**CANDIDATE INFORMATION AND GOALS FOR CAREER DEVELOPMENT**

**Candidate’s Background**

My long-term goal is to develop into an independent physician scientist and leader in the clinical investigation of pulmonary hypertension (PH). My early career platform to achieve that objective will be portopulmonary hypertension (PoPH), a type of PH that develops in patients with underlying liver disease. In PoPH, mechanisms of disease pathogenesis, optimal prognostic biomarkers, and best approach to treatment with targeted pulmonary vasodilator and liver transplantation are poorly understood. The research plan and training outlined in this K23 application will provide me with the necessary tools and expertise to address this unmet need, translating scientific discoveries into advancements that improve outcomes in PoPH, and form the basis for a future career investigating pulmonary vascular disease mechanisms and clinical biomarkers.

My first exposure to research occurred as an undergraduate student studying biomedical engineering from 2003 to 2007 at the Johns Hopkins University in Baltimore, Maryland. Although I worked on several biomedical engineering projects as an undergraduate, including investigating novel modes of drug delivery under Justin S. Hanes PhD and innovative cerebrovascular blood flow imaging techniques in Nitish V. Thakor PhD’s laboratory, my interest in translational cardiovascular research was piqued by my senior capstone project. Guided by Dr. Gordon F. Tomaselli, our team developed a novel implantable cardioverter defibrillator lead, eventually filing a provisional patent and presenting the work at the 2007 Frontiers in Biomedical Devices Conference. Witnessing the aspirations of these physician scientists to improve patient care and change clinical practice through research inspired me, galvanizing my desire to become a clinical investigator.

Given my desire to combine superb clinical training with impactful scientific research, I continued my education at Johns Hopkins and completed both my medical degree in 2012, and my internal medicine residency in 2015 as a member of the “Osler” program. During my training, my experience working on the pulmonary service with Dr. Stephen C. Mathai inspired me to focus on pulmonary vascular disease. I found the physiologic complexity of these disease to be both mentally challenging and intellectually rewarding. After my rotation I continued to work with Dr. Mathai on a small research project investigating the link between lung fibrosis and pulmonary vascular hemodynamics, and although this data was never published, it was my first formal introduction to biostatistics, epidemiology, and clinical research design.

In light of my growing interest in pulmonary vascular disease, I pursued a Pulmonary and Critical Care fellowship at the George Washington University from 2015 to 2018. I structured my fellowship experience to include clinical and research rotations at the Inova Fairfax Heart and Lung Institute, and I also reached out independently to pulmonary vascular disease specialists Dr. Steven D. Nathan, Dr. Oksana A. Shlobin, and Dr. Mardi Gomberg-Maitland. This experience was by far my most transformative, and under the mentorship provided by these physician investigators, my capabilities as a PH clinician and pulmonary vascular disease scientist grew stronger. With their help, I designed, completed, analyzed, drafted, and published a number of manuscripts studying prognostic biomarkers in pulmonary vascular disease. This work resulted in a 2017 first-author publication in the journal *Chest* investigating the ventricular diastolic pressure ratio as a marker of treatment response in PH, a 2018 first author publication in the *European Respiratory Journal* studying the predictive role of pulmonary vascular hemodynamic responses during exercise in fibrotic lung disease patients, and a 2018 first author publication in the journal *Sarcoidosis, Vasculitis, and Diffuse Lung Diseases* evaluating the role of pulmonary function testing as a screening tool for PH in sarcoidosis patients. These publications highlighted novel biomarkers that may have utility in the diagnosis and prognostication of pulmonary vascular disease patients, a research interest that ultimately formed the basis of this K23 application investigating new prognostic clinical biomarkers in PoPH patients.

During my fellowship I presented my work, in both poster and oral format, at national and international meetings including the Sentara Heart Mid-Atlantic Pulmonary Arterial Hypertension Symposium, the American Thoracic Society (ATS) International Conference, and the International Society of Heart and Lung Transplantation (ISHLT) Annual Meeting. In 2017 this work was recognized by an ATS Abstract Scholarship award from the Pulmonary Circulation assembly, and a first-place award at the Sentara Heart Mid-Atlantic Pulmonary Arterial Hypertension Young Investigator research competition. As I explored the current gaps in our understanding of pulmonary vascular disease pathogenesis and clinical management, my mentors encouraged me to develop a working knowledge of basic biostatistics and research design, and sharpen my scientific writing skills. This formative experience also taught me key lessons about resourcefulness, hard work, and time management, was instrumental in identifying the gaps in my own training that will need to be addressed to achieve independence, and directly informed the career development activities outlined in this K23 application.

To obtain formal training in clinical research and intensive clinical training in the care of pulmonary vascular disease patients, I joined the University of Cincinnati (UC) as a clinical instructor in the Division of Pulmonary, Critical Care, and Sleep Medicine after completing my fellowship in the Summer of 2018, and was fortunate to receive one of three highly coveted Internal Medicine Scholarly Training in Academic Research (IMSTAR) one-year fellowship spots. The IMSTAR program was developed to identify and train promising junior faculty to become successful physician-scientists. As an IMSTAR fellow I completed a thesis project on imaging biomarkers in PH, received multidisciplinary mentorship from senior research faculty, and completed graduate-level instruction in biostatistics, clinical research, and epidemiology. Aside from the IMSTAR program, one of the other major draws of UC was its PH center, headed by Dr. Jean M. Elwing, which is accredited by the Pulmonary Hypertension Association as one of only 54 Certified Centers of Comprehensive Care in the nation. UC is also closely linked to the Cincinnati Children’s Hospital Medical Center (CCHMC), home to William C. Nichols PhD’s National Biological Sample and Data Repository for Pulmonary Arterial Hypertension (PAH Biobank). These resources are vital to my research goal of studying PH biomarkers, and both Drs. Elwing and Nichols, mentors on this K23 application, are nationally-recognized experts in the scientific investigation of pulmonary vascular disease. Their guidance will be immensely beneficial to structuring my scientific plan, growing my clinical proficiency, and guiding me towards independence as a PH physician-scientist.

Following my IMSTAR fellowship I completed a Master’s Degree in Clinical and Translational Research (MSCTR) in August of 2019 at UC, and was promoted to the rank of Assistant Professor. Over the past year I have also built my clinical and research skills specific to PH, both as an attending physician under the guidance of Dr. Elwing, and as a sub-investigator in three research studies that she leads as the site Principal Investigator: INSPIRE (NCT03399604), ARENA (NCT03497689), and EXPEDITE (NCT03626688). Under the tutelage of Dr. Elwing I developed basic skills in the design and implementation of clinical research studies, completed an introductory grant-writing course offered by UC, and was awarded a competitive intramural research grant in January of 2019 for my project studying PH intestinal microbiota. This award, offered annually to one promising candidate through the UC Center for Clinical and Translational Science and Training, is specifically designed to promote the career development of promising junior clinician-scientists.

In order to enhance my ability to communicate the findings of my work and collaborate with the broader scientific community, this past year I designed and moderated a scientific symposium on pulmonary vascular exercise hemodynamics for the 2019 ISHLT Annual Meeting, and will lead a session on PH mechanical circulatory support at the 2020 ISHLT Annual Meeting. Most recently, I have used the skills acquired in my previous training to study using cardiac magnetic resonance imaging for PH prognosis, and investigate the role of anticoagulation as a treatment for pulmonary arterial hypertension. This work was awarded the distinction of being one of the top five abstracts presented at the 2019 Pulmonary Hypertension Association professional network symposium, one of the top 15 clinical submissions to be featured at the 15th Annual Respiratory Disease Young Investigator’s Forum, and has led to the drafting of two first-author original research manuscripts (submitted for publication). In summary, my past experiences have strengthened and focused my goal of becoming an independent physician-scientist and clinical expert in pulmonary vascular disease, provided me with a baseline level of research competency, and informed my current research focus on PH biomarkers. These experiences have also identified key gaps in my training, including a need for further education on advanced biostatistics, grantsmanship, scientific speaking, and clinical research design and implementation, that require the support of this award to successfully address and transition to independence.

**Career Goals and Objectives**

My overarching goal is to develop a career as an independent physician scientist and leader in the clinical investigation of PH. Successful completion of the currently proposed work, investigating the value of novel biomarkers of fibrotic RV dilation in assessing disease severity and treatment response in PoPH, will provide the basis for future R01 studies exploring the mechanisms and corresponding biomarkers driving cardiovascular remodeling in various types of pulmonary vascular disease. This career path is a natural extension of my current scientific development to date, but in order to transition to independence I will require multidisciplinary mentorship and the development of a number of new skills and proficiencies as follows:

* Knowledge Base: I have completed internal medicine training at the Johns Hopkins Hospital in 2015, followed by fellowship in Pulmonary and Critical Care medicine with a focus on pulmonary vascular disease, at the George Washington University and Inova Fairfax Hospital in 2018. In order to become a PH specialist, I will require additional education in aspects of cardiovascular medicine and hepatology as they relate to pulmonary vascular disease. The mentorship of Dr. O’Donnell, a cardiologist and imaging specialist, and Dr. Gandhi, an expert in chronic liver diseases, will provide sub-specialty specific education and help me address this knowledge gap.
* Scientific Communication Skills: I have presented my work at national and international scientific forums in the form of posters, mini-symposia, and as a developer and moderator of scientific sessions. I have also authored several research papers on various clinical biomarkers that may have prognostic value in PH, and my work has been featured in prominent scientific journals including *Chest*, *European Respiratory Journal*, and *Pulmonary Circulation*. In order to achieve the goals outlined above, I will require further development of both my oratory skills as well as continued scientific productivity. My mentors Dr. McCormack and Dr. Elwing, widely published experts in clinical pulmonary disease, are intimately involved in the planning and development of major scientific meetings including the annual CHEST and ATS meetings, and are uniquely qualified to help enhance this aspect of my development.
* Mentorship for Scientific Development: I have been fortunate thus-far to benefit from the experience and support of superb physician-scientist mentors. To successfully navigate the transition to independence, I will required continued mentorship, and have constructed a top-notch multidisciplinary team of mentors with complementary skills to help me achieve my career goals.
* Clinical Patient-Oriented Research: I have previously designed, conducted, analyzed, and published a number of retrospective studies on PH clinical biomarkers. Over the past year I have also served as a Sub-Investigator on a number of PH clinical trials being conducted at the University of Cincinnati under Dr. Jean Elwing. These experiences have highlighted the need for additional mentorship and training in the design and completion of prospective patient-oriented clinical research. The mentorship and guidance of Dr. Elwing will help facilitate successful completion of the currently proposed work, allowing me to extend the findings to subsequent R01 studies and achieve scientific independence.
* Advanced Biostatistics: In my previous work studying PH biomarkers, I relied primarily on self-acquired biostatistics skills to collect, analyze, and interpret my data. Recognizing the need for more formal biostatistics training, I subsequently completed a Master’s Degree in Clinical and Translational Research at UC in August 2019 via the IMSTAR program, providing a solid foundation from which to build upon. In pursuit of my career goal investigating PH clinical biomarkers, I will need to analyze and interpret large sets of biological, transcriptomic, and genomic data. To prepare for this, I will seek additional training in topics like advanced regression analysis, cluster analysis, and machine learning.
* Expertise in Biomarker Assay Techniques: To date I have relied upon existing data and clinical repositories to investigate PH biomarkers. In order to achieve my stated research goals of understanding the mechanisms that drive PoPH and other forms of PH, I will need a deeper understanding of the strengths and limitations of various biomarker assay techniques, technical proficiency in ELISA development and preparation, and a working knowledge of more advanced analytic tools like transcriptomic analysis. In order to achieve an appropriate level of mastery, I will rely on the mentorship of Drs. McCormack, Gandhi, and Nichols, all of whom are well established physician-scientists overseeing basic science laboratories, are committed to my career growth, have developed biomarkers in both a basic and translational setting, and are extremely knowledgeable about biomarker assays, their applications, and how to build upon and extend the results of these techniques.

**Candidate’s Plan for Career Development/Training Activities During Award Period**

Over the course of this award, I will commit at least 75% of full-time professional effort dedicated to research and related career development activities. This commitment is ***not*** contingent on the support of this award. I have assembled a distinguished multidisciplinary mentorship team with diverse areas of expertise relevant to my career and scientific goals. I will convene formal meetings of the entire team **monthly** to review my progress, provide feedback, identify barriers to success, and troubleshoot solutions to achieving my overall career goals. I will also meet individually with members of this team as follows:

|  |  |  |
| --- | --- | --- |
| **Mentor** | **Meeting Frequency** | **Contribution to Development** |
| Full Mentorship Team  (UC and CCHMC) | Monthly | * Review research and career goals progress, assess achievement of benchmarks * Assess and troubleshoot barriers to success, appropriate resources, and networking to overcome barriers |
| Francis X. McCormack, MD  (UC)  Taylor Professor of Medicine  Division Director Pulmonary, Critical Care, and Sleep Medicine | Weekly  In-person | * Overall guidance on career trajectory, networking, and establishing independence * Guidance with clinical trial planning and management * Planning of subsequent studies and grant applications to investigate pathogenesis of PH * Guidance presenting at local and national meetings * Assistance with biomarker assay techniques (ELISA, Multiplex bead assay, etc.) for PH serum biomarkers * Guidance on identifying biomarkers with physiologic relevance, mechanistic plausibility, and greatest potential for patient impact |
| Chandrashekhar R. Gandhi, MSc, PhD  (CCHMC)  Professor of Medicine and Surgery  Division of Gastroenterology, Hepatology, and Nutrition | Bi-Weekly  In-person | * Guidance/mentorship in cross-divisional networking and research partnerships with both basic and clinical hepatology researchers * Content expertise in chronic liver disease biomarkers, vasoactive biomarkers, and vascular manifestations of chronic liver disease * Assistance with biomarker assay techniques (ELISA, Multiplex bead assay, etc.) specifically for PoPH serum biomarkers * Assistance with analysis and interpretation of liver-specific serum biomarkers, selecting appropriate statistics for data interpretation, and incorporation of animal models of liver disease * Guidance on identifying biomarkers with physiologic relevance, mechanistic plausibility, and greatest potential for patient impact |
| Jean M. Elwing, MD  (UC)  Professor of Medicine  Director of Pulmonary Hypertension  Division of Pulmonary, Critical Care, and Sleep Medicine | Bi-Weekly  In-person | * Content expertise in pulmonary vascular disease and PoPH * Mentorship in design and implementation of patient-oriented research with a focus on PH * One-on-one guidance in successful completion of PH clinical trials * Assistance in research subject identification and recruitment * Guidance with presentations at local and national meetings, PH-specific networking, and refinement of skill in PH clinical care |
| William C. Nichols, PhD  (CCHMC)  Professor of Pediatrics  Associate Director of Human Genetics  Director of National PAH Biorepository | Monthly  In-person | * Content expertise in biomarkers of pulmonary vascular disease * Assistance with utilization/navigation of PAH biobank at CCHMC * Assistance with biomarker assay techniques (ELISA, Multiplex bead assay, etc.) for PH serum biomarkers * Assistance in identifying and interpreting genetic and transcriptomic basis of novel biomarkers, including selection of appropriate statistical methods for data interpretation |
| Robert E. O’Donnell, MD  (UC)  Associate Professor of Medicine, Division of Cardiovascular Diseases Division | Monthly  In-person | * Content expertise in cardiovascular physiology and cardiac MRI imaging techniques, strengths, and weaknesses * Member of UC Cardiovascular Imaging reading group * Guidance in PH patient MRI image acquisition and interpretation, including assessment of ventricular chamber dimensions, ventricular mass, and cardiac function |

To supplement the mentorship of the team described above, I have also developed an individualized didactic plan to acquire the needed skills and education necessary to complete my career goals and achieve independence as a PH physician scientist. I have completed the following coursework as part of my IMSTAR Master’s Degree in Clinical and Translational Research, obtained at the University of Cincinnati in 8/2019:

|  |  |  |
| --- | --- | --- |
| **Course Name** | **Credits**  **Grade** | **Topic** |
| BE 7011 – Statistical Computational Software | 1.0  A | Introduction to statistical computational software including R, SPSS, SAS |
| BE 7022 – Introduction to Biostatistics | 3.0  A- | Introduction to biostatistics including T-tests, ANOVA, and regression analysis |
| BE 7067 – Scientific Integrity | 2.0  P | Scientific integrity, ethics in research, and protection of clinical research subjects |
| BE 7076 – Introduction to Epidemiology | 2.0  A | Introduction to epidemiology and basics of population research |
| ENV 7091 – Master’s Thesis Research | 2.0  P | Independent Retrospective Research on Cardiac MRI prognostication in PAH |
| BE 7082 – Introduction to Data Science | 3.0  A | Introduction to analysis of “big data” including cluster analysis and neural networks |
| BE 7089 – Experimental Design | 3.0  A | Introduction to the design of clinical research studies including case-control, cohort, randomized, and adaptive |
| BE 8062 – Introduction to Medical Informatics | 3.0  A | Introduction to medical informatics, including the storage, organization, and interpretation of “big data” |
| EDST 7011 – Statistical Data Analysis II | 3.0  A | Advanced statistical analytic techniques including linear and logistic regression analysis |
| BE 7061 – Biostatistics in Research | 3.0  A | Overview of biostatistics techniques and their application to clinical research including regression and survival analysis |
| BE 7068C – Decision Analysis | 3.0  A | Introduction to decision analytic techniques such as cost-effectiveness, Markov Model, and shared decision making |
| BE 9066 – Clinical Research Scholars Seminar | 1.0  P | Seminar analyzing barriers in clinical research and professional development, and solutions to overcome them |
| BE 9075 – Design and Management: Field Studies | 3.0  A- | Overview of design of large-scale clinical research, with a focus on NIH-Style research protocol and grant writing |

During the period of award support, I intend to pursue the following didactic coursework to complement my previous academic training, achieve my research and career goals, and transition to independence:

|  |  |  |
| --- | --- | --- |
| **Course Name** | **Credits**  **Semester** | **Topic** |
| BE 8001  Bioinformatics Practicum | 3.0  Fall | * Project-oriented course using electronic medical record (EMR) to answer research questions * Enhances ability to analyze large EMR data |
| CS 6037  Machine Learning | 3.0  Fall | * Introduction to using machine learning algorithms * Useful for analyzing large datasets generated from biomarker analysis and future genomic/transcriptomic studies |
| BE 7025  Comparative Effectiveness | 2.0  Fall | * Study designs and statistics in comparative patient-oriented research * Improves ability to evaluate the cost-benefit assessment of novel prognostic PH biomarkers and imaging modalities such as MRI |
| BE 7090C  Applied Survival Analysis | 3.0  Fall/Spring | * Application of survival analysis * Useful to analyze PH clinical data on the prognostic value of PH biomarkers in predicting mortality |
| BE 7094  Data Science for Biomedical Research | 3.0  Spring | * Data mining techniques to analyze large datasets * Analytic skills for large biomarker, genomic, transcriptomic data generated from proposed work |
| BE 7025  Advanced Biostatistics | 3.0  Spring | * Advanced regression analysis examples and applications * Analytic skills for using biomarker data for correlations and prognostication |

**Total Annual Time Commitment = 2.5 Person Months (21% estimating 40 hours/week at 100% effort)**

To build upon the educational coursework listed above, while also supplementing and expanding upon the knowledge gained from my mentorship committee in the broad fields of hepatology, cardiology, and pulmonary vascular disease, I will also pursue a number of academic tutorials, seminars, and conferences. These experiences will occur in parallel to the existing patient-oriented research studies where I serve as a PI or Sub-I. UC is an ideal location to pursue these experiences due to its status as a tertiary care center, a PH referral center, and a high-volume liver transplant center. These experiences will not only serve to complement the education I will receive during the award period, but also build up the scientific communication and research skills necessary for scientific independence. Additionally, the academic development activities I have outlined below will allow me to devote the majority of my research time in the second and third years of this award towards data collection and patient recruitment of the currently proposed study, providing the critical data needed to structure and submit a successful R01 grant in the final years of the award:

|  |  |  |
| --- | --- | --- |
| **Activity** | **Time Commitment** | **Topic** |
| IRB Board Membership | 2 hours a month | Voting member of the UC IRB board, review and evaluate research proposals on scientific and ethical soundness. This experience will build upon my ability to design and conduct high-quality, thoughtful, rigorous research studies. |
| Medical Grand Rounds Committee Member | 1 hour a month | As a voting member and Pulmonary Division representative, I will evaluate medical grand rounds speakers. I will also present annually on PH topics to the Medicine Department, developing my communication skills. |
| UC Pulmonary Research Meeting | 2 hours a month | Divisional Pulmonary research is presented, assessed, and strategies for success are discussed. I will present my own work quarterly for feedback from the Division. |
| Center for Clinical Effectiveness Meeting | 1 hour a month | Multidisciplinary forum for discussion and presentation of patient-centered effectiveness research, with a focus on comparative effectiveness. I will present my own work twice a year and get feedback and suggestions for improvement. |
| UC Journal Club | 2 hours a month | Multidisciplinary forum to discuss research and grant writing. Includes members from across the institution, many with NIH-funded awards, to offer mentorship and guidance to junior trainees. I will present twice a year to get guidance from more senior funded investigators on my work. |
| UC “K” Club and Office of Research Meetings | 1 hour a month | Didactic and practical workshop where early career investigators meet with senior faculty to work on topics like time management, team building, and grant writing. |
| National Meetings | 2 weeks a year | Attendance and presentation at national meetings in cardiopulmonary diseases, with a focus on pulmonary vascular disease. Conferences include Chest, American Thoracic Society, Grover Conference, and International Society of Heart and Lung Transplantation. This experience will further develop my scientific communication skills and allow me to establish relationships and collaborations with physician-scientists from across the country. |
| Institutional Presentations | 1 hour a month | I will attend and present pulmonary vascular disease topics of interest to various Divisions in the Medicine Dept. including Pulmonary, Cardiology, Hepatology, Liver Transplantation, and at the Veterans Affairs Hospital. This exposure will strengthen my communication skills while also exposing my work to a diverse audience. |
| UC CReFF Study (PI) | 1 Person Months | I will serve as the PI on this one-year study, sponsored through the UC Clinical Research and Feasibility Fund (CReFF), investigating the significance of the intestinal microbiome in PH, which directly complements and enhances the proposed work. |
| Investigator Sponsored Study (PI) | 1 Person Months | I will serve as the PI on this two-year study investigating the value of heart rate variability as a biomarker of clinical response in PH. This is an Investigator Sponsored Study through the United Therapeutics Company. This work directly complements and enhances the proposed project. |
| UC PH Clinic - Clinical Trial Participation | 0.5 Person Months | I will serve as a Sub-Investigator on a number of clinical trials being conducted at the UC PH Clinic under one of my mentors Dr. Elwing. This experience will address my development as an independent physician scientist able to design and complete large-scale clinical studies. |
| Research Skills- Biomarker Analysis | 4 hours a month | In order to effectively collect and analyze biomarker data, facility in the various techniques and platforms for biomarker analysis, including their strengths and limitations, will be essential. To address this gap, I will spend time in the lab of Dr. McCormack, Dr. Gandhi, and Dr. Nichols to gain familiarity with ELISA, multiplex bead assays, and more advanced analytic techniques. |

**Total Annual Time Commitment = 4 Person Months (33% estimating 40 hours/week at 100% effort) for year one, 3 Person Months (25%) for year two, and 2 Person Months (17%) from the third year onwards**

Pathway to Independence – As an Assistant Professor in the Division of Pulmonary and Critical Care, my current responsibilities are divided between clinical research (58%) and teaching/patient care (42%). My clinical care duties include attending in the Medical Step-Down Unit, Medical ICU, and outpatient PH clinic. During this award, **I will have at least 75% of my effort** dedicated to research and career development activities, and spend the remaining 25% serving as an attending physician in the settings listed above. These settings are complementary to my clinical and research interests by serving as locations for potential subject screening and enrollment, allow me to care for the full spectrum of pulmonary vascular disease from outpatient to ICU setting, and allow me to appreciate the complex interplay between cardiopulmonary physiology and advanced liver disease. In order to take full advantage of the support provided by this award and successfully navigate a personalized pathway to independence I will monitor my progress by the following benchmarks:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Activity/Effort** | **Current** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** |
| Clinical Activities, Teaching, Patient Care | 42% | 25% | 25% | 25% | 25% | 25% |
| Academic Coursework | 0% | 21% | - | - | - | - |
| Mentorship, Career Development, and Academic Activities to achieve independence | 13% | 13% | 13% | 13% | 13% | 13% |
| Data collection and analysis from other projects | 21% | 21% | 13% | 4% | 4% | 4% |
| Data collection and analysis – PoPH project | 0% | 11% | 24% | 38% | 18% | 3% |
| Submission of Abstracts to National Meetings | 4% | 2% | 10% | 5% | 5% | 10% |
| Symposium Presentation at National Meetings | 4% | 2% | 10% | 5% | 5% | 10% |
| Publish Manuscript (Microbiome) | 0% | 5% | - | - | - | - |
| Publish Manuscript (Heart Rate Variability) | 0% | 0% | 5% | - | - | - |
| Publish Manuscript (PoPH Biomarkers) | 0% | 0% | 0% | 5% | - | - |
| Publish Manuscript (PH Mechanisms) | 0% | 0% | 0% | 0% | 5% | - |
| Submission of Institutional Grants (Rehn Foundation, Junior Faculty Pilot, Collaborative) | 8% | 0% | 0% | 0% | 5% | 5% |
| Submission of Foundational Grants (Parker B Francis, AHA, Entelligence, Team PH, Chest) | 8% | 0% | 0% | 5% | 5% | 5% |
| Submission of R01 Grant | 0% | 0% | 0% | 0% | 15% | 25% |
| **Total Effort** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

As detailed above, this career development award is critical to my pathway to independence as a physician scientist and pulmonary vascular disease specialist. The support provided by this award will allow me to expand my fund of knowledge, acquire important technical skills in biomarker analysis, supplement those skills with advanced didactic training in biostatistics, improve my scientific communication skills, enhance my scientific exposure through publications and national meeting presentations, and provide the time and mentorship needed to successfully submit an R01 grant. I have been careful to structure this development program to ensure that my other research projects and all of my non-research activities (patient care, clinical duties) are directly related to pulmonary vascular disease and support my main research and career objectives. The result is a comprehensive, rigorous, and personalized plan for career development and achieving independence tailored to addressing my individual gaps in training and promoting future success.