resistant nephrotic syndrome. This panel has the potential to assist physicians in the early diagnosis of steroid resistance and help them to tailor more appropriate treatment plans for patients with this serious and progressive disease. Additionally, Dr. Bennett's group has established reference values for Acute Kidney Injury Biomarkers in healthy children, which is a necessary step in bringing these markers from the bench into clinical practice.

David Hooper, MD MS

Dr. Hooper's research interests lie in improving clinical outcomes for children with kidney disease through the design of reliable healthcare systems. His primary focus is to combine clinical outcomes research with quality improvement methodology to reliably prevent cardiovascular disease, the leading cause of long-term death and disability in children with kidney disease. During the past year, Dr. Hooper led the effort to develop a clinical registry for the chronic kidney disease, dialysis and kidney transplant patients capable of tracking process of care and outcomes in near real time for more than 30 different measures. He has led the Kidney Transplant Innovation Team in implementing practice change such as routine 24-hr ambulatory blood pressure monitoring and quality of life and psychosocial assessment for all kidney transplant recipients. Furthermore he has led the design of a sophisticated comprehensive web-based pre-visit planning tool that integrates medical record data, medication pharmacokinetic data and patient adherence data to provide decision support in kidney transplant care. Dr. Hooper is extending the reach of Cincinnati Children's Hospital Medical Center by applying the lessons learned in reliable care at Cincinnati Children's by developing a learning health network for children with a kidney transplant throughout the United States.

Rene Vandevoorde, MD

Dr. VanDeVoorde is the medical director of Dialysis. His research interest lies in the different sequelae of chronic kidney disease in children with a focus on end stage renal disease and dialysis. He participates in multi-center studies or registry based analysis of interventions and outcomes. Particular areas of include anemia management, bone and mineral disease, growth, psychosocial development, and associated morbidities of dialysis. He is the lead investigator for four studies looking at the safety and efficacy of drugs in advanced chronic kidney disease specifically in children: an intravenous iron supplement, a calcimimetic agent which binds the calcium-sensing receptor of the parathyroid gland, and a phosphate binder. Our dialysis unit is also one of 27 pediatric units examining factors to reduce the rate of infections in children receiving dialysis. This project has shown a 27% reduction in peritonitis rates in infants and children receiving peritoneal dialysis. The successes of this collaboration has spawned additional investigations into the risk of peritonitis in infants who have much higher risk, interventions to reduce the rate of blood stream infections with hemodialysis catheters, and the overall cost of dialysis related infections.

Jens Goebel, MD

Dr. Goebel is the clinical director of Nephrology and medical director of Kidney transplantation. His research interests focus on a better understanding of immune mechanisms affecting transplant outcomes. He has continued to advance knowledge about immunosuppressive agents used in pediatric kidney transplantation, and about renal issues in pediatric bone marrow transplantation. Examples for the former include the use of pharmacogenetics to better predict patients' responses to drugs such tacrolimus or mycophenolate and the application of advanced immune phenotyping to further characterize possibly tolerogenic effects of sirolimus. Examples for the latter are ongoing work in pediatric bone marrow transplantation to further characterize the role of BK virus as a significant pathogen in that field and to develop novel insights into thrombotic microangiopathy, a dreaded complication seen in patients who receive bone marrow transplants. Dr. Goebel also remains actively involved in work focusing on adherence and quality improvement in pediatric kidney transplantation, and he continues his role as center-PI for the CKID study, a large, NIH-sponsored effort to

better understand the effects of chronic kidney disease in children over time.

Donna Claes, MD MS

By creating a highly reliable, clinical care delivery system, Dr. Claes' academic interest is to significantly slow the rate of decline in kidney function over time in pediatric chronic kidney disease (CKD) patients at Cincinnati Children's by focusing on the improved treatment of common associated comorbidities – such as hypertension and proteinuria. In less than twelve months, Dr. Claes has lead a team composed of clinical providers, outcome managers, and data analysts to first define the overall quality of care we wish to achieve in this patient population and then build the necessary framework and decision support tools to process and assimilate relevant outcome data over time. As there are no national benchmarks to compare the rate of pediatric CKD progression across the US by center – especially in regards to the management of these common comorbidities associated with CKD progression - Dr. Claes' vision is for Cincinnati Children's to become the leader in pediatric CKD care delivery. Dr. Claes is also the site PI for multi-center clinical and pharmacologic studies directed at the pediatric nephrotic syndrome patient population, including the NIH funded longitudinal study, CureGN.

Elif Erkan, MD MS

Dr. Erkan's research focus is to understand the mechanisms underlying the detrimental effects of proteinuria in glomerular diseases and to examine the protein-protein interactions involved in protein endocytosis in the proximal tubule. She investigates the mechanism of albumin endocytosis in proximal tubule epithelial cells and determines how albumin overload may contribute to tubular apoptosis/autophagy in glomerular diseases. The goal is to dissect the molecular pathways and specific protein-protein interactions involved in cross-talk between apoptosis and autophagy in glomerular disease particularly in focal segmental glomerulosclerosis (FSGS). She has also initiated collaborations to understand the metabolic derangements that may play a role in progressive nature of FSGS by examining the urinary metabolomics of patients with FSGS. In addition, she seeks to determine the effect of insulin induced signaling pathways in albumin endocytosis in the proximal tubule. She has demonstrated a novel pathway linking insulin signaling to albumin endocytosis through downstream insulin mediator protein kinase B (Akt) in proximal tubule epithelial cells.

Brian Siroky, PhD

Dr. Siroky's laboratory is focused on understanding the mechanisms of renal cyst and tumor formation that occur in the inherited disease Tuberous Sclerosis Complex (TSC), and the identification of targeted therapies for these lesions. In a recently published study, he provided evidence that TSC-associated renal angiomyolipomas originate from a specialized vascular cell, the pericyte, and may respond to therapies that target angiotensin II receptor signaling, a vascular cell signaling pathway. He is also interested in the structural and functional relationship between renal epithelial primary cilia, which are specialized cellular organelles whose dysfunction is linked to cystogenesis, and mTOR signaling, the pathway that is dysregulated in TSC. Dr. Siroky also collaborates on a project studying the mechanisms by which renal epithelial cells sense and adapt to a hyperosmolal microenvironment, specifically the role of the primary cilium in this process.

Significant Publications

Ronco C, Garzotto F, Brendolan A, Zanella M, Bellettato M, Vedovato S, Chiarenza F, Ricci Z, **Goldstein SL**. Continuous renal replacement therapy in neonates and small infants: development and first in-human use of a miniturised machine CARPEDIEM. *Lancet*. 2014 24;383(9931):1807-13.

Continuous renal replacement therapy in neonates and small children: development and first-in-human use of a miniaturised machine (CARPEDIEM). *The Lancet*; 383:1807-13, 2014. This paper represents the culmination of

a 5-year project to develop, validate and apply a novel acute continuous renal replacement therapy (CRRT) platform specifically designed for the critically ill neonatal population with acute kidney injury (AKI). Prior to CARPEDIEM, all CRRT platforms had been designed for adults or larger children, requiring often label use in smaller pediatric populations, with system tolerances that represented a challenge to provision of optimal pediatric care for the most vulnerable populations. This report of the 3 kg child with severe AKI and multi-organ failure treated with CARPEDIEM highlights the importance of developing pediatric specific devices, as this child likely would not have survived using previous technologies.

Kupferman J, Aronson Friedman L, Cox C, Flynn J, Furth S, Warady B, **Mitsnefes MM. BP Control and Left Ventricular Hypertrophy Regression in Children with CKD.** *J Am Soc Nephrol*, 2014; 25(1):167-74.

This is the largest longitudinal study analyzing the effect of blood pressure on cardiac structure in children with chronic kidney disease stages 2-4. In this study, hypertension was found to be strongly associated with left ventricular hypertrophy. Importantly, any decrease in blood pressure also corresponded to regression of left ventricular hypertrophy over time, with a decline in the actual prevalence of left ventricular hypertrophy from 16% to 11% after the 4 year period of observation. The study concluded that regression of left ventricular hypertrophy can be accomplished with better blood pressure control.

Nehus E, Goebel J, Succop P, Abraham E. Focal segmental glomerulosclerosis in children: multivariate analysis indicates that donor type does not alter recurrence risk. *Transplantation*. 2013 96(6):550-4.

This retrospective study evaluated risk factors for recurrence of focal segmental glomerulosclerosis (FSGS) in pediatric kidney transplant recipients, with special emphasis on donor type (living vs. deceased donor). The study reported the novel findings that FSGS recurrence is highest in young, white children, whereas donor type was not independently associated with increased risk of recurrence.

Division Publications

1. Al-Uzri A, Matheson M, Gipson DS, Mendley SR, Hooper SR, Yadin O, Rozansky DJ, Moxey-Mims M, Furth SL, Warady BA, Gerson AC, Chronic Kidney Disease in Children Study G. **The impact of short stature on health-related quality of life in children with chronic kidney disease.** *J Pediatr*. 2013; 163:736-41 e1.
2. Barletta GM, Flynn J, Mitsnefes M, Samuels J, Friedman LA, Ng D, Cox C, Poffenbarger T, Warady B, Furth S. **Heart rate and blood pressure variability in children with chronic kidney disease: a report from the CKiD study.** *Pediatr Nephrol*. 2014; 29:1059-65.
3. Basu RK, Zappitelli M, Brunner L, Wang Y, Wong HR, Chawla LS, Wheeler DS, Goldstein SL. **Derivation and validation of the renal angina index to improve the prediction of acute kidney injury in critically ill children.** *Kidney Int*. 2014; 85:659-67.
4. Claes DJ, Yin H, Goebel J. **Protective immunity and use of bortezomib for antibody-mediated rejection in a pediatric kidney transplant recipient.** *Pediatr Transplant*. 2014; 18:E100-5.
5. Cruz DN, Ferrer-Nadal A, Piccinni P, Goldstein SL, Chawla LS, Alessandri E, Belluomo Anello C, Bohannon W, Bove T, Brienza N, Carlini M, Forfori F, Garzotto F, Gramaticopolo S, Iannuzzi M, Montini L, Pelaia P, Ronco C, Investigators N. **Utilization of small changes in serum creatinine with clinical risk factors to assess the risk of AKI in critically ill adults.** *Clin J Am Soc Nephrol*. 2014; 9:663-72.
6. Davison D, Basu RK, Goldstein SL, Chawla LS. **Fluid management in adults and children: core curriculum 2014.** *Am J Kidney Dis*. 2014; 63:700-12.
7. Devarajan P. **Acute kidney injury in children: Clinical features, etiology, evaluation, and diagnosis.** In: TK Mattoo, MS Kim, eds. *UpToDate*. Waltham, MA: UpToDate; 2014.
8. Devarajan P. (2014) **Denys-Drash Syndrome.** New York, Medscape. .

9. Devarajan P. (2014) **Oliguria**. New York, Medscape. .
10. Devarajan P. **Prevention and management of acute kidney injury (acute renal failure) in children**. In: TK Mattoo, MS Kim, eds. *UpToDate*. Waltham, MA: UpToDate; 2014.
11. Devarajan P. **NGAL for the detection of acute kidney injury in the emergency room**. *Biomark Med*. 2014; 8:217-9.
12. Devarajan P. (2013) **Medullary Cystic Disease**. New York, Medscape. .
13. Devarajan P. (2013) **Renal Cortical Necrosis**. New York, Medscape. .
14. Devarajan P, Arnold W. (2014) **Myoglobinuria**. New York, Medscape. .
15. Devarajan P, Chen Z. **Autoimmune effector memory T cells: the bad and the good**. *Immunol Res*. 2013; 57:12-22.
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17. Funk JA, Janech MG, Dillon JC, Bissler JJ, Siroky BJ, Bell PD. **Characterization of renal toxicity in mice administered the marine biotoxin domoic Acid**. *J Am Soc Nephrol*. 2014; 25:1187-97.
18. Goldstein SL, Chawla L, Ronco C, Kellum JA. **Renal recovery**. *Crit Care*. 2014; 18:301.
19. Goldstein SL, Kirkendall E, Nguyen H, Schaffzin JK, Bucuvalas J, Bracke T, Seid M, Ashby M, Foertmeyer N, Brunner L, Lesko A, Barclay C, Lannon C, Muething S. **Electronic health record identification of nephrotoxin exposure and associated acute kidney injury**. *Pediatrics*. 2013; 132:e756-67.
20. Haase-Fielitz A, Haase M, Devarajan P. **Neutrophil gelatinase-associated lipocalin as a biomarker of acute kidney injury: a critical evaluation of current status**. *Ann Clin Biochem*. 2014; 51:335-51.
21. Henske EP, Rasooly R, Siroky B, Bissler J. **Tuberous sclerosis complex, mTOR, and the kidney: report of an NIDDK-sponsored workshop**. *Am J Physiol Renal Physiol*. 2014; 306:F279-83.
22. Homik CP, Krawczeski CD, Zappitelli M, Hong K, Thiessen-Philbrook H, Devarajan P, Parikh CR, Patel UD, Consortium T-A. **Serum brain natriuretic Peptide and risk of acute kidney injury after cardiac operations in children**. *Ann Thorac Surg*. 2014; 97:2142-7.
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24. Inge TH, King WC, Jenkins TM, Courcoulas AP, Mitsnefes M, Flum DR, Wolfe BM, Pomp A, Dakin GF, Khandelwal S, Zeller MH, Horlick M, Pender JR, Chen JY, Daniels SR. **The effect of obesity in adolescence on adult health status**. *Pediatrics*. 2013; 132:1098-104.
25. Inge TH, Zeller MH, Jenkins TM, Helmuth M, Brandt ML, Michalsky MP, Harmon CM, Courcoulas A, Horlick M, Xanthakos SA, Dolan L, Mitsnefes M, Barnett SJ, Buncher R, Teen LC. **Perioperative outcomes of adolescents undergoing bariatric surgery: the Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS) study**. *JAMA Pediatr*. 2014; 168:47-53.
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27. Jodele S, Licht C, Goebel J, Dixon BP, Zhang K, Sivakumaran TA, Davies SM, Pluthero FG, Lu L, Laskin BL. **Abnormalities in the alternative pathway of complement in children with hematopoietic stem cell transplant-associated thrombotic microangiopathy**. *Blood*. 2013; 122:2003-7.
28. Kingswood JC, Jozwiak S, Belousova ED, Frost MD, Kuperman RA, Bebin EM, Korf BR, Flamini JR,

- Kohrman MH, Sparagana SP, Wu JY, Brechenmacher T, Stein K, Berkowitz N, Bissler JJ, Franz DN. **The effect of everolimus on renal angiomyolipoma in patients with tuberous sclerosis complex being treated for subependymal giant cell astrocytoma: subgroup results from the randomized, placebo-controlled, Phase 3 trial EXIST-1.** *Nephrol Dial Transplant.* 2014; 29:1203-10.
29. Klinger AS, Foley RN, Goldfarb DS, Goldstein SL, Johansen K, Singh A, Szczech L. **KDOQI US commentary on the 2012 KDIGO Clinical Practice Guideline for Anemia in CKD.** *Am J Kidney Dis.* 2013; 62:849-59.
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35. Mitsnefes MM. **Ambulatory arterial stiffness index: Is there an additional value to characterize cardiovascular risk in children with kidney transplant?.** *Pediatr Transplant.* 2013; 17:595-7.
36. Nehus EJ, Goebel JW, Succop PS, Abraham EC. **Focal segmental glomerulosclerosis in children: multivariate analysis indicates that donor type does not alter recurrence risk.** *Transplantation.* 2013; 96:550-4.
37. Paoli S, Mitsnefes MM. **Coronary artery calcification and cardiovascular disease in children with chronic kidney disease.** *Curr Opin Pediatr.* 2014; 26:193-7.
38. Peralta C, Scherzer R, Grunfeld C, Abraham A, Tien P, Devarajan P, Bennett M, Butch A, Anastos K, Cohen M, Nowicki M, Sharma A, Young M, Samak M, Parikh C, Shlipak M. **Urinary biomarkers of kidney injury are associated with all-cause mortality in the Women's Interagency HIV Study (WIHS).** *HIV Med.* 2014; 15:291-300.
39. Riley AA, Jefferies JL, Nelson DP, Bennett MR, Blinder JJ, Ma Q, Devarajan P, Goldstein SL. **Peritoneal dialysis does not adversely affect kidney function recovery after congenital heart surgery.** *Int J Artif Organs.* 2014; 37:39-47.
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41. Schaffzin JK, Dodd CN, Nguyen H, Schondelmeyer A, Campanella S, Goldstein SL. **Administrative data misclassifies and fails to identify nephrotoxin-associated acute kidney injury in hospitalized children.** *Hosp Pediatr.* 2014; 4:159-66.
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43. Srivaths P, Krishnamurthy R, Brunner L, Logan B, Bennett M, Ma Q, VanDeVoorde R, Goldstein SL.

Cardiac calcifications are more prevalent in children receiving hemodialysis than peritoneal dialysis.

Clin Nephrol. 2014; 81:231-7.

44. Swiatecka-Urban A, Devarajan P. (2014) **Anti-GBM Antibody Disease**. New York, Medscape. .

45. Xiao N, Tandon A, Goldstein S, Lorts A. **Cardiogenic shock as the initial presentation of neonatal systemic hypertension**. *J Neonatal Perinatal Med.* 2013; 6:267-72.

Faculty, Staff, and Trainees

Faculty Members

Prasad Devarajan, MD, Professor

Leadership Louise M. Williams Endowed Chair; Director, Division of Nephrology and Hypertension; Director, Clinical Nephrology Laboratory; CEO, Dialysis Unit; Director, Nephrology Fellowship Training Program

Research Interests Pathogenesis, biomarkers, and novel therapies of acute kidney injury; Pathogenesis and biomarkers of focal segmental glomerulosclerosis; Pathogenesis and biomarkers of lupus nephritis

Michael Bennett, PhD, Assistant Professor

Leadership Director, Biomarker Laboratory

Research Interests Biomarker discovery in acute and chronic kidney disease; focal segmental glomerulosclerosis

Donna Claes, MD, Assistant Professor

Research Interests Clinical trials in nephrotic syndrome and chronic kidney disease

Bradley P. Dixon, MD, Assistant Professor

Research Interests DNA damage and repair, cell biology of the augmented bladder, atypical hemolytic uremic syndrome and thrombotic thrombocytopenic purpura

Elif Erkan, MD, Associate Professor

Research Interests Mechanisms of proteinuria - induced kidney damage

Jens Goebel, MD, Professor

Leadership Medical Director of Transplantation; Clinical Director, Nephrology; Associate Division Co-Director

Research Interests Advancing basic and translational investigations into immunological aspects especially relevant to the field of transplantation

Stuart Goldstein, MD, Professor

Leadership Director, Center for Acute Care Nephrology; Medical Director, Pheresis Service; Associate Division Co-Director

Research Interests Acute Kidney Injury, End Stage Renal Disease, Multi-Organ Dysfunction Syndrome, Continuous Renal Replacement Therapy, Cardio-Renal Syndrome, Nephrotoxic medication injury

Elizabeth Jackson, MD, Associate Professor

Leadership Director, Healthy Bladder Clinic

Research Interests Nocturnal enuresis, kidney stones, lower urinary tract dysfunction

Paul McEnery, MD, Professor Emeritus

Research Interests Glomerulonephritis; vitamin D resistant rickets; End Stage Renal Disease

Mark Mitsnefes, MD, Professor

Leadership Program Director, Clinical Translational Research Center

Research Interests Cardiovascular abnormalities and risk factors for increased cardiac morbidity and mortality in children with CKD; evaluation of LVH; cIMT; hypertension

Edward Nehus, MD, Assistant Professor

Leadership Associate Director, Nephrology Fellowship Program

Research Interests Comparative effectiveness research with special emphasis on long-term outcomes of pediatric kidney transplant recipients

C. Frederic Strife, MD, Professor Emeritus

Research Interests Clinical aspects of glomerulonephritis and dialysis

Rene Vandevoorde, MD, Assistant Professor

Leadership Medical Director, Dialysis Unit

Research Interests Chronic Kidney Disease; Dialysis including Infant Dialysis; Epidemiology of Renal Diseases; Medical Education

David Hooper, MD, Assistant Professor

Research Interests Reliable and innovative chronic disease management, cardiovascular outcomes following kidney transplantation

Trainees

- **Ahmad Kaddourah, MD**, PL-3
- **Nianzhou Xiao, MD**, PL-3
- **Stella Shin, MD**, PL-2
- **LaTawnya Pleasant-Griffin, MD**, PL-2
- **Keri Drake, MD**, PL-1
- **Gilad Hamdani, MD**, PL-1

Grants, Contracts, and Industry Agreements

Grant and Contract Awards

Annual Direct

DEVARAJAN, P

2014 Medical Student Summer Research Program

National Institutes of Health

P50 DK 096418	06/01/14-08/31/14	\$28,000
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Critical Translational Studies in Pediatric Nephrology

National Institutes of Health

P50 DK 096418	09/21/12-08/31/17	\$512,018
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Novel Biomarkers in Cardiac Surgery to Detect Acute Kidney Injury

National Institutes of Health(Yale University School of Medicine)

R01 HL 085757	04/12/12-03/31/17	\$17,393
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Novel Serum and Urinary Biomarkers of Diabetic Kidney Disease

National Institutes of Health(Yale University School of Medicine)

R01 DK 096549	09/01/12-06/30/17	\$5,774
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Progression of Acute Kidney Injury to Chronic Kidney Disease		
National Institutes of Health(Yale University School of Medicine)		
	09/19/13-06/30/18	\$20,000
DIXON, B		
DNA Damage and Response in the Bladder Microenvironment.		
National Institutes of Health		
K08 DK 081737	07/01/11-04/30/15	\$136,922
GOLDSTEIN, S		
Drug Induced Renal Injury Consortium (DIRECT)		
International Serious Adverse Events Con		
	05/01/13-04/30/15	\$23,077
Pediatric Kidney Disease: AKI and Acute Kidney Function Biomarkers		
Casey Lee Ball Foundation		
	09/01/13-08/31/15	\$100,000
Pharmacokinetics of Understudied Drugs Administered to Children per Standard of Care		
National Institutes of Health(Duke University)		
HHSN-2752010000031	02/27/13-06/25/15	\$8,085
Antibiotic Safety in Infants with Complicated Intra-Abdominal Infections		
National Institutes of Health(Duke University)		
HHSN-2752010000031	05/07/14-09/23/16	\$3,080
MITSNEFES, M		
Cardiovascular Disease in Children with Chronic Kidney Disease		
National Institutes of Health		
K24 DK 090070	07/01/11-06/30/16	\$158,114
Cincinnati Center for Clinical and Translational Sciences and Training		
National Institutes of Health(University of Cincinnati)		
UL1 TR 000077	04/30/09-03/31/15	\$1,247,115
Current Year Direct		\$2,259,578
Industry Contracts		
BISSLER, J		
Novartis Pharmaceuticals		\$425,979
DIXON, B		
Otsuka Pharmaceutical Development		\$17,363
GOEBEL, J		
Millennium Pharmaceuticals		\$751

GOLDSTEIN, S

Gambro Renal Products, Inc		\$27,874
Current Year Direct Receipts		\$471,967
Total		\$2,731,545