Investing in the Future. Evaluation of the Activities of the Developmental Core of Emory University Center for AIDS Research: A Case Study

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ABSTRACT

BACKGROUND: Despite significant advances in HIV research, treatment, and prevention, Georgia is experiencing a raging epidemic. The Atlanta metropolitan area contains almost two-thirds of the state's diagnosed cases of HIV. It is also home to the federally-funded Emory University Center for AIDS Research (Emory CFAR), which invests heavily into the careers of early stage investigators who are ready to enter HIV/AIDS research field.

OBJECTIVE: The main goal of this project was to analyze the impact of Emory CFAR Developmental Core services on institutional efforts to recruit early stage investigators (ESIs) into the field of HIV research and develop their careers, increase AIDS-designated grant funding, and promote public knowledge about the HIV epidemic. Specifically, it looked at the Emory CFAR's investment into the careers of ESIs through several Developmental Core grant mechanisms, as well as the impact of this investment from three perspectives: global, organizational, and personal.

METHOD: Global impact was evaluated by first indexing all ESI-authored publications that resulted from research supported by Emory CFAR Developmental Core funding. Then, journal impact factors were calculated and analyzed to determine if these publications appear in respected journals. Organizational impact was assessed by looking at the total CFAR investment into ESIs via various Developmental Core mechanisms, determining the total amount of new extramural funding to the University that resulted from these investments, and then calculating the return on investment (ROI). To evaluate personal impact, a short survey was distributed to all the Developmental Core awardees that are still at Emory University.

RESULTS: The analysis of publications showed that Developmental Core awardees do publish in peer-reviewed journals, both open access and traditional, with respectful impact factors. ROI

analysis showed that the activities of the Emory CFAR Developmental Core impact the university's fiscal portfolio. ESIs reported receiving new grants resulting from their CFAR Developmental Core award. Depending on the award mechanism, ROI ranged from about 100% to over 6000%. Even though an 84% response rate was achieved, there were not enough data to determine the personal impact-specifically, if receipt of a Developmental Core award impacted the age of ESIs when they received their first R01 grant. However, the survey did uncover additional benefits of CFAR Developmental Core services for ESIs.

CONCLUSIONS: Overall, the activities of the Emory CFAR Developmental Core were found to have three separate impacts: global, organizational, and personal. Findings also support previous studies that addressed the need for similar faculty development programs. This analysis is the first of its kind. While methods would need to be modified to fit local CFAR mechanisms, this project developed a framework that can be used by other CFARs to evaluate the impact of their Developmental Core services. Results also can be used by Core leadership to make decisions about services that should be offered in the future. CFAR leadership can present results to the University when requesting funding. Likewise, this analysis can be used by the NIH CFAR to demonstrate the effectiveness of the program.

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LIST OF ACRONYMS

AIDS – Acquired Immune Deficiency Syndrome

CDC – Centers for Disease Control and Prevention

CFAR – Center for AIDS Research

FAC – Facilities and Administrative Costs

FRB-Funded Research Base

F&A – Facilities and Administration Costs

HIV – Human Immunodeficiency Virus

IDC – Indirect Costs

IRB – Institutional Review Board

JAMA – Journal of American Medical Association

JIF - Journal Impact Factor

MD – Doctor of Medicine

MHS – Master of Health Science

MMWR – Morbidity and Mortality Weekly Report

MPH – Master of Public Health

MSC – Master of Science

NCI – National Cancer Institute

NIH – National Institutes of Health

OAR – Office of AIDS Research (National Institutes of Health establishment)

PATH – Comprehensive Platform of Assistance and Training in HIV Research

PEPFAR – President's Emergency Plan for AIDS Relief

PD/PI - Project Director/Principal Investigator

PhD – Doctor pf Philosophy

R01, P01, U01, K01, K07, K23 – types of grants

ROI – Return on Investment

TSFRE – Thoracic Surgery Foundation for Research and Education

UNAIDS – Joint United Nations Program on HIV and AIDS

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DEDICATION

I dedicate this work to my family, which grew from two to four while I was working on my degree: Yevgeniy, Arina, and Nicholas. To my mother and father for their support and faith in me. Thank you for your patience as I took time to improve myself.

I dedicate it to my friends, who supported me and believed in me throughout this journey.

I dedicate it to Dr. Kimbi Hagen, who promised to make sure I complete my studies, and did so as she herself had so much to deal with.

I dedicate it to Mr. Jon Diller and his family, who gave me my first opportunity that lead me here.

I dedicate it to Mr. Joseph Riley, who supported me, but is not with us to witness this moment.

From the bottom of my heart, THANK YOU ALL!

It was a great mystery to all of us." (Ho in "The Age of AIDS", (Simone, 2006)*)*

"By the time the first cases of AIDS in the United States were diagnosed, 250,000 Americans were infected." (Curran in "The Age of AIDS", (Simone, 2006)*)*

"The epidemic of HIV in America is forgotten, but not gone." (del Rio in "Why the South is the epicenter of the AIDS crisis in America, (PBS NewsHour, 2016)*)*

Chapter I

INTRODUCTION

This work will study the impact of the Emory Center for AIDS Research (CFAR) Developmental Core on efforts to recruit early stage investigators into the field of HIV research, develop their careers, increase AIDS-designated grant funding to Emory University, and promote public knowledge about the HIV epidemic. The CFAR at Emory University is sponsored both by university funds through institutional commitments and by taxpayers' dollars through the National Institutes of Health. Demonstrating that funds from both sources are used effectively and efficiently would support the need for continuation and possible expansion of the program both on national and local levels.

This project will look at the impact of Emory CFAR by examining its contributions in three areas:

1. How have Emory CFAR Developmental Core awardees increased knowledge and success around HIV in public health?

2. How much in external funds have Emory CFAR Developmental Core awardees increased the Emory University fiscal portfolio as it pertains to AIDS-designated NIH funding? More specifically, what is the rate of return on the dollars awarded via developmental grant mechanisms, which include Ramp Up awards, CFAR-series awards, and Administrative supplements?
3. How have Emory CFAR Developmental Core services and funding improved the success of individual HIV investigators new to the field? In particular, since NIH reports the increasing age of first-time grantees, how do Developmental Core awardees' age compare to the NIH's data on the age of investigators at the time of receipt of a first R01-equivalent grant? Also, how successful are the Core awardees in establishing contacts and collaborations that can potentially lead to future independent NIH funding?

For the purposes of this study the following definition of "early stage investigator" will be used:

Early stage investigator-a researcher who has not previously competed successfully as Project Director/Principal Investigator (PD/PI) for a substantial NIH independent research award. Specifically, a PD/PI is identified as an early stage investigator if he/she has not previously competed successfully for an NIH-supported research project other than the certain early stage or small research grants or for the indicated training, infrastructure, and career awards (National Institutes of Health, 2016b).

"The Emory CFAR has been extremely successful in strategically expanding a University-wide, multidisciplinary community of scientists whose NIH-funded research has led to globally recognized interventions that prevent new HIV transmissions and enhance the wellbeing of people living with and at risk for HIV." (del Rio, Curran, Hunter, 2016, p. 337). Part of forming

and expanding that University-wide community is not only connecting existing researchers and providing support for their activities, but also recruiting new investigators into HIV/AIDS research by providing resources they need in order to establish successful careers. Those activities are managed through the Emory CFAR Developmental Core, which provides numerous services and resources to faculty members interested in HIV research. Through those efforts, early stage investigators are able to advance their careers in the field. Ultimately, this support can contribute to scientific developments in HIV treatment and prevention in order to improve the public health of not only local residents, but of people living with HIV/AIDS everywhere in the world. This work will focus on evaluating activities of the CFAR Developmental Core to determine if these investments impact certain areas of development of early stage investigators.

The federally funded Centers for AIDS Research (CFAR) program, administered through the NIH, provides administrative and shared research support to synergistically enhance and coordinate high-quality HIV research projects. CFARs accomplish this through core facilities that provide expertise, resources, and services that cannot otherwise readily be obtained through traditional funding mechanisms.

The CFAR program emphasizes the importance of interdisciplinary collaboration, especially between basic science and clinical investigators, in order to facilitate translational research in which findings from the laboratory are brought to the clinic and vice versa. Likewise, the program places an emphasis upon the inclusion of minorities and inclusion of prevention and behavioral change research (National Institute of Allergy and Infectious Diseases, 2018a). CFAR is funded by multiple institutes within the NIH. The mission of the CFAR program is to support a multidisciplinary environment that promotes basic, clinical, epidemiologic, behavioral, and

translational research in the prevention, detection, and treatment of HIV. CFARs accomplish this mission by:

- Providing scientific leadership and institutional infrastructure dedicated to HIV research;
- Stimulating scientific collaboration in interdisciplinary and translational research;
- Promoting development of sustainable multidisciplinary HIV/AIDS research programs at each CFAR institution;
- Strengthening capacity for HIV research in developing countries;
- Fostering scientific communication;
- Sponsoring training and education;
- Promoting knowledge of CFAR-supported research findings and the importance of HIV research through community outreach;
- Promoting and supporting innovative NIH HIV/AIDS research initiatives;
- Establishing collaborative research between CFARs and supporting HIV research networks;
- Facilitating technology transfer and development through the promotion of scientific interactions between CFARs and industry;
- Supporting research on prevention and treatment of HIV in hard-to-reach domestic populations, especially among urban, low-income rural, and minorities (National Institute of Allergy and Infectious Disease, 2015).

Currently, there are 19 CFARs located throughout the United States (National Institute of Allergy and Infectious Diseases, 2018b).

FIGURE 1: CENTERS FOR AIDS RESEARCH, DEVELOPMENTAL CFARS SITES. SOURCE: NATIONAL INSTITUTE OF ALLERGY AND INFECTIOUS DISEASES, 2018B

All CFARs are selected on a competitive basis. Institutions or organizations with an HIV/AIDS funded research base (FRB) -i.e. the annual total amount paid to an organization using NIH "AIDS dollars" funding - of $10M annually are eligible to apply. Based on the actual amount of total HIV/AIDS FRB during the fiscal year (October 1-September 30) preceding the calendar year of application, applications may be submitted for the following amounts:

Tier 1: Minimum FRB of $10M, but less than $40M, organization may apply for $1.5M total costs in the first year;

Tier 2: Minimum FRB of $40M, but less than $80M, organization may apply for $2.25M total costs in the first year;

Tier 3: Minimum FRB of $80M, organization may apply for $3M total costs in the first year;

In order to apply for a certain tier, institution must maintain the same FRB during the year of submission. They also must maintain that minimum in order to qualify for the same tier in subsequent years after year 1 (Department of Health and Human Services, 2017).

During the 2016 competitive renewal cycle, Emory University qualified to apply and was funded as a tier 2 CFAR with base funding of 2.25 M. Sustained tier 2 eligibility was especially exciting, because a university's FRB may change quickly due to many factors, like grants ending, investigators leaving, etc.

Atlanta, located in the epicenter of the epidemic, is well resourced. Emory University has a record of outstanding results in the fight to stop the disease. Emory researchers have been instrumental in discovering and developing effective therapies for the treatment of HIV, reducing transmission rates, and improving patients' quality of life. The impact of the University cannot be overstated. More than 90% of patients in the U.S. (and many around the world) who are on medication for HIV take antiretroviral drugs developed at Emory (Loftus, 2010). Additionally, the Emory CFAR, which started as an AIDS Interest Group in 1995, has shaped and strengthened the HIV research landscape by providing otherwise unavailable equipment, services, materials, and expertise to HIV investigators (del Rio, Curran, Hunter, 2016). It is precisely this multidisciplinary approach that must continue to bring HIV rates down, not only in Georgia, but worldwide. Investigators belonging to the Emory CFAR network work together to address the epidemic locally by focusing on areas around Atlanta as well as concentrating on the Southern States. They also work in many countries, including South Africa, Kenya, Georgia, and many others. Additionally, many investigators are involved in research that utilizes modern technology, such as mobile apps and games to drive up HIV awareness, and the rates of testing and prevention. Localized efforts could benefit the entire country and beyond as successful strategies of getting people tested, diagnosed, and into treatment are identified.

The wide variety of barriers that exist today in the fight to combat the global HIV pandemic require researchers from multiple backgrounds, disciplines, and community groups to

come together to successfully combat this disease. In particular, it is critical to develop interest about HIV research among early stage investigators, and to nurture and grow that interest by offering opportunities and resources.

In today's funding climate, it is difficult for early stage investigators to obtain independent funding. The Emory CFAR Developmental Core seeks to provide critical support to promising junior faculty as they transition from an unfunded mentee to a NIH-funded independent AIDS investigator, and then to an HIV research mentor in their own right (del Rio, et al., 2016).

"The overarching goal of the Developmental Core is to expand the breadth and depth of NIH-funded HIV/AIDS research at Emory University and Morehouse School of Medicine through strategic recruitments; the funding, mentoring, and development of HIV/AIDS investigators; and the synergistic development of individual and institutional partnerships" (Emory University, 2016a).

The Emory CFAR Developmental Core provides support to early stage investigators through a Comprehensive Platform of Assistance and Training in HIV Research (PATH) initiative. This initiative provides a broad, integrated program of funding and mentoring support. The four components of PATH are:

1. Research funding
2. Mentoring assistance
3. Proposal support
4. Professional development

These components form an integrated platform of services across the "idea to independence and beyond" continuum (Center for AIDS Research at Emory University, 2016a).

Another one of the Core's most significant activities is the small grants program. Currently, the Developmental Core offers the following funding opportunities (Emory University, 2016a):

CFAR-Series Awards

- CFAR-03 Mentored Research Award is designed to help move CFAR early stage investigators toward NIH independent investigator status in HIV/AIDS research by funding mentored research projects that will strengthen the competitiveness of subsequent NIH applications. Typically, these awards provide up to $40,000 in direct costs for up to two years.
- CFAR-CFAR (CFAR-C) Mentored Research Award is designed to enable cross-CFAR collaborations that will foster inter-institutional research synergy and help move CFAR early stage investigators toward independent investigator status in NIH-funded HIV/AIDS research. The budget is also up to $40,000 in direct costs for up to two years from Emory CFAR funds, with additional contributions by the collaborating CFAR.
- CFAR-K (CFAR-K) Mentored Research Award is designed to help CFAR early stage investigators who currently hold NIH K awards move more rapidly toward independent investigator status in NIH-funded HIV/AIDS research by providing research funding for projects not fully covered by the NIH K award. These projects also offer up to $40,000 in direct costs for up to two years.

Emory CFAR purposely bases their awards program on NIH R03 awards so that early stage investigators are exposed to the "NIH way" as early as possible. The reasons for selecting the R03 mechanism on which to model the CFAR-Series awards include:

- R03 NIH awards can be requested for pilot or feasibility studies;

- They do not require preliminary data;
- They may be requested to develop methodology or new research technology;
- They are small, self-contained research projects with budgets for direct costs of $50,000 per year;
- NIH has a standardized application and review process (National Institutes of Health, 2016c)

This development award mechanism helps early stage investigators not only learn how to prepare a competitive application, but also become familiar with standard NIH forms and the application and review process. They also learn how to work with pre- and post-award teams available through the Emory Research Administration shared service centers. The ultimate goal of this type of award is to generate enough data in order to submit a successful application for funding to the NIH or to develop a concept that, with some additional resources, will drive such an application.

Ramp Up Awards

- CFAR Opportunity Awards are intended to remove obstacles to HIV research productivity among CFAR investigators by providing small but crucial resources that cannot easily or immediately be obtained through other funding mechanisms. Funds can be requested for multiple uses, including the following: overcoming obstacles encountered during a current NIH-funded research project; obtaining data needed for a scored NIH grant application that is being revised for a resubmission; and/or supporting a new application that is expected to be submitted within the next 12 months. Funding is limited to $2,000 in direct costs.

- CFAR Collaborative Travel Awards are designed to enable collaborations that will immediately or ultimately lead to new NIH funded projects in HIV/AIDS. Funds of up to $2,000 in direct costs are available in order to make it possible for CFAR early stage investigators to meet face to face with potential research collaborators from other institutions in order to develop a solid NIH grant application.
- CFAR Poster Printing Awards provide training in the design of scientific posters that will attract attention, be easy for other researchers to scan, efficiently summarize research, and stimulate interest in the poster presenter's research. These awards also provide poster tutorial recipients with funding toward the printing of posters that will assist early career and new HIV investigators in disseminating the results of their research

Administrative Supplements

- NIH CFAR Administrative Supplements provide early stage investigators with the opportunity to apply for administrative supplements to the CFAR base grant. These supplements are federally funded and can be used for equipment or special projects for which funds are not available through the regular Emory CFAR Administrative or Developmental Cores.
- CFAR ADELANTE Program is a national grants program currently in its second cycle. The goals of the ADELANTE Program are to decrease HIV-related health disparities in the Hispanic/Latino community and to promote the mentored development of new investigators to focus on HIV in Hispanic/Latino populations. The funding is for two years with an annual budget of up to $75,000 in direct costs.

Evident from this list of available funding opportunities, Emory CFAR invests heavily in the development of faculty interested in HIV research. This investment comes not only from the

NIH (taxpayer) dollars, but also from other Emory University institutional sources and organizations, including Children's Healthcare of Atlanta, the Nell Hodgson Woodruff School of Nursing, the Winship Cancer Institute, the Georgia Clinical & Translational Science Alliance, and the Morehouse School of Medicine (Emory University, 2016a).

In addition to pilot award funding, the Emory CFAR Developmental Core provides the following services:

- Proposal support activities that build skills in the foundation of work of conceptualizing, developing, writing, submitting, reviewing, and responding to peer-review application critiques; all with the ultimate goal of increasing the strength of fundable NIH applications in HIV research.
- Mentoring assistance activities that address the field from multiple perspectives including mentoring administration, relationship formation, implementation, and training for investigators who wish to make the mentee to mentor transition.
- Professional development activities that help CFAR investigators cultivate new or enhanced expertise in research methods, science writing, NIH-style research proposal reviewing, and science communication (del Rio, et al., 2016).

Even though all the CFAR Developmental Core activities have been in place for a long time, they have not been formally evaluated. Prior awardees' subsequent performance in securing additional NIH funding suggests a high rate of success in terms of a monetary return on investment at an estimated 2,000%. Notably though, various additional factors must be considered to calculate a true percentage of the Core's return on investment. This analysis of the CFAR Developmental Core should factor in more than simple dollar-to-dollar investment, as evaluating strictly financial returns in terms of downstream NIH funding after Core service

utilization would provide an incomplete picture. There are many more types of professional and personal outcomes possible from dollars invested. A formal evaluation of various Developmental Core activities would demonstrate which of those activities are most successful, and which may need improvement.

Such evaluation would be beneficial not only for the CFAR program itself, but for the larger research community, the University, the federal government, and the general public, given that taxpayer money is largely being used to fund federal AIDS research programs. Through this analysis, CFARs and similar centers that offer developmental services to early stage investigators would gain a better understanding of which services are most beneficial and cost-efficient. The University, which co-funds many of the centers with internal funds, would be able to clearly see the impact of its funding use. Finally, with an ever-increasing demand for transparency when it comes to use of taxpayer money, funding agencies would be able to demonstrate effective and efficient use of grant funds.

Additionally, in 2015, the NIH announced that it will no longer support setting a fixed 10% of its budgets to fund research on HIV as it had in prior years (Kaiser Family Foundation, 2015). Kaiser (2015) writes that that mandated budget level made it difficult for some of the institutes to ensure high-quality research, as the fixed funding regulation forced NIH to fund projects that were on a low-priority list. As a result of the 2015 NIH decision, some funding will be repurposed to fund other high-priority areas.

Adding to the concerns about funding is the fact that the new administration, elected in 2016, has shifted priorities from public health and research to border security and other areas. President Trump has repeatedly proposed cutting health research funds both for domestic and international programs. However, so far, Congress pushed back on those proposals (Beaubien,

2018; Pear, 2017;The AIDS Institute, 2018). Unfortunately, some cuts are happening anyway, as the current administration has repurposed funding remaining from the previous fiscal year in the Ryan White program, which provides support services for people living with HIV but do not have sufficient health care coverage or financial resources, to care for separated migrant children (Shugerman, 2018). This is concerning, since using AIDS resources to alleviate another unrelated crisis has the potential to make the HIV/AIDS epidemic worse. Concerns about the future funding of these programs makes the ability to demonstrate effectiveness and efficiency of federally funded research programs that much more critical. In the short term, programs must show that they are effective in combating the HIV/AIDS epidemic. In the long term, they must show that investing in this research and developing early stage investigators is beneficial to the country as a whole by improving public health in general and the quality of life of those living with HIV.

Demonstrating success of the CFAR's developmental grants program could present an argument for maintaining or even increasing the budget levels dedicated to AIDS research.

With the possibility that HIV/AIDS research funding levels will be reduced, CFARs and HIV investigators will become increasingly accountable to the NIH for each dollar spent. In order for Emory CFAR and the NIH CFAR to justify their existence, clear evidence of successful results must be available. With this data on hand, a potential increase in NIH funding for specific areas of research and programs, as well as increased commitments from Universities and the public, could be possible.

The main goal of this project is to demonstrate the impact of the Emory CFAR Developmental Core on the success of HIV research programs, not only within Emory University and the Atlanta Metro Area, but throughout the nation. The Emory CFAR is

sponsored by Emory University funds and taxpayers' dollars, as made available and administered through the NIH. Demonstrating that funds from both sources are used effectively and efficiently would warrant the continuation and possible expansion of the program. Moreover, success of the CFAR Program could mean advances to curb the HIV epidemic, which would eventually benefit society as a whole through improved public health. Working locally, Emory CFAR researchers are making an impact globally. Demonstrated success of even one CFAR could spur the development of additional public policies that would accelerate efforts in the battle against HIV and other deadly diseases.

Three areas of impact of Emory CFAR Developmental Core will need to be evaluated:

1. How have Emory CFAR Developmental Core awardees increased knowledge and success around HIV in public health? Global impact of Core awardees will be evaluated by looking at publications that resulted from the support provided by the Developmental Core. More specifically, this project will look at the journal impact factors (JIF) of journals where awardees published their work and citation factors for each of the articles published.
2. How much in external funds have Emory CFAR Developmental Core awardees increased Emory University's fiscal portfolio as it pertains to NIH funding? This section will determine the return on investment (ROI) for each of the different funding mechanisms offered by the Developmental Core (Ramp up awards, CFAR-Series, and Administrative supplements).
3. How have Emory CFAR Developmental Core services improved the success of individual early stage investigators? This section will examine what services awardees view as the most beneficial at certain stages of their careers. This section will also

examine if services provided by the Developmental core assist early stage investigators in obtaining their first independent funding at an earlier age.

The following chapters will look closely at the potential impact of grant and university funded activities and their effects on developing early stage investigators' careers, increasing public knowledge about HIV research findings, increasing Emory University's AIDS-designated fiscal portfolio, and promoting collaborations in order to build on the successful and meaningful fight against HIV.

The literature review will look at the current funding climate and the importance of public financing of biomedical research, will illustrate effects of that funding on faculty success, and will provide a brief history of NIH grant programs. It also will talk about the impact of competitive grant funding on faculty productivity (particularly measured by publications), as well as provide some examples of successful faculty development programs.

The methodology section of this work will describe in detail the research questions it aims to address and methods for evaluating activities of the Emory CFAR Developmental Core. Various approaches will be taken to answer each of the three questions, from data-gathering to conducting a brief survey among Developmental Core awardees.

The results will be then presented in the analysis and findings section, providing information as to whether the activities are effective and what, if any, adjustments need to be made. Given that Emory CFAR submitted a successful competitive renewal application to the NIH in 2016, feedback will be useful no matter the outcome. Successful activities can be enhanced and improved during this funding cycle, and those not seen as beneficial can be redesigned in order to strengthen the competitive renewal proposal that will be due in 2021. The

timeline works because Emory CFAR will have time to make any adjustments and/or enhancements and analyze the outcomes of those changes before competing for funding again.

Research findings will further be discussed in the conclusions section and recommendations will be presented to the Emory CFAR on what, if any, improvements or adjustments to Developmental Core activities are needed or whether additional evaluations would be beneficial.

Chapter II

LITERATURE REVIEW

This chapter will look at the literature available currently as it pertains to grant funding, challenges that early stage investigators face when trying to get established as independent investigators, impact of funding on faculty productivity, and some of the successful faculty development programs implemented at other organizations, among other aspects. It is the goal of this review to provide a good illustration of the need for investing in early stage investigators in order to magnify their impact on the future of public health.

Brief History of HIV/AIDS Epidemic

The AIDS epidemic that continues to this day was the reason for the development and implementation of the CFAR program. To better understand the significance of the epidemic and the need for resources to fight it, looking at the history of AIDS in the United States is beneficial.

On June 5, 1981, the U.S. Centers for Disease Control and Prevention published a Morbidity and Mortality Weekly Report (MMWR) that described cases of a rare lung infection, *Pneumocystis carinii* pneumonia, in five young, previously healthy gay men. The ages of these men ranged from 29 to 36, and all of them were treated with medications available at the time. However, at the time of the publication of the MMWR, two of the five patients had died (Centers for Disease Control and Prevention, 1981). *Pneumocystis pneumonia* in the United States is almost exclusively limited to immunosuppressed patients (Walzer, Perl, Krogstad, Rawson, & Schultz, 1974). It was unusual to see this disease in five previously healthy individuals with no

apparent immunodeficiency. The fact that all infected individuals were homosexuals suggested that there was some association between the lifestyle and acquisition of the disease, perhaps through sexual contact (Centers for Disease Control and Prevention, 1981).

This report would become the first mention of what later would become known as the AIDS epidemic. Throughout the year, more similar cases of men, whose immune systems were not working properly, were reported. In addition to opportunistic infections (infections that occur more frequently and are more severe in individuals with weakened immune systems) (Centers for Disease Control and Prevention, 2016b), Kaposi sarcoma was reported. Typically, this type of cancer occurred in elderly persons or immunosuppressed renal transplant recipients, and was rarely life-threatening. By the end of 1981, 159 cases of Kaposi sarcoma and other opportunistic infections had been reported in the United States (Curran, 2011). By year's end, there were 270 total cases of severe immune deficiency among gay men, and 121 of those individuals had died (AIDS.gov, 2016). It became clear that a new, highly concentrated epidemic of life threatening illness was occurring in the US, and that it was one of immunosuppression (Curran, 2011). Several studies were conducted among gay men that found many patients with AIDS had sexual contact with another person with AIDS within 5 years before the symptoms appeared (Centers for Disease Control and Prevention, 1982a). This finding strongly suggested that the new syndrome was caused by a sexually transmissible infectious agent (Curran, 2011).

In 1982, an elderly man with severe hemophilia A was reported to have died from *Pneumocystis carinii* pneumonia, and two more cases of this disease were reported in young men with severe hemophilia. All of these cases were accompanied by severe immunosuppression, and none of the patients engaged in homosexual contact or needle sharing (Centers for Disease Control and Prevention, 1982b). Then, AIDS cases were also reported in infants (Centers for

Disease Control and Prevention, 1982c; Oleske, et al., 1983; Ruvenstein, et al., 1983), female sex partners of men with or at high risk of AIDS (Centers for Disease Control and Prevention, 1983; Harris, et al., 1983), and infants and adults who had received blood transfusions (Centers for Disease Control and Prevention, 1982d; Curran, et al., 1984). These cases provided evidence that AIDS was caused by an infectious agent that could be transmitted by blood and from mother to child, as well as through homosexual and heterosexual contact (Curran, 2011). What was initially called a "gay plague" was shown to be putting other people at risk of the disease (Curran, 2011). It was not until 1983 that the actual virus was discovered.

Multiple science teams around the world worked on finding the cause of AIDS. On April 23, 1984, Margaret Heckler, the Secretary of Health and Human Services, announced that Dr. Gallo of the National Cancer Institute (NCI) of the NIH had isolated the virus which caused AIDS, and that there would be soon a commercially available test that would be able to detect the virus with almost 100% certainty (Rainey, 2006). However, this discovery was not without a controversy. The reality of the human immunodeficiency virus (HIV) discovery is that two scientists of the Pasteur Institute in France, Dr. Luc Montagnier and Dr. Francoise Barre-Sinoussi, successfully isolated the virus and sent the samples to Dr. Gallo. In December of 1983 Dr. Gallo submitted a paper for publication proposing the theory that a retrovirus was the cause of AIDS (Rainey, 2006). Later, a test was developed to detect HIV antibodies. The U.S. government denied the French scientists a patent and awarded it to Dr. Gallo instead. The Pasteur Institute challenged the patent in court. Gallo and Montagnier agreed out of court to share equal credit for their discovery (Rainey, 2006). In 1987 this dispute was finally decided on at the government level, which was unusual. Prime Minister Chirac and President Reagan announced that the initial contest ended in a draw with both parties being presented with equal

rights to the patent for testing of HIV (Rawling, 1994). Dr. Luc Montagnier, and Dr. Francoise Barre-Sinoussi were awarded the Nobel Prize in Physiology in 2008 for their discovery of the human immunodeficiency virus, HIV (Nobel Prize, 2008).

But this case is not about a U.S. scientist misleading the public and claiming credit for a scientific discovery. This story highlights just how important it is for researchers to have sufficient resources and support in order to make discoveries and publish their findings. Science is not stagnant, and work continues all the time, with new discoveries happening frequently. It is those scientists that have the best support (financial, mentoring, or other) that are often able to be the first to publish (Hagen, 2016).

Now that the cause of AIDS was identified, scientists could start working on finding ways to at least manage the newly identified virus and its impact. The significance of the impact of this new disease is demonstrated by Harden and Fauci (2012), who write that "between 1950s and 1981, physicians, whose practice focused on infectious disease, almost always saw their patients get well. Penicillin and broad spectrum antibiotics, coupled with vaccines against polio and other childhood diseases, freed most patients and physicians in the industrialized world from the fear of death by diseases caused by bacteria, viruses, and other types of microbes" (Harden & Fauci, 2012). The new virus would demonstrate to the physicians and researchers just how vulnerable human life still was.

The HIV epidemic continues to this day. According to a Joint United Nations Programme in HIV/AIDS (UNAIDS) fact sheet, there were 36.9 million people living with HIV in the world in 2015 (UNAIDS, 2018). Sub-Saharan Africa remains the most severely affected region, with nearly 1 in every 25 adults (4.1%) are currently living with HIV and accounting for nearly two-

thirds of the people living with HIV worldwide (World Health Organization, 2018). The map below depicts the distribution of HIV cases throughout the world:

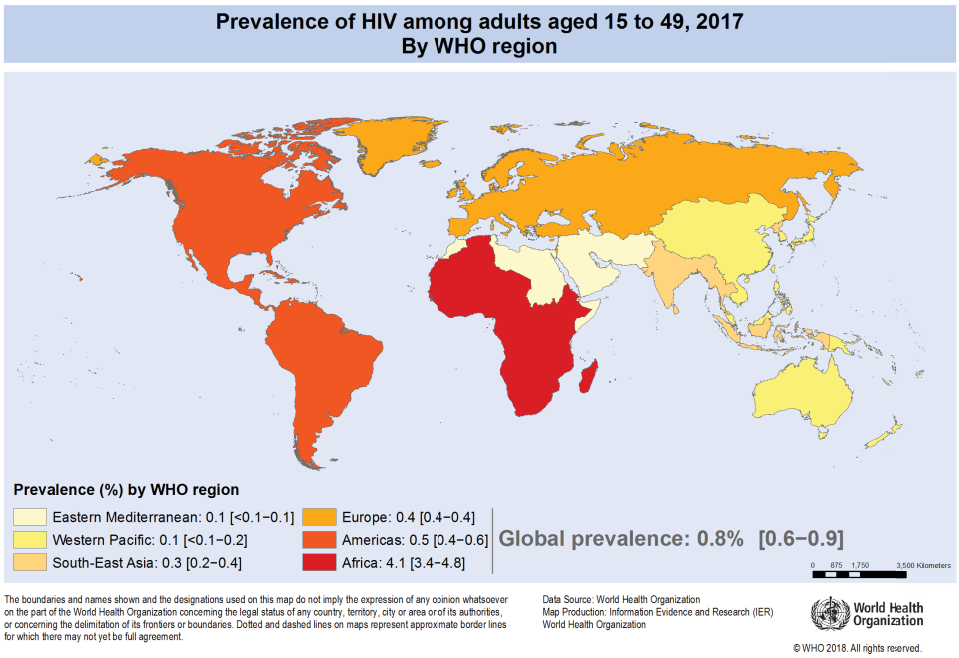

FIGURE 2:PREVALENCE OF HIV ADULTS AGED 15 TO 49, 2017. BY WHI REGION SOURCE: WORLD HEALTH ORGANIZATION, 2018

But it is not necessary to venture far to see, firsthand, just how big the HIV epidemic still is. At the beginning of the 21st century, Georgia found itself in the middle of the raging HIV/AIDS epidemic, despite advances in prevention and treatment options available. Georgia was ranked fifth highest in the nation for the total number of adults and adolescents living with HIV infection in 2016. The total number of persons living with HIV infection in Georgia was 56,789 as of the end of 2016. Seventy-nine percent of those diagnosed with HIV infection in Georgia during 2016 were male, 71% were Blacks, and 83% of males 13 years and older were men who have sex with men. A large portion of diagnosed persons (20%) were tested late, which resulted in missed opportunities for prevention and treatment of HIV infection. Georgia ranked

1st in the rate of HIV diagnosis among adults and adolescents, and 3rd in the rate of persons living with HIV, surpassed only by New York and Texas (Georgia Department of Public Health, 2016).

Localizing the problem even further, a look at Metro Atlanta is even more alarming. The Atlanta metropolitan area contains almost two thirds (61%) of the state's diagnosed cases of HIV (Georgia Department of Public Health, 2016). These statistics raise a question among HIV researchers about the reasons for increased HIV infection diagnosis at a time when accurate tests, effective treatment options, and education materials have been developed and are available. Multiple reasons have been cited. Dr. Wendy Armstrong, site Director for the Emory CFAR Clinical Research Core, operating out of the Ponce Clinic performance site, states that access to care for the African American HIV-positive community is one of the main reasons the epidemic continues in great numbers among that demographic group: "It is such a prevalent disease in our population for a group of patients who don't have easy access to care" (PBS NewsHour, 2016). Other major contributors to the continuing epidemic include stigma against certain lifestyles (homosexuality, drug use, transgenderism, and being poor or underprivileged) and the disease itself, and funding shortfalls due to Georgia's decision not to expand Medicaid under the Affordable Care Act (PBS NewsHour, 2016).

In 1985, Slaff and Brubaker pointed out that, despite significant research efforts globally, effective AIDS treatments have not been identified. As of that time, science has not been able to increase the average life expectancy of AIDS patients beyond 18 months following the diagnosis. They go on to state that antiviral agents and immune boosters have been ineffective and that the general consensus in the medical and scientific communities is that effective therapy or a cure would not be possible for many years to come (Slaff & Brubaker, 1985). Today, thanks to the efforts of researchers around the world, HIV-positive people can enjoy a nearly normal life span

and most likely will never progress to AIDS thanks to the available antiretroviral therapies (AIDS.gov, 2015). This is possible today because governments around the world invested in their scientists and in the efforts to study HIV and AIDS. In the United States, the NIH "has led the global research effort against HIV/AIDS over the past 34 years, enabling the development of rapid HIV tests and the identification of a new class of HIV-fighting drugs that could be combined in life-saving ways in the clinic" (U.S. Department of Health and Human Services, 2015).

In particular, two public policies in the United States played a significant role in the fight against HIV not only inside the country, but also around the world.

1. In 1988, NIH established the Office of AIDS Research (OAR) to coordinate AIDS research and to serve as a focal point for AIDS policy and budget development (U.S. Department of Health and Human Services, 2016). Since 1990 AIDS has received 10% of the NIH's overall budget, when Congress and NIH informally agreed that it should grow in step with NIH's overall budget (Kaiser, 2015). In FY18, the total OAR budget was $58,348,000, which is lower than in previous fiscal years (U.S. Department of Health and Human Services, 2018).

2. On July 30, 2008, H.R. 5501, the Tom Lantos and Henry J. Hyde United States Global Leadership Against HIV/AIDS, Tuberculosis, and Malaria Reauthorization Act of 2008 was signed into law, authorizing up to $48 billion over the next 5 years to combat global HIV/AIDS, tuberculosis, and malaria. Today, this U.S. Government initiative to help save the lives of those suffering from HIV/AIDS around the world is known as the U.S. President's Emergency Plan for AIDS Relief (PEPFAR). The special focus of the program is on improving the health of women, newborns and children. The Global Health

> Initiative's goal is to save the greatest number of lives by increasing and building upon what works and, then, supporting countries as they work to improve the health of their own people (The United States President's Emergency Plan for AIDS Relief, 2016).

These policies were especially important, since the very beginning of the AIDS epidemic was practically ignored by the Reagan administration. Dr. James Curran states: "There was an open neglect, if you will, and the failure of the president for many years to even mention the term AIDS. One of the most difficult things for us at the CDC was feeling like the communities that were at greatest increased risk didn't trust us because we worked for an administration which wouldn't mention the word AIDS" (Simone, 2006). That is why additional resources not only meant increased financial commitment, but also demonstrated that this country is ready to fight the disease with all its ability. It is because of that commitment that major advances happened that allow people with HIV to have a nearly normal life now. HIV infection has changed from a virtual death sentence into a manageable chronic disease. Today, HIV-infected people in their 20s who receive combination therapy may expect to live to age 70 or beyond (U.S. Department of Health and Human Services, 2015). That is why it is so important to continue those efforts.

Today, because of the longer life expectancy for people with HIV, it is easy to think that the epidemic is over, that there are effective treatments, and the problem is not significant. True, knowledge that people infected with HIV virus can have an almost normal life is encouraging. However, the magnitude of the continuing epidemic becomes especially clear when looking at historical data. In 1985 Slaff and Brubaker estimated that there were about 500,000 people living with what was then called AIDS infection (Slaff & Brubaker, 1985). The CDC (2001) reported that in 1981-1987 there were 50,280 people with the AIDS diagnosis in the US (Centers for Disease Control and Prevention, 2001). At the end of 2013, there were 1,242,000 people living

with HIV in the United States (Centers for Disease Control and Prevention, 2016a). Clearly, the epidemic continues to this day. Carlos del Rio, Emory CFAR Principal Investigator and Co-Director, summarizes current situation well: "The epidemic of HIV in America is forgotten, but not gone" (PBS NewsHour, 2016). Efforts to fight HIV/AIDS must continue through development of new enthusiastic researchers that will work in many different areas of life, including basic sciences, behavioral sciences, policy studies, public finance, and many others. Not only will these researchers benefit people living with HIV/AIDS, reduction in the number of people living with HIV would lessen financial burden on the economy by reducing healthcare costs for a significant number of people and also by having a healthier population that can live a productive life.

Biomedical Research Funding Climate

Federal funding for biomedical research in the United States has fueled discoveries that have advanced our understanding of human disease, led to novel and effective diagnostic tools and therapies, and made the US research enterprise an international model. Additionally, NIH funding has become an essential source of support for academic medical centers, providing funding for faculty and staff salaries, operational expenses, and even capital improvements related to research (Loscalzo, 2006). In addition to being a source of new treatments and preventive measures, research is also seen as a route to public policy, economic development, and new commercial products (Dorcey, De Roulet, Thompson, Reminick, Thai, Ehite Stellato, Beck, George, Moses, 2010). The NIH is the largest non-commercial funder of biomedical research in the United States (Cech, 2005). With a budget of about $24 billion annually (U.S. Department of Health and Human Services, 2018), the NIH supports many research activities in many areas. The National Institute of Allergy and Infectious Disease's annual budget is around

$1.4 billion (U.S. Department of Health and Human Services, 2018). The funding amounts have not always been this high. The NIH began to support biomedical research in 1938 with a total appropriation of $464,000 (Mandel & Vessell, 2004), an amount that has steadily increased to the current level. In 1995, the US House of Representatives' budget resolution called for a cut in funding for the National Institutes of Health of 5% for FY 1996 and a freeze on NIH funding through FY 2000. However, the NIH received an increase of almost six percent for FY 1996, followed by 7% increases in each of the following two years, despite the economy still being weak (Porter, 2005). An increased pace of scientific discoveries and increasingly strong political support fueled the doubling of the NIH budget over the next five-year period, from FY 1999 through FY 2003, after which the growth slowed down in FY 2004 and FY 2005 (Mandel & Vessell, 2004). In fact, it can be argued that after the funding boom of 1998-2003, the following years were stagnant for the NIH. The NIH budget for FY 2007 was $28.6 billion, which is a 0.1% decrease from the previous year, and a 3.8% decrease after adjustments for inflation were made. This was the first budgeted reduction in NIH support since 1970 (Loscalzo, 2006). Nevertheless, the United States remains the largest funder of life sciences. In 2003, the total U.S. investment in research and development from all sources (industry, government, academia, philanthropy) totaled $284 billion, which represented 2.6% of the nation's gross domestic product (Porter, 2005). In 2010, global expenditure on life sciences research was $240 billion. The U.S. was the largest funder with about $70 billion in commercial and $40 billion in governmental and non-profit funding annually. This number represented slightly more than 5% of the U.S. healthcare expenditure (Mcleod, Michie, Roberts, Dirnagl, Chalmers, ioannisis, Al-Shahi Salman, Chan, Glasziou, 2014).

As stated above, biomedical research funding plays a significant role in support of university research centers by covering the bulk of their operating expenses. In 2002, total biomedical research expenditures at universities and colleges was $19.6 billion, up from $10.7 billion in 1995. Federal expenditures accounted for 64%, and institutional funds accounted for 17%. Interestingly, the percentage of the funds going to ten of most heavily funded institutions remained the same at 19% (Moses III, Dorsey, Matheson, & Thier, 2005). This is an interesting fact, since it suggests that the same universities are receiving the most NIH dollars due to certain factors, which may include infrastructure, expertise available, and research record. It is clear that the investment by the federal government in biomedical research is not a small one. The significant role this investment plays is not only in advancing public health, but also in providing ways to sustain functioning research centers within universities, necessitating development efforts that provide junior faculty within universities and colleges with skills and training in order to receive this research funding via various grant mechanisms.

Faculty Career Development and Grant Funding

Before getting into a discussion about why career development programs are important, it is necessary to define development. Camplin and Steger (2000, 1) define development as "targeted enhancement of an individual or a collective set of individuals to serve better the mission of the organization." Various funding agencies that sponsor biomedical research already recognize the importance of investing in junior researchers and already have mechanisms in place that provide funding for specific training and development projects. Those mechanisms range from training awards for graduate students to fellowship and career development grants. The goal of such training awards is to develop researchers that will lead science in the future. Some grant mechanisms are intended to facilitate the transition from the mentored scientist to the

independent investigator, or to provide protected time for newly independent investigators to develop their research programs. Other grants go directly to research institutions to educate and train predoctoral students and postdoctoral or clinical fellows. These programs cover scientists, clinicians, and other health professionals conducting basic, translational, and clinical research (Mason, Faupel-Bader, Ginsburg, Seger, DiJoseph, Schnell, Wiest, 2013). Many researchers will argue that the main goal of such programs is to cultivate scientists that will be successful in getting external funding, mainly R-series grants from the NIH.

Career development awards (K-award programs) from the NIH comprise the most significant mechanisms for securing research funding and may be predictive of future R01 support for junior faculty. The NIH K programs were created with the specific mission of training independent scientific investigators through intensive mentoring and dedicated research time (Rangel & Lawrence, 2004). The importance of developing early stage investigators is obvious, since NIH has fifteen different career development programs listed on its web site. Those programs range from awards designed to support new investigators who still need mentoring to programs designed to support those researchers who want to develop specific skillsets or who may be ready to transition into an independent investigator (National Institutes of Health, 2018a). NIH programs that target developing investigators are particularly important because previous NIH funding is the strongest predictor of future NIH support, and recipients of career development awards have access to preliminary data and a track record of funding to facilitate the successful transition to winning their first R01 grant (Rangel & Lawrence, 2004).

Current Challenges

While there is an emphasis on developing early stage investigators and a push to support and mentor the new generation of scientists, a disturbing change has been happening within the

field of sponsored research. Who is being funded for what type of research has changed steadily over the last years. Investigators now receive their first independent research grant, an R01 or other equivalent R-series award, at a median age of 42 years for those with PhD degrees, and 44 years for those with MDs (Cech, 2005). Cech (2005, 1390) quotes Zerhouni, who wrote: "In today's world, Marshall Nirenberg would get his Nobel Prize before he got his first NIH grant". Newer information provided by Daniels (2015) in his article adds that the average age at which an investigator with a medical degree receives their first R01 or equivalent grant has increased from less than 38 years in 1980 to more than 45 year in 2013. At the same time, the number of principal investigators for such grants who are 36 years old or younger has declined from 18 % in 1983 to 3% in 2010. More than twice as many R01s are awarded to researchers who are over 65 years old as are to investigators younger than 36 years old. Moreover, this trend is visible in all NIH grants, as the percent of all grant funding awarded to scientists under the age of 36 has decreased from 5.6% to 3% from 1980 to 2012 (Daniels, 2015).

Cech (2005) lists several reasons for the increase in age when investigators receive their first R01 grant. They include the fact that new faculty wait longer to apply for NIH funding, and the fact that almost half of first-time applications are ranked as noncompetitive, so they are not discussed at the study sections and are returned to the applicants for revisions and possible resubmission. Rejection reasons cited by study sections include applications being overly ambitious, the need for more preliminary results confirming projects' feasibility, and the desire for significant assurance that projects will work (Cech, 2005). This seems to place early stage investigators in a difficult predicament since, without their own funding, they are unable to start their own laboratories, pursue their own research, and advance their own careers in academic

science. As a result, many young researchers choose to leave their research careers for careers in industry, other countries, or outside of science altogether (Daniels, 2015).

Daniels (2015) also proposes three reasons for decline in research funding to young scientists. They are similar to the reasons cited by Cech (2005), and include longer training periods that introduce a delay in obtaining research grants, disadvantage of young scientists due to aspects of the grant process that tend to favor systematically more experienced scientists over new entrants, and imbalances in the total costs of federally funded research borne by sponsoring institutions, such as universities and research laboratories, relative to the NIH. While the first reason is obvious, the second reason cites such factors as the complexity of the grant application process, lack of preliminary funding and available resources, and even personal preferences of the reviewers. The third reason references the fact that the university share of support for all university-based research has risen from 8.7% in 1962 to 19.4% in 2012. This increase may jeopardize universities' ability to support robust scientific research (Daniels, 2015).

Similar trends were observed with research funding even in the 1960s and 1970s. A study by RAND Corporation found that even at those times, more experienced researchers were more likely to receive research project funding and career development funding than those who were in the "new investigator" career stage. Also, higher-quality candidates from institutions that were considered more research intensive were more likely to be approved for funding or awarded higher priority scores (Carter, Winkler, & Biddle, 1987). This agrees with the statements above, that grants are more likely to be awarded to more experienced researchers, for projects that have a high probability to succeed. Thus, early stage investigators may find themselves in a vicious circle of trying to obtain funding while having their application denied even a chance for review due to lack of that very funding.

One may ask why it is important to allow investigators to obtain funding at a younger age. Jacob and Lefgren provide a couple of reasons. First, graduate training represents a large financial investment by taxpayers, universities, and students. In 2009, authors state "the average cost of tuition, fees, and living expenses associated with graduate study of the biological sciences in a high quality program was approximately $51,000. Therefore, social return of such investments should be maximized by ensuring a smooth transition from a graduate program into independent research" (Jacob & Lefgren, 2011, 864). The second reason for the need to ensure that researchers are funded at a younger age is derived from the study by Stephan and Levin, who found that the research productivity of life scientists is greatest prior to the age of forty (Stephen & Levin, 1989, Jacob & Lefgren, 2011).

Gender Differences

One other dimension of grant funding is worth looking at. It is possible that gender may play a role on the success rates of applications and funding levels. Multiple studies on this subject were conducted for both basic science researchers and clinicians. Anderson Eloy, Svider, Kovalerchik, et al. looked at grant funding of otolaryngologists. They found that the mean NIH award to men was $362,946, and was statistically different than the mean award to women of $287,188. Male researchers were found to have statistically higher total NIH funding per individual than female researchers. They also found that, by academic rank, male investigators had higher mean NIH awards and mean total NIH funding per individual than female researchers at all ranks, except associate professor. However, statistical significance was only seen on comparisons of assistant professors (Anderson Eloy, et al., 2013). The authors discovered that, overall, women had fewer submissions of grant applications, and suggest that any disparities in grant funding are likely due to underrepresentation of female researches at senior academic

ranks. However, this study did find that lower-ranked female faculty had statistically lower awards and funding levels than their male colleagues. At the same time, the authors note that higher funding levels may be due to the fact that male investigators simply applied for higher amounts (Anderson Eloy, Svider, Kovalerchik, Baredes, Kalyiussef, Chandrasekhart, 2013).

Another study that looked at gender differences in research grant applications and funding outcomes found significant gender difference in the mean number of submissions per applicant, success rate, number of years, and amount requested. In all of those variables, values were higher for male researchers than for female researchers. However, similarly to the study described earlier, after controlling for academic rank, success rates were not significantly different. Also, similarly to the study by Anderson Eloy et al, this study showed that significant differences in the amounts awarded to males compared to amounts awarded to females exist only among lower academic ranks (in this case, instructor and associate professor). Also, female investigators submitted fewer applications per person during the 3-year study period and were less likely than their male counterparts to submit more than one grant. Women also requested lower amounts of funding, which agrees with the study described previously. Grants submitted by women also received fewer years of funding. The study did find similar results to the one by Anderson Eloy et al., which concluded that significant differences between sexes in dollars awarded exist at the ranks of instructor and associate professor. Among higher academic ranks, however, women attained parity with their male colleagues in both the amount of funding and number of years requested (Waisbren, Bowels, Hasan, Emans, Goldberg, Could, Levine, Lieberman, Loeken, Longtine, Nadelson, Farkas Perenaude, Quinn, Randolph, Solet, Ullrich, Walensky, Weitzman, Christou, 2008).

NIH also conducted a study on sex differences in application, success, and funding rates in the agency's extramural program. The results were similar to the studies described above and showed that success and funding rates for men and women were not statistically different in most programs. The disparities were often related to overall lower percentage of women applicants compared to men, and not due to decreased funding rates of successful applications from women. There was, however, a statistically significant difference in both application and funding rates for subsequent grants. Looking at the R01 mechanism, women and men had success rates (meaning number of applications funded) that were not statistically different, but women had a lower funding rate (meaning their awards were smaller than those of male researchers) that was statistically significant. Also, experienced male applicants had higher funding rates than experienced females. Men were also more successful submitting renewal applications compared to women, when measured by success rates or funding rates. Interestingly, this study presents results different from the studies described above. In analysis of the R01 program, the only subgroup in which men outperformed women with statistical significance was experienced investigators applying for renewal awards (Pohlhaus Reineke, Jiang, Wagner, Schaffer, & Pinn, 2011).

Multiple reasons are thought to contribute to the disparities among sexes in successfully obtaining grant funding. They include lack of mentorship opportunities, family considerations (Anderson Eloy, et al., 2013), and greater commitment to education (being more involved in teaching and clinical practice) being observed more among women researchers than in men (Anderson Eloy, et al., 2013; Waisbren, et al., 2008). Additionally, Waisbren et al. (2008) suggest that women may become co-investigators instead of principal investigators due to reasons described above. Finally, Pohlhaus et al. (2011) acknowledges that the reasons for lower

funding rates among female investigators are unknown, but could include unconscious bias in review or selection due to male investigators' more developed social networks.

Of particular importance is the fact that lower ranking female faculty do show lower levels of funding and success. Success in obtaining grant funding is not only important to advance scientific knowledge, but also is critical to the career development of faculty (Waisbren, et al., 2008). Inadequate mentorship was cited as one of the reasons for observed lower success and funding rates of women researchers among other things. These reasons are in line with what Emory CFAR is trying to address through the work of its Developmental Core.

Impact of Training Programs

While it seems logical and expected that training programs that invest in early stage investigators would contribute to increasing their chances of success when submitting grant applications, a study evaluating career development awards programs at the National Cancer Institute (NCI) offered some interesting results. New NCI K mechanisms have been consolidated or created to target specific scientific disciplines, career paths, or populations shown to be underrepresented in biomedical research. In 2013, the NCI Center for Cancer Training supported ten K grant mechanisms that varied by discipline, program focus, and applicant eligibility (Mason, et al., 2013). Mason and colleagues studied these mechanisms in order to determine whether being funded through a K mechanism contributed to receiving one's first R01 grant faster, and whether having a K award led to more subsequent NIH grant funding and an increased number of publications. The results of the study showed that more K awardees in the comparison cohort were awarded grants from the NIH Institutes and Centers than non-awardees. The awarded grants included not only R01 grants, but also P01, U01 and other research project grants.

The study also looked at peer-reviewed publications as a relevant indicator of subsequent research activity. Findings indicated that a significantly larger portion of awardees had subsequent research publications than non-awardees. Additionally, the study found that among those who published, the average and median number of publications per awardee were significantly higher than for non-awardees for some K-type awards (K01, K07, and K23 mechanisms). K awardees also had significantly improved odds of conducting subsequent funded research or contributing to research in clinical trials. However, there was one area where having K award did not show a significant advantage. The mean time to receive an R01 grant for awardees and non-awardees was within 1 year of each other, so there was no significant difference in time to receive R01 funding for K awardees and non-awardees. The only significant difference in the full cohort was found in the K01 mechanism, as the K01 applicants' median time to R01 was shorter than the comparison cohort median for all K mechanisms combined. Finally, the study found that the median age of K applicants for awardees and non-awardees was similar (between 36 and 37 years). Since the time to first R01 was similar, (at about 3.5-4 years), the study concluded that the age at which both K awardees and non-awardees received their first R01 grant was 40 to 41 years old, which is consistent with other studies and publications. Overall, the study concluded that K awardees were more likely to apply for and receive subsequent research funding from the NIH and to derive additional benefits in pursuing research careers and participating in the scientific enterprise (Mason, et al., 2013).

While the K mechanism seems to positively impact the likelihood of future funding and publication rates, not all career development or training programs have that distinct of an impact. An F32 postdoctoral fellowship program was found by Jacob and Lefgren to have only a slightly positive effect on the number of publications. That impact was statistically insignificant.

However, they found that receiving an F32 fellowship has a statistically significant impact in several career productivity "thresholds", which include 5 or more publications in years 1-5 and 6-10 following an awarded application, 5 or more first author publications over the same time periods, more than 200 citations in the 10 years after an awarded application, and more than $200,000 in NIH funding within 10 years of the F32 application being awarded. Therefore, the study concluded that receipt of an NIH postdoctoral fellowship (F award) significantly increases the probability that a new PhD will successfully make the transition to a research career and yield a high number of publications from an individual during the 10 year period after receiving the grant (Jacob & Lefgren, 2011).

Another study by Camblin and Steger (2000) presents reasons for an increased need of faculty development initiatives, which include addressing the issues of vitality and renewal, strengthening relationships among colleagues, supporting stated institutional missions, and dealing with both the faculty member's and institution's "capacity to survive". These reasons may be translated into the world of research faculty, where the "need for vitality and renewal" and the "capacity to survive" refer to the requirement of obtaining external funding in order to maintain one's faculty appointment and to continue his or her research. Additionally, they could mean the need to develop new skills in order to "branch out" into new, less crowded, research fields. Again, the ultimate goal is to obtain external funding. As discussed above, relationships with colleagues are also important for efforts to secure research grants, as some authors argue that networking and relationships may play a role when the decisions about whether to review a particular application or to fund a specific proposal are made.

Successful Examples

A study conducted at the University of Cincinnati focused on a new faculty development initiative. While the University offered many faculty development initiatives, inclusive of workshops, travel awards, and others, there was a need for a more advanced program. An agreement was reached between the administration and faculty, in which the university agreed to provide funds dedicated to professional development. As a result of this agreement, series of awards and workshops were established, which included individual grants of up to $5,000, collaborative grants of up to $100,000, departmental grants of up to $100,000, a Faculty Summer Institute Workshop, a Technology Workshop, and formation of an endowment in the amount of $200,000 per year for future faculty development activities. All projects had to be completed within twelve months of funding. When the survey about the experience with the program was sent out, nearly half of respondents came from two colleges within the University, the college of Medicine (23%) and the College of Arts and Sciences (23%). Of those who received funding, 47% indicated that they had also indirectly benefited from an award made to someone else. This percentage is triple the rate of the contact made with the faculty who were unsuccessful in obtaining developmental funds. Again, the biggest portion of responses from funded faculty came from Arts and Sciences (Camblin & Steger, 2000). While this study does not focus on obtaining further research funding, it does confirm that both universities and faculty find value in career development programs. From establishing contacts and collaborations, to adjusting the way faculty teach or conduct research, to learning how to navigate the grant application process, and to receiving independent external funding, investing in faculty is important and in demand.

A study by Jones, Mack, Patterson, and Cohn (2011) focused on the return on investment from research funding by the Thoracic Surgery Foundation for Research and Education

(TSFRE). The study found that over 70% of respondents to the survey still collaborate with their mentor and that 70% have residents or students in their own research laboratories. The study also found that TSFRE funding helps to support the next generation of extramurally-funded thoracic surgeons-scientists. Forty four percent of co-sponsored NIH/TSFRE K-awardees had an R01 grant at the time of the study, and received these R01s on average about 5 years after the first year of their K award. Additionally, even without a K award, the rate of junior faculty obtaining R01 awards after receiving TSFRE award is nearly 40% (Jones, et al., 2011). This particular study is important to this work because it demonstrates that developmental awards from sources other than the NIH have a significant impact on the researchers' ability to secure NIH R01 awards.

Return on investment (financial and through publications)

Now that the importance of career development programs and investment in the development of faculty and researchers has been made clear, a question of feasibility and efficiency arises. Developmental programs require resources, often significant, in order to continue existing. Programs that award grants need constant flow of funds in order to fund proposals. Continued investment in such programs requires good return. The question of return on investment on such programs is becoming more and more important. From universities to the NIH, information on effectiveness of developmental programs is desired.

Evaluating return on investment of NIH grants is difficult. The typical approach of calculating dollars earned does not always work, because investing in biomedical research comes back as additional knowledge, expertise, collaborations, publications, medicines, and other aspects in addition to subsequent grant funding. Cech (2005, 1390) explains the reason for such challenges: "There is reason for optimism that … the huge investments in molecular biology and

genomics research made 10 or 30 years ago will provide an increasingly robust flow of new and effective medicines. Yet this gap of 10 to 30 years between discovery research and pharmaceuticals being prescribed by physicians also gives reason to pause. In the investment world, "past performance is no guarantee of future results." Similarly for biomedicine, just because the funding policies in place decades ago are bearing fruit today, there is no guarantee that today's funding policies will provide the same level of future returns of research discovery."

Traditionally, the contribution of scientific research to knowledge has been measured by the number and impact of scientific papers in peer reviewed literature (Grant, Cottrell, Cluzeau, & Fawcett, 2000). A study by Svider, Hussain, Folbe, Couldwell, Liu, and Anderson Eloy (2014) looked at the relationship between NIH funding and scholarly impact as it applies to neurological surgery. This study found that the h index (a bibliometric measure) was higher for those faculty that were successful in obtaining NIH funding. This association between NIH funding and scholarly impact is preserved even after controlling for academic rank (Svider, et al., 2014).

A look at one more study by Pagel and Hudetz (2015) shows a similar approach to evaluating return on investment of grant funding by using the *h*-index together with publication, duration of activity, publication rate, citation, citation rates, and NIH funding for each recipient. The study found that recipients of Foundation grants (non-federal awards from research foundations) had high rates of publications, and those publications are often cited. Additionally, recipients of these grants received NIH funding in the amount of $448.44 million. Those who acquired NIH grants had greater scholarly output (publications) than those who did not receive NIH funding. In turn, recipients with more publications were also more likely to receive more NIH grants (Pagel & Hudetz, 2015). This last finding is interesting and returns to the first assumption of this work, which speculates that increased investment in researchers leads to increased NIH funding in the

future. Pagel and Hudetz (2015) demonstrated that a smaller investment may lead to an increased number of high-impact publications, which, in turn, may lead to the increased NIH funding.

Significance of Journal Impact Factor

It is necessary to explore the concept of publication impact. Raff, Johnson, and Walter (2008, 36) write: "Published papers are the currency of science…" That currency is often measured by the impact factor of journals in which the articles appear. In the same letter, Raff et al. (2008) states that in the current research climate, it is often more important where you publish than what you publish, and a high level of importance is given to papers published in high-impact journals such as *Science* (Raff, et al., 2008). Alberts, Brooks, and Kelner (2008) add that an inappropriately high value is placed in publishing in certain journals. Notkins (2008) explains that high-profile journals are generally identified by and are synonymous with high impact factor scores. A common practice in biomedical research has been judging the importance and quality of a publication by the impact factor of the journal in which the article appeared. Those impact factors are often used in making decisions about hiring a researcher, tenure, and receiving promotions and grants (Notkins, 2008). It is true that journal impact factor, as a measure of performance, faces a significant amount of criticism. At the same time, those people that criticize it acknowledge that it has become a performance standard now dominating research practices (Sheckman, 2013). Additionally, it is not uncommon for laboratory leaders (principal investigators) to make not only hiring decisions, but to decide how to allocate resources, time, mentorship, etc, based on the impact factor of a journal in which his/her mentee investigator is planning to publish (Rushforth & De Rijcke, 2015). Even Eugene Garfield, the inventor of the journal impact factor measurement, acknowledges that use of the term "impact factor" has gradually evolved, especially in Europe, to include both journal and author impact. Granting and

other agencies are tempted to use the journal impact factor in their decisions. “Presumably, the journal’s impact and the mere acceptance of the paper for publication is an implied indicator of prestige and subsequent citation” (Garfield, 1999, 980).

Despite widespread criticism, it is obvious that using journal impact factor as a measure of performance in the biomedical research field has become part of “the culture” of that field (Rushforth & De Rijcke, 2015). Garfield (1999) adds that while journal impact factor is not perfect, there is nothing better that has the advantage of being in existence. He adds that experience shows that the best journals are those in which it is the most difficult to have an article accepted. He concludes that the use of the journal impact factor as a measurement is widespread because it fits well with the opinion about the best journals in each field (Garfield, 1999).

Several key publications will guide the analyses that will take place in the future chapters of this project. Since publishing in high-profile journals seems to be a large part of the biomedical research culture, a close examination of the Developmental Core awardees’ publications will be performed in order to determine where they fall in the perceived importance in the field of HIV research. As Garfield (1999), Raff et al. (2008) and others note, impact factors often may play a key role in decisions related to the early stage investigator’s career moves and even his or her ability to obtain grant funding. While journal impact factor is not a perfect tool to measure researchers’ impact (Garfield, 1999), it is still often used to do that, so ensuring that Developmental Core awardees are publishing in journals that are perceived as influential in the field would be one way to contribute to their successful careers.

Rangel and Lawrence (2004) wrote that previous NIH funding may be a predictor of future R01 support for junior faculty (Rangel & Lawrence, 2004). Based on this publication, we

should see at least some success among recipients of the Developmental grants when it comes to obtaining R01 grants.

Another key focus of this project's analysis will be the average age of Developmental Core awardees at the time they obtain their first independent NIH award. Cech (2005) and Daniels (2015) demonstrate current challenges new investigators face due to various factors resulting in delays with obtaining initial independent NIH awards and the average age of first-time awardees increasing over time, which may result in significant losses to society, both financial and related to productivity, as described by Jacob and Lefgren (2011) and Stephen and Levin (1989). This study will also refer to Cech (2005) when determining return on investment, both financial and through journal publications.

This project will attempt to determine whether the activities of the CFAR Developmental Core yield results similar to the study by Mason at al. (2013), which shows that recipients of some career training awards from the NIH were more successful in obtaining future NIH funding, and being able to secure independent funding at a younger age.

As previously mentioned, the extent of the current HIV/AIDS epidemic is large, not only on global level, but also close to home. With advances in therapies and treatments available, it is easy to forget about the epidemic taking place in our own backyard. HIV/AIDS can be considered a manageable chronic disease, which may make it seem less severe. However, enormous numbers of people are still infected every year, and thousands go without treatment. That is true especially for some groups. We still do not have a vaccine, and we still do not have a cure for this disease. At the same time, it is due to efforts of countless researchers that effective therapies exist now. That is why it is critical to continue to support research efforts and to continue recruiting, training, and developing new researchers who will carry these efforts into

the future. Many factors come into play when talking about developing new HIV/AIDS investigators.

As can be seen from the above discussion, early stage investigators interested in establishing independent careers face significant challenges in a competitive funding climate, from access to good mentoring programs, to publishing in quality journals, to obtaining independent funding, requiring continuous support. With grants being awarded to more established researchers, early stage investigators face additional hurdles that they must overcome on their way to successfully securing independent funding. Additionally, female investigators in lower academic ranks may face added challenges, which lead to lower rates of independent funding. However, it is also clear that certain programs may increase success and provide support necessary for those researchers in order to get a head start in the fields in which they are interested.

NIH has several programs, such as post-doctoral fellowships and training awards that seem to contribute, at least on some level, to the success with publications and obtaining funding. Also, universities are recognizing more and more the need to support new investigators not only to receive more grant dollars, but also to establish and retain leadership in certain research areas. Successful programs were piloted in several universities, and Emory University has several programs as well.

Based on this literature review, it is the goal of this project to determine if the CFAR Developmental Core successfully and effectively promotes growth of independent HIV/AIDS investigators and helps them develop skills necessary in order to consistently publish in quality journals and obtain independent NIH funding. Additionally, this project will, for the first time, gather and analyze a wide scope of data that will assess whether CFAR as a program provides

significant benefits not only to researchers and universities, but also to the American public through slowing the spread of HIV/AIDS and curtailing the epidemic.

The following chapters will focus on the efforts of the Emory CFAR Developmental Core to recruit, develop, and retain junior faculty in the critical area of HIV/AIDS research.

Chapter III

METHODOLOGY

As described in Chapter I, the main goal of this work was to examine the impact of the Developmental Core of the CFAR at Emory University in three ways: globally on the HIV/AIDS knowledge base; locally on Emory University; and individually on early career HIV investigators.

The CFAR at Emory is sponsored both by university funds and by the taxpayers' dollars through the NIH. Demonstrating that funds from both sources are used effectively and efficiently would warrant the continuation and possible expansion of the program both on national and local levels. Moreover, success of the program could mean success in the fight against HIV, which would benefit society by enabling better public health. Working locally, Emory CFAR investigators are making an impact globally. Demonstrated success of even one of the 19 national CFARs could lead to adjustment and development of additional public policies that would boost efforts in the fight against HIV and other deadly diseases.

Three research questions relevant to the public administration impact of the Emory CFAR Developmental Core were evaluated:

1. *Global Impact — how have Emory CFAR Developmental Core awardees contributed to the global HIV knowledge base?*
2. *Organizational Impact — what impact have Emory CFAR Developmental Core awardees had on Emory University's fiscal portfolio as it pertains to the NIH funded research*

base? More specifically, what is the rate of return on the dollars awarded via the CFAR-series pilot grant mechanism, Administrative Supplement mechanism, and Ramp Up award mechanism?

3. *Personal Impact — how have Emory CFAR Developmental Core services personally impacted the professional development and funding success of early stage and new HIV investigators?*

The main approach to answering these questions was through data-gathering from various sources within CFAR's programmatic records, including the Emory CFAR's application for competitive renewal, individual awardees' progress reports submitted to the Emory CFAR, annual Emory CFAR progress reports submitted to the NIH, and a survey distributed to all of the Developmental Core awardees. Additionally, an internal Emory University database, OnBase, was utilized to gather data on AIDS-designated external grants awarded to Emory University as a direct result of CFAR Developmental Core-supported research.

The following sections describe the methodology used to answer each of these questions.

Research question 1: Global Impact — how have Emory CFAR Developmental Core awardees contributed to the global HIV knowledge base?

In answering research question 1, the following hypotheses were established:

$H1_0$: Emory CFAR Developmental Core awardees had no impact on the global HIV knowledge base.

$H1_1$: Emory CFAR Developmental Core awardees had an impact on the global HIV knowledge base.

The timeframe for this section of the project is 1998-2016. These years cover the time from when the Emory CFAR was established through the year in which the latest competitive funding

application was submitted to the NIH. During this time, Developmental Core services have not significantly changed.

This evaluation looked at whether recipients of Developmental Core awards were able to contribute to the global knowledge base on HIV/AIDS. Contribution to the global knowledge base is made, in part, through publications in scientific research journals. In order for publications to be viewed as significant, they must appear in respected top-tier, peer-reviewed journals. Publishing in such journals is especially important to early stage investigators, as it gives their findings more credibility and recognition early in their careers. This question is particularly timely because numerous online scientific journals have been recently established and in the media. These online journals and databases are not always peer-reviewed. Therefore, even multiple publications in such journals would not contribute greatly to the global knowledge base and would not generate the same amount of recognition for investigators in the field of HIV. Being recognized as an expert at the very beginning of one's research career is critical for the early career and new investigators, as it may contribute to establishing their name in the field and obtaining independent NIH funding.

While there was not a perfect way to evaluate each publication, journal impact factors (JIF) and citation factors were used to judge the impact of each publication on the global HIV knowledge base. The output of the Developmental Core was represented by journal publications that stemmed from research supported by the CFAR Developmental Core small grants program. This information was self-reported by Developmental Core awardees through mandatory, annual progress reports submitted to the Core. Publication data for 2012-2016 were available, and publication data for 1998-2011 were collected by reviewing progress reports submitted to the Core. The quality of each publication was measured by two parameters: citation factor and JIF.

Citation factor is defined as the cumulative number of times that an individual publication was cited by one or more other published journal articles. This factor allowed for evaluation of the contribution of a particular publication to the scientific knowledge base. The contribution is considered greater for publications that have been cited more times. This information was gathered through the Emory University library, using the Thomson Reuters Web of Science databases.

JIF is a statistical measure used to compare journals in a given field. The list of impact factors is published every year and is available through the Emory University library. Impact factor is an important measure of contribution to the global knowledge base, as research published in journals with higher impact factors is considered to be more significant. Since publications are very field-specific, the journals that are recognized as being the most respected were used as a benchmark for this work and will include *Science*, *AIDS, The Journal of American Medical Association (JAMA),* and *AIDS and Behavior.* These publications cover not only work produced by basic scientists, but also clinician scientists and behavioral scientists who work in the area of HIV.

For the JIF evaluation, impact factors for each of the benchmark journals was recorded for each year in which there were publications that resulted from Developmental Core-supported research. Impact factors change annually for each journal, so this information for each reported publication needed to be collected. Then, the impact factors of all journals for each particular year were averaged, recorded, and compared to the benchmark impact factors.

To see a clear visual representation of the quality of publications, JIFs were plotted on a chart with the year of publications on the X axis, and the impact factor on the Y axis. While the relationship between publication year of the journal and journal impact factors cannot be

established, such plotting made it easy to see if recipients of Developmental Core awards publish in journals that are comparable to benchmark journals, or if they publish in less reputable journals. There are many other factors that may affect the quality of each publication, such as availability of mentoring, research resources, personal circumstances, etc. However, the activities and practices of the Developmental Core have not changed significantly over the years. Therefore, data-gathering for this particular question only served to signal whether the Core needed to devote additional resources to guide awardees to publish in more scientifically significant journals. This element of the project could reveal if investigators may need to be educated about the importance of targeting their manuscript submissions to well-respected, peer-reviewed journals instead of publishing in journals that are not peer-reviewed. In other words, teaching investigators to prioritize quality publications over the sheer quantity of published work.

An additional dimension of the contribution to the HIV knowledge base is the citation factor. Since there is not a single most respected publication that can be used as a benchmark, citation factors for all publications were recorded in Table A1 (Appendix A). This information is available through the Web of Science database. The higher the number of times a particular article was cited, the more significant the contribution to the global knowledge of HIV.

To summarize, this part of the study sought to answer "Yes" or "No" to two questions:

1. Are recipients of Developmental Core awards publishing in respected peer-reviewed HIV/AIDS journals?
2. Do other researchers cite Emory CFAR awardees' publications in their work?

If the answer was "Yes" to one or both of these questions, the conclusion will be that the Developmental Core awardees do indeed contribute to global HIV knowledge base.

Research question 2: Organizational Impact — what impact have Emory CFAR Developmental Core awardees had on Emory University's fiscal portfolio as it pertains to the NIH funded research base? More specifically, what is the rate of return on the dollars awarded via the CFAR-series pilot grant mechanism, Administrative Supplement mechanism, and Ramp Up award mechanism?

External research funding often comprises a large portion of universities' budgets. In particular, grant and contract funding from federal agencies, such as the NIH and the Centers for Disease Control and Prevention, as well as funding from large pharmaceutical companies are important to not only advance biomedical research, but also to provide employment to many different professions (scientific, clinical, teaching, and administrative) through provision of funds that cover salaries, fringe benefits, and other expenses. Therefore, external grant funding likely plays a significant role in most research universities' financial well-being. The CFAR Developmental Core aims to contribute accordingly, through development of early stage investigators by means of pilot grant funding. This initial funding allows investigators to generate crucial data in order to secure independent NIH funding. This project examined the impact of the Developmental Core grant mechanisms on Emory University's fiscal portfolio by looking at the rate of return on CFAR dollars invested. A positive return on investment would indicate that the program is working as intended. The higher the rate of return indicates stronger program outcomes.

The return on investment (ROI) is a calculation that determines the amount of additional profits produced as a result of a certain investment. ROI is usually expressed as a percentage. The formula used for calculating ROI is:

$$ROI = \frac{\text{Gain from Investment} - \text{Cost of Investment}}{\text{Cost of investment}} X100$$

Emory CFAR Developmental Core has three developmental grant mechanisms in which it awards funds to early stage and new HIV investigators:

- CFAR-series awards (CFAR-03, CFAR-C, CFAR-K);
- Ramp Up awards (Opportunity Awards, Collaborative Travel Awards, and Poster Awards);
- Administrative Supplements awarded by the NIH and managed through the Developmental Core

Calculating separate ROIs on each of these activities is useful to Emory University when evaluating the effectiveness of its investments of institutional resources and to the NIH when evaluating the effectiveness and efficiency of its Developmental Cores. A clear picture of which award mechanism is the most effective in generating financial return would allow both the NIH CFAR Program and the Emory CFAR to make more informed decisions and adjustments to the program to ensure that only the most beneficial funding mechanisms are utilized. Therefore, a separate ROI for each type of award was determined.

Based on the discussion above, the following hypotheses were tested in this section of the project:

$H2_0$: There is no relationship between Emory CFAR Developmental Core awardees receiving funds via a Developmental Core mechanism and the Emory fiscal portfolio as it pertains to NIH funding.

$H2_1$: There is a positive relationship between Emory CFAR Developmental Core awardees receiving funds via a Developmental Core mechanism and the Emory fiscal portfolio as it pertains to NIH funding.

$H3_0$: There is no difference in the return on investment (ROI) among the three Emory CFAR Developmental Core award mechanisms.

$H3_1$: The ROI of the CFAR-series pilot grant mechanism is different from the ROI of the Administrative Supplement mechanism.

$H3_2$: The ROI of the Administrative Supplement mechanism is different from the ROI of the Ramp Up award mechanism.

$H3_3$: The ROI of CFAR-series pilot grant mechanism is different from the ROI of the Ramp Up award mechanism.

For the purposes of testing these hypotheses, the following terms were be used:

Emory University fiscal portfolio - the total amount of funding in dollars received from the NIH as a result of a competitive application process by all investigators at Emory University. It is important to establish a distinction between the full Emory University fiscal portfolio and the level of contribution of Developmental Core awardees. This project will look at the return on investment (expressed as a percentage) on the CFAR dollar only and a total contribution (expressed in total NIH dollars) of CFAR Developmental Core awardees relative to the total Emory University fiscal portfolio.

Investment - total CFAR Developmental Core dollars invested in the development of early stage and new HIV investigators through various funding mechanisms as described below. This information is tracked and is available for the entire project period of 1998-2016.

Return on Investment - calculated ratio of total NIH dollars received by Emory University through grant funding to total CFAR dollars invested in early stage and new HIV investigators through various Developmental Core funding mechanisms.

Total NIH dollars - sum of all grant dollars received by Emory University that resulted from an initial Developmental Core investment. This information is partially available. All external grants obtained as a result of the Core-supported research are reported to the Core using unique NIH grant numbers. The NIH RePORTER system that provides grant data will be used to confirm total funding amounts for grants that have ended. The Emory University grants database, OnBase, which stores all notices of awards to all investigators will be used to confirm full funding amounts for grants that are active. Only external grants that were awarded to Emory University will be used in the calculation of total NIH dollars received.

Impact of Developmental Core awardees - additional NIH dollars received by Emory University via the competitive grant application process by investigators who received pilot funding from the CFAR Developmental Core.

The return on investment was calculated based on the total CFAR dollars (both federal and university) invested through CFAR's three funding mechanisms and total NIH dollars received by the University as grant funding.

The difficulty in calculating ROI on CFAR funded projects comes from the fact that funding for all pilot awards comes from both NIH and institutional sources. Some developmental awards are funded by NIH dollars, while others are funded by institutional dollars. Federally funded projects provide money not only for direct costs, but also for indirect costs, which at Emory University could range from 26% to 78.5% depending on the project activity scope and the location where the activity is conducted (Emory University, 2016b). Direct costs are defined by the NIH as costs that can be identified specifically with a particular sponsored project, an instructional activity, or any other institutional activity, or that can be directly assigned to such activities relatively easily with a high degree of accuracy. Indirect costs, (also referred to as

facilities and administration (F&A, FAC or IDC) are defined as necessary costs incurred by a recipient for a common or joint purpose benefitting more than one cost objective, and not readily assignable to the cost objectives specifically benefitted, without effort disproportionate to the results achieved (National Institutes of Health, 2016a).

Projects funded with institutional funds generally do not include F&A. Therefore, a pilot project that has $40,000 in direct costs and is funded with NIH dollars that carries 56% F&A will have a total budget of $62,400, while a similar project funded with institutional dollars will have a total budget of $40,000. Generally, F&A on projects funded with institutional dollars is "cost-shared," or covered by internal institutional resources.

Such variance between these types of total budgets presents a challenge when calculating ROI, so it is important to define the base on which ROI is calculated. Due to complexities arising from trying to account for cost-shared expenses, and to better reflect CFAR investment and returns on that investment, the ROI in this project was calculated on total CFAR dollars. This approach makes cost-sharing contributions irrelevant. In other words, if calculating ROI on two projects with $40,000 direct costs, but funded from different sources, the total amount of CFAR dollars invested will be $62,400 + $40,000 = $102,400.

This approach was used for the ROI calculation for all types of awards issued by the Developmental Core. The gain from investment equaled the total amount of external NIH funding received by investigators as a result of the Developmental Core-supported research. This information is collected by the Emory CFAR regularly and is available for public use. Unique NIH grant numbers are also available, which can be used in the NIH RePORTER system to confirm grant data and total amounts for grants that ended. However, this dataset has one limitation. The total grant amounts are available through their most current active year. This

meant that ROI may be skewed because grants still have several years to be funded, which are not calculated into the gain. A permission from Finance Grants and Contracts was requested and granted to obtain the full amount of funding by looking up notices of awards in the University-wide database. This approach resolved most of the inaccuracies in calculating ROI.

It was the focus of this study to only look at the ROI as it pertains to NIH dollars. Therefore, this work only looked at the return on investment generated by grants awarded by the NIH, since that is the only funding source of value to the NIH - the CFAR Program's funding agency - when considering the success of the CFAR Developmental Core. It is important, however, to remember that true ROI is almost certainly much higher if this project expanded the analysis to include all grants resulting from CFAR Developmental Core awards. Many Developmental Core awardees go on to receive funding from other agencies and sponsors, such as the Centers for Disease Control and Prevention (CDC), pharmaceutical companies, and private foundations. Since the goal of this work was to determine the impact of Developmental Core awardees on Emory's fiscal portfolio, grants obtained by investigators external to Emory University were not included in the ROI calculation.

Therefore, the final formula to be used in this work was:

$$ROI = \frac{\text{Total NIH Dollars Awarded} - \text{Total CFAR Developmental Core Dollars Invested}}{\text{Total CFAR Dollars Invested}} X100$$

In addition to calculating a cumulative ROI on all developmental awards, ROI was also calculated for each type of award mechanism (pilot grants, opportunity awards, and supplements). This separate calculation allowed clear delineation of what funding mechanism yields the highest ROI and, therefore, is most successful.

While the approach to this research question was relatively straightforward, the main limitation to addressing this question was incomplete reporting of grants obtained as a direct

result of Developmental Core funding. However, the survey described in the next research question was designed to solicit responses that helped to reduce or eliminate this limitation.

Research Questions 3: Personal Impact — how have Emory CFAR Developmental Core services personally impacted the professional development and funding success of early stage and new HIV investigators?

One of the main goals of the Emory CFAR Developmental Core is to ensure the success of investigators who are new to the HIV research field. Success in fields like HIV research extends beyond individual investigators. It has the potential to improve the reputation of the academic institution and to impact public health locally and globally. Public administrators, including grant managers and program officers at funding agencies, must be interested in the success of new investigators due to their potential impact on the entire population of the country. In academic research, the main measure of success is the ability to secure independent grant funding. However, it is also important to look at other personal and professional measures of success. The main indicator studied in this section of the project was the early stage investigator's age when he or she first received an R01-equivalent grant, specifically if the first independent funding directly resulted from CFAR Developmental Core-supported research. Obtaining independent grant funding at a younger age would indicate possible individual success that resulted from the work of the Developmental Core. This data was collected through a survey. Additionally, awardees were asked to assess the importance of other related Developmental Core services that they received. The following hypotheses were tested for this section of the project:

$H4_0$: There is no relationship between Emory CFAR Developmental Core Services and an investigator's age at time of receipt of his or her first ever NIH R01-equivalent.

$H4_1$: There is a relationship between Emory CFAR Developmental Core Services and an investigator's age at time of receipt of his or her first ever NIH R01-equivalent.

NIH reports suggest that the current median age at which PhDs get their first NIH grant is 42, and 44 for MDs. A younger age at receipt of first independent NIH grant may signal that the investigator utilized more successful strategies that could be expanded to other investigators and applied to similar programs. Specifically, it may indicate that the CFAR Developmental Core mechanisms and services used by these successful investigators are working as designed, helping early stage and new investigators get established earlier in the field of HIV research through securing independent funding. Information on age at time of receipt of a first NIH grant was obtained via a survey distributed to all Developmental Core awardees that are still at Emory University.

Developmental Core awardees were contacted through a brief email request to answer several questions. Only those investigators who are internal to Emory University were contacted. Emory CFAR keeps detailed records of all awardees, so the entire population is available to be contacted, which eliminates the need to select a representative sample. The choice to contact only Emory internal investigators was made in order to stay consistent with the approach in calculating ROI. This is also consistent with the main goal of this project which is to demonstrate benefit not only to individual investigators and potential program impact on public health, but to Emory University as an academic institution that providing significant funding support to the CFAR program.

Given the fact that the latest trends in NIH funding show that the average age at which investigators are awarded their first independent NIH grant is increasing, a lower average age at

the time of securing first NIH independent grant would show success of the Developmental Core programs in the development of early stage and new investigators.

All identified awardees were contacted via email. This email contained an invitation and a link to participate in a brief web-based survey. The survey was built and administered via Qualtrics, a survey tool available to Valdosta State University students. The main goal of the survey was to gather demographic information and compare the results to the trends described in the literature review. An inquiry about collaboration resulting from the CFAR developmental award was included in order to gauge the impact of such funding on the potential for obtaining future grants. Questions to assess the awardees' opinions on various other Developmental Core services were added. These questions addressed which available Developmental Core services early stage investigators in various stages of their careers viewed as most beneficial. A sample of the survey is included in Appendix E. Names of the respondents were collected in order to facilitate future contact in case clarification or follow up inquiry was needed. Two reminders were sent out to those who had not responded at 1 and 2 weeks after the original invitation was sent via email. Knowing names of those who had not responded eliminated frustration among those who did respond, as they did not receive survey reminders.

A *t-test* was planned to be utilized to compare the mean of ages of Developmental Core early stage investigators and the mean of ages of first time R01-equivalent recipients reported by the NIH. Currently, NIH data on age is available through 2013. That timeline fits with this analysis, because Emory CFAR excludes from the analysis awards that ended two years ago or less and those awards that are still active. R01-equivalent grants may have not been obtained every year from 1998-2013. Therefore, years with no grants received were excluded from the

analysis. That result could indicate that the work of the Emory CFAR Developmental Core has affected new investigators' success in the field of HIV research.

Additionally, this project looked at established contacts and collaborations, as those could potentially lead to successful applications and receipt of NIH funding in the future. The ultimate goal of the Developmental Core is to provide necessary support to new investigators to be able to secure independent funding. While a particular investigator may have been unsuccessful in obtaining an independent R01 or equivalent grant after completing their pilot award, some may view newly established contacts and collaborations as an alternative but equally significant gain. If a majority of respondents reported that they have established promising contacts and possible collaborative opportunities, this could signal potential for successful grant applications in the future, thus impacting the personal success of individual investigators. This information was obtained via the same survey that went out to Emory faculty who had received CFAR Developmental Core awards.

Finally, this project looked at which services Developmental Core awardees perceive as the most important and beneficial. Those questions addressed whether any services need to be eliminated, improved, or expanded. A low response rate was an anticipated limitation of this study, however a high response rate for this survey was achieved because CFAR awardees have stayed in close contact with the Developmental Core personnel long after they have completed their awards and established themselves as independent investigators.

There could be additional factors that affect awardees' abilities to obtain grants. For instance, there is no information available on what portion of NIH-reported first time R01 equivalent awardees had access to similar programs to the CFAR Developmental Core. It was not within the scope of this work to account for all possible factors impacting (or promoting) the

success of investigators. Instead, it was the goal of this project to determine if a more comprehensive study is needed to confirm the validity and efficacy of Developmental Core methods.

A look at these three research questions separately presented a solid picture of how effective the CFAR Developmental Core is in its efforts to improve public health in the local areas and beyond through providing support to early stage and new HIV investigators. Studying the three research questions described above demonstrates how the Developmental Core performed over the last 17 years. A review of the chart displaying the rankings of publications and journals that have published Developmental Core-supported research allows core leadership to see whether more emphasis needs to be placed on advising awardees to submit their work to higher ranking journals. Also, it could demonstrate that the Core may need to expand its mentoring services. Additionally, if the chart shows consistently high impact and citation factors compared with the leading AIDS publications, this would signal that Emory CFAR Developmental Core awardees are contributing to the knowledge base in HIV research.

The ROI shows which of the three Developmental Award mechanisms is the most successful. The mechanisms that yield the highest ROI in terms of bringing NIH dollars to Emory University were deemed the most successful. Core leadership may be able to make decisions to award more of a certain type of grant, while limiting or completely eliminating another, which would result in a more efficient use of federal and institutional funds.

The *t*-test shows whether Emory CFAR Developmental Core awardees are receiving independent funding at a younger age. If they are, this could mean that the practices of the Developmental Core truly impact new investigators' careers by providing necessary funding for pilot studies and much needed mentoring and professional development. Receiving NIH funding

at a younger age indicates that investigators become established in the field of HIV research earlier and have more productive years left to conduct research and, hopefully, advance the fight against HIV at a faster pace. A majority of Developmental Core recipients reporting that collaborations developed as a result of Developmental Core support would indicate that his or her potential to continue to develop in the field, moving on to publications and independent grant applications.

Finally, the menu of Developmental Core services was evaluated for applicability and importance. The results could help determine if any adjustments to the services provided by the Developmental Core are needed. Depending on the results, several actions could take place. A greater emphasis could be placed on mentoring. A look at the various Developmental Core award mechanisms and their calculated ROI could demonstrate which (pilot award, opportunity award, or supplement) is the most successful in expanding Emory University's fiscal portfolio. Decisions could be made to reallocate funds and manpower to focus more on awarding and administering the most successful mechanisms. Results of the survey could trigger a shift to place focus on developing and strengthening certain Developmental Core services, while maintaining, limiting, or even eliminating others.

Since the effect of the Core's activities is so multi-dimensional, answering the three research questions would generate a good set of information about success of the Core overall. This information will be important during future progress reports, as well as competitive applications for continuing funding to the NIH. Additionally, positive results demonstrated by this small project could be presented to the main NIH CFAR in order to confirm that the program is functioning as it was designed.

On the National CFAR level, results could be used by other CFARs to develop similar programs, if this study finds Emory practices successful. The NIH program team mentioned inconsistencies in practices from one CFAR to another, making an overall evaluation challenging. Streamlining some of the processes and services could allow for a set of cross-CFAR evaluation criteria to be developed. Additionally, other CFARs may elect to adopt services and award mechanisms being used by the Emory CFAR if this project demonstrates that they generate good ROI.

Additionally, NIH has a number of similarly-structured, grant-giving programs that could use the framework of this study to evaluate their own developmental activities. On a smaller scale, positive results of this study could provide CFAR leverage when requesting institutional support from Emory University. Therefore, this project could potentially have an impact at the university level, as well as contribute to shaping of national policy when it comes to funding of HIV research.

Chapter IV

RESULTS

This chapter will present, interpret, and synthesize data obtained over the course of this project. The main goal of the data collection was to assess the impact of the Emory CFAR Developmental Core investments (both monetary and non-monetary) in HIV/AIDS research on three levels - global, organizational, and personal:

1. *Global Impact — how have Emory CFAR Developmental Core awardees contributed to the global HIV knowledge base?*
2. *Organizational Impact — what impact have Emory CFAR Developmental Core awardees had on Emory University's fiscal portfolio as it pertains to the NIH funded research base? More specifically, what is the rate of return on the dollars awarded via the CFAR-series pilot grant mechanism, Administrative Supplement mechanism, and Ramp Up award mechanism?*
3. *Personal Impact — how have Emory CFAR Developmental Core services personally impacted the professional development and funding success of early stage and new HIV investigators?*

As stated in Chapter 3, global impact was assessed by analyzing the journal impact factor and the citation factor of publications that resulted, at least in part, from Emory CFAR Developmental Core services and activities; organizational impact was measured by the CFAR Developmental Core funding mechanisms' return on investment of total CFAR dollars - both

federal and institutional (Emory University); and personal impact was gauged by a Developmental Core award recipient's age at the time of obtaining his or her first R01-equivalent award. Developmental Core service usage by the awardees was examined in order to determine which, if any, services are being utilized. Examining service usage also presented a clearer picture about what services awardees see as most beneficial depending on the stage of their careers.

Publication data were obtained from progress reports that the Emory CFAR annually submits to NIH and the Thomson Reuters Web of Science database. Return on investment data were collected from the Emory CFAR's self-compiled annual progress reports submitted to the NIH, as well as NIH RePORTER and eRA Commons federal funding databases. Using eRA Commons, federal notices of awards to Emory University investigators that resulted, at least partially, from CFAR developmental awards were downloaded and award amounts were confirmed in order to accurately calculate returns. Finally, data on investigators' age and service usage were obtained via a short survey. The entire population of developmental awardees was available to receive questionnaires, and the survey yielded a response rate of over 80%. Such an approach allowed data collection and analysis that produced a multi-dimensional picture of the impact of investments made by the Emory CFAR Developmental Core.

This project also assessed the value add of the CFAR Developmental Core funding opportunities and services. Return on investment was calculated for each of the three developmental award mechanisms. The results were compared to determine the effectiveness of each mechanism. Non-funding services provided by the Core also were examined in order to determine what investigators view as valuable.

The following sections of the chapter will describe results of those analyses. First, the global impact will be presented by cataloging all the publications that resulted from CFAR developmental awards and analyzing the publications' journal impact factor (JIF) and citation counts. The second section will take a deep look at return on investment generated by CFAR developmental awards. In other words, it will include a detailed analysis of the return on every dollar the Emory CFAR has invested in early stage HIV investigators via various developmental award mechanisms. Finally, results of the investigator survey will be summarized and analyzed to determine if there is a correlation between activities of the CFAR Developmental Core and the age of Core-supported investigators when they received their first R01-equivalent award.

ANALYSES AND FINDINGS

Research Question 1: Global Impact

In order to answer the first research question, **"***How have Emory CFAR Developmental Core awardees contributed to the global HIV knowledge base?"* a significant amount of publication data had to be collected, cataloged, and analyzed. Data were used to test the following hypotheses:

$H1_0$: Emory CFAR Developmental Core awardees had no impact on the global HIV knowledge base.

$H1_1$: Emory CFAR Developmental Core awardees had an impact on the global HIV knowledge base.

The criteria to determine if an awardee's publication contributes to the global HIV knowledge base included:

1. Awardees are publishing articles in scientific journals;
2. Published articles appear in journals that were:

a) Peer-reviewed or included publications by invitation only;

b) Had journal impact factors (JIF) of more than "0"[1];

c) Were available to a wide audience either by print or via online versions;

3. Published articles have citation counts of more than "0," meaning that the articles were cited in other publications at least one time.

For the purposes of this project, satisfying conditions 1 *and* either 2 or 3 suggests that the publication is contributing to the global HIV/AIDS knowledge base.

Data collection

Since CFAR Developmental Core awardees' contribution to the global HIV knowledge base is measured in journal impact factor and citation counts, information on publications that resulted from research supported by the Core first needed to be gathered, organized by publication year, and analyzed for impact. A publication list was compiled from Emory CFAR annual progress reports to NIH and CFAR competitive renewal applications. Additionally, investigators who had received CFAR developmental awards were asked in the fall of 2017 to send publication updates to the CFAR. These self-reported publications were added to the evaluation in order to capture the most updated picture of the CFAR Developmental Core's impact on the global HIV knowledge base. Journal impact factor data were only available through 2016; therefore, publications from 2017 were not included in the analysis. Similarly, these publications were not evaluated for their citation count, because they are too new to have been cited.

After the CFAR Developmental Core-supported publications were cataloged, the next step was to address the impact of the scientific journals in which these publications appeared. In order

[1] Per World of Science database, there were nine journals with JIF of "0" in 2016

to do that, a journal impact factor (JIF) for each scientific journal was recorded using the Thomson Reuters Web of Science database. The JIF is a measure of a journal's relative importance in the field as compared to other journals. It is calculated by dividing the number of current year citations to the source items published in that journal during the previous two years (Clarivate, 2018). A separate JIF for each journal was retrieved from the database for every year in which a relevant publications appeared.

Unfortunately, JIFs were not available for six journals for the years in which Developmental Core related articles appeared. Additionally, there were no publications in 2001 and 2002. No specific reasons were identified for not having publications in these two years; it was simply by chance. Publications without an available journal impact factor and the years of missing data (2001 and 2002) are accounted for in the analysis below.

Next, a benchmark JIF was needed in order to see where journals with CFAR developmental awardee publications fell. Four areas of publications were considered when setting the benchmarks: overall biomedical science, clinical, AIDS overall research, and AIDS and behavioral sciences. Covering these four areas was necessary because CFAR investigators have varying research backgrounds and areas of expertise. They also often collaborate with colleagues with training and research portfolios in different topical areas. Additionally, by covering these four publication areas, it ensures that the potential audience for developmental awardees' publications represents a diverse pool.

After a review of publications by senior HIV researchers at Emory University and discussions with CFAR Developmental Core leadership, four journals were selected as benchmarks for impact: *Science, AIDS*, *The Journal of American Medical Association* (*JAMA*), and *AIDS and Behavior*. *Science* and *JAMA* are recognized by biomedical research community

as top journals for basic science and clinical science, respectively. *AIDS* and *AIDS and Behavior* are field-specific journals, recognized as having high impact on HIV/AIDS research.

These four benchmarks represent a cross-section of high impact journals in which early stage HIV investigators would strive to have their work published - with *Science* being the ultimate goal. Publications in journals like *Science* and *JAMA* would be of interest to the entire biomedical research community, even researchers who are not in the HIV field. Theoretically, such exposure could trigger not only new HIV research collaborations, but also cross-field collaboration (i.e. cancer, cardiovascular, etc.) that could lead to groundbreaking research with a more global impact on the well-being of all people.

It is important to note that the majority of CFAR Developmental Core support is directed to early stage investigators and to those who are new to HIV/AIDS research. Therefore, it is not expected that their publications would appear in these aforementioned benchmarks journals since they are viewed by the most seasoned researchers as the ultimate place to publish. Compounding this limitation is the fact that HIV is a somewhat narrow research field. It is more reasonable to expect that early stage investigators would first publish in field-specific journals.

Once the four benchmark journals were selected, a JIF for each journal for each year of the Emory CFAR (1998-2016) was collected and recorded to be used later in the analysis (Appendix A, Table A1).

Lastly, after obtaining journal impact factor data, each developmental awardee publication was analyzed through the Web of Science database to calculate its citation count (i.e. the number of times that particular publication was cited in other works). It is important to note that *h*-index an author-level metric that measures both the productivity and citation impact of a particular

researcher does exist. However, it was not an appropriate measure for this project, as it takes into account all scholar's publications, not just a specific group.

Findings

The results of the data collection were impressive. Through 2016, 128 articles were published by CFAR Developmental Core awardees. The awardees' articles appeared in 66 separate sources — one was a magazine (*Migration World Magazine*), 62 were peer-reviewed journals, and three were journals that only accept articles by invitation (*Current Infectious Disease Reports, Current Opinion in HIV and AIDS*, and *Immunological Reviews*). Several of these journals were open access, meaning that readers do not need to pay to access the articles published in them. See Table A2 in Appendix A for a full list of CFAR Developmental Core award-relevant publications.

The JIFs for journals in which these articles were published were then recorded separately by publication and by year. The lowest JIF recorded was 0.59 (*Patient Education and Counseling*, 1998), and the highest was 31.027 (*Science,* 2012). The average JIF for all publications was 4.498. These results are provided in Table A1 (Appendix A). Since JIFs were not available for six journals for the years in which Developmental Core related articles appeared, these journals were not factored in to the average journal impact factor. Publications without an available JIF are highlighted in yellow in Table A1 (Appendix A).

Just as with the CFAR-publishing journals, average JIFs were also calculated for the four benchmark journals using data from 1998-2016 (Figure 3). The average benchmark JIFs are as follows:

- *Science*-29.49
- *JAMA*-25.61

- *AIDS*-5.98
- *AIDS and Behavior*-2.61

In order to visually represent how the CFAR-publishing journals compare to the benchmark journals, the JIFs for the four benchmark journals were first plotted in a chart. The publication year was used as the *x*-axis and the journal impact factor as the *y*-axis in the chart to clearly show the benchmarks that were used to determine impact of other publications. After plotting the benchmarks, the impact factors of journals that contain publications by developmental awardees were averaged for each year and plotted as a separate line. (Figure 3).

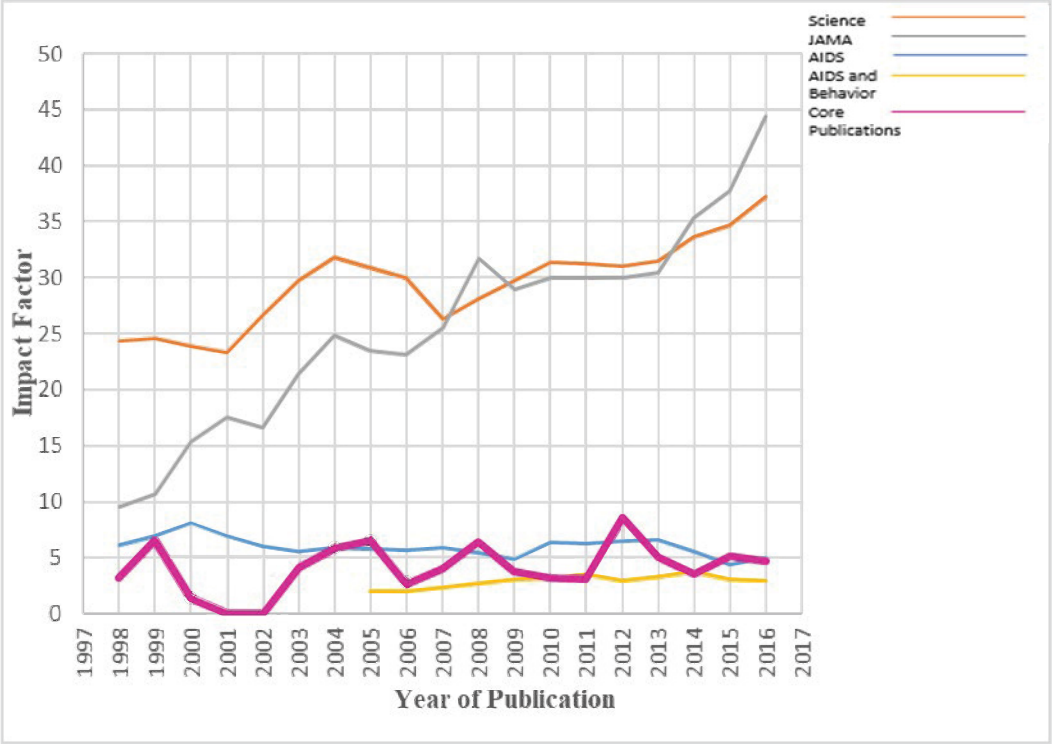

FIGURE 3. IMPACT FACTORS OF JOURNALS CONTAINING EMORY CFAR DEVELOPMENTAL CORE PUBLICATIONS, 1998-2016

Since Emory CFAR Developmental awardees did not report any publications in 2001 and 2002, there was no impact to the global HIV knowledge base via publication for those years. The average JIFs for CFAR-funded journals for 2001 and 2001 were set at "0" for plotting purposes, as seen in the fifth line in Figure 3 above.

Finally, citation counts for each developmental awardee publication were calculated and recorded. A full list of Developmental Core-supported publications with the citation factor (i.e. number of citations) is provided in Table A2 (Appendix A).

Analysis

Aside from 2001 and 2002, developmental awardees published their research in numerous scientific journals in every year since 1998 - the year the Emory CFAR was established (Table A2, Appendix A). As stated earlier, most of these publications appeared in peer-reviewed journals (n = 62). Additionally, a few publications appeared in journals that only accept invited papers. Both data points indicate a certain level of respect and credibility for the work produced by Emory CFAR investigators. In recent years, CFAR-supported publications have increasingly appeared in open access journals. Open access journals also are peer-reviewed, ensuring the credibility of the published research. However, unlike the traditional scholarly journals, open access publications are available to everyone without the requirement of a paid subscription. This allows a much broader audience to have access to high-quality, peer-reviewed articles. These results demonstrate that Emory CFAR early stage investigators are utilizing multiple venues for publications, which should help them reach the widest audience possible.

Journal Impact Factor Analysis

As mentioned above, the journal impact factor (JIF) reflects a journal's ability to attract high-quality publications (Garfield, 1996). This journal-based data point is applicable to Developmental Core awardees' publications; the implication is that if an awardee had an article published in a journal with a high JIF, it indicates that the publication was deemed as "the best" among other articles. It is true that this approach is subjective. However, it satisfies the demands of the CFAR Developmental Core leadership team and offers a uniform measure to evaluate

awardees' contribution to the global HIV knowledge. It is important to note that the use of JIFs as a performance metric has come under scrutiny in the past. Even so, the research community still relies on this measure when considering faculty promotion, tenure, and even funding allocation.

As seen in Figure 3, the average JIF for awardees' publications remained relatively stable from 1998 to 2016 (excluding 2001 and 2002 in which no CFAR-supported publications were reported). There appears to be a peak in 2012, resulting from one publication in *Science*. Publications in *Science* are atypical for early stage investigators, so this particular result can be viewed as an outlier. Consistent JIF data suggest that, even with recent technological developments and easy-access publishing venues, awardees are consistently publishing in journals that are respected in the field of HIV research. It also suggests that awardees are consistently contributing to the global HIV knowledge base.

Figure 3 also shows *Science* and *JAMA* journal impact factors are consistently higher than *AIDS* and *Behavior and AIDS,* as well as the average JIF for awardees' publications. That is explained by the fact that first two journals cover a wide variety of research and medical sectors. *AIDS* and *Behavior and AIDS* are very specific to the HIV research field, making their overall reach narrower and impact lower due to the large number of competing scientific and clinical publications. The same can be said for the vast majority of journals that are publishing HIV-specific work from the CFAR developmental awardees. Therefore, it is logical that the line for the average JIF for Developmental Core-publishing journals fell closer to the lines for the two field-specific journals (*AIDS* and *AIDS and Behavior*).

Looking closer at the average five JIF scores, it is easy to see that Emory CFAR Developmental Core-supported publications (4.498) compare well with the benchmark

publications. The Developmental Core average falls between the values for *AIDS and Behavior* (2.61) and *AIDS* (5.98), suggesting that CFAR early stage investigators publish in journals that are respected in the field of HIV research. While these field-specific journals are not read by as wide of an audience as *Science* (29.49) and *JAMA* (25.61), the global HIV research community is expected to have access to these publications and thus, the CFAR developmental awardees' findings.

It is important to reiterate that the purpose of this section is not to assess the size of developmental awardees' publications impact on the HIV global knowledge base, but whether the publications had an impact at all. The main concern with respect to global impact is that, with technology developing rapidly, online journals are available that are not necessarily reputable and often publish articles "for a fee." It would be easy for quantity to overshadow the quality of publications. The main goal of the journal impact factor analysis was to see if awardees are publishing in respected journals that utilize a peer-review process and are viewed as having some impact in the field.

Citation count analysis

Since publications supported by the Emory CFAR Developmental Core are the focus of this project, citation count analysis was performed only for those publications that met these criteria. In total, the 128 articles resulting from activities of the Emory CFAR Developmental Core were cited a total of 3,395 times. Out of the 128 articles published by developmental awardees, only 7% (n = 9) of publications did not have any associated citations. Six of those nine publications were published in the last year of data collection (2016), feasibly making them too new to be cited. The highest citation count calculated for the developmental awardee publications was 303, the average was 26.52, the median was 16, and standard deviation was

36.94. (Table A2, Appendix A). The citation count findings are important for the evaluation of awardees' contribution to the global HIV/AIDS knowledge base because it shows that their work is being referred to by other publications. That implies a certain level of expertise that the Development Core awardees are thought to have in this research field. Awardees' work continues to contribute to global HIV/AIDS knowledge through being cited in other publications by other researchers.

Determination

The research question for this component of the project addressed whether Emory CFAR developmental core awardees contributed to the global HIV knowledge base on satisfying following conditions:

1. Awardees are publishing articles in scientific journals;
2. Published articles appear in journals that were:
    a) Peer-reviewed or included publications by invitation only;
    b) Had journal impact factors (JIF) of more than "0";
    c) Were available to a wide audience either by print or via online versions;
3. Published articles have citation counts of more than "0".

A review of all of the publications that resulted from Developmental Core funding from the beginning of Emory CFAR until 2016 showed that most publications satisfy these conditions. Only 7% of publications (n = 9) did not have any citations, and there were only two years in which awardees did not report any publications. Since the goal of this component of the project was to determine whether there was a contribution to the global HIV knowledge base - *not* to evaluate that impact or determine significance of each individual publication, it is possible to

argue that CFAR Developmental Core awardees do contribute to the global HIV knowledge base.

The results detailed above indicate the Emory CFAR Developmental Core contributed to common knowledge. Over the first 18 years of the Emory CFAR, investigators supported by the Developmental Core funding mechanisms have actively published dozens of articles in reputable, peer-reviewed journals. Additionally, many have taken advantage of the availability of open source journals that make research more accessible to the general public by lifting any financial barriers. Results show that developmental awardees utilize multiple sources to disseminate their study findings (traditional journals, open source journals, magazines, online journals, and international publications), contributing to a broad HIV knowledge base. Additionally, these contributions are strengthened by the fact that several CFAR-supported publications appeared in journals that publish work only by invitation. This confirms that research conducted by early stage investigators who are supported by the CFAR Developmental Core is recognized in the scientific community in myriad ways.

Based on the results described above, the null hypothesis is rejected and alternative hypothesis is accepted:

Research Question 2: Organizational Impact

To answer the second research question, "*Organizational Impact — what impact have Emory CFAR Developmental Core awardees had on Emory University's fiscal portfolio as it pertains to the NIH funded research base? More specifically, what is the rate of return on the dollars awarded via the CFAR-series pilot grant mechanism, Administrative Supplement mechanism, and Ramp Up award mechanism?"* data on CFAR developmental awards and the outcomes from those funded projects were analyzed. The following hypotheses were tested:

$H2_0$: There is no relationship between Emory CFAR Developmental Core awardees receiving funds via a Developmental Core mechanism and the Emory fiscal portfolio as it pertains to NIH funding.

$H2_1$: There is a positive relationship between Emory CFAR Developmental Core awardees receiving funds via a Developmental Core mechanism and the Emory fiscal portfolio as it pertains to NIH funding.

$H3_0$: There is no difference in the return on investment (ROI) among the three Emory CFAR Developmental Core award mechanisms.

$H3_1$: The ROI of the CFAR-series pilot grant mechanism is different from the ROI of the Administrative Supplement mechanism.

$H3_2$: The ROI of the Administrative Supplement mechanism is different from the ROI of the Ramp Up award mechanism.

$H3_3$: The ROI of CFAR-series pilot grant mechanism is different from the ROI of the Ramp Up award mechanism.

The Emory CFAR supports three types of developmental funding awards: Ramp Up awards, CFAR-series pilot grants, and Administrative Supplements. Each award type has a different purpose, and they all also differ in funding amounts. Ramp Up awards are quick small-scale grants (typically up to $2,000), designed to fill a critical, time-sensitive need. CFAR-series pilot grants are medium-scale awards ($40,000-$60,000), designed to allow an early stage investigator to perform preliminary research that will enable them to collect pilot data to bolster future applications for independent federal funding. These awards provide up to two years of non-renewable funding. Administrative Supplements are large-scale awards (usually at least

$100,000) to cover special interest projects that are designated, funded, and initiated by NIH. For additional detail on the award types offered through the CFAR, please see Appendix C.

Overall, the goal of all the awards offered by the CFAR Developmental Core is to enable early stage investigators to successfully compete for independent NIH funding, preferably R01-equivalent grants, by providing necessary funding, resources, mentoring support, and training.

Emory University has several similar pilot grant mechanisms administered by other programs and centers. In the case of the CFAR, Emory University provides additional institutional funding to share the costs of the CFAR developmental awards program with the Emory CFAR's primary funding agency, the National Institutes of Health. In other words, non-federal university funds supplement the CFAR program. Even though these institutional funds are tracked separately, they are considered part of the Developmental Core's total funds. Awards may be funded in one of three ways: only NIH federal funds, only Emory institutional funds, or co-funded from both federal and institutional sources. Therefore, it is important to consider the total CFAR investment in all analyses.

Data collection

Data on each CFAR Developmental Core award mechanism and the outcomes were collected from annual progress reports that CFAR submitted to NIH. Before data analysis began, it became clear that there is a reporting inconsistency that may skew results reported to the NIH. When reporting outcomes that resulted in part due to a CFAR developmental grant, some awardees reported anticipated or remaining funding amounts as of the date when they wrote the progress report. Others reported the total awarded amount. The rest reported just the funding amount for the current grant year. This discrepancy could have resulted in an inaccurate calculation of the ROI that was reported to the NIH. To rectify reporting inconsistencies, original

NIH notices of award were pulled from the NIH Commons database, and amounts from those original documents were recorded in the outcomes tables (Tables B3, B4, and B5 in Appendix B).

Before diving into analysis, it is appropriate to reiterate that total CFAR investment refers to *total* CFAR dollars. It includes both NIH federal and Emory institutional funds. Therefore, the calculation for the return on investment (ROI) for each category will be as follows:

$$ROI = \frac{\text{Gain from Investment (Total new NIH grants awarded to Emory)} - \text{Cost of Investment(Total Emory CFAR Funds)}}{\text{Cost of investment (Total Emory CFAR funds)}} X100$$

Since two key terms (NIH R01 grant and ROI) are visibly similar and may not be easily distinguishable by a reader, an underline will be used to clearly mark ROI (return on investment).

Findings

Ramp Up Awards

Over the first 18 years that the Emory CFAR has been in existence, 62 Ramp Up awards were issued for a total of $132,870. One of these Ramp Up award was issued to cover data collection for an existing NIH-funded R34 grant, so no project outcome was expected. Even so, this Ramp Up award was factored into the ROI calculation in order to properly reflect the entire CFAR investment. An additional three of the 62 Ramp Up awards were issued as supplemental funding to existing CFAR-series pilot awards to provide additional funding to fill a critical need (i.e. data collection, equipment and/or supply purchase). These three awards were not included in the ROI calculation for Ramp Up awards. Instead, they were included in the ROI calculation for CFAR-series pilot awards.

Data indicated that 11 Ramp Up awards were converted into NIH-funded extramural awards — two of which were new R01 grants and one was an R01 supplement. An additional two Ramp Up awards contributed to the successful application for a single NIH award. As previously stated, the total CFAR investment (both NIH and Emory) in the Ramp Up awards mechanism totaled $132,870. The total amount of new extramural grants awarded to Emory University as a result of these Ramp Up awards was $8,731,680. All data are presented in Table B3 (Appendix B). The ROI calculation was as follows:

$$ROI = \frac{8{,}731{,}680 - 132{,}870}{132{,}870} x100 = 6{,}472\%$$

The results of the Ramp Up award calculation shows that the ROI was 6,472%. That means that for each dollar invested by the Emory CFAR into Ramp Up awards, Emory University received $6,472 in new funding from NIH. This is impressive information, especially given that Ramp Up awards are very small in terms of funding power. Please note that the calculation used the total CFAR investment of $132,870 in order to determine the correct ROI. While only $35,027 was invested in Ramp Up awards that actually were converted into extramural grants, using this figure would be inaccurate since it excludes a large portion of the total funds invested into this funding mechanism. Therefore, an ROI value that excludes the total CFAR investment would be artificially inflated. Additionally, NIH requests that ROI is calculated on total money invested, not just the portion converted into new grants.

CFAR-series Awards

A total of 58 CFAR-series pilot awards were issued to early stage investigators. As stated above, three Ramp Up grants were awarded to supplement existing CFAR-series grants. The amount of these Ramp Up awards is included in the calculation of total Emory CFAR investment

because they were issued as additional money to existing CFAR-series awards. It would be inaccurate to calculate them into the Ramp Up award ROI, as they were not expected to be converted into extramural grants. Instead, their purpose was to remove an obstacle encountered by an investigator during the course of a CFAR-series award. The data collection showed total Emory CFAR investment into CFAR-series awards was $2,672,668. Awardees reported that their CFAR-series awards helped, at least in part, to successfully apply for a total of 30 new NIH grants issued to Emory University.

While several types of extramural NIH awards were reported as being received by the CFAR-series award recipients, R01-equivalent grants are reported separately to the NIH and are of particular interest. The moment when an investigator obtains an R01-equivalent is usually considered the start of the scientist's career as an independent investigator and researcher. Therefore, while all grants received by developmental awardees are valuable, R01-equivalent grants - particularly an investigator's first ever R01-equivalent grant - are the ultimate goal of CFAR Developmental Core funding mechanisms. Thirty new NIH awards were obtained by Core awardees based on, at least partially, the support provided by the CFAR Developmental Core.

Out of 30 new NIH grants received by Emory University, there were 43% (n=13) R01-equivalent grants that resulted from CFAR-series pilot funding. Nine of those 30 R01-equivalent grants were the recipient's first ever independent NIH award. Another 13% (n=4) were the developmental awardee's first ever NIH R01-equivalent awards, but not his or her first NIH independent funding (Figure 4). In other words, these investigators reported that they have had independent NIH awards that were funded by mechanisms other than R01 (such as Developmental Research Grant Award (R21), Research Scientist Development Award (K02)).

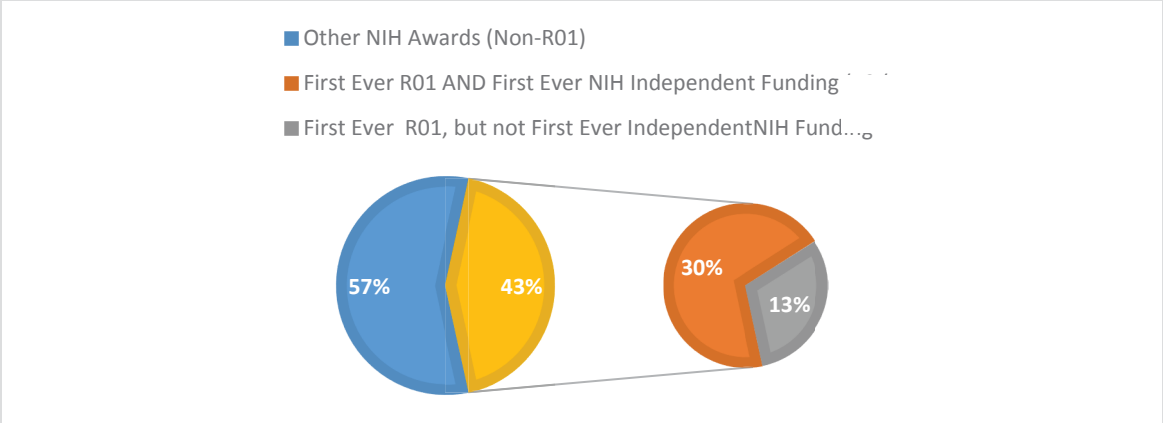

FIGURE 4 NEW NIH AWARDS OBTAINED, AT LEAST PARTIALLY, DUE TO SERVICES OF EMORY CFAR DEVELOPMENTAL CORE

Total Emory CFAR investment (both NIH and Emory) into the CFAR-series pilot award program was $2,672,668. The total external dollars awarded to Emory University as a result of CFAR-series pilot projects equaled $36,254,300. Details for the CFAR-series pilot awards issued and NIH grants received as a result of that pilot funding are in Table B4 (Appendix B). The ROI calculation was as follows:

$$ROI = \frac{36{,}524{,}300 - 2{,}672{,}668}{2{,}672{,}668} x100 = 1{,}266\%$$

As can be seen from the above numbers, CFAR-series pilot awards bring an impressive amount of NIH dollars to the university, resulting in an ROI or 1,266%. Not all CFAR-series grants were converted into new NIH awards. Even so, those that were converted succeeded in bringing large extramural federal grants relative to a relatively small CFAR investment of between $40,000 and $60,000. Furthermore, the resulting NIH grants were awarded by different institutes, suggesting a wide scope of HIV research was supported by the Emory CFAR Developmental Core through the pilot funding award mechanism.

Administrative Supplements

The Emory CFAR has been successful in obtaining several types of federal supplements to the main CFAR grant from NIH. NIH awards these Administrative Supplements to the Emory CFAR in order to fund promising special interest research projects that have the potential to generate additional external funding. This component of the project looks at such NIH Administrative Supplements that are administered through the CFAR Developmental Core.

There were a total of seven NIH Administrative Supplements awarded to Emory CFAR investigators, resulting in a total CFAR investment (NIH and Emory) of $1,220,148. Only one of the seven Administrative Supplements was converted into an independent R01-equivalent award. However, that single award brought a total funding amount of $2,393,299 to Emory University. It is also worth noting that this award was the first *ever* R01-equivalent received by this particular investigator. Therefore, the total ROI for Administrative Supplements was 96%, as calculated below:

$$ROI = \frac{2{,}393{,}299 - 1{,}220{,}148}{1{,}220{,}148} x100 = 96\%$$

Likewise, details of the Administrative Supplemental awards obtained by Emory investigators and NIH grants obtained as a result of this funding are in Table B5 (Appendix B).

Determination

This component of the project assessed the efficiency of the three funding award mechanisms provided through the Emory CFAR Developmental Core. In particular, it compared the three mechanisms to discover if one was more successful than others in generating NIH funding for Emory University. Such analysis was necessary in order to determine the best use of CFAR resources. As described above, each mechanism varies in the amount of dollars invested. Ramp Up awards are small-scale and targeted grants, designed to fulfill a critical need or to

eliminate a specific barrier. On the other hand, CFAR-series pilot grants and Administrative Supplements are designed to provide initial seed funding for a particular idea or project that has potential to generate additional federal funding. Administrative Supplements were analyzed separately, as NIH funds them and requests reporting on them separately.

Based on the fact that each developmental award mechanism was able to generate revenue and had a positive ROI, $H2_0$ can be rejected. Therefore, we can accept this alternative hypothesis:

$H2_1$: There is a positive relationship between Emory CFAR Developmental Core awardees receiving funds via a Developmental Core mechanism and the Emory fiscal portfolio as it pertains to NIH funding.

Clearly, each CFAR Developmental Core-supported award mechanism contributes to increasing of Emory University fiscal portfolio on some level.

When it comes to ROI, the results indicate that each mechanism has a different impact in terms of dollar-for-dollar return on investment. Ramp Up awards showed the highest ROI (6,472%), followed by CFAR-series pilot grants (1,266%), and closing with the Administrative Supplements (96%). These results allow us to reject the null hypothesis $H3_0$, and accept the following alternative hypotheses:

$H3_1$: The ROI of the CFAR-series pilot grant mechanism is different from the ROI of the Administrative Supplement mechanism.

$H3_2$: The ROI of the Administrative Supplement mechanism is different from the ROI of the Ramp Up award mechanism.

$H3_3$: The ROI of CFAR-series pilot grant mechanism is different from the ROI of the Ramp Up award mechanism.

It is important to understand that, while all ROI calculations are different, the goal of this component of the project is not to determine which ROI is better. Rather, NIH simply requests CFARs to gather accurate ROI data and calculate precise ROI values every year as a barometer of the CFAR's overall success rate.

The variation in ROI between developmental award mechanisms also has internal value for the CFAR. Seeing that the ROI values differ for each type of developmental award should allow CFAR leadership to make decisions on how to best allocate precious limited financial and staff resources. Of particular interest are the ROI values of Ramp Up and CFAR-series pilot awards. At first glance, it may seem that Ramp Up awards are much more successful based on the ROI alone. However, other factors must be considered, such as the number of external awards received and the number of investigators successfully applying for NIH grants that resulted from this funding mechanism. While the calculated ROI is much higher for Ramp Up awards, the actual number of external grants awarded is much less than the number of NIH grants obtained as a result of the CFAR-series pilot awards. The lower ROI for CFAR-series awards represents more external awards, but higher CFAR investment. CFAR directors may use this information when deciding whether to make changes or enhancements to a particular developmental grant mechanism. Also, having accurate ROI numbers provides the CFAR directors with information that can be useful when requesting additional resources from the university or other potential sponsors.

Finally, these ROI numbers are requested by the NIH at the time of CFAR progress report. They are then used to help secure new or maintain current funding levels for the National NIH CFAR Program. Showing strong ROI numbers signals that the program is successful and has an

impact on the careers of early stage investigators, as well as the public health community and general public who benefit from HIV research.

This component of the project also illuminated other useful information for the Emory CFAR. Over the course of this project, it was discovered that there was variation in how CFAR-supported investigators were reporting total funding amounts for external grants that resulted from their CFAR developmental awards. Some reported total awards as of that particular year, others reported total awards just for that year, while the rest reported total amounts awarded. Inconsistent reporting skews ROI calculations, potentially negatively impacting the final overall ROI value that NIH assigns to the Emory CFAR.

Research Question 3: Personal Impact

To answer the third research question, "*Personal Impact - how have Emory CFAR Developmental Core services personally impacted the professional development and funding success of early stage and new HIV investigators?",* a short survey was sent to all recipients of CFAR developmental in order to test the following hypotheses:

$H4_0$: There is no relationship between Emory CFAR Developmental Core Services and an

investigator's age at time of receipt of his or her first ever NIH R01-equivalent.

$H4_1$: There is a relationship between Emory CFAR Developmental Core Services and an investigator's age at time of receipt of his or her first ever NIH R01-equivalent.

Please note that for the purposes of this project, individual success of an early stage investigator is measured as age of receipt of the first NIH R01-equivalent grant. Ideally, the results would show that Emory CFAR developmental awardees are receiving their first R01-equivalent grants at an age that is significantly lower than the average age of first time R01-

equivalent recipients as reported by the NIH. A significant difference was agreed to be equal or more than five years.

Data collection

The survey was sent to the entire population of CFAR Developmental Core awardees who were still at Emory University. It was intentionally designed as a short questionnaire to make it more attractive to busy faculty members. In total, 49 surveys were sent via email, which included a link to the survey. After two follow-up emails, 41 surveys were returned, two awardees declined to participate as they are retired and are out of the research field, and the rest of the surveys were not returned. The response rate equaled 84%.

Findings

Degrees

All of the respondents had either an MD or a PhD degree. Thirty-nine percent of respondents (n = 16) indicated an MD as their degree, 56 % (n = 23) indicated that they have a PhD, and 5% (n = 2) had a dual MD/PhD degree. Of the 16 respondents with an MD degree, six had another graduate-level degree (MPH, MSc), and two of the 23 respondents with a PhD degree had another graduate-level degree (MPH, MHS). Of all respondents, 24% (n = 10) has multiple degrees (i.e. MD/PhD, MHS, MPH, MSC).

Funding

Of the 41 people who returned the survey, 61% (n = 25) indicated that they were able to secure external federal funding that resulted at least in part from a developmental award. Of those 25 respondents, only one did not receive an NIH grant; rather, that investigator was awarded a CDC U01, which is a large grant, often totaling over $1 million per year. Sixteen of these 25 respondents were successful in obtaining their first ever R01-equivalent grant and

indicated in the survey answers that the Developmental Core did contribute to their success at least on some level. Nine of these 25 respondents indicated that they were successful in obtaining multiple NIH awards. Awardees reported receiving four of the R01-equivalent grants in 2017. However, these grants would not have been included in the pilot award outcomes analysis above as they are too new.

It is worth reiterating that NIH requires the Emory CFAR to report on two types of funding outcomes resulting from developmental awards: total NIH funding and funding obtained via R01-equivalent grants (typically considered to be the start of an investigator's independent research career). Mirroring that NIH data request, this project looked at all NIH funding obtained at least partly from Emory CFAR developmental awards, as well as tracking CFAR-sponsored projects that resulted in R01-equivalent awards.

Of all 41 respondents, 58% (n=21) said that their CFAR Developmental Core award helped in obtaining their first ever NIH award. However, only 47% (n=16) of all respondents reported the same when it came to obtaining their first R01-equivalent award. That lower number may be explained by many reasons. For example, some investigators may have decided to leave the field of HIV/AIDS research. The implication is that while their first NIH funding was supported by the Developmental Core, the subsequent R01-equivalent may have been in an area unrelated to the activities of the CFAR.

Age at Time of Receipt of First R01-Equivalent Grant

The research question that was the most intriguing was whether the activities of the Emory CFAR Developmental Core played a role in significantly lowering the age at which investigators received their first NIH grant. This question arose from literature that suggests that

there has been "graying" of NIH researchers, meaning that investigators have been receiving their first grants at an increasingly older age over time.

The survey data indicated the average age at which the CFAR early stage investigators received their first ever NIH award was 40.94 years. The youngest investigator was 28, and the oldest was 58. However, the survey data cannot be compared to a national sample of NIH investigator age data, because a report on the first NIH non-R01 grant recipient age is not available. However, reports are available for investigator age at the time of receipt of their first ever R01-equivalent award ("Average Age and Degree of NIH R01-Equivalent First-Time" report provided in (Appendix D)). Therefore, it is possible to compare those numbers to the same category of Developmental Core awardees once the survey data are cleaned up and data on just the first ever R01-equivalent awards are isolated by excluding any investigators with awards that were not their first ever R01-equivalent grants or those with other types of grants. First ever R01-eqivalent data were obtained via survey. Sixteen respondents indicated that they acquired their first ever R01-equivalent awards due to, at least in part, their developmental awards. However, upon closer examination, three investigators' awards could not be located in the NIH database, which means that either they were not the Principal Investigators on the grants or that the grants were awarded by agencies other than the NIH. Another three awards were obtained in 2017, for which NIH age data is not available. Therefore, Emory CFAR investigator data were available for five years: 2007, 2009, 2010, 2011 and 2015. The average age of Emory CFAR early stage investigators at the time of receipt of their first R01-equivalent grant was 43. As can be seen from "Average Age and Degree of NIH R01-Equivalent First-Time" report provided in Appendix D, this result is very close to the average ages reported by the NIH.

A comparison via a one-sample *t*-test was planned to be performed for NIH average versus CFAR average age by degree type- grantees with MD degree only; grantees with PhD degree only; and recipients with a dual MD/PhD degree. However, concerns about the resulting sample size arose, especially because some years (2007, 2009, and 2011) only had one data point each. With that concern in mind, a decision was made to perform a calculation to estimate the power of such test. Based on the assumption that five years would be considered "significantly lower" than what is reported as averages by the NIH and descriptive statistics for the sample below, power calculations were performed in Sigma XL program to evaluate the chance of the proposed *t*-test to be able to reject the null hypothesis.

Age at time of Receipt of first R01-equivalent	
Mean	43.6
Standard Error	2.012185103
Median	43
Mode	39
Standard Deviation	6.363087999
Sample Variance	40.48888889
Kurtosis	2.12590824
Skewness	1.307796559
Range	22
Minimum	36
Maximum	58
Sum	436
Count	10

FIGURE 5 DESCRIPTIVE STATISTICS FOR AWARDEES REPORTING RECEIPT OF FIRST EVER R01-EQUIVALENT DUE TO, AT LEAST IN PART, CFAR DEVELOPMENTAL CORE SERVICES

After performing an estimated power calculation based on a set of specified parameters, results showed that the power of a one-sample *t*-test comparison of means would only be 0.596, which is not sufficient for the test to be successful:

Sample Size (N)	Difference	Standard Deviation	Significance Level (Alpha)	Power (1 - Beta)
10	5	6.4	0.05	0.596090

FIGURE 6 ESTIMATED POWER OF ONE-SAMPLE T-TEST COMPARISON OF MEANS FOR FIRST TIME R01-EQUIVALENT RECIPIENTS.

Since a power value of 0.9 is typically viewed as being sufficient to reject the null hypothesis, it is clear that the *t*-test, if performed with the sample size available, would only have 0.596 chance of being able to do that. Therefore, a *t*-test cannot be performed due to low power of available data.

Next, a sample size necessary to satisfy the requirement of power value of 0.9 or higher needed to be determined. Another test was performed in Sigma XL program using the same assumptions. The results are below:

Power (1 - Beta)	Difference	Standard Deviation	Significance Level (Alpha)	Sample Size (N)	Actual Power
0.9	5	6.4	0.05	20	0.911898709

FIGURE 7 SAMPLE SIZE NECESSARY IN ORDER TO ACHIEVE POWER LEVEL OF 0.9 TO TEST FOR SIGNIFICANCE OF DIFFERENCES OF THE MEANS OF FIRST TIME R01-EQUIVALENT RECIPIENTS.

Determination

As these results show, the minimum sample size necessary to test for differences of the means of Emory CFAR awardees and NIH-reported age at time of receipt of first R01-equivalent is 20. Therefore, the sample of 10 that is available based on the survey results is insufficient to perform statistical analysis of the means. With that, there is not enough information to reject the null hypothesis:

$H4_0$: There is no relationship between Emory CFAR Developmental Core Services and an investigators' age at time of receipt of first ever NIH R01-equivalent.

While this relationship cannot be confirmed, it is possible that without the help of the Developmental Core, the average age of Emory CFAR early stage investigators could have been higher than the average age at the time of first R01-equivalent award receipt reported by the NIH. A look at the entire NIH CFAR program and all of the users of the Developmental Cores across the other 19 CFARs could offer a more definitive picture by providing a sample large enough to perform necessary statistical analyses.

Additional Information

Recipients of CFAR developmental awards also were asked about their use of other Developmental Core services in the online survey. These additional questions helped to assess what services early stage investigators view as most valuable. Knowing this information could help the CFAR directors to make better informed decisions about what services the Developmental Core should offer in the future, as well as how to better allocate monetary and staff resources.

Professional Contacts

For the survey question on whether CFAR developmental awards were helpful in developing new professional contacts that have led or may lead to future collaborations, 83% (n = 36) respondents said "yes." When asked to quantify the number of those collaborations, answers ranged from 1 to 30. This is encouraging, as such contacts could lead to successful applications for NIH funding in the future.

Developmental Core Services

As described previously, the Emory CFAR Developmental Core offers multiple services to the HIV research community. They include mentorship, developmental funding awards (CFAR-series, Ramp Up, and Administrative Supplements), study design consultation, pre-submission feedback, grant writing training and assistance, IRB protocol preparation assistance, and several other services. (See Appendix C for a complete list.)

For the survey questions on utilization of these Developmental Core services, results varied for past versus future plans. This outcome was expected, and it can likely be explained by whether or not the respondent considers him or herself an independent researcher. Developmental awards are of most interest to early stage investigators who are just trying to begin their independent research careers. This funding-based service offered by the Developmental Core provides a "kick start" for recipients in terms of their ability to generate pilot data, allowing them to develop more competitive NIH award applications. Developmental awards also help their early careers by financially supporting participation in conferences - which in turn promote networking, new collaborations, and opportunities to present the research results.

Not surprisingly, the largest service utilized in the past was CFAR-series awards. Almost all of the survey respondents indicated that they received this type of support. However, moving forward, investigators plan to use other CFAR Developmental Core services more proportionally. Figure 8 below shows what services the respondents planned to utilize in the future. The leading responses were collaboration travel awards, Ramp Up awards, study design consultation, pre-submission feedback, R-Club membership, and project-based training.

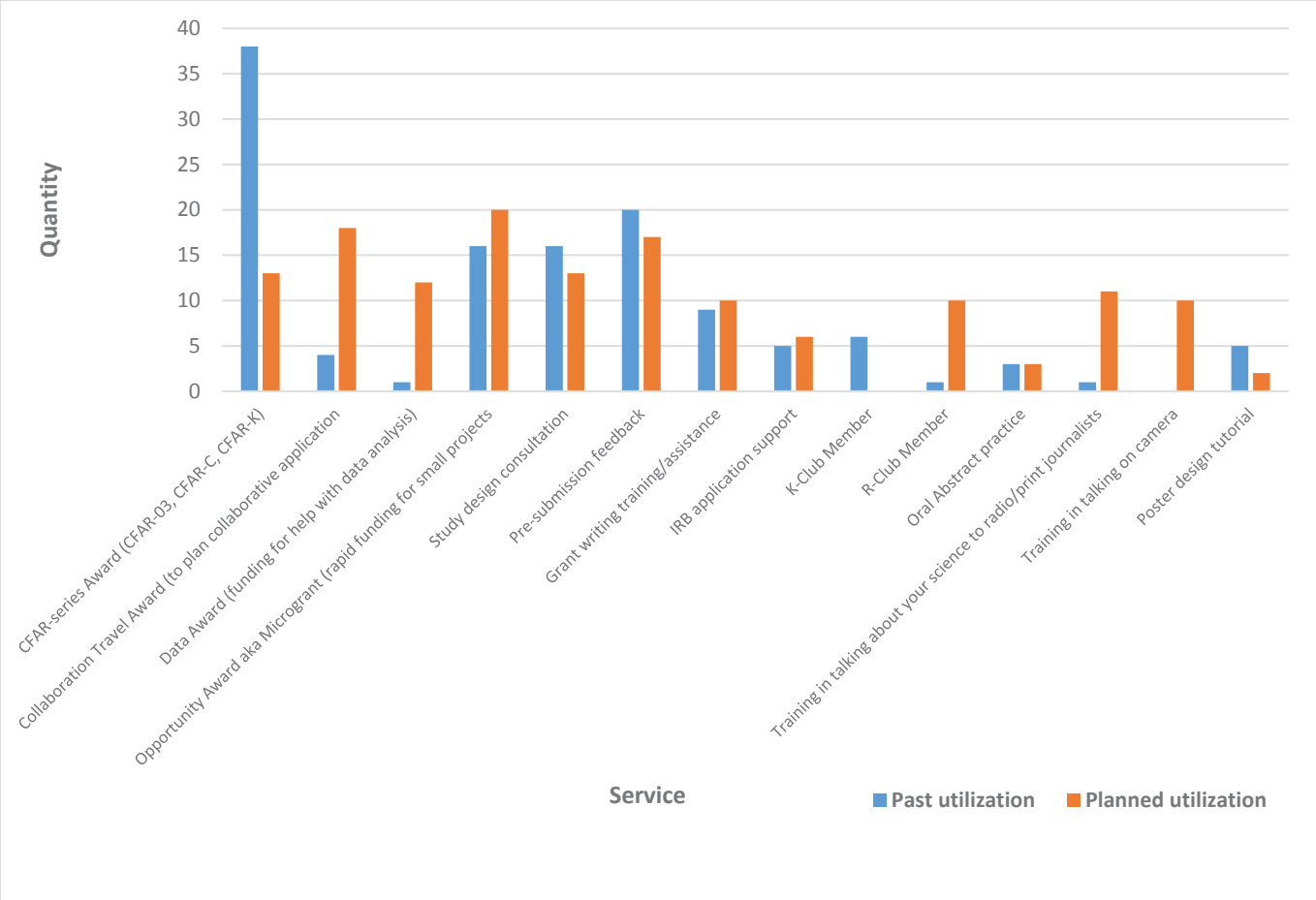

FIGURE 8. UTILIZATION OF SERVICES PROVIDED BY THE EMORY CFAR DEVELOPMENTAL CORE (PAST VS. FUTURE)

The results are logical and not surprising. CFAR-series pilot grants are designed to mirror the NIH application and work process. During the course of a CFAR-series award, early stage investigators are trained to apply for grants, manage their funding within strict guidelines, properly report outcomes, develop collaborations, and publish results. The goal of these awards is to enable the awardees to apply for independent NIH funding, preferably R01-equivalent awards. Therefore, after CFAR-series awards are completed, services like Ramp Up awards (designed to fill a specific gap), pre-submission feedback, collaboration travel awards, IRB protocol development should be in a higher demand by past developmental awardees, as they prepare their initial independent NIH applications.

Conclusion

This chapter presents results of a research project that investigated the impact of the investments of the Emory CFAR Developmental Core from three vantage points: global, organizational, and personal.

Global impact was assessed through a thorough publication analysis. The results indicate that early stage investigators who have utilized Emory CFAR Developmental Core services do contribute to global HIV knowledge by publishing in peer-reviewed journals. Also, the publications resulting from the investigators' developmental awards are being cited by other investigators. For the most part, the impact factors of journals containing Emory CFAR Developmental Core-supported publications fall near selected benchmark, suggesting the quality of those publications is satisfactory.

Organizational impact was evaluated through analysis of the return on investment (ROI) for each of the three CFAR Developmental Core award mechanisms to assess if developmental awardees are contributing to Emory University's fiscal portfolio. Overall, the CFAR developmental awards program is successful, but the ROI differs for each award mechanism. A closer look needs to be taken at Ramp Up awards, as they show an ROI of over 6,000%. A return of this magnitude is not expected as only a few of the small-scale Ramp Up awards were converted into NIH-funded grants. However, this high ROI does suggest that the program is successful and has the potential to bring large benefits in return for a small investment. CFAR-series pilot grants also were found to be successful, as their ROI was high (over 1,000%). In fact, the quantity of CFAR-series awards converted into NIH-funded grants was higher than Ramp Up awards, indicating that the pilot funding offered through the CFAR-series may make a more lasting impact on careers of higher numbers of investigators. Administrative Supplements

yielded an ROI of just about 100%. This result, while still positive, is much lower than the other two categories. However, it is not surprising that projects with limited periods of performance and highly targeted topics could be less successful, given that NIH funding priorities may change while these Supplemental projects are being performed.

Finally, a survey was used to measure personal impact. Survey results suggest that investigators' interest in the CFAR Developmental Core services is strong. A trend appeared during the analysis, highlighting that interest in CFAR funding decreased and interest in other Core services increased after investigators obtained developmental awards. That makes sense, since availability of funding probably allowed them to obtain data and/or remove barriers in order to submit competitive NIH applications. At that point, services like pre-submission feedback and/or IRB preparation were more valuable.

There was no clear evidence that Developmental Core funding helps to lower the average age of investigators at the time of first R01-equivalent award. However, it is possible that the age at receipt of first R01-equivalent award would have been even higher if early stage investigators did not utilize services offered by the Emory CFAR Developmental Core.

Overall, activities of the Emory CFAR Developmental Core were found to be successful. This project also revealed that certain factors may influence how outcomes and ROI data are reported to the NIH. While the results indicate that the Core is doing what it was designed to do, they also show certain adjustments in reporting processes may ensure that project outcomes are accurately collected and reported to NIH. Additionally, these project results provide useful information about what services early stage investigators are interested in at various points in their careers. This information will be useful to the CFAR leadership when planning which services to continue offer through the Developmental Core and what, if any, changes and/or

improvements need to be made. The following chapter will look in greater detail at the results and lessons learned.

Chapter V

CONCLUSIONS

In 1981 the world was struck with an unknown disease that caused people to die. At first, it presented itself as *Pneumocystis carinii* pneumonia in five young, previously healthy gay men (Centers for Disease Control and Prevention, 1981). Over the next several months, more people of different ages and backgrounds became ill and died of this unknown disease, which was named Acquired Immune Deficiency Virus. It was not until 1983 that the actual Human Immunodeficiency Virus causing AIDS was discovered.

The HIV epidemic continues to this day. There is still no cure or vaccine. According to the Joint United Nations Programme in HIV/AIDS (UNAIDS) fact sheet, there were 36.7 million people living with HIV in the world in 2015 (UNAIDS, 2018). This problem also hits close to home, as Georgia finds itself in the middle of the raging HIV/AIDS epidemic. Georgia was ranked fifth highest in the nation for total number of adults and adolescents living with HIV infection in 2013. The number of people with undiagnosed HIV infection in Georgia is estimated to be the second highest in the US, at 18.7%. The nine-county Atlanta metropolitan area contains two thirds (66%) of the state's diagnosed cases of HIV, with Fulton and DeKalb counties accounting for 47% of all of the state's diagnosed cases (Georgia Department of Public Health, 2016).

In the years since the discovery of the HIV, major advances have been achieved in the fight against the disease. These successes were made possible by investments from governments and other organizations around the world, and by the dedication of scientists who tirelessly work to one day discover a cure for AIDS. There is still a lot to be done, so there is a constant need for researchers interested in the HIV/AIDS fight. Developing and retaining talented scientists is one of the areas on which the Emory University Center for AIDS Research (Emory CFAR) focuses. More specifically, it is the goal of the Emory CFAR Developmental Core to support early stage investigators by providing necessary resources and support as they try to establish themselves as independent researchers (ideally, by obtaining an NIH R01- equivalent grant).

This project was designed to examine the services of the Emory CFAR Developmental Core and to study and evaluate the impact of Developmental Core award recipients on three levels:

1. *Global Impact — how have Emory CFAR Developmental Core awardees contributed to the global HIV knowledge base?* (Research Question 1);
2. *Organizational Impact — what impact have Emory CFAR Developmental Core awardees had on Emory University's fiscal portfolio as it pertains to the NIH funded research base? More specifically, what is the rate of return on the dollars awarded via the CFAR-series pilot grant mechanism, Administrative Supplement mechanism, and Ramp Up award mechanism?* (Research Question 2);
3. *Personal Impact — how have Emory CFAR Developmental Core services personally impacted the professional development and funding success of early stage and new HIV investigators?* (Research Question 3).

Research Question 1: Global Impact

Question Background and Findings

Traditionally, the contribution of scientific research to knowledge has been measured by the number and impact of scientific papers published in peer-reviewed literature (Grant, et al., 2000). Several studies found that investigators with previous grant funding experience have higher scholarly output as measured by the number of publications, their impact, and citation factors (Svider, et al., 2014), (Pagel & Hudetz, 2015). Publication output is not only important for contribution to the global HIV/AIDS knowledge base, but it is often used as the currency of scientific research. It is often more important where a scientist publishes than what they publish (Raff, Johnson, & Walter, 2008). This high emphasis on publications by scientists, and especially by early stage investigators as they try to claim their place in the biomedical research community, dictated this project's approach in evaluating the impact of CFAR Developmental Core awardees on the global HIV/AIDS knowledge base. Assuming that previous funding is an indicator of scholarly output (Svider, et al., 2014), information about all publications resulting from Developmental Core awards was gathered and evaluated for impact and citation factors. Contributions to the global HIV knowledge base were measured by awardees' publications in scientific journals. More specifically, impact factors of journals containing awardees' publications, and citation factors of those publication were examined. Several conditions were set in order to determine the answer to research question 1.

The following hypotheses were tested:

$H1_0$: Emory CFAR Developmental Core awardees had no impact on the global HIV knowledge base.

$H1_1$: Emory CFAR Developmental Core awardees had an impact on the global HIV knowledge base.

The results showed that awardees did have an impact on the global HIV knowledge base. There were 128 publications, most of which were published in peer-reviewed journals. Several publications appeared in journals that publish works by invitation only, which suggests that those articles were regarded as high-quality by other experts in the field. Many of the publications appeared in open access journals, ensuring access by a wider interested population. Journal impact factor (JIF) analysis showed that Core-related awardees' publications had JIFs that are more in line with selected field-specific journals, *AIDS* and *Aids and Behavior*, and remained stable from 1998 to 2016. The average JIF for Developmental Core publications was 4.498, which fell right between the average JIF for *AIDS* (2.61) and *AIDS and Behavior* (5.98). This information shows that awardees consistently publish in respected journals that reach not only the biomedical research community, but also an audience outside of the scientific field through open access journals which lift any financial burdens there may be when it comes to journal subscriptions. It is important to note that this analysis applies to the field of HIV/AIDS research. When comparing to impact factors of *Science* (29.49) and *JAMA* (25.61), which are widely considered the gold standards in research and clinical communities, JIFs of CFAR-related publications were much lower. This finding is not surprising, as early stage investigators are not expected to be highly successful publishing in those journals so early in their research careers.

Another dimension of contributing to the global HIV/AIDS knowledge base that was studied was the number of citations that awardees' publications generated, the assumption being that global knowledge is disseminated by investigators' work being cited in other researchers' publications. That means that works by Developmental Core awardees are respected and that

awardees are thought to have achieved a certain level of expertise in the field. Only 7% (n=9) of publications did not have any citations. Six of those nine were published in 2016, feasibly making them too new to be cited. Overall, the works of Developmental Core awardees were cited 3,395 times. The highest citation count calculated for the developmental awardee publications was 303, the average was 26.52, the median was 16, and the standard deviation was 36.94.

Based on analysis of the results, the null hypothesis can be rejected and the alternative hypothesis can be accepted. Developmental Core awardees did have an impact on the global HIV knowledge base.

Research question 2: Organizational Impact

Question Background and Findings

In order to continue advancing biomedical research in any area, including HIV/AIDS, funding must be secured. NIH remains the largest non-commercial funder of biomedical research in the US (Cech, 2005). In recent years, NIH faced budget freezes and cuts (Mandel & Vessell, 2004) (Loscalzo, 2006). Nevertheless, the United States remains the largest funder of life science research. In 2003, U.S. investment in research and development from all sources (industry, government, academia, philanthropy) totaled $284 billion and represented 2.6 percent of the nation's Gross Domestic Product (Porter, 2005).

Biomedical research is not cheap. A large portion of it is done at university research centers, which rely on external funding to cover the bulk of their expenses. Most often, such funding is secured via various grant mechanisms awarded through a competitive application and review process. One of the main goals of the Emory CFAR Developmental Core is to identify early stage HIV/AIDS investigators and to support them by providing pilot funding necessary to

generate results that could be used in a successful application for an independent NIH award (preferably, an R01-equivalent grant). Showing that Emory CFAR is successful in this effort would allow it to be argued that the CFAR program is effective in bringing NIH dollars to Emory University. Since Emory University co-funds Emory CFAR with institutional dollars, demonstrating that there are financial gains to the University would allow Emory CFAR leadership to justify their requests for that support to continue and even be increased.

Three types of developmental awards were studied in order to answer research question 2: Ramp Up awards, CFAR-series pilot awards, and Administrative Supplements. Return on investment (ROI) was calculated for each type, and the following hypotheses were tested:

$H2_0$: There is no relationship between Emory CFAR Developmental Core awardees receiving funds via a Developmental Core mechanism and the Emory fiscal portfolio as it pertains to NIH funding.

$H2_1$: There is a positive relationship between Emory CFAR Developmental Core awardees receiving funds via a Developmental Core mechanism and the Emory fiscal portfolio as it pertains to NIH funding.

$H3_0$: There is no difference in the return on investment (ROI) among the three Emory CFAR Developmental Core award mechanisms.

$H3_1$: The ROI of the CFAR-series pilot grant mechanism is different from the ROI of the Administrative Supplement mechanism.

$H3_2$: The ROI of the Administrative Supplement mechanism is different from the ROI of the Ramp Up award mechanism.

$H3_3$: The ROI of CFAR-series pilot grant mechanism is different from the ROI of the Ramp Up award mechanism.

Information about funds received by Emory University as a result of Developmental Core grants was obtained from progress reports submitted to the NIH on an annual basis. Awardees are required to report to the CFAR if they were able to obtain any grants as a result, at least partially, of their Developmental funding received from CFAR. This means that, if early stage investigators generated data, presented at meetings, or acquired training on how to develop competitive applications, which were later funded by the NIH, with the help of the funding received from CFAR Developmental Core, they must report these results to the Emory CFAR. Emory CFAR then reports those results to the National CFAR at the NIH. Awardees typically know what factors contributed to the success of their applications. Those could include training, mentoring, and, as in the case of the CFAR, pilot funding to generate data.

The ROI calculation was performed for each type of developmental award. The findings showed that Ramp Up awards had an ROI of 6,472%, CFAR-series pilot grant awards had an ROI of 1,266%, and Administrative Supplements had an ROI of 96%. Based on these calculations, the null hypotheses for this question can be rejected and the alternative hypotheses can be accepted. Results showed that there is a positive relationship between Emory CFAR Developmental Core awardees receiving funds via a Developmental Core mechanism and the Emory fiscal portfolio as it pertains to NIH funding, and ROI for each type of award is different.

This research project uncovered that for years, CFAR has made an error in reporting funding in the Developmental Core tables as a result of relying on awardees to self-report their outcomes. Some awardees reported amounts for grants they were able to secure after their developmental awards as the total amount awarded for all years of the grant, while some reported the amount awarded for a single year, and some reported for the current and all previous years of the grant. This altered the ROI calculation when reporting the overall outcomes to the NIH. This

discrepancy was resolved by accessing original NIH award documents and confirming amounts of the grants received at least in part because of having received a developmental award for each year of each grant. To mitigate this going forward, Developmental Core leadership should revise developmental award notices to include language that clearly explains what amount to include when reporting back to the National CFAR. The initial NIH NOA that awardees receive typically includes a recommended amount of funding per year for the duration of the grant. CFAR award documents should include instructions to the early stage investigator for reporting outcomes and grants received based at least partly due to the CFAR award, and should be clear that the amount of the award they report they received is the sum of recommended funding for all years as listed in the original NIH NOA for that grant. This change will ensure consistent data will be reported yielding a more accurate calculation of ROI.

Research question 3: Personal Impact

Question Background and Findings

One of the main goals of the Emory CFAR Developmental Core is to bolster the success of investigators new to the HIV/AIDS research field. Many efforts of the Core focus on career development of early stage investigators, which will help them become truly independent, ideally by obtaining an NIH R01-equivalent grant. Camplin and Steger (2000) define development as the targeted enhancement of an individual or a collective set of individuals to serve better the mission of the organization. Many sponsors of biomedical research recognize how critical it is to develop early stage investigators and have mechanisms in place that target those researchers that are trying to start and develop their careers in the fields of their interest.

One of the concerns that exists is the "graying" of investigators. In other words, investigators today are older at the time they receive their R01-equivalent grant than they were in

the past. Investigators now receive their first independent research grant at a median age of 42 years for those with PhD degrees, and 44 years for those with MDs (Cech, 2005). Daniels (2015) writes that the average age at which an investigator with a medical degree receives their first R01 or equivalent grant has increased from less than 38 years in 1980 to more than 45 years in 2013. At the same time, the number of principal investigators for such grants who are 36 years old or younger has decreased from 18 % in 1983 to 3% in 2010. This is a concern because one can argue that investigators who establish themselves in biomedical research at a later age have less time to conduct research and make significant advances. Additionally, this delayed career start can be expensive, as there is less time during one's active career to recover the investment made on his or her education and training ((Stephen & Levin, 1989), (Jacob & Lefgren, 2011)).

Emory CFAR Developmental Core provides many services, including initial pilot funding, to early stage investigators who are trying to develop their careers in the field of HIV/AIDS research. Based on observations about the aging of researchers, this project sought to determine whether these services and support that the Core provides help lower the average age at which CFAR awardees receive their first R01-equivalent award. The following hypotheses were tested:

$H4_0$: There is no relationship between Emory CFAR Developmental Core Services and an investigator's age at time of receipt of his or her first ever NIH R01-equivalent.

$H4_1$: There is a relationship between Emory CFAR Developmental Core Services and an investigator's age at time of receipt of his or her first ever NIH R01-equivalent.

The entire population of CFAR awardees was available to be surveyed, and a response rate of 84% was achieved. Out of 41 respondents, 51% (n = 21) reported that their CFAR Developmental Core award helped in obtaining their first ever NIH award. The rate of awardees

confirming that the Developmental Core helped them secure their first ever NIH R01-equivalent was lower at 39% (n = 16). This can be explained by several factors.

There are two ways in which the Developmental Core can help early stage investigators obtain NIH funding: by providing money to generate data on which to base an application for another NIH award, and by training investigators on how to compile a fundable application package. Applications for CFAR-series awards are subject to peer review as is an application to the NIH, and this provides a learning experience for investigators even if their application to CFAR was not funded. This question was vague enough for respondents to possibly omit some contributions to their success when thinking about the Developmental Core. More than likely, they all benefitted from their experience with the Developmental Core, as they all learned about the process and what interactions and actions are necessary in order to submit an application. Therefore, the percent of people that think that the CFAR Developmental Core helped with securing their first R01 may be artificially low simply due to confusion with the survey question.

Awardees may have received other types of grants after the developmental award that contributed to securing that first ever NIH grant. Additionally, some investigators may have left the field of HIV/AIDS research as their work may have lead them to develop interest in other areas. Nevertheless, this result is exciting, as Developmental Core awards were helpful, at least in part, for nearly half of all awardees in obtaining their first ever NIH R01-equivalent award.

One of the most intriguing questions of this project was to determine whether there is a relationship between CFAR Developmental Core Services and the age of early stage investigators when they obtain their first ever R01-equivalent grant. Data on age were obtained via survey and were to be compared to the average age reported by the NIH. The results showed that the average age of CFAR awardees at the time they received their first R01-equivalent

award was 43.6. However, a power calculation performed showed that a *t*-test could not be performed due to low power of data available. The sample size that was available was n = 10. However, for a *t*-test to be meaningful, a sample size of n = 20 is needed. Therefore, the null hypothesis cannot be rejected. It is important to state that while no clear relationship can be confirmed, it is possible that the average age of CFAR investigators at the time of receipt of their first ever R01-equivalent award could be even higher without the services provided by the Developmental Core.

Finally, awardees were asked to share their opinion on what Core Services they viewed as most valuable. The results showed that after obtaining their developmental awards, awardees view other services that aim to assist in preparation of their application to the NIH as most useful. Those services included collaboration travel awards, data awards, opportunity awards designed to fill a critical need, study design consultation, pre-submission feedback, grant writing training, and training to present their results. As compared to services utilized in the past, these types of services were more desirable as awardees completed their developmental awards and were working on competitive NIH applications.

The survey showed that every service is in demand. However, those that are most desired vary depending on where early stage investigators are in their careers. Investigators who are brand new to the field of HIV/AIDS research are mostly interested in pilot funding and study design, while investigators who completed their pilot awards are more interested in services that prepare them for competing for independent awards and, hopefully, future independent careers.

Limitations

Several limitations can be identified. First, due to the fact that this study was designed and conducted specifically for the needs of the Emory CFAR, the criteria that were chosen

accordingly. Metrics that matter to the Emory CFAR were selected, such as journal impact factor, return on investment, and age of investigators at the time of receipt of their first NIH R01 grant. Other CFARs may focus on different development areas. Therefore, their metrics to be evaluated may be different. Results are exploratory and may not be replicable due to the limited nature of the study. No two CFARs in the country are the same, as each offers a unique set of services. Emory CFAR purposely bases their awards program on NIH R03 awards so that early stage investigators are exposed to the "NIH way" as early as possible, meaning that early stage investigators get a full practice in grant application process even before they submit their first application to the NIH. The results of this study are unique to the Emory CFAR, and this project was designed to be a case study, so this limitation was to be expected. These findings offer important insight into how awardees are adjusting to the new era of technology and the abundance of publication venues, (such as open access journals), by utilizing those new venues in order to reach broader audience; how work of the Developmental Core is influencing Emory University's overall fiscal portfolio; and what services are the most desired by early stage investigators affiliated with this particular CFAR. Therefore, the selected approach and methods meet the specific needs of the Emory CFAR Developmental Core.

The second limitation is that JIF has come under criticism for not being an appropriate measure of publication quality (Alberts, Brooks, & Kelner, 2008) (Notkins, 2008) and for being used as a measure to determine promotions, resource allocations, and even funding (Sheckman, 2013) (Rushforth & De Rijcke, 2015). However, JIF is still being used, as it has become part of "the culture" (Rushforth & De Rijcke, 2015) and is readily available (Garfield, 1999). For these reasons, using JIF to determine whether awardees had impact on global knowledge is appropriate.

Third, a limitation that applies to all of the research questions addressed in this work is the fact that Emory CFAR relies on awardees to report outcomes of their developmental awards. Therefore, it is possible that not all publications that resulted from the awards were reported. Awardees may simply not realize that their Developmental Core funding and training contributed to the development of their publication because some time has passed since they interacted with the Core. Or, they could simply forget to include all appropriate publications in their report. While all publication information was confirmed through the Web of Science database, it is not possible to know if there are any other publications that awardees did not report. If there are, results could shift slightly. However, based on the trends seen from the publications analyzed, they would most likely fall on the same level as other publications as it pertains to JIF. Citations could yield results that are more different, meaning that it is not possible to predict how many times a certain article would be cited. However, if anything, unreported publications would yield more citations overall, not less. It is reasonable to expect that if there are any unreported publications, they have been cited at least once by other works, unless they are too new (i.e., published in 2016 or after).

Fourth, the questions in the survey did not specify in which way the Developmental Core helped with obtaining investigator's first independent grant. Was it funding that was helpful, or experience that provided training on application development, or both? As stated above, awardees may not be linking their experience with the Core award to the eventual success of their NIH applications. In the real world, it is not always possible for early stage investigators to be able to convert their first pilot award of $40,000 into a full-size R01. Often, more studies and data gathering are needed. It is possible that some CFAR award recipients received their NIH awards after conducting additional studies and developing a better application. However, the

Developmental award is what allowed them to start in the first place and created a "domino effect" that led to their success. In this type of scenario, awardees may not be thinking about that developmental award as the starting point that ultimately contributed to their successful NIH grant application.

During the course of this study, results showed that reliance on self-reporting of grant data is flawed due to inconsistencies in reporting. Awardees reported amounts received from the NIH inconsistently, thus affecting the ROI reported to the NIH. Additionally, it is possible that not all external grants obtained at least in part due to a CFAR developmental award were reported to the CFAR. This problem was partially remedied by accessing original grant award documents and confirming the awarded amounts for all years. Additionally, the survey distributed as part of research question 3 information gathering included questions that could potentially identify grants that were not reported. Nonetheless, reliance on investigators to self-report this information will never be error-proof. Consistent with the factors described above, the results could be artificially low if respondents did not report all their grants that were aided by their developmental awards. The CFAR is not in a position to verify that all awards resulting from CFAR Developmental Core funds were reported. Since only respondents can identify those awards, potential for underreporting of outcome exists.

Fifth, since grants from agencies other than the NIH were excluded from the ROI calculation due to reporting requirements set by the NIH, the true dollar-for-dollar return is likely much higher for each of the developmental grant mechanisms. Awardees reported securing grants from the CDC and other sources, both federal and non-federal. Therefore, ROI calculations reached by this study could be higher than the study discovered. A more extensive study requesting awardees to report all grants they were able to obtain based on having received,

at least partially, Emory CFAR Developmental awards, would need to be conducted. Such a study would allow calculation of the true dollar-for-dollar ROI for each of the grant mechanisms that the CFAR Developmental Core offers. It is important to note that the focus of the study was to only determine ROI as it pertains to the NIH funding. While not a true limitation as far as answering this particular study question, it can be viewed as a limitation when it comes to presentation of the data to the Emory leadership when requesting institutional funding. The resulting ROI may appear lower than it really is because not all grants obtained with the help of the Developmental Core are included in the ROI calculation.

A Sixth limitation, in attempt to answer research question 3, only total CFAR dollars (NIH and University) invested via the three developmental grant mechanisms were used to calculate ROI. This calculation fails to take into account other investments and resources, such as CFAR staff time, research administration staff time, and other non-financial resources that are necessary in order to keep the program running smoothly. Such all-inclusive analyses are possible, but would require an extensive study of all resources involved, which is beyond the scope of this project. Additionally, NIH requires ROI reporting to be based on each dollar invested in various developmental grant mechanisms. Funds are awarded by the NIH and the University to cover other expenses connected with maintenance of the Developmental Core programs, and hence are not limited to dollars directly funding the developmental mechanisms only.

Lastly, one of the most significant barriers to answering research question 3 was the small sample size, which makes it impossible to answer one of the central questions of this project. It could not be determined whether a relationship exists between activities of the Developmental Core and the age at which investigators received their first ever NIH R01-

equivalent award due to the insufficient sample size of awardees meeting specific criteria. However, the project did determine an appropriate sample size, so a similar test would be theoretically possible if data from all CFARs were obtained and analyzed.

As can be seen from the above discussion, several limitations are common to all parts of this study. Reliance on self-reported information presents a concern because information may be incomplete. Critics may say that many of the criteria for this study are subjective. While this may be true, these criteria were developed in close collaboration with the leadership of the Emory CFAR Developmental Core in response to the reporting requirements set by the NIH. Questions that were asked and answered within these criteria are ones on which the Emory CFAR is required to report. The answers obtained through the course of this work will make information available that can be not only included in reports to the sponsoring agency, but can also be used when thinking about advancing CFAR Developmental Core services further.

While certain limitations exist, this study provides a framework for other CFARs in conducting multidimensional evaluations of activities of their own Developmental Cores. Since each CFAR is different, specific methodological adjustments will be needed. However, this project provides background and examples of how similar evaluations by CFARs and other programs focusing on the development of early stage investigators can be structured.

Implications of the findings and recommendations

The main goal of this project was to demonstrate the impact of the Emory CFAR Developmental Core on the success of HIV/AIDS programs not only within Emory University and the Atlanta Metro Area, but also throughout the entire country and beyond. Emory CFAR works on improving success of efforts to fight the epidemic by investing in early stage investigators via several award mechanisms and various services provided by the Developmental

Core. By investing in these researchers, Emory CFAR is investing in the fight that can potentially impact the epidemic all over the world, as early stage investigators mature and work in different regions affected by HIV/AIDS. In order to evaluate that impact, this project examined the services of the Emory CFAR Developmental Core and, based on certain analyses, drew conclusions about their effect on the careers of early stage investigators.

Another goal was to determine the ROI of the CFAR's investments on both monetary and non-monetary levels. Large amounts of money (both federal and non-federal) are being invested in the CFAR program. Evaluating the return of those investments is critical to demonstrate that the funds are used in ways that generate results, especially in the current climate in which funding amounts are at risk of being reduced. While monetary ROI is easy to understand, non-monetary ROI is represented by publications, citations, and other factors, such as collaborations formed with other researchers.

Developing early stage investigators aligns with the goals of the NIH. As discussed previously, the NIH sponsors multiple career development awards that target this group of investigators. The Developmental Core, which utilizes both NIH and institutional funds, works similarly. It offers pilot funding to investigators in the beginning stages of their careers. Rangel and Lawrence (2004) state that previous NIH funding is the strongest positive predictor of future NIH support. While no formal analysis was conducted to evaluate this claim within the scope of this project due to myriad other factors that can influence funding success, awardees reported receiving 62 new NIH grants based, at least partly, on their Developmental Core award. These findings reinforce the statements by Rangel and Lawrence (2004) as 62 new NIH awards represent 85% success rate for Developmental Core awardees. While those successful applications may have benefitted from the CFAR awards only partly, it is possible that these

successes depended on the pilot funding, training, and experience provided by the initial CFAR award. Eighty-five percent of the early stage investigators confirming that they were able to obtain their first independent award as a result (at least partially) of their CFAR grant *supports* Rangel's and Lawrence's (2004) finding that previous NIH funding is a good predictor of future NIH awards. While CFAR awards are administered through Emory CFAR and do not come directly from the NIH, they follow the same rules and procedures and adhere to the same application evaluation criteria as those submitted to the NIH. This experience, in addition to the actual funding for a pilot project, can be invaluable to an early stage investigator trying to navigate the confusing world of applying to the NIH for grant funding.

There is increased concern about the fact that researchers are receiving their first R01 equivalent grants at an increasingly higher age (Cech, 2005; Daniels, 2015; Jacob & Lefgren, 2011; Stephen & Levin, 1989). According to Daniels (2015), investigators' average age at the time of receipt of first R01-equivalent grant was 45 years old. The results of this study were consistent with this figure, as it was determined that the average age at which Developmental Core awardees received their first R01-equivalent grant was 43.6 years old, which is close to the NIH average. Unfortunately, as noted above, limitations due to the sample size of this study make it impossible to determine if this figure is statistically significant. However, it appears to be in line with the overall averages. Another dimension of this question is the fact that Mason, et al (2013) found that K01 award recipients were, in fact, able to get their first R01-equivalent grant in a shorter period of time than those who did not have a K01 award or those who had other types of K awards. Mason's study was one of the reasons CFAR wanted to look at whether the Developmental Core was contributing to lower ages at the time of receipt of first R01-equivalent grants by the developmental award recipients. However, the small sample size ultimately fitting

certain specified criteria presented a barrier for making a determination on any impact the receipt of a Developmental award may have.

While the project did not uncover enough data to evaluate whether CFAR awardees received their first R01 earlier than those who did not have a similar award, it still presented groundwork that could be used to answer this question in the future. During the period examined, Developmental Core awardees received 13 K awards. Of them, four were K01 grants. Those awards can be tracked over time and outcomes can be reevaluated at a later date to see if those early stage investigators were able to receive their first R01 grant at a younger age than those who did not have a K01 award. Positive results would support Mason's et al. (2013) findings as it pertains to the CFAR early stage investigators and would indicate that, while not directly, the Developmental Core still influenced the careers of those investigators by providing crucial funding early on.

Similarly, positive findings would align with arguments made by Chamblin and Steger (2000) that the reasons faculty development initiatives are needed include strengthening relationships among colleagues, supporting stated institutional missions, and dealing with both the faculty member's and institution's "capacity to survive". Obtaining initial funding that later led to a successful K01 award application, which, in turn, led to a decreased time to obtaining the first R01 award, would allow the early stage investigator to not only work with colleagues and strengthen those relationships, it would alleviate anxiety about the need to be successful in obtaining grant funding. This step-by-step process (receipt of a CFAR award followed by a K01 award and then an R01 award) would gradually teach early stage investigators how to write successful grant applications and deal with feedback on applications that did not get funded. Either way, this investment presents a valuable training tool to the investigators, which

ultimately should allow them to be successful in supporting the University's mission through their research.

This project did look at JIFs and citation factors in order to determine if there are returns as measured by publication output and the perceived quality of published works that contributed to the global HIV/AIDS knowledge base. Garfield (1999) and Raff et al. (2008) noted that JIFs often play an important role in decisions related to the early stage investigators' careers and grant funding. Therefore, JIF and citation factors were deemed an important ROI dimension for the purposes of this project. It was discovered that awardees did publish in respected journals, as specified by certain criteria described in previous chapters. This information shows that leadership of the Emory CFAR and of the Developmental Core is advising early stage investigators effectively when it comes to selecting venues in which to publish. Consistently publishing in respected journals will position CFAR-sponsored early stage investigators better in the culture where JIFs are frequently used as currency or even as the basis for promotions and grant funding.

Finally, and not the least important, is monetary ROI. As stated before, biomedical research is expensive, and universities are asked to cover increasingly larger portions of these costs (Daniels, 2015). For this reason, determining financial ROI was extremely important. With limited resources, universities will be forced to pick and choose what programs and research centers they will support. Emory University has been extremely supportive of the CFAR program and provided generous financial contributions to support its activities. The results of this study show that CFAR dollars invested in careers of early stage investigators via various developmental award mechanisms yield an extremely high return. Presenting data that shows this substantial ROI elevates the likelihood that the CFAR program will continue receiving support

from the University, as this study demonstrates that the funds are used strategically and effectively. CFAR leadership can rely on the results of this study to present to stakeholders the positive impact of the University's investment into the CFAR program. On a more global level, strong ROI demonstrates to the NIH that taxpayer money is being used wisely and contributes to the goals of the overall CFAR by supporting promising early stage investigators who are able to multiply invested dollars at high rates.

The results of this study are useful on many levels. In particular, they can be applied on a personal level to continue helping individual early stage investigators develop, on a CFAR organizational level to continue developing the program at Emory University, and on a national level to continue advancing the National CFAR program. Findings suggest that the CFAR Developmental Core is doing for early stage investigators what it was designed to do. Specifically, it provides resources, both monetary and non-monetary, to attract them into the field of HIV/AIDS research and to aid them in establishing their research independence. As discussed earlier, investigators are considered independent in the biomedical research when they obtain their first individual NIH R01-equivalent grant. R01-equivalent grants are extremely competitive, and resources provided by the CFAR Developmental Core are desirable by early stage investigators just entering the field of HIV/AIDS research. The Core should continue funding the various developmental award programs, as all of them showed positive financial ROI, and many of the awards contributed directly to obtaining R01-equivalent grants by early stage investigators.

Core leadership should consider the results of the survey when it comes to providing non-financial support to investigators, especially those who have completed their CFAR-series

awards and are preparing to submit competitive NIH applications. The survey clearly showed that investigators at different stages of their careers benefit from different types of support.

Core awardees should continue to receive assistance when it comes to publishing their work. The results showed that awardees publish in well-respected HIV/AIDS journals, thus contributing to the global knowledge base. Additionally, publishing in respected journal ensures a certain image in the biomedical research community due to the culture of relying on impact factors of journals when evaluating researchers' work. This culture carries consequences not only for an investigator's ability to obtain grant funding, but also for the ability to progress in an individual's career. Until a new measure to gauge researchers' work is agreed upon, it is important for the Core to ensure that early stage investigators carefully choose the venues for publishing their work. As per the words of Dr. Rana Chakraborty, it is more important to publish in high impact factor journals in the beginning of one's career, because, at that point, quality is more important than quantity. The impact factor becomes less important as a researcher's career advances and they are considered experts in their fields (Chakraborty, 2016).

On a CFAR organizational level, findings of this project are particularly useful when demonstrating the effectiveness of University investments into the program. As stated previously, CFAR is funded by the NIH as well as Emory University itself. It is important to demonstrate to the University that the investment is and continues to be worthwhile. Particularly, the University would be interested to know what ROI the program is able to yield when looking at dollar-for-dollar returns. This project showed that the ROI for CFAR dollars was at minimum close to 100% (Administrative Supplements) and as much as 6,000% (Opportunity Awards). These numbers can be useful to CFAR leadership when justifying the University's investment into the program and when requesting additional support to develop and grow the program.

Additionally, publication data can be used to demonstrate that the CFAR program contributes to the prestige of the University, since CFAR investigators are consistently publishing in respected journals and awardee publications are often being cited by other researchers. Also, these results can be used in progress reports and competitive renewal applications. For competitive renewals in particular, the model of this study can be used to obtain updated data on the impact and effectiveness of the Developmental Core.

This research has similar implications on the National CFAR level. As the CFAR program is funded by the NIH, the ability to prove its effectiveness is critical. This case study provides a snapshot of one CFAR, but can be used by other CFARs and even the national CFAR, should they desire to conduct similar evaluations. As on the organizational level, results can be used when arguing for additional funding for development and expansion of the program. Additionally, results can be used to demonstrate achievements of early stage investigator development in the field of HIV/AIDS research.

Future research

Multiple opportunities exist for future research based on findings of this project. First, on the national level, data can be obtained from all CFARs and compiled in order to evaluate the effectiveness of the national CFAR program and can be used in making the case for advancing the program. It would be interesting to see if other CFARs have similar outcomes of their Developmental Core initiatives. It would also be interesting to see how different CFARs compare to each other when it comes to awardees' publications, ROI, desired services, and investigator age at the time of receipt of his or her first independent R01-equivalent grant. The challenge is that no two CFARs operate in the same way or provide the same services. Comparing one CFAR to another would not be possible, however, this project provided

framework methodology that can be used both by individual CFARs and by the national CFAR to study individual centers. The model can be adjusted by individual CFARs depending on what services their Developmental Cores provide, and evaluation on three levels (personal, organizational, and global) would still be possible.

Second, the NIH cites the increasing age of investigators at the time they receive their first R01-equivalent as a negative trend. Levitt and Levitt (2017) argue that young researchers are crucial to basic science as they make unexpected, fundamental discoveries. Young investigators are needed to keep the US biomedical science field truly innovative, the authors maintain. Additionally, there are concerns about the "graying" of the investigators because older researchers have fewer productive years remaining in their careers. This means that the significant investment made in the careers of these researchers by the investigators themselves, universities, and taxpayers may not gain sufficient return. When discussing graying of the investigators, the fact that the average life expectancy also increased over the years has not been considered. There is an opportunity for a research project to be conducted that would focus on biomedical researchers and would evaluate their productivity while accounting for their age at the receipt of their first R01-equivalent grant and increased life expectancy. It would be interesting to see if concerns about reduced returns on investment and shorter active phases of research careers are valid in the climate of the changing demographic characteristics. Particularly, a look at how recent medical advances are allowing people to lead longer healthier lives affects their productivity in biomedical research field could uncover a different side to the debate. It is possible that established investigators are as productive and innovative as early stage investigators, and just as interested in continuing to develop their skills. Additionally, with large

parts of their lives invested in the research, they may be more productive as they possess the knowledge and experience that early stage investigators do not.

Third, while excluded from this project, a study of how Developmental Cores of all CFARs influence the success of early stage investigators by gender would be extremely interesting. There is a significant amount of research that suggests that differences do exist (Anderson Eloy et al, 2013; Waisbren et al, 2008, Pohlhaus Reineke, et al., 2011; Pohlhaus et al, 2011). It would be interesting to see if Developmental Cores are able to eliminate or reduce those differences as it relates to an individual's ability to secure NIH R01-equivalent grants. This research excluded this question from the analysis due to small sample size that fit necessary criteria.

Another study that would be interesting to conduct would be to examine Emory CFAR awardees' success rates versus the NIH average success rate for funded grant applications. In FY17 with the average NIH success rate for grant applications at only 21.2 % (National Institutes of Health, 2018b), securing NIH funding is highly competitive, with most applications going unfunded. But this research found that 85% of early stage investigators funded by the CFAR were successful in obtaining subsequent independent funding. What is not known is how many times CFAR awardees applied or whether their proposals were funded on their first attempts. Determining the true success rate of CFAR awardees would offer a good point of comparison between the general NIH applicant pool and those applicants that CFAR supported.

Finally, in light of concerns about the graying of investigators pertaining to the CFAR program itself, more research is needed on whether the program helps lower investigators' age at the time of receipt of their first ever R01-equivalent. This project attempted to do this, however, a sufficient sample size to test the difference of the means was not available. It is recommended

that data on age are obtained from all active CFARs using similar surveys and the sample of awardees' ages be evaluated for power. If the power calculation indicates that the sample size is sufficient, a comparison of the means between CFAR investigators' ages and NIH-reported ages of investigators at the time of receipt of their first ever R01-equivalent grants should be performed. This particular research project would be of great importance, since one of the central goals of CFAR programs is to promote the careers of early stage investigators. If research supports the theory that the Developmental Cores help lower investigators' age at the time of receipt of their first R01-equivalent grant, CFAR would have powerful evidence supporting the effectiveness and importance of the program.

With all the possible research directions, it is important that, if a survey is developed, questions are formulated in a way that removes any vagueness in order to ensure that the most accurate data are gathered. This project demonstrated how questions that leave even very little room for interpretation can yield results that may be incomplete. However, that should not be considered a failure of the project, as this type of evaluation has never been conducted before. Instead, the results of this project should be viewed as a foundation for development of strong evaluations specific to each active CFAR.

Conclusions

This project looked at the ongoing efforts to develop promising early stage investigators into successful researchers who can work toward addressing the HIV/AIDS epidemic. Developmental Core awardees are already publishing in respected journals and are consistently being cited by other researchers, which helps to establish themselves as experts in the field. Many of them were successful in obtaining various NIH grants, including R01-equivalents. Some have become extremely successful and have multiple ongoing grants supporting their work

toward ending HIV/AIDS epidemic. They are bringing significant dollar amounts to the University, which contributes to Emory's world-renowned biomedical research reputation. Still, many studies need to be done to obtain a full picture of the impact that the CFAR program has on early stage investigators. This project presents a small sample of questions that can be asked and answered about the initiatives of similar programs. Throughout the country, similar centers and programs exist that focus on development of investigators in various areas of biomedical research, and this study can be used as a framework to conduct similar evaluations for those programs.

In a time when increased financial transparency is demanded by the public, studies like this can present an opportunity for agencies to demonstrate exactly what taxpayers' money is being used for and what areas of public health they are impacting. It is easy to connect certain researchers to certain discoveries and advances made in the field of HIV/AIDS research, and none of those discoveries would have been possible without grant funding. A clear demonstration of the positive impact taxpayer dollars have made on public health research could make the public more enthusiastic about contributing to research and to public health.

On the administrative side, the same results could present an opportunity for CFAR directors to continue securing the support of the University. The CFAR grant itself is relatively small, but it is hugely impactful. The University's support is critical when it comes to CFAR's success, so being able to show that this support pays off is very important.

Most importantly, these results can be used when deciding whether to establish, expand, or improve programs that support early stage investigators. That, in fact, is already happening. The new CFAR Adelante National Grants Program administered by the Emory CFAR can be evaluated using this model. Adelante leadership has decided to use Ramp Up awards as part of

their continuous commitment to the careers of early stage investigators who study the HIV/AIDS epidemic in Hispanic populations. The basis for that decision was the result of this project through its demonstration of the high ROI resulting from Ramp Up awards.

These same results were referenced also when developing a community grants program sponsored by Gilead. Mechanisms similar to Ramp Up and CFAR-series awards will be used in that initiative, which also aims to alleviate the HIV/AIDS epidemic in the Deep South states. Therefore, this project is already affecting decisions being made in the field of HIV/AIDS research.

Overall, this project was able to demonstrate that the Emory CFAR has a large impact on HIV/AIDS research on many levels. It invests in early stage investigators who later become successful independent researchers, thus contributing to the University by the means of bringing in additional grants and to the country's and world's public health by grooming and developing investigators who will continue to be successful and remain dedicated to the fight. Emory CFAR Developmental Core awardees publish in respected journals, contributing to the global HIV/AIDS knowledge base. They are successful in obtaining external independent grants, thus increasing the Emory University fiscal portfolio, and they are reporting that Developmental Core services are useful to them on a personal level.

As discussed above, the results of this study are already being used by other programs, which confirms that the Emory CFAR's approach was recognized as valuable and effective. This project also demonstrates just how multidimensional the fight with this epidemic is. There are many stakeholders, from investigators to civilians, to universities and countries that are affected by the outcomes of CFAR's work. A large portion of the fight with HIV/AIDS starts with the

recognition that a continuous investment is needed into similar programs in order to make progress against the disease.

Continuous support of promising researchers supports the prospect of years of continued advances in the fight against the HIV/AIDS epidemic, improved quality of life for people living with the disease, improved public health, and hopefully one day, complete eradication of HIV/AIDS.

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APPENDIX A:

Publication Data

Table A1, Impact factors for journals containing Emory CFAR Developmental Core Related Publications, 1998-2016

IMPACT FACTORS FOR JOURNALS CONTAINING EMORY CFAR DEVELOPMENTAL CORE RELATED PUBLICATIONS, 1998-2016																		
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Patient Education and Counceling	0.59																		
Journal of Virology	5.828	5.942								5.332								4.606	
Journal of Immunology		7.14						6.486		6.068		5.646				5.362	4.922		
Journal of Adolescent Health			1.415																
Migration World Magazine			x																
Journal of Infectious Diseases						4.481					5.682	5.865							
Journal of Acquired Immune Deficiency Syndroms						3.681			3.946	4.412					4.653				3.935
AIDS							5.893												
Journal of STD and AIDS									1.274										
Experimental Biology and Medicine									2.845										
Sexually Transmitted Infections										2.616									
American Journal of Public Health										3.612		4.371		3.926				4.138	
American Journal of Medical Sciences										1.618									
Journal of Molecular Biology										4.472									
British Medical Journal											12.827								
American Journal of Respiratory Cell and Molecular Biology											4.477								
Pharmacotherapy											2.527								
Immunology												3.276							
Laboratory Investigation												4.602							
Perspectives on Sexual and Reproductive Health												2.222							
AIDS Research and Human Retroviruses												2.178	2.082				2.325		
Current Topics in Microbiology and Immunology												4.16							
PLOS Pathogens												8.978				8.057	7.562		
PLOS One												4.351	4.411	4.092	3.73	3.534	3.234		
AIDS Education and Prevention												1.506							
Journal of Urban Health												2.205							
Journal of Virological Methods												2.133							
Culture, Health, and Sexuality												1.068		1.553					
Child Abuse and Neglect													1.945						
AIDS Research and Therapy													x	x					
Current Infectious Disease Reports (expert reviews)													x						
International Journal of Health Geographics													2.341						
Retrovirology													5.236		5.657				
Journal of the International Association of Providers of AIDS Care													x						
AIDS Care														1.603					
Journal of Clinical Pharmacology														2.911					
Alcoholism - Clinical and Experimental Research														3.343					
Journal of Medical Internet Research														4.409					
Journal of Medical Ethics														1.363					
Journal of Biological Chemistry														4.773					
Social Science & Medicine														2.699					2.797
Science															31.027				
Antiviral Therapy															3.073				
African Journal of Reproductive Health															x				
Current Opinion in HIV and AIDS (invited articles only)															4.704				
Molecular Therapy															7.041	6.425			
Drug and Alcohol Dependence																3.141			3.222
The Wetern Journal of Emergency Medicine																x			
AIDS and Behavior																3.312	3.728		
Immunological Reviews (by invitation)																12.909			
Medical Anthropology Quarterly																1.382			
Global Public Health																1.205		1.978	1.614
The Journal of the Association of Nurses in AIDS Care																	1.274		
AIDS Care - Psychological and Socio-Medical Aspects of AIDS/HIV																	2.095	1.902	
Nicotine and Tobacco Research																	3.296		
Sexually Transmitted Diseases																	2.842		2.358
Antimicrobial Agents and Chemotherapy																	4.476		
Journal of Clinical Investigation																		12.575	
Journal of Histochemistry and Cytochemistry																		2.14	
Nature Communications																		11.329	
Journal of Child Sexual Abuse																		0.969	
Journal of the International AIDS Society																		6.256	
Clinical Infectious Diseases																			8.216
Children and Youth Services Review																			1.226
Cell Host and Microbe																			14.946
Current Opinion in Infectious Disease																			4.242
Average Impact Factor	**4.498**																		
Lowest Impact Factor	0.590																		
Highest Impact Factor	31.027																		

Table A2, Publications resulting from the work of Emory CFAR Developmental Core, 1998-2016

PUBLICATIONS RESULTING FROM THE WORK OF EMORY CFAR DEVELOPMENTAL CORE, 1998-2016		
Citations	**Year Published**	**Publication**
0	2000	Hirsch JS.(2000). En El Norte La Mujer Manda: Gender, Generation and Geography in a Mexican Transnational Community. Immigration Research for a New Century (Ed.) New York: 369-89.
0	2003	Galati D, Paiardini M, Cervasi B, Albrecht H, Bocchino ML, Costantini A, Montroni M, Piedimonte G, Magnani M, Silvestri G. 2003. Post-translational regulation of nucleolin in the cell cycle disease of HIV-infected patients. J Infect Dis. 188:1483-1491.
0	2014	Berg, C. J., E. J. Nehl, X. D. Wang, Y. Y. Ding, N. He and F. Y. Wong (2014). "Utilization of Cessation Resources Among HIV-Positive and HIV-Negative Men Who Smoke and Who Have Sex With Men in Chengdu, China." Nicotine & Tobacco Research 16(10): 1283-1288. PMID: 24827789. PMCID: PMC4168294
0	2015	Winskell K[1], Holmes K, Neri E, Berkowitz R, Mbakwem B, Obyerodhyambo O., Making sense of HIV stigma: Representations in young Africans' HIV-related narratives. Glob Public Health. 2015;10(8):917-29. doi: 10.1080/17441692.2015.1045917. Epub 2015 Jul 1.
0	2015	Miller KS[1], Winskell K[2], Pruitt KL[2], Saul J[1]., Curriculum Development Around Parenting Strategies to Prevent and Respond to Child Sexual Abuse in Sub-Saharan Africa: A Program Collaboration Between Families Matter! and Global Dialogues., J Child Sex Abus. 2015;24(8):839-52. doi: 10.1080/10538712.2015.1088913.
0	2016	Winskell K1, Sabben G2., Sexual stigma and symbolic violence experienced, enacted, and counteracted in young Africans' writing about same-sex attraction., Soc Sci Med. 2016 Jul;161:143-50. doi: 10.1016/j.socscimed.2016.06.004. Epub 2016 Jun 2.
0	2016	Winskell K[1], Sabben G[1], Stephenson R[2], Pruitt KL[1], Allen K[1], Findlay T[1]., From condemnation to normalisation: Young Africans' narratives about same-sex attraction and implications for communication and advocacy efforts. Glob Public Health. 2016 Jul 13:1-15. doi: 10.1080/17441692.2016.1203969. [Epub ahead of print]
0	2016	Johnson EL[1], Chakraborty R., HIV-1 at the placenta: immune correlates of protection and infection., Curr Opin Infect Dis. 2016 Jun;29(3):248-55.
0	2016	Rolle CP[1], Bolton MD, Kelley CF., Use of a Prospective Sex Diary to Study Anal Lubricant and Enema Use Among High Risk Men Who Have Sex With Men-Implications for Human Immunodeficiency Virus Prevention., Sex Transm Dis. 2016 Aug;43(8):476-8.
1	2012	Jarlais, D. C. D., H. L. F. Cooper, H. Bramson, S. Deren, A. Hatzakis and H. Hagan (2012). "Racial and ethnic disparities and implications for the prevention of HIV among persons who inject drugs." Current Opinion in Hiv and Aids 7(4): 354-361. PMID: 22498481
1	2016	Wall, K. M., W. Kilembe, L. Haddad, B. Vwalika, S. Lakhi, N. H. Khu, I. Brill, E. Chomba, J. Mulenga, A. Tichacek and S. Allen (2016). "Hormonal Contraception, Pregnancy, Breastfeeding, and Risk of HIV Disease Progression Among Zambian Women." Jaids-Journal of Acquired Immune Deficiency Syndromes 71(3): 345-352. PMID: 26379070. PMCID: PMC4752415

1	2013	Winskell K[1], Brown PJ, Patterson AE, Burkot C, Mbakwem BC., Making sense of HIV in southeastern Nigeria: fictional narratives, cultural meanings, and methodologies in medical anthropology.Med Anthropol Q. 2013 Jun;27(2):193-214. doi: 10.1111/maq.12023. Epub 2013 Jun 26.
1	2013	Beres LK[1], Winskell K, Neri EM, Mbakwem B, Obyerodhyambo O., Making sense of HIV testing: social representations in young Africans' HIV-related narratives from six countries., Glob Public Health. 2013;8(8):890-903. doi: 10.1080/17441692.2013.827734. Epub 2013 Sep 5.
1	2016	Winskell K[1], Miller KS[2], Allen KA[1], Obong'o CO[3]., Guiding and supporting adolescents living with HIV in sub-Saharan Africa: The development of a curriculum for family and community members., Child Youth Serv Rev. 2016 Feb;61:253-260.
1	2015	Dagnra AY[1], Mlaga KD[2], Adjoh K[3], Kadanga E[1], Disse K[3], Adekambi T[4]., Prevalence of multidrug-resistant tuberculosis cases among HIV-positive and HIV-negative patients eligible for retreatment regimen in Togo using GeneXpert MTB/RIF.New Microbes New Infect. 2015 Sep 10;8:24-27.
2	2000	Hirsch, JS. 2000. Because he misses his normal life back home: masculinity, sexuality and AIDS risk behavior in a Mexican migrant community. Migration World Magazine. 29(4).
2	2008	Ofotokun, I., E. P. Acosta, J. L. Lennox, Y. Pan, and K. A. Easley. 2008. Pharmacokinetics of an indinavir-ritonavir-fosamprenavir regimen in patients with human immunodeficiency virus. Pharmacotherapy 28:74-81. PMID:18154477
2	2011	Khosropour, C. M. and P. S. Sullivan (2011). "Risk of disclosure of participating in an internet-based HIV behavioural risk study of men who have sex with men." Journal of Medical Ethics 37(12): 768-769. PMID: 21708832. PMCID: PMC3593712
2	2013	Stephenson, R., C. D. Hall, W. Williams, K. Sato and C. Finneran (2013). "Towards the development of an intimate partner violence screening tool for gay and bisexual men." West J Emerg Med 14(4): 390-400. PMID: 23997849. PMCID: PMC3756706
2	2014	Rentsch, C., Bebu, I., Guest, J. L., Rimland, D., Agan, B. K., & Marconi, V. (2014). "Combining Epidemiologic and Biostatistical Tools to Enhance Variable Selection in HIV Cohort Analyses." *PLoS ONE*, *9*(1), e87352. PMID: 24489902. PMCID: PMC3906149
2	2016	Linton, S. L., H. L. F. Cooper, R. Y. Luo, C. Karnes, K. Renneker, D. F. Haley, J. Hunter-Jones, Z. Ross, L. Bonney and R. Rothenberg (2016). "People and places: Relocating to neighborhoods with better economic and social conditions is associated with less risky drug/alcohol network characteristics among African American adults in Atlanta, GA." Drug and Alcohol Dependence 160: 30-41. PMID: 26781062. PMCID: PMC4767629
3	2009	Zhao, C., C. J. Crews, C. A. Derdeyn, and J. L. Blackwell. 2009. Lac-regulated system for generating adenovirus 5 vaccine vectors expressing cytolytic human immunodeficiency virus 1 genes. J Virol Methods 160:101-10. PMID:19409930
3	2014	Finneran, C. and R. Stephenson (2014). "Social Network Composition and Sexual Risk-Taking Among Gay and Bisexual Men in Atlanta, GA." Aids and Behavior 18(1): 59-68. PMID: 23904146. PMCID: 4046889
3	2015	Johnson EL[1], Chu H[1], Byrareddy SN[2], Spearman P[3], Chakraborty R[4]., Placental Hofbauer cells assemble and sequester HIV-1 in tetraspanin-positive compartments

		that are accessible to broadly neutralizing antibodies., J Int AIDS Soc. 2015 Jan 22;18:19385. doi: 10.7448/IAS.18.1.19385. eCollection 2015.
4	2009	Winskell, K., and D. Enger. 2009. A new way of perceiving the pandemic: the findings from a participatory research process on young Africans' stories about HIV/AIDS. Cult Health Sex 11:453-67. PMID:19353391
4	2013	Finneran, C. and R. Stephenson (2013). "Gay and Bisexual Men's Perceptions of Police Helpfulness in Response to Male-Male Intimate Partner Violence." West J Emerg Med 14(4): 354-362. PMID: 23930149. PMCID: PMC3735383
4	2013	Stephenson, R., C. Rentsch, P. Sullivan, A. McAdams-Mahmoud, G. Jobson, H. Struthers and J. McIntyre (2013). "Attitudes Toward Couples-Based HIV Counseling and Testing Among MSM in Cape Town, South Africa." Aids and Behavior 17: S43-S50. PMID: 22961498. PMCID: PMC3529975
4	2014	Tangpricha, V., S. E. Judd, T. R. Ziegler, L. Hao, J. A. Alvarez, A. M. Fitzpatrick, G. A. McComsey and A. R. Eckard (2014). "LL-37 Concentrations and the Relationship to Vitamin D, Immune Status, and Inflammation in HIV-Infected Children and Young Adults." Aids Research and Human Retroviruses 30(7): 670-676. PMID: 24798231. PMCID: PMC4077005
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46	2013	Finneran, C. and R. Stephenson (2013). "Intimate Partner Violence Among Men Who Have Sex With Men: A Systematic Review." Trauma Violence & Abuse 14(2): 168-185. PMID: 23271429. PMCID: PMC4046894
47	2013	Dunham, R. M., M. Thapa, V. M. Velazquez, E. J. Elrod, T. L. Denning, B. Pulendran and A. Grakoui (2013). "Hepatic Stellate Cells Preferentially Induce Foxp3(+) Regulatory T Cells by Production of Retinoic Acid." Journal of Immunology 190(5): 2009-2016. PMID: 23359509. PMCID: 3575565
49	2016	Quicke KM[1], Bowen JR[1], Johnson EL[2], McDonald CE[1], Ma H[3], O'Neal JT[1], Rajakumar A[4], Wrammert J[1], Rimawi BH[4], Pulendran B[3], Schinazi RF[5], Chakraborty R[2], Suthar MS[6]., Zika Virus Infects Human Placental Macrophages., Cell Host Microbe. 2016 Jul 13;20(1):83-90. doi: 10.1016/j.chom.2016.05.015. Epub 2016 May 27.

52	2007	Priddy, F. H., C. D. Pilcher, R. H. Moore, P. Tambe, M. N. Park, S. A. Fiscus, M. B. Feinberg, and C. del Rio. 2007. Detection of acute HIV infections in an urban HIV counseling and testing population in the United States. J Acquir Immune Defic Syndr 44:196-202. PMID:17312561
52	2013	Kim, M. C., J. M. Song, E. J. O, Y. M. Kwon, Y. J. Lee, R. W. Compans and S. M. Kang (2013). "Virus-like Particles Containing Multiple M2 Extracellular Domains Confer Improved Cross-protection Against Various Subtypes of Influenza Virus." Molecular Therapy 21(2): 485-492. PMID: 23247101 PMCID: 3594028
56	2005	Hon H, Oran A, Brocker T, Jacob J. 2005. B lymphocytes participate in cross presentation of antigen following gene gun vaccination. Journal of Immunology. 174:5233-42.
57	1998	Paul M, Mazumder S, NU Raja and MA Jabbar. 1998. Mutational Analysis of the HIV-1 Vpu transmembrane domain that promotes the enhanced release of virus-like particles from the plasma membrane of mammalian cells. Journal of Virology. 72:1270-1279.
64	2008	Jacobson, J. M., M. S. Saag, M. A. Thompson, M. A. Fischl, R. Liporace, R. C. Reichman, R. R. Redfield, C. J. Fichtenbaum, B. S. Zingman, M. C. Patel, J. D. Murga, S. M. Pemrick, P. D'Ambrosio, M. Michael, H. Kroger, H. Ly, Y. Rotshteyn, R. Buice, S. A. Morris, J. J. Stavola, P. J. Maddon, A. B. Kremer, and W. C. Olson. 2008. Antiviral activity of single-dose PRO 140, a CCR5 monoclonal antibody, in HIV-infected adults. J Infect Dis 198:1345-52. PMID:18771406
65	2011	Sullivan, P. S., C. M. Khosropour, N. Luisi, M. Amsden, T. Coggia, G. M. Wingood and R. J. DiClemente (2011). "Bias in Online Recruitment and Retention of Racial and Ethnic Minority Men Who Have Sex With Men." Journal of Medical Internet Research 13(2). PMID: 21571632. PMCID: PMC3221372
68	2010	Jewkes, R. K., K. Dunkle, M. Nduna, P. N. Jama, and A. Puren. 2010. Associations between childhood adversity and depression, substance abuse and HIV and HSV2 incident infections in rural South African youth. Child Abuse Negl 34:833-41. PMID:20943270. PMCID:2981623
69	2007	Rong, R., S. Gnanakaran, J. M. Decker, F. Bibollet-Ruche, J. Taylor, J. N. Sfakianos, J. L. Mokili, M. Muldoon, J. Mulenga, S. Allen, B. H. Hahn, G. M. Shaw, J. L. Blackwell, B. T. Korber, E. Hunter, and C. A. Derdeyn. 2007. Unique mutational patterns in the envelope alpha 2 amphipathic helix and acquisition of length in gp120 hypervariable domains are associated with resistance to autologous neutralization of subtype C human immunodeficiency virus type 1. J Virol 81:5658-68. PMID:17360739
73	2007	Dunkle, K. L., and R. Jewkes. 2007. Effective HIV prevention requires gender-transformative work with men. Sex Transm Infect 83:173-4. PMID:17569718. PMCID:2659081
82	2000	Kingree, J. B., R. Braithwaite, and T. Woodring. 2000. Unprotected sex as a function of alcohol and marijuana use among adolescent detainees. J Adolesc Health 27:179-85. PMID:10960216
94	2009	Kohler, J. J., S. H. Hosseini, A. Hoying-Brandt, E. Green, D. M. Johnson, R. Russ, D. Tran, C. M. Raper, R. Santoianni, and W. Lewis. 2009. Tenofovir renal toxicity targets mitochondria proximal tubules. Lab Invest 89:513-9. PMID:19274046

106	2007	Hirsch, J. S., S. Meneses, B. Thompson, M. Negroni, B. Pelcastre, and C. del Rio. 2007. The inevitability of infidelity: sexual reputation, social geographies, and marital HIV risk in rural Mexico. Am J Public Health 97:986-96. PMID:17463368. PMCID:1874214
110	2012	Chahroudi, A., S. E. Bosinger, T. H. Vanderford, M. Paiardini and G. Silvestri (2012). "Natural SIV Hosts: Showing AIDS the Door." Science 335(6073): 1188-1193. PMID: 22403383. PMCID: PMC3822437
120	2009	Rong, R., B. Li, R. M. Lynch, R. E. Haaland, M. K. Murphy, J. Mulenga, S. A. Allen, A. Pinter, G. M. Shaw, E. Hunter, J. E. Robinson, S. Gnanakaran, and C. A. Derdeyn. 2009. Escape from autologous neutralizing antibodies in acute/early subtype C HIV-1 infection requires multiple pathways. PLoS Pathog 5:e1000594. PMID:19763269
129	2009	Okulicz, J. F., V. C. Marconi, M. L. Landrum, S. Wegner, A. Weintrob, A. Ganesan, B. Hale, N. Crum-Cianflone, J. Delmar, V. Barthel, G. Quinnan, B. K. Agan, and M. J. Dolan. 2009. Clinical outcomes of elite controllers, viremic controllers, and long-term nonprogressors in the US Department of Defense HIV natural history study. J Infect Dis 200:1714-23. PMID:19852669.
141	2009	Spaulding, A. C., R. M. Seals, M. J. Page, A. K. Brzozowski, W. Rhodes, and T. M. Hammett. 2009. HIV/AIDS among inmates of and releasees from US correctional facilities, 2006: declining share of epidemic but persistent public health opportunity. PLoS One 4:e7558. PMID:19907649
303	2008	Jewkes, R., M. Nduna, J. Levin, N. Jama, K. Dunkle, A. Puren, and N. Duvvury. 2008. Impact of stepping stones on incidence of HIV and HSV-2 and sexual behaviour in rural South Africa: cluster randomised controlled trial. BMJ 337:a506. PMID:18687720. PMCID:2505093

APPENDIX B:

ROI Outcome Tables

Table B3, Ramp Up awards outcomes

RAMP UP AWARDS OUTCOMES				
CFAR Investigator	**YR Funded**	**Funding**	**NIH Award Number**	**NIH Award Amount**
Daniel Kalman	YR8: 2005	$2,000		
Jeffrey Lennox	YR8: 2006	$1,229		
Michael Powell	YR8: 2006	$1,520		
Richard Rothenberg	YR8: 2005	$2,000	R01DA019393-04S1	$59,729
Maricia Holstad	YR9: 2008	$2,000	R21NR010862	$425,938
Wendy Armstrong	YR10: 2009	$2,000		
Natasha Hochberg	YR10: 2009	$2,000		
Patrick Sullivan	YR10: 2009	$2,000	NIH: R34MH086331	$706,021
Patrick Sullivan	YR10: 2008	$2,000		
Bruce Wade (Spelman)	YR10: 2008	$900		
Kristin Dunkle	YR11: 2010	$2,000		
Annie Horn	YR11: 2010	$2,000		
Anne Spaulding	YR11: 2010	$2,000		
Rob Stephenson	YR11: 2010	$2,000	R21 HD066306	$426,250
Sinead Young (MSoM)	YR11: 2009	$2,000		
Southeast AIDS Training and Education Center; Ira Schwartz PI (H4A HA 00067)	YR12: 2010	$7,000		
Lisa Haddad	YR12: 2010	$10,000	5K23HD078153	$635,175
Allison Ross	YR12: 2010	$2,000		
Julia Painter	YR12: 2010	$2,000		
Rebecca Culyba	YR12: 2011	$2,000		
Rana Chakraborti	YR12: 2011	$2,000		
Wendy Armstrong	YR13: 2012	$2,000		
Vincent Bond	YR13: 2012	$2,000		
Paula Frew	YR13: 2011	$2,000		
Lisa Haddad	YR13: 2011	$10,667	5K23HD078153 (reported above)	
Sophia Hussen	YR13: 2012	$559		
Vincent Marconi	YR13: 2012	$150		
Jessica Sales	YR13: 2012	$2,000		
Rob Stephenson	YR13: 2012	$1,995		

Patrick Sullivan	YR13: 2011	$2,000		
Frank Wong	YR13:	$1,500	5R01AI106715	$894,823
Albert Anderson	YR14: 2012	$2,000.00	1K23MH095679	$899,400
Carla Berg	YR14: 2012	$2,000.00		
Allison Eckard	YR14: 2014	$2,000.00		
Marica Holstad	YR14: 2013	$2,000.00		
Colleen Kelley	YR14: 2012	$360.00	K23 AI108335	$887,463
Russell Kempker	YR14: 2013	$2,000.00		
Travis Sanchez	YR14: 2012	$2,000.00	1R01AI112723	$3,055,493
Aaron Siegler	YR14.1: 2012	$2,000.00		
Aaron Siegler	YR14.2: 2012	$500.00	1R43HD078154	$741,388
Anne Spaulding	YR14: 2012	$1,080.00	No outcome expected due to nature of award	
Rob Stephenson	YR14.1: 2013	$2,000.00		
Rob Stephenson	YR14.2: 2013	$2,000.00		
Colleen Kelley	YR15: 2012	$2,000.00		
A.D. McNaghten	YR15.1: 2013	$2,000.00		
A.D. McNaghten	YR15.2: 2013	$2,000.00		
JaNelle Ricks	YR15	$3,960.00		
Travis Sanchez	YR15:2013	$2,000.00		
Kristin Wall	YR15: 2014	$500.00		
Julie Zuniga	YR15: 2014	$2,000.00		
Sophia Hussen	YR16: 2014	$2,000.00		
Ameeta Kalokhe	YR16: 2015	$450.00		
Igho Ofotokun	YR16:	$2,000.00		
Travis Sanchez	YR16	$2,000.00		
Amit Shahane	YR16	$2,000.00		
Aaron Siegler	YR16	$2,000.00		
Patrick Sullivan	YR16.1	$2,000.00		
Patrick Sullivan	YR16.2	$2,000.00		
Anders Camacho-Gonzalez	YR17	$1,500.00		

Paula Frew	YR17	$2,000.00		
Aaron Siegler	YR17	$1,000.00		
Sophia Hussen	YR17	$2,000.00		

Table B4, CFAR-series awards outcomes

CFAR-series awards outcomes						
CFAR Investigator (Last, First)	**Date of CFAR-series award (m/dd/yyyy)**	**Total Cost (Direct + Indirect)**	**First Directly Related Award** (as PI)**	**Total Cost of First Directly Related Award (Direct + Indirect)**	**First Directly Related R01-Equivalent Award**	**Total Cost of First Directly Related R01-Equivalent Award (Direct + Indirect)**
Blackwell, Jerry	8/15/2005	$20,000	R01AI069987	$1,486,500	R01AI069987	$1,486,500
Bostik, Pavel	8/15/2005	$30,396	R01AI065362	$1,377,000	R01AI065362	$1,377,000
Dunkle, Kristin	8/15/2005	$20,000	R03MH085599	$155,000		
Ofotokun, Igho	8/15/2005	$14,889	K23AI073119	$640,035		
Winskell, Samantha Kate	8/15/2005	$20,000	R03HD054323	$153,000	R01HD085877	$1,486,056
Kate Winskell	Yr 8	$2,000				
Kohler, James & Lewsi, William	7/24/2006	$38,000	K01DK078513	$323,500		
James Kohler	Yr 8: 2006	$2,000				
Ly, Hinh	7/24/2006	$35,144				
Spaulding, Anne	7/24/2006	$13,041	R34DA035728	$687,960		
Blackwell, Jerry	1/15/2007	$30,000	R21AI076080	$426,063		
Ye, Ling	1/15/2007	$30,000	R01AI077446	$1,349,719	R01AI077446	$1,349,719
Cooper, Hannah & Bonney, Loida	5/15/2008	$91,129	R01DA029513	$2,645,181	R01DA029513	$2,645,181
Hannah Cooper & Loida Bonney	Yr 10	$2,000				

Sullivan, Patrick	5/15/2008	$45,900	R01MH85600	$3,153,441	R01MH85600	$3,153,441
Ali, Sayed	11/1/2008	$9,880	*F31AI091484	$38,910		
Joshy, Pratibha	11/1/2008	$39,126	R01AA017627	$1,379,755	R01AA017627	$1,379,755
Song, Byeongwoon	11/1/2008	$47,358				
Radziewicz, Henry & Grakoui, Arash	7/1/2009	$60,000	R01DK083356	$1,525,655	R01DK083356	$1,525,655
Johnson, Brent	7/1/2009	$46,500				
Eckard, Allison Ross	3/15/2010	$30,000	K23HD069199	$630,720		
Stephenson, Rob	3/15/2010	$46,501	R03MH090897	$150,876	R01HD075655	$3,012,674
Tirado-Ramos, Alfredo & Saltz, Joel	4/15/2010	$75,001				
Galipeau, Jacques & Silvestri, Guido	4/15/2010	$93,000				
Chakraborty, Rana	5/1/2010	$52,020	U01AI131566	$2,264,985	U01AI131566	$2,264,985
Marconi, Vincent	5/1/2010	$45,890				
Rengarajan, Jyothi & Ray, Susan	6/15/2010	$60,000				
Frew, Paula	3/1/2011	$30,000	R03AG042831	$155,078		
Kang, Sang-Moo	3/1/2011	$30,000	R01AI105170	$3,743,620	R01AI105170	$3,743,620
Yue, Ling & Marconi, Vincent	5/11/2011	$60,000				
Chahroudi, Ann	8/29/2011	$45,900	R56AI117851*	$892,484	R01AI133706	$4,114,890
Spaulding, Anne & Ward, Kevin	3/1/2012	$49,019				

Winskell, Samantha Kate	9/1/2012	$20,000	R34MH106368	$682,590		
Wright, Elizabeth	6/10/2013	$31,114	-	-		
Sun, Yan	7/23/2013	$62,322				
Tukvadze, Nestani	8/1/2013	$30,000				
Kelley, Colleen	9/1/2013	$31,200	P30AI050409S	$156,000		
Perkins, Molly	1/1/2014	$62,400	P30AI050409S	$155,356		
Gavegnano, Christina	3/1/2014	$62,400				
Hepburn, Ken	6/20/2014	$61,776				
Joe Lipscomb	8/1/2014	$62,380				
Adekambi, Toidi	9/9/2014	$39,249				
Gary, Becky	10/10/2014	$38,352	R01NR014973	$2,510,304	1R01NR014973	$2,510,304
Wall, Kristin	11/1/2014	$62,189	K01MH107320	$514,845		
Hussen, Sophia	1/7/2015	$39,988				
Haddad, Lisa	3/1/2015	$51,280				
Neigh, Gretchen (co-funded w/ UAG Aging R24)	6/1/2015	$20,000				
Bond, Craig	8/1/2015	$42,450				
Frew, Paula	8/1/2015	$40,000				
Goswami, Neela	9/1/2015	$40,000				
Jenness, Sam & Morris, Martina (UW)	2/1/2016	$59,102	R21MH112449	$442,103		
Bernal-Mizrachi, Leon	6/13/2016	$40,000				

Siegler, Aaron & Little, Susan (UCSD)	8/1/2016	$62,397				
Kalokhe, Ameeta & Sales, Jessica	9/21/2016	$76,091				
Alonso, Alvaro	12/9/2016	$61,331				
Kulpa, Deanna	12/9/2016	$62,400				
Mocarski, Edward	5/1/2017	$35,000				
Auld, Sara	8/1/2017	$62,353				
Cranmer, Lisa	8/1/2017	$62,400				
Rubtsova, Anna	8/1/2017	$62,400				
Wall, Kristin	8/1/2017	$62,400				
Colasanti, Jonathan	8/16/2017	$15,000				

Table B5, Administrative Supplements outcomes

Administrative Supplements Outcomes						
CFAR Investigator (Last, First)	**Date of Supplement Award (m/dd/yyyy)**	**Total Cost (Direct + Indirect)**	**First Directly Related Award****	**Total Cost of First Directly Related Award (Direct + Indirect)**	**First Directly Related R01-Equivalent Award**	**Total Cost of First Directly Related R01-Equivalent Award (Direct + Indirect)**
Amara, Rama	12/21/2005	$242,460				
Armstrong, Wendy	8/1/2013	$98,767				
Kalokhe, Ameeta	8/1/2013	$100,000				
Kelley, Colleen and Kraft, Colleen	8/1/2014	$156,000	R01AI128799	$2,393,299	R01AI128799	$2,393,299
Kelley, Colleen	8/1/2015	$155,526				
Anderson, Albert	8/1/2015	$155,395				
Siegler, Aaron	8/1/2016	$312,000				

APPENDIX C:

CFAR Developmental Core PATH Activities




Research Funding **Proposal Support** **Mentoring Assistance** **Professional Development**

- CFAR-series Awards
- Ramp Up Awards
- NIH Supplements
- Science Writing
- NIH Reviewer Training
- Qualitative Research & Analysis
- Pre-Proposal Feedback
- Grant Guru
- Grant Writing Workshops
- TAM workshops
- Quantitative Research & Analysis
- Mentor Connections
- K-Club
- CLC On Call
- Oral Abstracts Practice
- Poster and Slide Design
- Tutorials

RESEARCH FUNDING

CFAR-series Awards: provide one year of non-renewable funding although the budget may be spread out over a longer project period, if needed in order to accomplish a project's scope of work. CFAR-series applications are accepted twice a year (November 1, May 1). Eligibility requirements may be found in each mechanism's RFA.

CFAR-03 awards are modeled after the NIH R03 mechanism. Single or dual PI awards are intended to generate data that will be used to ground a future NIH application in a CFAR and/or NIH OAR high priority area of research.

CFAR-K awards provide supplementary (non-salary) funding that will fill in or extend the research of NIH K awardees preparing to make the K to R transition.

CFAR-C awards are intended to promote new research collaborations between a junior faculty member at Emory and one or more investigators at other NIH-funded CFARs.

Ramp Up Awards: provide small amounts of financial support to address discrete, time critical HIV research challenges. Ramp Up applications are accepted on a rolling basis.

Opportunity Awards (OA) enable data collection for unfunded research (e.g. for recruitment and / or participant incentives). They also enable expansion of, or overcame obstacles encountered during, currently funded NIH research.

Data Awards (DA) support costs for data pulls and analyses stemming from use of the new *CFAR HIV Disease Registry*. The mechanism also provides support for new and early stage investigators who require specialized training or assistance with quantitative data from sources other than the HIV Disease Registry.

Collaboration Travel Awards (CTA) make it possible for unfunded, early stage investigators to meet face to face with proposed collaborators at other institutions in order to

engage in needed training or to develop, in real time, the specific aims and approach of an application being prepared for submission to NIH or the Emory CFAR.

Poster Awards (PA) are for current and former Developmental Core CFAR-series grant recipients who have completed a Poster Design Tutorial. These awards provide ongoing printing for posters describing CFAR-supported research.

NIH Administrative Supplements (CFAR Adelante, NIH CFAR-initiated)

CFAR Adelante is a national mechanism administered for NIH/OAR by the Emory CFAR that funds research to reduce HIV-related health disparities in the Hispanic / Latino community. CFAR Adelante projects incorporate a 4 month mentored training preparation period followed by a mentored research period of approximately 20 months. The next CFAR Adelante application submission deadline has not yet been established by NIH/OAR.

NIH CFAR-initiated calls for administrative supplement projects in narrowly targeted, high priority areas are periodically issued by NIH. Because each CFAR is limited in the number of applications that can be submitted, the Emory CFAR Developmental and Administrative Cores competitively review submitted preproposals for development into full applications. An announcement is made through the Emory CFAR listserv each time the NIH CFAR issues a call for projects.

PROPOSAL SUPPORT

Pre-Proposal Feedback. Strong research starts with rigorously considered specific aims and a well-articulated approach. The Developmental Core arranges opportunities for junior faculty to present their research ideas for discussion and feedback by senior CFAR scientists and members of CFAR's community advisory board. **Grant Guru:** Not everyone has comprehensive training in grant writing. To assist those who would benefit from one-on-one training, the Developmental Core sponsors access to a grant writing expert who works with early stage investigators on their NIH applications.

Grant Writing Workshops: As a means of ensuring that the Developmental Core receives the strongest possible CFAR-series applications, we offer a grant writing workshop prior to each application submission deadline. The workshop includes strategies for preparing a successful application, including building a mentoring team, negotiating support from the CFAR science cores, creating slides and a talk outline for an optional pre-proposal feedback session with the CFAR CLC and Core Directors, preparing the required appendices, writing a strong specific aims page, and developing a scope of work in keeping with the timelimited nature of a CFAR-funded project.

Science Writing: The Developmental Core offers three mechanisms for helping investigators strengthen their science writing skills: 1) The Core will enroll junior faculty as special standing students in GH592: "Successful Scientific Writing for Public Health Professionals," a ½ semester (7 meeting) course; 2) will provide co-funding of any monies awarded by Emory's Center for Faculty Development and Excellence (CFDE) Scholarly Writing and Publishing Fund (SWAP), with the award earmarked for hiring editorial support or a writing coach; and 3) will provide Ramp Up funding for that same purpose to faculty unable to secure a CFDE SWAP award.

MENTORING ASSISTANCE

Mentor Connections: Although most faculty receive assistance in establishing career mentors by their departments, CFAR members frequently benefit from additional, HIV-specific mentors. The Developmental Core leadership helps interested faculty identify potential mentor candidates, checks their availability and interest, and makes introductions.

K-Club: The CFAR co-sponsors a monthly meeting that provides an educational forum to assist fellows and faculty with successful NIH career development award applications. Meetings cover various topics pertaining to the conception, development, submission, and post-award process for NIH career development awards. KClub members have an excellent track record of receiving NIH K01, K23, and other award funding.

CLC On Call: Investigators who are interested in conducting human subjects research that is of maximal relevance to the community under study benefit from consultation with members of the CFAR's Community Liaison Council (CLC). Consultations are provided at the protocol design stage and may involve reviewing the cultural relevancy of proposed data collection plans, giving suggestions for optimizing study participant recruitment and retention, and/or discussing options for translating research findings back to the community.

TAM (Training AIDS Mentors) workshops: As new investigators transition to Independent investigator status, they are expected to make a concurrent transition from mentee to mentor. TAM provides skill building training for new mentors on multiple topics including: *The mentoring continuum*: Transitioning from mentee to mentor; *Building your mentorship skillset*: Communication, aligning expectations, assessing mentee understanding; *Defining your mentoring approach*: Choosing mentees and developing mentoring agreements; and *Lessons from senior mentors*: Benefits of mentoring; tips and advice.

NIH Reviewer Training: Pairs junior faculty with senior CFAR scientists for mentored participation as reviewers on Developmental Core study sections, which are operated on the NIH model. Training includes review of summary statement drafts, study section meeting coaching, and application discussion feedback.

PROFESSIONAL DEVELOPMENT

Poster and Slide Tutorials: Well-designed posters and slides add significance to scientific meeting presentations yet many investigators are unaware of best practices in poster and slide design. The

Developmental Core provides individual poster/slide design tutorials and, for tutorial graduates, free printing of one poster and ongoing review of new posters and slides being prepared for presentation at national conferences.

Oral abstracts practice: Prior to major HIV conferences such as CROI or the International AIDS Conference, the Developmental Core organizes formal sessions in which CFAR members sign up to practice presenting their accepted oral abstracts and receive constructive feedback on talk/slide content, timing, and delivery.

Quantitative Research and Analysis: The CFAR Biostatistics and Bioinformatics Core is currently developing a series of analytical skill building courses. Once the training is rolled out,

receipt of funding for Ramp Up Data Awards will be contingent on applicants first having attended or "tested out" of each applicable workshop.

Qualitative Research and Analysis: The Developmental Core will enroll interested faculty and postdocs in the Qualitative Research Methods and Qualitative Data Analysis workshops that are periodically offered through the Hubert Department of Global Health Continuing Education.

Source: http://www.cfar.emory.edu/services/cores/dev/CFAR_Dev_Core_Services.pdf

APPENDIX D:

Average Age and Degree of NIH R01-Equivalent First-Time Investigators

National Institutes of Health
Office of Extramural Research

Table 117-16
Average Age and Degree of NIH R01-Equivalent
First-Time Investigators
Fiscal Years 1980-2015

Source: Numbers for FY1980 -2012 are historical and from previously published sources.
2013 data drawn from Success Rate File accessed January 2, 2014.
2014 data drawn from Success Rate File accessed December 2, 2015.
2015 data drawn from Success Rate File accessed March 24, 2016.

Notes:
* The definition of First-Time investigator has changed over time, and data reflect investigator policies that were in place during those years. In general, a Program Director/Principal Investigator (PD/PI) is considered a First-Time investigator if he/she has not previously competed successfully as PD/PI for a substantial NIH independent research award. R01-Equivalents include activity codes R01, R23, R29, and R37, and beginning in 2008 included DP2 awards to First-Time NIH investigators. Not all these activities are in use by NIH every year.
Excludes American Recovery Reinvestment Act (ARRA).
Includes NIH direct budget authority awardees only in FY 2013 and later.

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FY	MD-PhD	MD Only	PhD Only
1980	36.1	37.7	35.7
1981	36.2	37.3	35.6
1982	36.3	37.7	36.0
1983	36.5	38.2	35.9
1984	36.9	38.8	36.4
1985	37.0	38.2	36.6
1986	37.5	38.0	37.3
1987	38.0	39.5	37.6
1988	38.2	39.1	37.9
1989	38.8	39.2	38.7
1990	39.0	39.7	38.7
1991	39.2	40.0	38.8
1992	39.2	40.7	38.9
1993	39.9	40.7	39.5
1994	40.0	40.5	39.8
1995	40.1	40.9	39.7
1996	40.1	41.1	39.8
1997	40.3	42.0	39.9
1998	40.4	42.0	40.0
1999	41.2	42.9	40.7

2000	42.2	43.2	41.8
2001	42.1	43.9	41.7
2002	42.2	44.0	41.7
2003	42.5	44.1	42.0
2004	42.1	43.5	41.7
2005	42.5	44.6	41.8
2006	42.3	44.2	41.7
2007	43.3	43.5	42.2
2008	43.6	44.2	41.8
2009	43.7	44.1	42.3
2010	44.3	45.4	41.7
2011	44.3	45.1	42.4
2012	44.7	44.7	42.2
2013	43.6	45.2	42.1
2014	44.8	45.0	42.0
2015	44.9	44.9	42.2

Source:
https://report.nih.gov/catalog_results.aspx?refUrl=index&sS=filter&sI=&sP=&sM=12&sA=62&sD=10&sV=&sY=&fI=&fP=2&fM=12&fA=62&fD=10&fV=&fY=2016

APPENDIX E:

Survey

Start

You are being asked to participate in a survey of CFAR Developmental Core recipients that will help us improve Developmental Core activities, titled ***"Investing in the Future. Evaluation of the activities of the Developmental Core of Emory University Center for AIDS Research: A Case Study."*** The survey is being designed and conducted by Developmental Core financial administrator ***Galina Terbova***, a student at Valdosta State University in partial fulfillment of the requirements of her Doctor of Public Administration degree. The survey should take less than 5 minutes to complete.

The following information is required for inclusion here by the Valdosta State University IRB: "This survey is confidential and only the researcher (Galina Terbova) will be able to see your identity and only for purposes of contacting you with follow-up questions. No private information, as defined by Valdosta State University, will be collected. The results will not be published outside of this research project. Your participation is voluntary. You may choose not to take the survey, to stop responding at any time, or to skip any questions that you do not want to answer. You must be at least 18 years of age to participate in this study. Your completion of the survey serves as your voluntary agreement to participate in this research project and your certification that you are 18 or older. Questions regarding the purpose or procedures of the research should be directed to Galina Terbova at gterbova@valdosta.edu. The IRB, a university committee established by Federal law, is responsible for protecting the rights and welfare of research participants. If you have concerns or questions about your rights as a research participant, you may contact the IRB Administrator at 229-259-5045 or irb@valdosta.edu."

Please provide your contact information

Name

Email Address

Your Degree(s)? (Check all that apply)

- ☐ MD
- ☐ PhD
- ☐ Other: (Please specify)

What NIH funding mechanism(s) have you secured as PI based at least partly on your Developmental Core award? (Check all that apply)

- ☐ K01
- ☐ K12
- ☐ K23
- ☐ R01
- ☐ R03
- ☐ R21
- ☐ Other (Please specify)
- ☐ None

We are trying to determine if CFAR Developmental Core support recipients receive their first NIH funding, and their first R01 level funding, at a younger age than the NIH-reported average. Please answer the questions below, as applicable to you:

Did your Developmental Core award help you get you first ever NIH funding of any sort?

- ○ Yes
- ○ No

How old were you when you received that first ever NIH funding?

Did your Developmental Core award help you get your first NIH R01-level award?

- ○ Yes
- ○ No

How old were you when you received that first NIH R01-level award funding?

Did the process of developing, applying for, implementing, publishing, and/or presenting the data from your Developmental award lead to new professional contacts that have led or may lead to future collaboration in HIV research?

- ○ Yes
- ○ No

Quantify the number of new contacts made as a result of developing, applying for, implementing, publishing, and/or presenting the data from your Developmental award

Check all of the Developmental Core services that you have used to date

Research Funding

- ☐ CFAR-series Award (CFAR-03, CFAR-C, CFAR-K)
- ☐ Collaboration Travel Award (to plan collaborative application)
- ☐ Data Award (funding for help with data analysis)
- ☐ Opportunity Award aka Microgrant (rapid funding for small projects)

Proposal Support

- ☐ Study design consultation
- ☐ Pre-submission feedback
- ☐ Grant writing training/assistance
- ☐ IRB application support

Mentoring Assistance

- ☐ K-Club Member
- ☐ R-Club Member

Professional Development

- ☐ Oral Abstract practice
- ☐ Training in talking about your science to radio/print journalists
- ☐ Training in talking on camera
- ☐ Poster design tutorial

Check all of the Developmental Core services that you can envision using in the future

Research Funding

- ☐ CFAR-series Award (CFAR-03, CFAR-C, CFAR-K)
- ☐ Collaboration Travel Award (to plan collaborative application)
- ☐ Data Award (funding for help with data analysis)
- ☐ Opportunity Award aka Microgrant (rapid funding for small projects)

Proposal Support

- ☐ Study design consultation
- ☐ Pre-submission feedback
- ☐ Grant writing training/assistance
- ☐ IRB application support

Mentoring Assistance

- ☐ K-Club Member
- ☐ R-Club Member

Professional Development

- ☐ Oral Abstract practice
- ☐ Training in talking about your science to radio/print journalists
- ☐ Training in talking on camera
- ☐ Poster design tutorial

APPENDIX F:

IRB Approvals

Institutional Review Board (IRB)
for the Protection of Human Research Participants

PROTOCOL EXEMPTION REPORT

PROTOCOL NUMBER: 03472-2017 **INVESTIGATORS:** Ms. Galina Terbova

PROJECT TITLE: *Investing in the Future: Evaluation of the Activities of the Developmental Core of Emory University Center for AIDS Research.*

INSTITUTIONAL REVIEW BOARD DETERMINATION:

This research protocol is **Exempt** from Institutional Review Board (IRB) oversight under Exemption Category 2. You may begin your study immediately. If the nature of the research project changes such that exemption criteria may no longer apply, please consult with the IRB Administrator (irb@valdosta.edu) before continuing your research.

ADDITIONAL COMMENTS:

- *Upon completion of your research study all collected data – including email addresses, etc. must be securely maintained for a minimum of 3 years.*

☒ ***If this box is checked, please submit any documents you revise to the IRB Administrator at irb@valdosta.edu to ensure an updated record of your exemption.***

Elizabeth W. Olphie *04/06/2017*
Elizabeth W. Olphie, IRB Administrator Date

Thank you for submitting an IRB application.
Please direct questions to irb@valdosta.edu or 229-259-5045.

Revised: 06.02.16

EMORY UNIVERSITY

Institutional Review Board

April 5th, 2017

Galina Terbova

RE: Determination: No IRB Review Required
Title: *Investing in the future: Evaluation of the activities of the Developmental Core of Emory University Center for AIDS Research: A Case Study*
PI: Galina Terbova

Dear Ms. Terbova:

Thank you for requesting a determination from our office about the above-referenced project. Based on our review of the materials you provided, we have determined that it does not require IRB review because it does not meet the definition of "research" with human subjects or "clinical investigation" as set forth in Emory policies and procedures and federal rules, if applicable. Specifically, in this project, you will conduct a quality improvement protocol to evaluate activities of the Emory University Center for AIDS Research Development Core and aim to improve services to its users. A survey will be sent to recipients of the Developmental Core funding at Emory University to determine if the activities of the Core contribute to individual success of new investigators in the HIV/AIDS field. This project is specific to the quality improvement of this program.

Please note that this determination does not mean that you cannot publish the results. This determination could be affected by substantive changes in the study design, subject populations, or identifiability of data. If the project changes in any substantive way, please contact our office for clarification.

Thank you for consulting the IRB.

Sincerely,

Parul Reddy, BS
Analyst Assistant

Emory University
1599 Clifton Road, 5th Floor - Atlanta, Georgia 30322
Tel: 404.712.0720 - Fax: 404.727.1358 - Email: irb@emory.edu - Web: http://www.irb.emory.edu
An equal opportunity, affirmative action university

APPENDIX G:

Letter of Support

EMORY UNIVERSITY | Center for AIDS Research

April 5, 2017

Galina Terbova
Rollins School of Public Health

Dear Ms. Terbova:

On behalf of the Center for AIDS Research (CFAR) at Emory University, we are pleased to provide this letter of support for the case study you are doing with the CFAR Developmental Core. You have our full support and permission to undertake that work on the Emory campus.

CFAR Assistant Director Kimberley S. (Kimbi) Hagen, EdD will serve as your liaison during your research; please direct any questions or concerns that arise during the conduct of your project to her. Dr. Hagen may be reached at (404) 727-8855 & by email at kbs.hagen@emory.edu.

The hallmark of the CFAR is a commitment to the ongoing development of early stage investigators. Your project will support the continued improvement of our efforts in this area. We wish you every success with your work and look forward to your findings and recommendations.

Sincerely,

James Curran, MD, MPH
Co-Director,
Administration &
HIV Policy

Carlos del Rio, MD
PI and Co-Director,
Clinical Science &
International Research

Eric Hunter, PhD
Co-Director,
Basic Science &
Translational Research

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