Rheumatology

Division Details

RESEARCH AND TRAINING DETAILS	
Faculty	**10**
Joint Appointment Faculty	**2**
Research Graduate Students	**3**
Total Annual Grant Award Dollars	**$937,626**
Total Annual Industry Award Dollars	**$1,002,401**
Total Publications	**48**

CLINICAL ACTIVITIES AND TRAINING	
Clinical Fellows	**6**
Inpatient Encounters	**569**
Outpatient Encounters	**6,006**

Row 1: R Mina, H Brunner, S Thornton, E Morgan, T Ting

Row 2: J Huggins, J Taylor, G Schulert, M Henrickson

Research Highlights

Bringing Best Practice Care to Children with Pediatric Rheumatic Diseases

The PR-COIN (Pediatric Rheumatology Care and Outcomes Improvement Network) is dedicated to improving remission rates in children with juvenile idiopathic arthritis, and focuses on identifying and spreading best practice care amongst the 18 participating hospitals. Esi Morgan, MD, MSCE, working with the Learning Networks Program of the James M. Anderson Center for Health Systems Excellence, has led PR-COIN and, demonstrated improvement in processes of care delivery and patient outcomes; more children now have inactive disease or lower disease activity thanks to the work of PR-COIN. The PR-COIN cohort consists of over 4,700 children with juvenile idiopathic arthritis (JIA). Further, PR-COIN expanded and now includes children with lupus.

Data from patient visits are entered into a shared registry and used for clinical care, quality improvement and research. Network teams review data and then share progress during monthly webinars. Cincinnati Children's care providers also share advance quality improvement initiatives with other PR-COIN teams during semiannual two-day learning sessions. Parent volunteers are very involved as co-producers in the PR-COIN improvement work, interacting closely with the rheumatology provider teams. PR-COIN has focused on self-management assessment and interventions during 2015-2016 including creating a new version of a “Helping Hands” book of materials for newly diagnosed families in partnership with parents, funded by AHRQ (PI Carole Lannon). In the past year, PR-COIN has transitioned to a new registry platform, and has partnered with Epic Corporation to develop standardized medical records template to enable a “data-in-once” strategy to allow clinical data to be efficiently re-purposed for quality improvement and research in the PR-COIN registry. The network has received grant funding (Current Opinion in Rheumatology) from AHRQ, PCORI, Pfizer and Novartis.

Research Flow Cytometry Core Provides Novel Technologies for CCHMC Investigators

Directed by Sherry Thornton, PhD, the Division of Rheumatology houses the Research Flow Cytometry Core (RFCC) and provides state-of-the-art equipment to over 140 research investigators to perform single cell analysis. In the last year, funding from the Research Foundation enabled the core to increase the capacity for highly multi-parametric flow cytometry that provides capability for more detailed cellular analysis. Furthermore, researchers developed an educational program for this technology, and offered it to our users. Three NIH center grants supports the core, the Cincinnati Rheumatic Disease Core Center (now funded for years 16-20 of the grant), the Center for Excellence in Molecular Hematology and the Digestive Health Center. To enhance the research of Cincinnati Children's investigators, the RFCC works closely with other core facilities-collaborations with Cincinnati Children's Gene Expression Core and its DNA Sequencing and Genotyping Core have improved the workflow of combining cell sorting and single cell analysis for RNA sequencing. Such innovative activities of the RFCC were presented at a workshop on "Bridging Flow Cytometry with New Technologies" at the 2015 Annual Meeting of the International Society for the Advancement of Cytometry in Glasgow, Scotland.

MicroRNA may serve as key regulators of inflammation in systemic juvenile idiopathic arthritis

Systemic juvenile idiopathic arthritis (JIA) is a chronic inflammatory disorder of childhood associated with potentially destructive arthritis and high risk of life-threatening complications. MicroRNA serve as key epigenetic regulators during inflammation, “fine-tuning” cellular responses including monocyte activation and polarization. In systemic JIA, innate immune cells including monocytes are thought to be key effectors, but the function and regulation of these cells remains largely unknown. In this study, Dr. Grant Schulert, and colleagues, identified significantly altered microRNA expression profiles in monocytes from children with active systemic JIA, including elevated miR-125a-5p which correlated with clinical and laboratory features of inflammation. Additionally, in vitro manipulation of miR-125a-5p levels altered polarized monocyte phenotypes, with overexpression enhancing features observed in systemic JIA. Together, these findings suggest that microRNA alterations impact the phenotype of monocytes in systemic JIA, and could represent novel targets for immune regulation.

Imaging Research in Neuro-Psychiatric Lupus

Supported by funding from the Lupus Foundation of America, collaborative research by Dr. Mark DiFrancesco, the Division of Radiology, and Dr. Hermine Brunner, the Division of Rheumatology, used advanced magnetic resonance imaging techniques to delineate the effects of lupus on the brain of children.

The team of researchers showed that impaired cognition in children with lupus associates with a significant decrease in global streamline density, depicted by diffusion tensor imaging ($p = 0.002$). This finding suggests that neuropsychiatric lupus associates with a breakdown of the structural neuronal network. Further, using arterial spin labeling interleaved with diffusion-weighted imaging, Drs. DiFrancesco and Brunner developed a new imaging method to non-invasively depict the integrity of the blood-brain barrier.

In a pilot study, researchers found children with lupus, and clinically normal cognitive ability, experienced a significant regional “leakiness” of their blood-brain barrier, thought to be the basis for pathological antibodies and inflammatory cytokines to reach the brain tissue resulting in degenerative changes to the brain. Taken together, changes in streamline density and blood-brain-barrier function measurement appear to be excellent candidates to serve as imaging biomarkers for neuropsychiatric lupus therapies.

Significant Publications

Thornton S, Strait, RT. **Head-to-head comparison of protocol modifications for the generation of collagen-induced arthritis in a specific-pathogen free facility using DBA/1 mice**. *BioTechniques*. 2016 Mar 1;60(3):119-28.

Collagen-induced arthritis is a widely used a model of inflammatory arthritis. However, protocols have differed between laboratories and animal facilities, with head-to head comparison of differing protocols not reported to date. Our studies indicated that administering various combinations of arthritis-inducing components, can achieve various grades of arthritic severity to robustly assess factors that predict to either inhibit or exacerbate arthritis. Importantly, by being able to achieve 100% incidence of arthritis in a pathogen free facility, the protocols indicated can reduce the number of mice necessary for an experiment, providing a humane benefit for our arthritis research.

Schulert GS, Zhang M, Fall N, Husami A, Kissell D, Hanosh A, Zhang K, Davis K, Jentzen JM, Napolitano L, Siddiqui J, Smith LB, Harms PW, **Grom AA**, Cron RQ. **Whole-Exome Sequencing Reveals Mutations in Genes Linked to Hemophagocytic Lymphohistiocytosis and Macrophage Activation Syndrome in Fatal Cases of H1N1 Influenza**. *J Infect Dis*. 2016 Apr 1;213(7):1180-8.

Drs. Grant Schulert and Alexei Grom, along with researchers at the University of Alabama Birmingham and the University of Michigan, found that patients with fatal H1N1 influenza infections died after their viral infections triggered a deadly hyperinflammatory disorder in susceptible individuals. According to their study, there is a high incidence of genetic variants in genes linked to familial hemophagocytic lymphohistiocytosis (HLH), a rare genetic inflammatory disorder. HLH causes the immune system to essentially overwhelm the body with inflammation that attacks vital organs, often leading to death. This study is the first to identify mutations of HLH-associated genes in H1N1 cases where patients had clinical symptoms of HLH and a related condition called macrophage activation syndrome (MAS).

Ting TV, Barnett K, Lynch-Jordan A, Whitacre C, **Henrickson M**, Kashikar-Zuck S. **2010 American College of Rheumatology Adult Fibromyalgia Criteria for Use in an Adolescent Female Population with Juvenile Fibromyalgia**. *J Pediatr*. 2016 Feb;169:181-7.

Drs. Tracy Ting and Susmita Kashikar-Zuck led a project that evaluated the utility of the Widespread Pain Index and Symptom Severity Questionnaire adapted from the 2010 ACR criteria for Adult Fibromyalgia for an adolescent population with Juvenile Fibromyalgia (JFM) in comparison to teenagers with localized pain conditions. This study revealed a sensitivity of 89.4% and specificity of 87.5% for JFM, suggesting that this questionnaire can assist with the classification of JFM without the use of the traditional tender point exam.

Kashikar-Zuck S, Carle A, Barnett K, Goldschneider KR, Sherry DD, Mara CA, Cunningham N, Farrell J, Tress J, **Morgan E**. **Longitudinal evaluation of patient-reported outcomes measurement information systems measures in pediatric chronic pain**. *Pain*. 2016 Feb;157(2):339-47.

The Patient Reported Outcomes Measurement Information System (PROMIS) is an initiative sponsored by the National Institutes of Health to support the development and validation of precise instruments to assess self-reported health domains across various health conditions (i.e., cross-cutting measures, not disease specific). The purpose of this study was to investigate the construct validity and responsiveness to change of seven PROMIS domains for the assessment of children with chronic pain – Pain Interference, Fatigue, Anxiety, Depressive Symptoms, Mobility, Upper Extremity Function and Peer Relationships. The study administered PROMIS measures over time to patients treated at either an outpatient chronic pain clinic or in an intensive amplified pain day-treatment program. All seven PROMIS domains showed responsiveness to change and results offered initial support for the validity of PROMIS measures in pediatric chronic pain.

Mina R, Harris JG, Klein-Gitelman MS, Appenzeller S, Centeville M, Eskra D, **Huggins JL**, Johnson AL, Khubchandani R, Khandekar P, Lee J, Liu HM, Pendl JD, Silva CA, Silva MF, Zaal AI, **DeWitt EM**, Ardoin SP, **Brunner HI**. **Initial Benchmarking of the Quality of Medical Care in Childhood-Onset Systemic Lupus Erythematosus**. *Arthritis Care Res (Hoboken)*. 2016 Feb;68(2):179-86.

Drs. Rina Mina and Hermine Brunner assessed the quality of care provided to children with lupus at Pediatric Rheumatology centers in the U.S., Brazil and India. Quality of care measured by the Quality Indicators for childhood-onset lupus, which were previously developed by the Cincinnati Children's team, are based on international consensus. They found marked variation in the quality of care provided at the different U.S. centers with respect to adhering to minimal care standards for lupus nephritis, vaccinations, bone health surveillance, education and transition planning. Overall, larger centers tended to follow the recommended testing, evaluation, education and treatment for children with lupus more consistently than smaller centers, irrespective of country of practice.

Division Publications

1. Abulaban KM, Fall N, Nunna R, Ying J, Devarajan P, Grom A, Bennett M, Ardoin SP, Brunner HI. **Relationship of Cell-Free Urine Microrna with Lupus Nephritis in Children.** *Pediatr Rheumatol Online J*. 2016; 14:4.
2. Aggarwal R, Ringold S, Khanna D, Neogi T, Johnson S, Miller A, Brunner H, Ogawa R, Felson D, Ogdie A. **Distinctions between Diagnostic and Classification Criteria?** *Arthritis Care Res (Hoboken)*. 2015; 67:891-97.

3. Askew RL, Cook KF, Keefe FJ, Nowinski CJ, Cella D, Revicki DA, Morgan DeWitt EM, Michaud K, Trence DL, Amtmann D. **A Promis Measure of Neuropathic Pain Quality.** *Value Health*. 2016; 19:623-30.

4. Bracaglia C, de G, K, Marafon D, Guilhot F, Ferlin W, Prencipe G, Caiello I, Davì S, Schulert G, Ravelli A. **Elevated Circulating Levels of Interferon-? And Interferon-?-Induced Chemokines Characterise Patients with Macrophage Activation Syndrome Complicating Systemic Juvenile Idiopathic Arthritis.** *Ann Rheum Dis*. 2016.

5. Cunningham NR, Tran ST, Lynch-Jordan AM, Ting TV, Sil S, Strotman D, Noll JG, Powers SW, Arnold LM, Kashikar-Zuck S. **Psychiatric Disorders in Young Adults Diagnosed with Juvenile Fibromyalgia in Adolescence.** *J Rheumatol*. 2015; 42:2427-33.

6. DeWalt D, Gross H, Gipson D, Selewski D, DeWitt E, Dampier C, Hinds P, Huang I-C, Thissen D, Varni J. **Promis (R) Pediatric Self-Report Scales Distinguish Subgroups of Children within and across Six Common Pediatric Chronic Health Conditions.** *Qual Life Res*. 2015; 24:2195-208.

7. Dodds CM, Britto MT, Denson LA, Lovell DJ, Saeed S, Lipstein EA. **Physicians' Perceptions of Shared Decision Making in Chronic Disease and Its Barriers and Facilitators.** *J Pediatr*. 2016; 171:307-9 e1-2.

8. Feldon M, Sikora K, Huggins JL, Billings SD, McMasters R, Brunner HI. **Polyarticular Arthritis and Skin Nodulosis in a 14-Year-Old Female.** *Arthritis Care Res (Hoboken)*. 2016; 68:700-5.

9. Grom A. **Juvenile Idiopathic Arthritis: Epidemiology and Immunopathogenesis**. Watham MA: UpToDate; 2015 [updated August 24, 2015].

10. Grom AA, Horne A, De Benedetti F. **Macrophage Activation Syndrome in the Era of Biologic Therapy.** *Nat Rev Rheumatol*. 2016; 12:259-68.

11. Grom AA, Ilowite NT, Pascual V, Brunner HI, Martini A, Lovell D, Ruperto N, Paediatric Rheumatology International Trials O, the Pediatric Rheumatology Collaborative Study G, Leon K, Lheritier K, Abrams K. **Rate and Clinical Presentation of Macrophage Activation Syndrome in Patients with Systemic Juvenile Idiopathic Arthritis Treated with Canakinumab.** *Arthritis Rheumatol*. 2016; 68:218-28.

12. Gulati G, Jones J, Lee G, Altaye M, Beebe D, Meyers-Eaton J, Wiley K, Brunner H, DiFrancesco M. **Blood Brain Barrier Permeability Is Altered in Patients with Systemic Lupus Erythematosus: A Novel Imaging Approach.** *Arthritis Care Res (Hoboken)*. 2016.

13. Harris JG, Bingham CA, Morgan EM. **Improving Care Delivery and Outcomes in Pediatric Rheumatic Diseases.** *Curr Opin Rheumatol*. 2016; 28:110-6.

14. Jacobson CJ, Jr., Kashikar-Zuck S, Farrell J, Barnett K, Goldschneider K, Dampier C, Cunningham N, Crosby L, DeWitt EM. **Qualitative Evaluation of Pediatric Pain Behavior, Quality, and Intensity Item Candidates and the Promis Pain Domain Framework in Children with Chronic Pain.** *J Pain*. 2015; 16:1243-55.

15. Jones J, Carle A, Wootton J, Liberio B, Lee J, Schanberg L, Ying J, DeWitt E, Brunner H. **Validation of Patient-Reported Outcomes Measurement Information System (Promis®) Short Forms for Use in Childhood-Onset Systemic Lupus Erythematosus.** *Arthritis Care Res (Hoboken)*. 2016.

16. Jones J, DiFrancesco M, Zaal A, Klein-Gitelman M, Gitelman D, Ying J, Brunner H. **Childhood-Onset Lupus with Clinical Neurocognitive Dysfunction Shows Lower Streamline Density and Pairwise Connectivity on Diffusion Tensor Imaging.** *Lupus*. 2015; 24:1081-86.

17. Jones JT, Cunningham N, Kashikar-Zuck S, Brunner HI. **Pain, Fatigue, and Psychological Impact on Health-Related Quality of Life in Childhood-Onset Lupus.** *Arthritis Care Res (Hoboken)*. 2016; 68:73-80.

18. Kashikar-Zuck S, Carle A, Barnett K, Goldschneider KR, Sherry DD, Mara CA, Cunningham N, Farrell J, Tress J, DeWitt EM. **Longitudinal Evaluation of Patient-Reported Outcomes Measurement Information Systems Measures in Pediatric Chronic Pain.** *Pain*. 2016; 157:339-47.

19. Kashikar-Zuck S, King C, Ting TV, Arnold LM. **Juvenile Fibromyalgia: Different from the Adult Chronic Pain Syndrome?** *Curr Rheumatol Rep*. 2016; 18:19.

20. Kashikar-Zuck S, Tran ST, Barnett K, Bromberg MH, Strotman D, Sil S, Thomas SM, Joffe N, Ting TV, Williams SE, Myer GD. **A Qualitative Examination of a New Combined Cognitive-Behavioral and Neuromuscular Training Intervention for Juvenile Fibromyalgia.** *Clin J Pain*. 2016; 32:70-81.

21. Lipstein E, Dodds C, Lovell D, Denson L, Britto M. **Making Decisions About Chronic Disease Treatment: A Comparison of Parents and Their Adolescent Children.** *Health Expect*. 2016; 19:716-26.

22. Lovell DJ, Ruperto N, Mouy R, Paz E, Rubio-Perez N, Silva CA, Abud-Mendoza C, Burgos-Vargas R, Gerloni V, Melo-Gomes JA, Saad-Magalhaes C, Chavez-Corrales J, Huemer C, Kivitz A, Blanco FJ, Foeldvari I, Hofer M, Huppertz HI, Job Deslandre C, Minden K, et al. **Long-Term Safety, Efficacy, and Quality of Life in Patients with Juvenile Idiopathic Arthritis Treated with Intravenous Abatacept for up to Seven Years.** *Arthritis Rheumatol*. 2015; 67:2759-70.

23. Lynch-Jordan AM, Sil S, Bromberg M, Ting TV, Kashikar-Zuck S. **Cross-Sectional Study of Young Adults Diagnosed with Juvenile Fibromyalgia: Social Support and Its Impact on Functioning and Mood.** *J Adolesc Health*. 2015; 57:482-7.

24. Mina R, Abulaban K, Klein-Gitelman MS, Eberhard BA, Ardoin SP, Singer N, Onel K, Tucker L, O'Neil K, Wright T, Brooks E, Rouster-Stevens K, Jung L, Imundo L, Rovin B, Witte D, Ying J, Brunner HI. **Validation of the Lupus Nephritis Clinical Indices in Childhood-Onset Systemic Lupus Erythematosus.** *Arthritis Care Res (Hoboken)*. 2016; 68:195-202.

25. Mina R, Harris JG, Klein-Gitelman MS, Appenzeller S, Centeville M, Eskra D, Huggins JL, Johnson AL, Khubchandani R, Khandekar P, Lee J, Liu HM, Pendl JD, Silva CA, Silva MF, Zaal AI, DeWitt EM, Ardoin SP, Brunner HI. **Initial Benchmarking of the Quality of Medical Care in Childhood-Onset Systemic Lupus Erythematosus.** *Arthritis Care Res (Hoboken)*. 2016; 68:179-86.

26. Moorthy LN, Muscal E, Riebschleger M, Klein-Gitelman M, Nigrovic LE, Horon JR, Rouster-Stevens K, Ferguson PJ, Eberhard BA, Brunner HI, Prahalad S, Schneider R, Nigrovic PA, American College of Rheumatology Special Committee on P, the Investigators of the Childhood A, Rheumatology Research Alliance. **Efficacy of an Interinstitutional Mentoring Program within Pediatric Rheumatology.** *Arthritis Care Res (Hoboken)*. 2016; 68:645-51.

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29. Ravelli A, Minoia F, Davi S, Horne A, Bovis F, Pistorio A, Arico M, Avcin T, Behrens E, De B, F. **2016 Classification Criteria for Macrophage Activation Syndrome Complicating Systemic Juvenile Idiopathic Arthritis a European League against Rheumatism/American College of Rheumatology/Paediatric Rheumatology International Trials Organisation Collaborative Initiative.** *Arthritis Rheumatol*. 2016; 68:566-76.

30. Ravelli A, Minoia F, Davi S, Horne A, Bovis F, Pistorio A, Arico M, Avcin T, Behrens E, De B, F. **2016 Classification Criteria for Macrophage Activation Syndrome Complicating Systemic Juvenile Idiopathic Arthritis a European League against Rheumatism/American College of Rheumatology/Paediatric Rheumatology International Trials Organisation Collaborative Initiative.** *Ann Rheum Dis*. 2016; 75:481-89.

31. Ravelli A, Minoia F, Davi S, Horne A, Bovis F, Pistorio A, Arico M, Avcin T, Behrens EM, De Benedetti F, Filipovic A, Grom AA, Henter JI, Ilowite NT, Jordan MB, Khubchandani R, Kitoh T, Lehmberg K, Lovell DJ, Miettunen P, et al. **Expert Consensus on Dynamics of Laboratory Tests for Diagnosis of Macrophage Activation Syndrome Complicating Systemic Juvenile Idiopathic Arthritis.** *RMD Open*. 2016; 2:e000161.

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34. Schmeling H, Mahler M, Levy DM, Moore K, Stevens AM, Wick J, McMillan JD, Horneff G, Assassi S, Charles J, Salazar G, Mayes MD, Silverman ED, Klien-Gitelman M, Lee T, Brunner HI, Reed AM, Fritzler MJ. **Autoantibodies to Dense Fine Speckles in Pediatric Diseases and Controls.** *J Rheumatol*. 2015; 42:2419-26.

35. Schulert G, Fall N, Harley J, Shen N, Lovell D, Thornton S, Grom A. **Monocyte Microrna Expression in Active Systemic Juvenile Idiopathic Arthritis Implicates Mir-125a-5p in Polarized Monocyte Phenotypes.** *Arthritis Rheumatol*. 2016.

36. Schulert GS, Bove K, McMasters R, Campbell K, Leslie N, Grom AA. **11-Month-Old Infant with Periodic Fevers, Recurrent Liver Dysfunction, and Perforin Gene Polymorphism.** *Arthritis Care Res (Hoboken)*. 2015; 67:1173-9.

37. Schulert GS, Grom AA. **Outburst of Macrophage Activation Syndrome in Mevalonate Kinase Deficiency: Comment on the Article by Schulert Et Al Reply.** *Arthritis Care Res (Hoboken)*. 2015; 67:1615-16.

38. Schulert GS, Zhang M, Fall N, Husami A, Kissell D, Hanosh A, Zhang K, Davis K, Jentzen JM, Napolitano L, Siddiqui J, Smith LB, Harms PW, Grom AA, Cron RQ. **Whole-Exome Sequencing Reveals Mutations in Genes Linked to Hemophagocytic Lymphohistiocytosis and Macrophage Activation Syndrome in Fatal Cases of H1n1 Influenza.** *J Infect Dis*. 2016; 213:1180-8.

39. Spreafico R, Rossetti M, van Loosdregt J, Wallace CA, Massa M, Magni-Manzoni S, Gattorno M, Martini A, Lovell DJ, Albani S. **A Circulating Reservoir of Pathogenic-Like Cd4+ T Cells Shares a Genetic and Phenotypic Signature with the Inflamed Synovial Micro-Environment.** *Ann Rheum Dis*. 2016; 75:459-65.

40. Thornton S, Strait R. **Head-to-Head Comparison of Protocol Modifications for the Generation of Collagen-Induced Arthritis in a Specific-Pathogen Free Facility Using Dba/1 Mice.** *Biotechniques*. 2016; 60:119-28.

41. Ting T, Barnett K, Lynch-Jordan A, Whitacre C, Henrickson M, Kashikar-Zuck S. **2010 American College of Rheumatology Adult Fibromyalgia Criteria for Use in an Adolescent Female Population with Juvenile Fibromyalgia.** *J Pediatr*. 2016; 169:181.

42. Tran ST, Guite JW, Pantaleao A, Pfeiffer M, Myer GD, Sil S, Thomas SM, Ting TV, Williams SE, Edelheit B, Ounpuu S, Rodriguez-MacClintic J, Zemel L, Zempsky W, Kashikar-Zuck S. **Preliminary Outcomes of a Cross-Site Cognitive-Behavioral and Neuromuscular Integrative Training Intervention for Juvenile Fibromyalgia.** *Arthritis Care Res (Hoboken)*. 2016.

43. Turnier JL, Brunner HI. **Tocilizumab for Treating Juvenile Idiopathic Arthritis.** *Expert Opin Biol Ther*. 2016; 16:559-66.

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47. Yang X, Sherwin CM, Yu T, Yellepeddi VK, Brunner HI, Vinks AA. **Pharmacokinetic Modeling of Therapies for Systemic Lupus Erythematosus.** *Expert Rev Clin Pharmacol*. 2015; 8:587-603.

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Grants, Contracts, and Industry Agreements

Annual Grant Award Dollars

Investigator	Title	Sponsor	ID	Dates	Amount
Hermine Brunner, MD Michael Bennett	Innovative Efficacy Measures of Lupus Nephritis Therapies	National Institutes of Health	U01 AR065098	7/26/2013 - 6/30/2017	$148,023
Hermine Brunner, MD	Optimization of Outcome Measures For Clinical Trials in Children with Lupus	National Institutes of Health	U01 AR067166	9/15/2014 - 9/14/2017	$195,464
Alexei A Grom, MD	MUNC13-4 gene Polymorphisms in Macrophage Activation Syndrome	National Institutes of Health	R01 AR059049	8/8/2011 - 7/31/2017	$344,250
Alexei A Grom, MD	Cincinnati Training Program in Pediatric Rheumatology Research	National Institutes of Health	T32 AR069512	5/1/2016 - 4/30/2021	$70,348
Jennifer L Huggins, MD	2015-2016 Amgen Fellowship Training Award	Rheumatology Research Foundation	RRF_Huggins	7/1/2015 - 6/30/2016	$50,000
Esi M Morgan, MD	Patients, Advocates and Rheumatology Teams Network for Research and Service	Patient-Centered Outcome Research Inst. (Duke University)	PPRN-1306-04601	9/13/2015 - 9/12/2018	$79,541
Grant S Schulert, MD	Scientist Development Award_Grant Schulert	Rheumatology Research Foundation	RRF_Schulert	7/1/2015 - 6/30/2017	$50,000
Total Annual Grant Award Dollars					**$937,626**

Annual Industry Award Dollars

Investigator	Industry Sponsor	Amount
Hermine Brunner, MD	Pfizer, Inc.	$62,231
Jennifer L Huggins, MD	Abbott Laboratories	$40,000
Daniel Joe Lovell, MD	Bristol -Myers Squibb	$395,385
Daniel Joe Lovell, MD	Janssen Research & Development, LLC	$504,785
Total Annual Industry Award Dollars		**$1,002,401**