

2014 Research Annual Report

Perinatal Institute



Institute Summary

RESEARCH AND TRAINING DETAILS

Number of Faculty	52
Number of Joint Appointment Faculty	1
Number of Research Fellows	11
Number of Research Students	12
Number of Support Personnel	14
Direct Annual Grant Support	\$18,843,294
Direct Annual Industry Support	\$153,375
Peer Reviewed Publications	215

CLINICAL ACTIVITIES AND TRAINING

Number of Clinical Staff	23
Number of Staff Physicians	13
Number of Clinical Fellows	14
Number of Clinical Students	10
Number of Other Students	10

Institute Leadership



L to R: L Muglia, J Greenberg, J Whitsett

Significant Accomplishments

Lung Atlas to Provide Framework for Understanding Lung Disease

Investigators in the Perinatal Institute and the Divisions of Neonatology, Perinatal and Pulmonary Biology, Developmental Biology, and Genetics were awarded a \$4 million grant from the National Heart, Lung, and Blood Institute (NHLBI) to establish a consortium of investigators that will produce a detailed map of the cells, structures, and transcriptome comprising the human and murine lung.

Jeffrey Whitsett, MD, Co-Director of the Perinatal Institute, and Steven Potter, PhD, Developmental Biology, serve as Co-Principal Investigators. Co-investigators from multiple divisions will conduct confocal microscopy, NexGen-RNA sequencing of the single cell transcriptome, and bioinformatic analyses to identify the multiple cell types, their interactions, and their changing structures during lung formation. Molecular imaging will be performed by the recently established Nikon Imaging Center, led by Matt Kofron, PhD.

The Cincinnati Children's team will work in a consortium with investigators from several institutions to produce a detailed molecular atlas of the lung during development, with an emphasis on the formation of alveoli, the tiny air sacs responsible for the exchange of oxygen and carbon dioxide. Understanding the normal processes of lung formation will provide the framework needed to understand bronchopulmonary dysplasia, respiratory distress syndrome, interstitial lung disease and other abnormalities in lung formation and growth that can lead to lifelong consequences.

Potential Gene Correction for Pulmonary Alveolar Proteinosis

Bruce Trapnell, MD, MS, and Takuji Suzuki, MD, PhD, have received an NIH grant to continue studying a

gene therapy approach for correcting pulmonary alveolar proteinosis (PAP), a rare lung disease caused by mutations in the GM-CSF receptor. Their recent publications show the ability to correct PAP in mice lacking GM-CSF receptor by transducing the alveolar macrophages with the normal receptor and placing the corrected cells into their lungs. Their work provides the groundwork for moving these remarkable findings into the clinical arena, by generating vectors and methodologies for transducing human bone marrow cells that will be used for future therapies of this life-threatening disorder.

Focusing on Infant Mortality and Preterm Birth

Our focus on crucial community health problems affecting our patients and families continues to gain momentum. Our new Familial Preterm Birth Clinic, led by **Louis Muglia, MD, PhD**, is providing research, innovation, and clinical care for women at risk for preterm delivery. In June 2013, we also established Cradle Cincinnati, a large collaborative that seeks to reduce infant mortality in Hamilton County.

The Perinatal Institute serves as the convening organization for Cradle Cincinnati, which also includes the City of Cincinnati, Hamilton County, the Cincinnati Health Department, the Hamilton County Health District, United Way, the Greater Cincinnati Foundation, Interact for Health, CareSource, Deskly Branding and Communications, UCMC, TriHealth, the Christ Hospital, the Mercy Regional Health System, and the Center for Closing the Health Gap. During its first year, Cradle Cincinnati formed a consensus around three key indicators of health relevant to infant mortality: Smoking, Safe Sleep, and Spacing (of pregnancies). We issued our first report to the community in February 2014, formed three community action networks to address these areas, and raised \$1.3 million in new annual funding.

The Perinatal Institute also provides leadership for several other community-based applied research and improvement programs. StartStrong-Avondale, funded by the Bethesda Foundation and Cincinnati Children's, seeks to reduce preterm birth and inappropriate emergency department use in the Avondale neighborhood. This program is a joint partnership between Every Child Succeeds, the Anderson Center, and the Perinatal Institute. The Best Babies Zone program, funded in part by the Kellogg Foundation, supports community awareness and action to reduce preterm birth in the Lower Price Hill and East Price Hill neighborhoods through facilitation of moms' groups, a block captain program and community-focused micro grants.

NICU Receiving More Out-Of-Region Referrals

Overall, Division of Neonatology physicians generated 117,290 encounters, up from 109,490 during the prior year. Our neonatal intensive care unit (NICU) also experienced its highest average daily census to date in FY14. The primary driver was a significant increase in out-of-region referrals for management of complex medical and surgical problems, including those managed by the Cincinnati Fetal Center.

The second phase of our NICU renovation was completed, which will optimize patient safety by providing state-of-the-art private rooms with superior visibility and access. Renovation continues through this year. The NICU team also significantly reduced the number of central line-associated blood stream infections in FY14 compared to the year before.

Research Highlights

Suhas Kallapur, Alan Jobe, and Louis Muglia

Suhas Kallapur, Alan Jobe, and Louis Muglia in the Perinatal Institute, together with Claire Chougnet in the Division of Immunobiology, have initiated important non-human primate studies with collaborating investigators at the California National Primate Research Center to determine the mechanism by which stress and infection interact to increase the risk for preterm birth and adverse outcomes of prematurity such as bronchopulmonary

dysplasia, as well as alter immune system development. Initial findings were published in the Journal of Immunology, and have resulted in new grants from the NIH and Burroughs Wellcome Fund.

Kurt Schibler, Ardythe Morrow

Kurt Schibler, Ardythe Morrow, and collaborators evaluated the consequences of antibiotic use in preterm infants with subsequent microbiome development. They found that infants treated in the first week of life had lower bacterial diversity in the second and third weeks of life. Infants receiving early antibiotics also experienced more cases of necrotizing enterocolitis, sepsis, or death than those not exposed to antibiotics (Journal of Pediatrics).

Neera Goyal

Neera Goyal and collaborators from Every Child Succeeds evaluated the impact of home visitation programs on pregnancy outcomes for high-risk mothers. They found that amongst these first time mothers enrolled prenatally in home visiting, higher dosage of intervention is associated with reduced likelihood of adverse pregnancy outcomes (Pediatrics).

Significant Publications

Steinoff MC, MacDonald N, Pfeifer D, **Muglia LJ**. Influenza vaccine in pregnancy: policy and research strategies. *Lancet*. 2014 May 10;383(9929):1611-3.

This article summarizes existing data on influenza vaccination in pregnancy that demonstrates improvement in birth weight and reduction in risk for preterm birth in vaccinated mothers. These important health benefits from vaccination should lead to more robust implementation measures as well as a new research agenda for understanding disease mechanisms.

Chen G, **Korfhagen TR**, Karp CL, Impey S, Xu Y, Randell SH, **Kitzmiller J**, **Maeda Y**, Haitchi HM, Sridharan A, Senft AP, **Whitsett JA**. *Foxa3 induces goblet cell metaplasia and inhibits innate antiviral immunity*. *Am J Respir Crit Care Med*. 2014 Feb 1;189(3):301-13.

Goblet cell metaplasia is associated with common lung diseases that are susceptible to recurrent viral infections. The mechanisms linking goblet cell metaplasia and susceptibility to viral infection are incompletely understood. In this study, the transcription factor FOXA3 was found to induce goblet cell metaplasia in response to infection. Suppression of interferon signaling by FOXA3 was shown to provide one mechanism that may serve to limit ongoing Th1 inflammation during the resolution of acute viral infection; however, inhibition of innate immunity by FOXA3 simultaneously contributes to susceptibility to viral infections with the chronic lung disorders.

Kallapur SG, Presicce P, Senthamaraikannan P, Alvarez M, Tarantal AF, Miller LM, **Jobe AH**, Chougnnet CA. *Intra-amniotic IL-1 induces fetal inflammation in rhesus monkeys and alters the regulatory T cell/IL-17 balance*. *J Immunol*. 2013 Aug 1;191(3):1102-9.

In this study, Kallapur, Jobe and colleagues define the effects of chorioamnionitis on the fetal immune system, IL-1 β was administered intra-amniotically at ~80% gestation in rhesus monkeys. IL-1 β caused histological chorioamnionitis, as well as lung inflammation (infiltration of neutrophils or monocytes in the fetal airways) and large increases in multiple proinflammatory cytokines. Importantly, IL-1 β significantly altered the balance between inflammatory and regulatory T cells. The results show that the chorioamnionitis-induced IL-1/IL-17 pathway is involved in the severe inflammation that can develop in preterm newborns. Boosting regulatory T cells and/or controlling IL-17 may provide a means to ameliorate these abnormalities.

Grants, Contracts, and Industry Agreements

Developmental Biology

CAMPBELL, K**Molecular Mechanisms Controlling Formation of Basal Ganglia Circuitry**

National Institutes of Health

R01 MH 090740 04/01/10-01/31/15 \$247,500

Roles of Gsh1 & Gsh2 in Telencephalic Neurogenesis

National Institutes of Health

R01 NS 044080 03/15/14-02/28/19 \$350,906

CHA, S**Wnt/PCP Signaling in the Intestinal Epithelium**

National Institutes of Health

K01 DK 101618 04/15/14-02/28/19 \$119,422

CHANG, C**MicroRNA Regulation of Neuronal Connectivity in C. Elegans**

National Science Foundation

IOS-1257023 09/15/13-08/31/17 \$117,410

Understanding MicroRNA Mechanisms for Developmental Decline in Axon Regeneration

Whitehall Foundation, Inc.

10/01/13-09/30/15 \$71,322

CHUANG, C**Specification of Stochastic Left-Right Asymmetric Neuronal Fates in C. Elegans**

National Institutes of Health

R01 GM 098026 08/31/12-07/31/17 \$183,350

GEBELEIN, B.**Hox Control of Cell-Specific EGF Signaling During Development**

National Institutes of Health

R01 GM 079428 08/09/13-05/31/17 \$190,000

HEGDE, R**EYA in Retinal Angiogenesis**

National Institutes of Health

R01 EY 022917 08/01/13-07/31/17 \$250,000

Mechanism of Action of Retinal Determination Proteins

National Institutes of Health

R01 EY 014648 04/01/14-03/31/18 \$225,000

JIANG, R**Molecular Genetic Analysis of Craniofacial Development**

National Institutes of Health

R01 DE 13681	07/01/11-06/30/15	\$283,575
Molecular Patterning of Mammalian Dentition		
National Institutes of Health		
R01 DE 018401	09/12/13-06/30/18	\$337,777
A Developmentally-Based Tissue Engineering Approach to Improve Tendon Repair		
National Institutes of Health(University of Cincinnati)		
R01 AR 056943	04/01/13-06/30/14	\$168,827
KOFRON, M.		
Ectoderm Formation in the Early Xenopus Embryo		
National Institutes of Health		
R01 HD 45737	04/01/13-03/31/15	\$193,622
KOPAN, R		
Assessing the Therapeutic Window for Future Anti-Notch Dimerization Agents		
National Institutes of Health		
R01 CA 163653	07/01/13-04/30/18	\$215,443
Biochemical and Genetic Analysis of Notch Signaling		
National Institutes of Health		
R01 GM 055479	09/01/13-04/30/15	\$84,732
Imaging Notch Interactions With Members Of Its Pathways		
National Institutes of Health(Washington University)		
P50 CA 094056	01/01/14-12/31/14	\$39,753
LIN, X		
Regulation of Wingless (Wg) Signaling and Morphogen Gradient Formation		
National Institutes of Health		
R01 GM 063891	04/01/12-03/31/16	\$200,000
MAYHEW, C		
Digestive Health Center: Bench to Bedside Research in Pediatric Digestive Diseases - Stem Cell Core		
National Institutes of Health		
P30 DK 078392	06/01/12-05/31/17	\$25,590
NAKAFUKU, M		
Endogenous CNTF Receptors and Adult, In Vivo Neurogenesis		
National Institutes of Health(University of Cincinnati)		
R01 NS 066051	07/01/09-06/30/14	\$10,392
NAKAFUKU, M / CAMPBELL, K		
Molecular Control of Neurogenesis in the Adult Subventricular Zone		
National Institutes of Health		
R01 NS 069893	04/01/10-03/31/15	\$304,936

POTTER, S**Digestive Health Center: Bench to Bedside Research in Pediatric Digestive Diseases - Gene Expression Core**

National Institutes of Health

P30 DK 078392	06/01/12-05/31/17	\$22,822
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Generating Molecular Markers that Selectively Label Urothelial Sub-Populations

National Institutes of Health(Columbia University Medical Center)

U01 DK 094530	09/30/11-08/31/16	\$24,167
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POTTER, S / WELLS**Single Cell/RNA-Seq Dissection of Human iPS Cell Development into Intestine**

National Institutes of Health

R01 DK 098350	09/20/13-07/31/17	\$217,500
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SHROYER, N**bHLH Factor Regulation of Mammalian Retinal Neuron Development**

University of California-Davis

01/01/12-12/31/14	\$57,000
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SUMANAS, S**Inhibition of Etv2 Function as a Novel Strategy to Prevent Tumor-Induced Angiogenesis**

Ohio Cancer Research Associates

07/01/13-06/30/15	\$27,273
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Molecular Mechanisms of Arterial-Venous Differentiation in Zebrafish

National Institutes of Health

R01 HL 107369	04/01/11-03/31/16	\$245,000
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WELLS, J**Directing Differentiation of Human Pluripotent Stem Cells to Generate 3-Dimensional Lung Tissue In Vitro**

National Institutes of Health(University of Michigan)

R21 HL 115322	08/10/12-06/30/14	\$35,185
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Generating Human Intestinal Organoids with an ENS

National Institutes of Health

U18 TR 000546	07/24/12-06/30/14	\$264,484
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Human Endocrine Cell Development

National Institutes of Health

R01 DK 092456	04/07/12-02/28/17	\$297,412
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YOSHIDA, Y**Mechanism of Neural Circuit Reorganization for Homeostasis after CNS Injury**

Japan Science and Technology Corporation

10/01/13-03/31/17	\$111,418
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ZORN, A

Collaborative Research: Ontology-Enabled Reasoning across Phenotypes from Evolution and Model Organisms

National Science Foundation(University of South Dakota)

DBI-1062542 07/01/11-06/30/15 \$7,534

Deciphering the Gene Regulatory Network Controlling Vertebrate Endodermal Fates

National Institutes of Health(The Regents of the University of California)

R01 HD 073179 07/05/13-04/30/18 \$80,000

Molecular Basis of Digestive System Development in Xenopus

National Institutes of Health

R01 DK 070858 04/01/14-03/31/18 \$223,613

Osr Transcription Factors Regulate Embryonic Lung Development

National Institutes of Health

R01 HL 114898 08/10/12-06/30/17 \$238,000

Production, Validation and Distribution of the Xenopus ORFeome

National Institutes of Health(University of Virginia)

R01 HD 069352 08/01/11-05/31/16 \$49,726

Xenbase: a Xenopus Model Organism Database

National Institutes of Health

P41 HD 064556 06/01/10-05/31/15 \$697,226

Current Year Direct \$6,217,917**Total \$6,217,917**

Reproductive Sciences

Grant and Contract Awards Annual Direct

CHA, J

Premature Uterine Aging and Preterm Delivery

National Institutes of Health

F30 AG 040858 09/16/11-09/15/15 \$47,232

DE FALCO, T

Macrophage Regulation of Fetal Testis Vascularization and Morphogenesis

March of Dimes

#5-FY14-32 02/01/14-01/31/16 \$68,182

DEY, S

Endocannabinoid Signaling via CB2 Protects Against Preterm Birth by Modulating Immune Responses

March of Dimes

#21-FY12-127 03/01/12-02/28/15 \$164,000

Molecular Signaling in Uterine Receptivity to Implantation

National Institutes of Health

R01 HD 068524 09/26/11-06/30/16 \$201,663

The Role of Bioactive Lipids in Inflammation and Cancer

National Institutes of Health(Mayo Clinic)

P01 CA 077839	06/01/13-05/31/17	\$159,030
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March of Dimes Prematurity Research Center (Project 3)

March of Dimes

22-FY-13-543	07/01/13-12/31/13	\$130,486
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March of Dimes Prematurity Research Center Ohio Collaborative (Project 3)

March of Dimes

22-FY14-470	01/01/14-12/31/14	\$263,636
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NAMEKAWA, S**DNA Damage Response Pathways in Meiotic Sex Chromosome Inactivation**

National Institutes of Health

R01 GM 098605	08/01/11-07/31/16	\$182,385
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Regulatory Mechanism of Active Epigenetic Modifications and its Transgenerational Effects

March of Dimes

#1-FY13-510	06/01/13-05/31/16	\$90,909
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OGAWA, Y**Organization of the Inactive X-Chromosome**

National Institutes of Health

R01 GM 102184	09/01/12-08/31/17	\$169,840
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Regulation of Escape Genes on the Inactive X-Chromosome

March of Dimes

#6-FY12-337	06/01/12-05/31/15	\$74,240
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Current Year Direct	\$1,551,603
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Total	\$1,551,603
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Section of Neonatology, Perinatal and Pulmonary Biology

Grant and Contract Awards

Annual Direct

BRIDGES, J**Role of GPR116 in the Regulation of Alveolar Surfactant Pool Size**

American Heart Association

13SDG17090028	07/01/13-06/30/17	\$70,000
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JOBE, A**Initiation and Progression of Preterm Lung Injury with Ventilation**

National Institutes of Health

R01 DH 072842	08/01/12-05/31/17	\$207,176
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PROP Attrition Reduction Study

National Institutes of Health(Children's Hospital of Philadelphia)

U01 HL 101794 05/01/12-04/30/14 \$982

Data Coordinating Center for the Prematurity and Respiratory Outcomes Program

National Institutes of Health(University of Pennsylvania)

U01 HL 101794 09/20/10-04/30/15 \$60,834

JOBE, A / CHOUGNET, C (MPI)

Biomarkers of Immunologic Function and Preterm Respiratory Outcomes

National Institutes of Health

U01 HL 101800 05/01/10-04/30/15 \$375,863

Jobe, A Core \$115,930

Chougnet, C Project \$80,237

Chougnet, C Project \$33,684

Kingma, P Project \$20,229

Hardie, W Project \$111,771

Morrow, A Project \$14,012

KALIN, T

Role of Foxm1 in Lung Cancer Microenvironment

National Institutes of Health

R01 CA 142724 07/01/10-06/30/15 \$189,199

Transcriptional Regulation of Cancer Progression and Metastasis by Foxm1

American Cancer Society National

07/01/13-06/30/17 \$175,000

KALINICHENKO, V

Foxf1 Transcription Factor in Development of Pulmonary Capillaries

National Institutes of Health

R01 HL 084151 05/01/11-04/30/15 \$245,000

LECRAS, T / HERSHEY, G (MPI)

Impact of Early Life Diesel Exposure Immune Patterning and Lung Structure/Function

National Institutes of Health

R01 HL 097135 09/01/09-07/31/14 \$305,215

LeCras, T \$119,129

Hershey, G \$186,086

MERHAR, S**Functional MRI to Predict Visual, Auditory, and Motor Outcomes in Infants with Brain Injury**

Thrasher Research Fund

08/01/12-07/31/14

\$9,451

Protein Supplementation in Infants with Brain Injury

The Gerber Foundation

PN12-004-424-3068

06/01/12-05/31/15

\$6,666

MORROW, A**The Role of Human Milk in Infant Nutrition and Health**

National Institutes of Health

P01 HD 013021

08/01/09-07/31/14

\$921,236

Jiang, X

Project 2

\$109,146

Jiang, X

Core D

\$84,618

MUGLIA, L**March of Dimes Prematurity Research Center**

March of Dimes

22-FY13-543

07/01/13-12/31/13

\$969,396

Dey, S

Project 3

\$130,486

March of Dimes Prematurity Research Center Ohio Collaborative

March of Dimes

22-FY14-470

01/01/14-12/31/14

\$1,929,801

Dey, S

Project 3

\$263,636

MUGLIA, L / CHOUGNET, C (MPI)**Maternal Temperament, Stress, and Inflammation in Preterm Birth**

National Institutes of Health

R01 HD 078127

09/01/13-08/31/17

\$505,993

Muglia, L

\$433,973

Chougnet, C

\$72,020

PERL, A**FGF and PDGF Regulate Myofibroblast Differentiation in Alveolar Regeneration**

National Institutes of Health

R01 HL 104003

07/01/10-06/30/14

\$235,620

PURI, K

Alteration of Microbial Flora in the Intestines of Preterm Neonates with Chorioamnionitis

American Academy of Pediatrics

09/01/13-06/30/14

\$3,000

SCHIBLER, K**NICHD Cooperative Multicenter Neonatal Research Network**

National Institutes of Health

U10 HD 027853

04/01/11-03/31/16

\$336,477

SHANNON, J**LPCAT1 is Essential for Perinatal Lung Function and Survival**

National Institutes of Health

R01 HL 098319

07/01/10-06/30/14

\$296,584

SINNER, D**Molecular Mechanisms Underlying Upper Airway Patterning and Tracheomalacia**

National Institutes of Health

K01 HL 115447

08/01/12-07/31/17

\$104,071

SOUTH, A**Intestinal Motility and Gastroschisis**

The Gerber Foundation

07/01/13-06/30/16

\$52,251

SUZUKI, T**Synthetic Endonuclease-Mediated Gene-Editing Therapy of Hereditary Pulmonary Alveolar Proteinosis**

American Thoracic Society

10/31/13-10/30/14

\$40,000

TRAPNELL, B**Role of GM-CSF in Myeloid Cell Function and Innate Immunity**

National Institutes of Health

R01 HL 085453

04/01/11-03/31/16

\$245,000

Childhood Interstitial Lung Disease (chILD) and Chemokine (C-C motif) Receptor 2 (CCR2) Deficiency

American Thoracic Society(The Johns Hopkins University)

10/31/13-10/30/15

\$5,640

Macrophage Based Gene Therapy for Hereditary Pulmonary Alveolar Proteinosis

National Institutes of Health

R01 HL 118342

05/01/14-04/30/18

\$428,386

Cincinnati Center for Clinical and Translational Sciences and Training - Pilot/Collaborative Studies

National Institutes of Health(University of Cincinnati)

UL1 TR 000077

04/03/09-03/31/15

\$23,051

VALENTINE, C

DHA Attenuates Inflammatory Responses through Altering Rage Signaling

National Institutes of Health(The Research Institute at Nationwide Hospital)

R01 AT 006880 09/30/11-06/30/14 \$11,626

Dietary Docosaehaenoic Acid for Women with Preeclampsia

National Institutes of Health(University of Cincinnati)

KL2 TR 000078 10/01/13-08/31/14 \$62,673

WEAVER, T**Stard7, a Novel Inhibitor of Allergic Lung Disease**

National Institutes of Health

R01 HL 122130 01/01/14-12/31/17 \$250,000

The Role of Autophagy in the Pathogenesis of interstitial Lung Disease

National Institutes of Health

R01 HL 103923 08/01/11-06/30/15 \$316,184

Digestive Health Center: Bench to Bedside Research in Pediatric Digestive Disease - P&F Study

National Institutes of Health

P30 DK 078392 06/01/12-05/31/17 \$50,000

WEXELBLATT, S**Neonatal Abstinence Syndrome (NAS) Project - Per patient**

Ohio Department of Jobs & Family Services(University Hospitals, Case Medical Center)

07/01/12-06/30/14 \$84,624

WHITSETT, J**"Lung MAP" Atlas Research Center**

National Institutes of Health

U01 HL 122642 06/15/14-04/30/19 \$495,784

Airway Progenitor Cell Proliferation and Differentiation During Lung Repair

National Institutes of Health

U01 HL 110964 01/01/12-12/31/16 \$528,069

Cleveland Clinic Center for Accelerated Innovations

National Institutes of Health(Cleveland Clin Lerner Col of Med of CWRU)

U54 HL 119810 09/26/13-07/31/20 \$12,000

Omics of Lung Diseases

National Institutes of Health

K12 HL 119986 09/01/13-05/31/18 \$249,818

Pulmonary and Cardiovascular Development Training Grant

National Institutes of Health

T32 HL 007752 07/01/09-06/30/14 \$258,283

Single Cell NexGen RNA Sequencing of Human Lung

National Institutes of Health(Duke University)

U01 HL 110967 01/01/14-12/31/14 \$49,020

Transcriptional Control of Submucosal Gland Formation and Function

National Institutes of Health

R01 HL 108907	07/01/11-04/30/15	\$254,823
Transcriptional Programming of Asthma Related Pathology in Respiratory Epithelia		
National Institutes of Health		
R01 HL 095580	04/15/13-03/31/18	\$338,555
Cystic Fibrosis Foundation Research Development Program (Core 1)		
Cystic Fibrosis Foundation		
	03/01/12-06/30/15	\$50,000
Molecular Atlas of Lung Development - Data Coordinating		
National Institutes of Health(Duke University)		
U01 HL 122638	06/15/14-04/30/19	\$34,773
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XU, Y		
Role of SREBP Network in Surfactant Lipid Homeostasis and Lung Maturation		
National Institutes of Health		
R01 HL 105433	07/01/11-06/30/15	\$285,650
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Current Year Direct		\$11,073,774
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Industry Contracts		
<hr/>		
MORROW, A		
Glycosyn LLC		
		\$17,967
Mead Johnson & Company		
		\$135,408
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Current Year Direct Receipts		\$153,375
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Total		\$11,227,149