

Division Details

Division Data Summary

Research and Training Details

Number of Faculty	9
Number of Joint Appointment Faculty	2
Number of Research Fellows	1
Number of Support Personnel	35
Direct Annual Grant Support	\$889,202
Direct Annual Industry Support	\$243,964
Peer Reviewed Publications	20

Clinical Activities and Training

Number of Clinical Staff	5
Number of Clinical Fellows	4
Number of Other Students	4
Inpatient Encounters	2,658
Outpatient Encounters	4,093

Division Photo



Row 1: B Lampkin
 Row 2: P Malik, K Kalinyak, T Kalfa
 Row 3: C Quinn, E Mullins, C Tarango
 Row 4: J Palumbo

Division Highlights

Punam Malik, MD & Jay Degen, PhD

A scientific collaboration between Drs. Punam Malik and Jay Degen is revealing a novel role for hemostatic system components in the pathogenesis of organ dysfunction related to sickle cell disease (SCD). Using mouse models of SCD and novel genetic tools for altering key coagulation system components *in vivo*, Drs. Malik and Degen directly established that interventions at the level of hemostatic factors could significantly ameliorate SCD-related organ pathologies and dramatically improve long-term survival. Their initial findings were the foundation for a newly-funded, multi-investigator grant from the National Heart, Lung and Blood Institute.

Theodosia Kalfa, MD

Dr. Theodosia Kalfa's laboratory has developed a state-of-the-art method to analyze terminal erythropoiesis using multiparameter high-speed cell imaging in flow. They demonstrated in a highlighted publication in Blood that erythroblast enucleation is a more complex process than previously thought, requiring a multistep action of tubulin and filamentous actin, as well as lipid raft formation coordinated by Rac GTPases. This study creates the basis for further research on terminal erythroid maturation with the potential to improve the efficiency of red blood cell production *in vitro*.

Thrombosis Program

Our thrombosis program has collaborated with Interventional Radiology in expanding the use of site-directed mechanical and pharmacologic thrombolysis in the treatment of blood clots in children and adolescents. The prompt restoration of venous blood flow by clot lysis procedures will significantly reduce the long-term consequences of thrombosis for our patients. Only a few pediatric centers nationally offer this therapeutic option. As such, we are increasing our referrals from other pediatric thrombosis centers for the procedure.

Charles T. Quinn, MD, MS

The American Society of Hematology (ASH) recognized Dr. Charles Quinn's work in sickle cell disease by choosing him as a National and International Program Co-chair and Speaker for the Highlights of ASH program in North America, Latin America and Asia.

Sickle Cell Center

The Sickle Cell Center has been awarded several national and regional grants that focus on improving outcomes for patients with SCD and related hemoglobinopathies. Dr. Lori Crosby was awarded over 2 million dollars in grant funding from the National Heart, Lung and Blood Institute as part of a collaboration between the Divisions of Hematology and Behavioral Medicine to study mechanisms to improve the crucial and complicated transition of sickle cell patients from the pediatric to the adult setting. Ms. Lisa Shook has been named the Program Director/Health Educator of the Ohio Department of Health Regional Sickle Cell Services Program, Bureau for Children with Medical Handicaps. The purpose of this program is promoting the early identification of children and adults with SCD and related hemoglobinopathies and facilitating their integration into systems of care that are accessible, continuous, comprehensive, family-centered, coordinated and culturally sensitive.

Significant Publications

Konstantinidis DG, Pushkaran S, Johnson JF, Cancelas JA, Manganaris S, Harris CE, Williams DA, Zheng Y, **Kalfa TA. Signaling and cytoskeletal requirements in erythroblast enucleation.***Blood.* Jun 21 2012;119(25):6118-27. Epub Mar 28 2012.

For this work, we developed a novel analysis protocol using multispectral high-speed cell imaging in flow to visualize and investigate the evanescent event of erythroblast enucleation, in a high enough number to produce reliable and statistically evaluable results. Thus we demonstrated that erythroblast enucleation is a more complex and multistep process than previously thought, resembling asymmetric cytokinesis: it requires establishment of cell polarity through microtubule function, followed by formation of a contractile actomyosin ring, and coalescence of lipid rafts between reticulocyte and pyrenocyte. We showed that Rac GTPases organize actin in the actomyosin ring and aggregate lipid rafts in the furrow between nascent reticulocyte and pyrenocyte during enucleation. Understanding of the mechanism of erythroblast enucleation is critical in order to reveal targets for *in vivo* therapeutic intervention for anemias due to terminal erythroid maturation defects as well as for improving the efficiency of red blood cell production *in vitro*.

DeBaun MR, Sarnaik SA, Rodeghier MJ, Minniti CP, Howard TH, Iyer RV, Inusa B, Telfer PT, Kirby-Allen M, **Quinn CT**, Bernaudin F, Airewele G, Woods GM, Panepinto JA, Fuh B, Kwiatkowski JK, King AA, Rhodes MM, Thompson AA, Heiny ME, Redding-Lallinger RC, Kirkham FJ, Sabio H, Gonzalez CE, Saccente SL, **Kalinyak KA**, Strouse JJ, Fixler JM, Gordon MO, Miller JP, Noetzel MJ, Ichord RN, Casella JF. **Associated risk factors for silent cerebral infarcts in sickle cell anemia: low baseline hemoglobin, sex, and relative high systolic blood pressure.***Blood.* Apr 19 2012;119(16):3684-90. Epub Nov 17 2011.

Sickle cell anemia patients are at significant risk for the development of strokes, silent cerebral infarcts (SCI)

and cognitive impairment. SCIs are the most common form of neurologic injury among children with sickle cell anemia occurring in at least 27% before 6 years of life and 37% by 14 years of life. This cross-sectional study examined potential risk factors in a well characterized group of children with no history of any neurological symptoms and whose MRIs were performed and read by the Neuroradiology Committee using a protocol detailed in this report. This study showed that low baseline hemoglobin concentrations and relative high systolic blood pressures are risk factors for the development of SCI. While this study did not examine treatments for preventing SCI, it does provide the basis for further research that might focus on increasing baseline hemoglobin in these young children and/or attenuate factors that contribute to the development of the relative high systolic blood pressures. Decreasing the occurrence of SCI in children with sickle cell anemia would likely result in improved outcomes with regard to decreasing the neurocognitive effects of this disease.

Sundaram N, Bennett M, Wilhelm J, Kim MO, Atweh G, Devarajan P, Malik P. **Biomarkers for early detection of sickle nephropathy.** *Am J Hematol.* ;86(7):559-66 Jul 2011. Epub May 31 2011.

Renal complications affect nearly 30-50% of adults with sickle cell anemia (SCA), causing significant morbidity and mortality. Standard renal function tests like serum creatinine and glomerular filtration rate become abnormal in this disease only when renal damage has become extensive and largely irreversible. Moreover, not all patients develop sickle nephropathy (SN). Therefore, noninvasive biomarkers that predict early onset of SN are necessary.

Our study identifies potential biomarkers for SN, and suggests longitudinal validation of these biomarkers for early detection of SN, so that therapeutic interventions can be applied before renal damage becomes irreversible.

Horowitz NA, Blevins EA, Miller WM, Perry AR, Talmage KE, **Mullins ES**, Flick MJ, Queiroz KC, Shi K, Spek CA, Conway EM, Monia BP, Weiler H, Degen JL, **Palumbo JS.** **Thrombomodulin is a determinant of metastasis through a mechanism linked to the thrombin binding domain but not the lectin-like domain.** *Blood.* 118(10):2889-95. Sep 8 2011. Epub Jul 25 2011.

These studies demonstrated, for the first time, that thrombomodulin, a key endothelial cell-associated regulator of thrombin activity and generation, is an important determinant of metastasis. These studies add a fundamental new dimension to the general understanding of hemostatic factors and cancer by directly establishing that endothelial cell-associated regulators of hemostatic function are major determinants of the malignant phenotype. Furthermore, these studies suggest that therapeutic strategies aimed at preserving or augmenting thrombomodulin-mediated regulation of thrombin could limit tumor dissemination.

Morris CR, Kim HY, Trachtenberg F, Wood J, **Quinn CT**, Sweeters N, Kwiatkowski JL, Thompson AA, Giardina PJ, Boudreaux J, Olivieri NF, Porter JB, Neufeld EJ, Vichinsky EP; Thalassemia Clinical Research Network. **Risk factors and mortality associated with an elevated tricuspid regurgitant jet velocity measured by Doppler-echocardiography in thalassemia: a Thalassemia Clinical Research Network report.** *Blood.* 118(14):3794-802. Oct 6 2011. Epub Jul 19 2011..

Thalassemia is a common blood disease that affects many organ systems, including the heart and lungs. This manuscript describes an NIH-funded, multi-center clinical investigation of the prevalence and predictors of an elevated tricuspid regurgitant jet velocity (TRJV), a marker for pulmonary hypertension, in children and adults with thalassemia intermedia and major. This study showed that an abnormally elevated TRJV was common in thalassemia—occurring in 1/3 of patients—and was associated with older age, splenectomy, hepatitis C infection, and smoking. These findings permit the better identification of individuals at risk for pulmonary hypertension, and highlight the role of splenectomy as an antecedent of pulmonary hypertension.

Division Publications

1. DeBaun MR, Sarnaik SA, Rodeghier MJ, Minniti CP, Howard TH, Iyer RV, Inusa B, Telfer PT, Kirby-Allen M, Quinn CT, Bernaudin F, Airewele G, Woods GM, Panepinto JA, Fuh B, Kwiatkowski JK, King AA, Rhodes MM, Thompson AA, Heiny ME, Redding-Lallinger RC, Kirkham FJ, Sabio H, Gonzalez CE, Saccente SL, Kalinyak KA, Strouse JJ, Fixler JM, Gordon MO, Miller JP, Noetzel MJ, Ichord RN, Casella JF. **Associated risk factors for silent cerebral infarcts in sickle cell anemia: low baseline hemoglobin, sex, and relative high systolic blood pressure.** *Blood*. 2012; 119:3684-90.
2. Degen JL, Palumbo JS. **Hemostatic factors, innate immunity and malignancy.** *Thromb Res*. 2012; 129 Suppl 1:S1-5.
3. George A, Benton J, Pratt J, Kim MO, Kalinyak KA, Kalfa TA, Joiner CH. **The impact of the 2009 H1N1 influenza pandemic on pediatric patients with sickle cell disease.** *Pediatr Blood Cancer*. 2011; 57:648-53.
4. Goldsmith JC, Bonham VL, Joiner CH, Kato GJ, Noonan AS, Steinberg MH. **Framing the research agenda for sickle cell trait: building on the current understanding of clinical events and their potential implications.** *Am J Hematol*. 2012; 87:340-6.
5. Gruppo RA. (2011) **Managing Atypical Hemolytic-Uremic Syndrome: What does the Future Hold?** Medscape Education. .
6. Hines J, Mitchell MJ, Crosby LE, Johnson A, Valenzuela JM, Kalinyak K, Joiner C. **Engaging patients with sickle cell disease and their families in disease education, research, and community awareness.** *Journal of Prevention and Intervention in the Community* . 2011; 39:256-72.
7. Horowitz NA, Blevins EA, Miller WM, Perry AR, Talmage KE, Mullins ES, Flick MJ, Queiroz KC, Shi K, Spek CA, Conway EM, Monia BP, Weiler H, Degen JL, Palumbo JS. **Thrombomodulin is a determinant of metastasis through a mechanism linked to the thrombin binding domain but not the lectin-like domain.** *Blood*. 2011; 118:2889-95.
8. Horowitz NA, Palumbo JS. **PL-25 Mechanisms coupling thrombomodulin to tumor dissemination.** *Thromb Res*. 2012; 129 Suppl 1:S119-21.
9. Konstantinidis DG, Pushkaran S, Johnson JF, Cancelas JA, Manganaris S, Harris CE, Williams DA, Zheng Y, Kalfa TA. **Signaling and cytoskeletal requirements in erythroblast enucleation.** *Blood*. 2012; 119:6118-6127.
10. Kurth M, Puetz J, Kouides P, Sanders J, Sexauer C, Bernstein J, Gruppo R, Manco-Johnson M, Neufeld EJ, Rodriguez N, Wicklund B, Quon D, Aledort L. **The use of a single von Willebrand factor-containing, plasma-derived FVIII product in hemophilia A immune tolerance induction: the US experience.** *J Thromb Haemost*. 2011; 9:2229-34.
11. Kwiatkowski JL, Kim HY, Thompson AA, Quinn CT, Mueller BU, Odame I, Giardina PJ, Vichinsky EP, Boudreaux JM, Cohen AR, Porter JB, Coates T, Olivieri NF, Neufeld EJ. **Chelation use and iron burden in North American and British thalassemia patients: a report from the Thalassemia Longitudinal Cohort.** *Blood*. 2012; 119:2746-53.
12. McCarville MB, Rogers ZR, Sarnaik S, Scott P, Aygun B, Hilliard L, Lee MT, Kalinyak K, Owen W, Garro J, Schultz W, Yovetich N, Ware RE, Investigators SW. **Effects of chronic transfusions on abdominal sonographic abnormalities in children with sickle cell anemia.** *J Pediatr*. 2012; 160:281-285 e1.
13. McCavit TL, Xuan L, Zhang S, Flores G, Quinn CT. **Hospitalization for invasive pneumococcal disease in a national sample of children with sickle cell disease before and after PCV7 licensure.** *Pediatr Blood Cancer*. 2012; 58:945-9.
14. Morris CR, Kim HY, Trachtenberg F, Wood J, Quinn CT, Sweeters N, Kwiatkowski JL, Thompson AA, Giardina PJ, Boudreaux J, Olivieri NF, Porter JB, Neufeld EJ, Vichinsky EP. **Risk factors and mortality associated with an elevated tricuspid regurgitant jet velocity measured by Doppler-echocardiography in**

- thalassemia: a Thalassemia Clinical Research Network report.** *Blood*. 2011; 118:3794-802.
15. Pan D, Kalfa TA, Wang D, Risinger M, Crable S, Ottlinger A, Chandra S, Mount DB, Hubner CA, Franco RS, Joiner CH. **K-Cl cotransporter gene expression during human and murine erythroid differentiation.** *J Biol Chem*. 2011; 286:30492-503.
 16. Quarmyne MO, Risinger M, Linkugel A, Frazier A, Joiner C. **Volume regulation and KCl cotransport in reticulocyte populations of sickle and normal red blood cells.** *Blood Cells Mol Dis*. 2011; 47:95-9.
 17. Quinn CT, Stuart MJ, Kesler K, Ataga KI, Wang WC, Styles L, Smith-Whitley K, Wun T, Raj A, Hsu LL, Krishnan S, Kuypers FA, Setty Y, Rhee S, Key NS, Buchanan GR. **Tapered oral dexamethasone for the acute chest syndrome of sickle cell disease.** *Br J Haematol*. 2011; 155:263-7.
 18. Sundaram N, Bennett M, Wilhelm J, Kim MO, Atweh G, Devarajan P, Malik P. **Biomarkers for early detection of sickle nephropathy.** *Am J Hematol*. 2011; 86:559-66.
 19. van der Loo JC, Swaney WP, Grassman E, Terwilliger A, Higashimoto T, Schambach A, Baum C, Thrasher AJ, Williams DA, Nordling DL, Reeves L, Malik P. **Scale-up and manufacturing of clinical-grade self-inactivating gamma-retroviral vectors by transient transfection.** *Gene Ther*. 2012; 19:246-54.
 20. Young G, Shapiro AD, Walsh CE, Gruppo RA, Gut RZ, Cooper DL. **Patient/caregiver-reported recombinant factor VIIa (rFVIIa) dosing: home treatment of acute bleeds in the Dosing Observational Study in Hemophilia (DOSE).** *Haemophilia*. 2012; 18:392-9.

Faculty, Staff, and Trainees

Faculty Members

Clinton H. Joiner, MD, PhD, Professor

Leadership Executive Co-Director, Cancer and Blood Diseases Institute; Director, Division of Hematology; Director, Comprehensive Sickle Cell Center

Research Interests Mechanisms of cell volume regulation; sickle cell disease and other hemoglobinopathies

Ralph A Gruppo, MD, Professor

Leadership Director, Hemophilia and Thrombosis Center

Research Interests Coagulation; hemophilia; thrombosis

Karen Ann Kalinyak, MD, Professor

Leadership Clinical Director, Hematology Oncology Program

Research Interests Hematology; bone marrow failure; sickle cell anemia; hemoglobinopathies

Joseph S. Palumbo, MD, Associate Professor

Research Interests Dissecting the mechanisms coupling the hemostatic and innate immune systems to cancer progression

Charles Quinn, MD, Associate Professor

Leadership Director, Hematology Clinical and Translational Research

Research Interests Sickle cell disease: causes and treatment of stroke in sickle cell disease; pathophysiologic role of hemoglobin desaturation; acute sickle cell pain; survival and long-term follow-up of children with sickle cell disease

Theodosia Kalfa, MD, PhD, Assistant Professor

Research Interests Study of erythropoiesis, red blood cell structural membrane biology, and of reactive oxygen species in sickle cell disease

Eric Mullins, MD, Assistant Professor

Research Interests Interactions between hemostatic factors and the immune system in inflammatory disease; hemophilia

Cristina Tarango, MD, Assistant Professor

Research Interests Thrombosis and hemostasis, medical education

Lisa Shook, MA, CHES, Instructor

Leadership Director, Ohio Department of Health Regional Sickle Cell Newborn Screening Program

Research Interests Sickle cell disease and trait, newborn screening, transition, chronic disease self-management, health education, quality improvement outcomes

Joint Appointment Faculty Members

Mi-Ok Kim, PhD, Associate Professor (Center for Epidemiology and Biostatistics)

Punam Malik, MD, Professor (Experimental Hematology and Cancer Biology)

Clinical Staff Members

- **Jennifer Benton, MSN, FNP, BC**
- **Margaret Kaiser, MSN, CPNP**
- **Darice Morgan, MSN, CPNP, FNP, BC**,
APN Program Lead for Hematology
- **Kelly Porter, MSN, CPNP**
- **Kathy Schibler, MSN, CPNP**

Trainees

- **Vennus Ballen, MD**, PL-IV, North Shore-Long Island Jewish Health System
- **Sharat Chandra, MD**, PS-VI, University of South Alabama
- **Maa-Ohui Quarmyne, MD**, PL-VI, Mt. Sinai Hospital
- **Brian Turpin, MD**, PL-VI, Cincinnati Children's Hospital Medical Center

Division Collaboration

Human Genetics » Mehdi Keddache, PhD and Kejian Zhang, MD

Development of a high-throughput gene chip for the diagnosis of known and discovery of new genetic mutations causing hemolytic anemia due to erythrocyte cytoskeleton disorders, e.g. spherocytosis, elliptocytosis. (T Kalfa, MD, PhD.)

Nephrology »

Development of special assays and genetic tests that will aid in the diagnosis and management of children with atypical hemolytic syndrome (aHUS), an acute illness with high morbidity and mortality. (R Gruppo, MD)

Cardiology » David Nelson, MD, PhD and Dave Cooper, MD

Forming an anticoagulation team for the cardiac intensive care unit. (C Tarango, MD)

Cardiology » Dave Cooper, MD and Jason Frischer, MD

Evaluating antithrombin infusions in ECMO patients. (C. Tarango, MD & J Palumbo, MD)

Interventional Radiology » Kamlesh Kukreja, MD

Evaluating post thrombotic syndrome in patients who have received thrombolysis. (C. Tarango, MD)

Gynecology » Jill Huppert, MD, MPH

Combined hematology and gynecology clinic for young women with bleeding disorders. (C. Tarango, MD)

Human Genetics » Sivakumaran Theru Arumugam, PhD

Hemoglobinopathy genetic diagnosis laboratory. (C. Quinn, MD)

Radiology » Daniel Podberesky, MD and Robert Fleck, MD

Evaluation of MRI-based methods for quantitation of hepatic iron overload in transfusion-dependent patients. (C. Quin, MD)

Cardiology » Michael Taylor, MD, PhD and Jeffrey Towbin, MD

Submission of an NIH Center Grant (U54) with focus on sickle cell disease-related cardiomyopathy. (C.Quinn, MD)

Nephrology » Prasad Devarajan, MD

Collaboration on a clinical trial of losartan in patients with sickle cell disease. (C.Quinn, MD)

Experimental Hematology and Cancer Biology » Punam Malik, MD

Collaboration on Studies involving patients with Sickle Cell Disease. Losartan Study, Zileuton Study and Gene Therapy Study. (C. Quinn, MD)

Pulmonary; Radiology » Raouf Samy Amin, MD and Robert Fleck, MD

Collaboration on clinical trial exploring the role of Placenta Growth Facot in Sickle Acute Chest Syndrome. (K Kalinyak, MD)

Pulmonary » Raouf Samy Amin, MD

Collaboration on study: Sibling Methacholine Study (K Kalinyak, MD)

Psychology » Lori Crosby, MD and Monica Mitchell, MD

Collaboration on projects dealing with adherence to prescribed medical care. Published results in Integrating Interactive Web-Based Technology to Assess Adherence and Clinical Outcomes in Pediatric Sickle Cell Disease in April , 2012. (K Kalinyak, MD)

Anderson Center »

Improving Sickle Cell Disease outcomes. Working on a standardized approach to be sure that every patient over the age of 5 years has a home pain management plan and that this plan is outlined clearly in the electronic medical record. Working on a standardized pain management approach in the emergency department. Working on closely monitoring the timing of patients getting their first Transcranial Doppler Study to identify patients at the highest risk of having a stroke. (K Kalinyak, MD)

Experimental Hematology and Cancer Biology » Punam Malik, MD

Collaboration on Studies involving patients with Sickle Cell Disease. Losartan Study, Zileuton Study, Placenta Growth Factor Study, Sibling Methacholine Study and Gene Therapy Study. (K. Kalinyak, MD)

Experimental Hematology and Cancer Biology » Jay Degen, PhD and Matthew Flick, PhD

Defining the role of hemostatic system components in cancer pathogenesis. (J Palumbo, MD)

Experimental Hematology and Cancer Biology » James Mulloy, PhD

Defining the role of tissue factor, pro/thrombin and TF/thrombin mediated signaling via protease activated receptors in leukemia progression. (J Palumbo, MD)

Gastroenterology » Kris Steinbrecher, PhD

Determining the role of thrombin and thrombin substrates in the pathogenesis of colitis and colitis-associated colon cancer. (J Palumbo, MD)

Experimental Hematology and Cancer Biology » Jay Degen, PhD and Matthew Flick, PhD

The role of hemostasis and hemostatic factors in inflammation and immune function. (E Mullins, MD)

Experimental Hematology and Cancer Biology » Punam Malik, MD

The role of thrombin proteolysis and fibrin deposition in sickle cell disease. (E Mullins, MD)

Grants, Contracts, and Industry Agreements

Grant and Contract Awards	Annual Direct
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GRUPPO, R

ATHNdata.Quality Counts

American Thrombosis & Hemostatis Network

01/15/11-01/14/13

\$10,315

Hemophilia And Thrombosis Center

Cascade Hemophilia Consortium(Hemophilia Foundation of Michigan)

06/01/03-05/31/13

\$90,000

Hemophilia Comprehensive Care

Maternal and Child Health Bureau(Hemophilia Foundation of Michigan)

H30MC00015

06/01/04-05/31/12

\$14,500

Public Health Surveillance for the Prevention of Complications of Bleeding and Clotting Disorders

Centers for Disease Control & Prevention(Hemophilia Foundation of Michigan)

U27 DD 000862

09/30/11-09/29/14

\$17,000

Hemophilia Patient Handbook

Hemophilia Alliance Foundation

05/01/2012-04/30/2013

\$5,000

JOINER, C

Cincinnati Sickle Cell Project

Health Resources & Services Admin (Ohio Department of Health)

03130011SK0411

07/01/1998-06/30/2012

\$123,469

KALFA, T

Rac1 and Rac2 Guanosine Triphosphatases in Erythroid Function and Differentiation

National Institutes of Health

K08 HL 088126

02/11/08-11/30/12

\$119,125

MULLINS, E

Mechanisms Linking Hemostatic Factors to Neuroinflammatory Disease

National Institutes of Health

K08 HL 105672

08/22/11-07/31/16

\$121,375

SHOOK, L

Cincinnati Sickle Cell Newborn Screening Network

Health Resources & Services Admin

U38 MC 22218

06/01/11-05/31/15

\$377,100

Sickle Cell Treatment Demonstration Program

Health Resources & Services Admin(University of Cincinnati)

U1EMC0755-06

09/01/11-08/31/14

\$11,318

Current Year Direct

\$889,202

Industry Contracts

GRUPPO, R

Baxter Healthcare Corporation

\$25,987

Rayer Healthcare Pharmaceuticals, Inc	\$15,828
Novo Nordisk Pharmaceuticals	\$34,768
PAREXEL International, LLC	\$11,758
Wyeth Pharmaceuticals	\$2,434
PTC Therapeutics, Inc	\$1,540
KALFA, T	
Baxter Healthcare Corporation	\$6,884
KALINYAK, K	
GlaxoSmithKline	\$6,545
QUINN, C	
GlycoMimetics, Inc.	\$26,488
Lilly USA, LLC	\$25,327
PALUMBO, J	
Novo Nordisk Pharmaceuticals	\$86,375
Current Year Direct Receipts	
\$243,964	
Total	
\$1,133,166	