

The Fogarty International Center's Non-Communicable Diseases & Disorders Research Training Programs

A review of the International Clinical, Operational and Health Services Research Training Award (ICOHRTA), Millennium Promise Awards: Non-Communicable Chronic Diseases Research Training Program (NCoD) and Chronic, Noncommunicable Diseases and Disorders Across the Lifespan Research Training Program (NCD-Lifespan)

FY2001-2017

Executive Summary

Effectively tackling the growing burden of noncommunicable diseases (NCDs) in low-and middle-income countries (LMICs) is an ongoing challenge. In 2018, the World Health Organization (WHO) published a report of its Independent High-Level Commission on NCDs stating the 2030 Sustainable Development pledge (SDG target 3.4) to reduce premature mortality from NCDs by one third will not be attained unless serious, accelerated change occurs at the national and international level.¹ Part of the challenge, as acknowledged in this report, is that countries lack the human and research capacity to address the NCD burden.

“Many countries do not have the requisite technical expertise, resources, research capacity, and data to address NCD challenges. These countries need technical support, training, implementation research, and capacity building”

“Time to deliver: report of the WHO Independent High-level Commission on NCDs” (p. 12)

The John E. Fogarty International Center (FIC) at the National Institutes of Health (NIH) has been supporting international collaborative research and training in NCDs since 2001. FIC’s NCD research training (D43) programs have included the 2001-2011 funded International Clinical, Operational, and Health Services Research and Training Award (ICOHRTA), the 2009-2014 funded Millennium Promise Awards: Non-communicable Chronic Diseases Research Training Program (NCoD) and the 2011 to present, Chronic, Noncommunicable Diseases and Disorders Research Training Program (NCD-Lifespan).

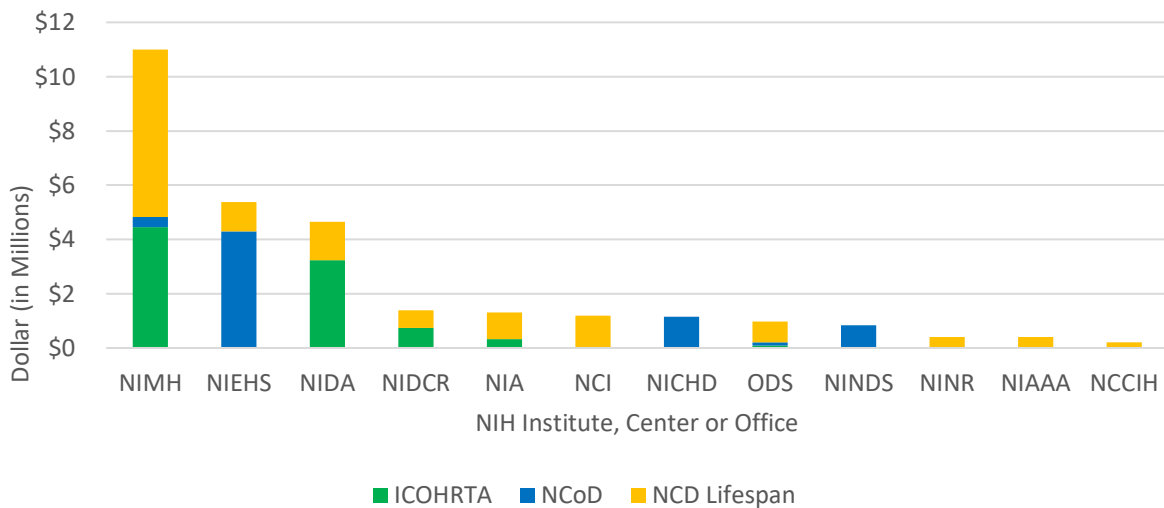
These three programs have helped to build NCD research capacity in LMICs by funding cutting edge science, providing short and long-term training opportunities, and supporting institutional capacity. To most effectively address the complex and diverse NCD challenges in LMICs, the NCD D43 Programs have supported training and research in a wide array of NCD topics--from mental health to cardiovascular disease to maternal child health to aging. The NCD D43 Programs have evolved in response to shifting research priorities and opportunities. The ICOHRTA Program was focused on training in clinical, operational, health services and prevention science research. In 2008, FIC recognized that ICOHRTA was not sufficiently addressing the highest priority NCDs and therefore created the NCoD Program to primarily support research and training for cancer, lung disease, diabetes, and cardiovascular disease. The current NCD-Lifespan Program was developed and launched to address lack of capacity for NCD research in LMICs across the research continuum from basic biomedical research to implementation science with a special appreciation for diseases across the lifespan, risk factors, and early developmental origins of disease.

Awards

Between 2001 and 2017, 79 awards were funded across the three NCD D43 Programs, an investment totaling \$79.4 million. Of that, 12 partner NIH Institutes, Centers or Offices (ICOs) contributed \$28.9M, or 36% of the NCD D43 Programs’ total costs. ICO partners include National Center for Complementary

¹ WHO. Time to deliver: report of the WHO Independent High-level Commission on Noncommunicable Diseases. Geneva: World Health Organization; 2018. License: CC BY-NCSA 3.0 IGO.

and Integrative Health (NCCIH), National Cancer Institute (NCI), National Institute on Aging (NIA), National Institute on Alcohol Abuse and Alcoholism (NIAAA), *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD), National Institute on Drug Abuse (NIDA), National Institute of Dental and Craniofacial Research (NIDCR), National Institute of Environmental Health Sciences (NIEHS), National Institute of Mental Health (NIMH), National Institute of Neurological Disorders and Stroke (NINDS), National Institute of Nursing Research (NINR), and Office of Dietary Supplements (ODS). Three of these ICs have administered their own awards under FIC’s NCD programs (one by NICHD, two by NIMH, and three by NIEHS). The partnership with NIMH is particularly strong; not only did they administer two awards, but they are the most significant contributor, investing over \$11M over the course of the NCD D43 Programs.



The NCD D43 Programs have research projects in 44 countries, with the most projects focused in China and India (11 awards each). In the last decade alone, direct awards to LMIC institutions have been awarded for 14 projects (9 planning awards). Uganda’s Makerere University received the most direct awards (2).



The most common research topics have been mental health (27%) and cardiovascular disease (24%). Predictably, mental health and substance abuse are prominent research areas given the contribution and involvement of NIMH.

Research Outcomes

Although the NCD D43 Programs were focused on capacity building, they have successfully contributed to the growing empirical evidence and research related to NCDs in LMICs. From 2003 to 2017, a total of 982 publications citing a FIC NCD grant were published. The most common areas of focus for these publications were mental health (128 articles; 22%), risk factors (e.g., obesity, nutrition), and cardiovascular disease. Mental health constitutes 128 articles (22%) of the 591 articles analyzed and is the focal point of 30% (24 of the 79) of the funded NCD grants. Cardiovascular disease research is the focus for 15% of the publications and 24% of the NCD grants. In contrast, 120 publications (20%) focus on “Risk Factors,” while this topic constitutes only 15% of the funded grants.

NCD category	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Grand Total
Mental Health/Behavioral Health		1	7	4	2	12	13	10	10	15	9	20	25	128
Risk Factors						4	6	8	11	17	25	27	22	120
Cardiovascular Diseases					2		2	1	6	14	15	16	35	91
Substance Abuse/Addiction			4	3	1	5	6	7	6	13	11	8	12	76
Cancers			1				1	10	8	11	13	7	11	62
Metabolic/Gastro/Digestive/Kidney Disorders	1		2		3	1	2		1	6	11	10	18	55
HIV/STIs/Infectious Diseases			2	5	1	8	6	4	4	2	6	12	4	54
Trauma/Injury		1	2		3	3	5	4	6	7	6	5	10	52
Neurological/Developmental Disorders		1	3	3	3	2	2	2	3	6	9	5	5	44
Maternal/Child Health				1		2			1	2		2	9	17
Reproductive								2	1	2	3	1	1	10
Environmental/Occupational Health									2	1	2		2	7
Bone Diseases							1		1	2	1	1		6
Eye Diseases						1	2	1						5
Respiratory Diseases							1			2		1	1	5
Oral Health										1			1	2
Aging Disorders												1		1
Grand Total	2	2	21	16	15	38	47	49	60	101	111	116	157	735

Important research outputs other than publications were also developed with the support of the NCD D43 Programs. These outputs included clinical protocols, patient registries and medical devices. For

The program certainly made research focused on mental health policy and the development of mental health services — of public mental health — legitimate in the face of ever-growing demands [in China] to do biological research and publish in the very highest ranked journals. FIC has every reason to feel enormously proud of their contribution to the development of research linked to some of the most critical mental health problems and programs in the country.

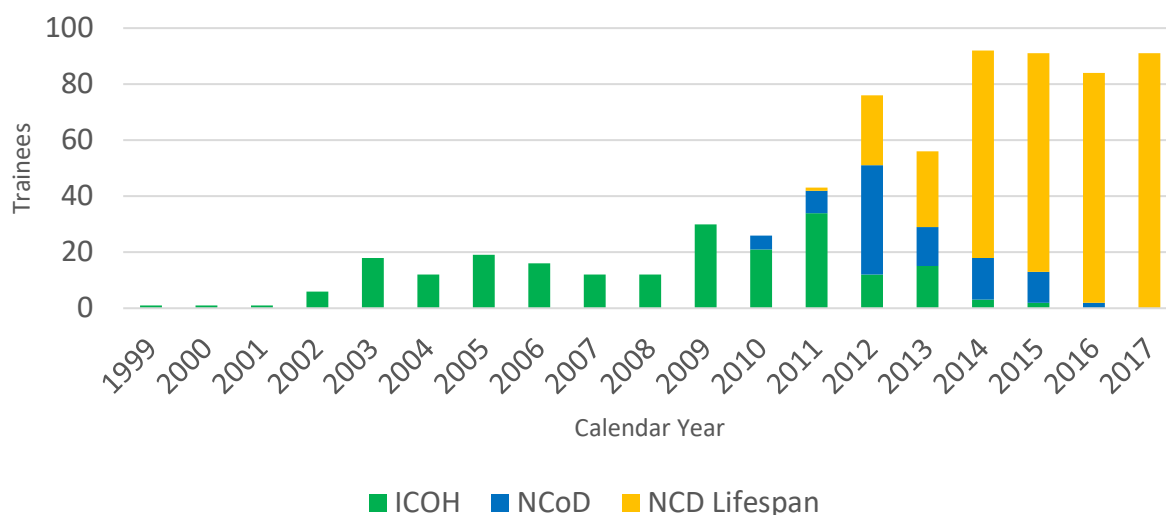
-ICOHRTA and NCD- Lifespan grantee

example, one grant used nanotechnology and stem cells to develop cardiac cells to repair the heart. Another project created a data analysis platform for genetic studies used to identify genotype-phenotype relations in genome-wide association studies.

Capacity Building

The FIC NCD D43 Programs contributed to building local capacity in NCD research as indicated by the growing number of trainees graduating from the NCD D43 Programs. A total of 660 trainees who trained for a period of more than six months have been recorded. While innovative research training models are encouraged, the typical training model used in the FIC NCD D43 Programs includes a mix of

informal training and degree-related training. The majority of long-term trainees (46%) participated in non-degree programs like fellowships or certificate programs; an additional 23% of trainees enrolled in a Master’s program and 12% in a PhD program.



Grantees and trainees have also leveraged their experiences in the NCD D43 Programs to successfully secure funding for further research or research training projects. Using survey results that represent the opinions of 51 of the 71 (72%) grants from the ICOHRTA, NCoD and 2010 NCD-Lifespan Programs, 50% of projects were associated with a PI or collaborator applying for and securing additional training funding. Sixty-eight percent were successful in securing funding, usually from an LMIC source such as an institution, foundation, or government, to continue their NCD research. Trainees also demonstrated success in applying for funding post-award. Of those reporting, 78% of grants resulted in at least one trainee applying for funding; of those who applied, 77% or roughly three-quarters were successful.

The NCD D43 Programs encourage establishing and fostering partnerships between the U.S. and local researchers and institutions. Of those responding to the survey, 92% of projects agreed that the NCD D43 Programs provided sufficient opportunities to interact with other awardees and their collaborators. All survey respondents acknowledged that their network of contacts expanded due to their involvement in the program. A co-citation analysis of 1,779 articles published by alumni grantees demonstrates that sustainable research collaborations had been seeded between U.S. grantees and LMIC researchers; the majority of NCD alumni grantees (69%) have published at least three articles or more with an LMIC co-author.

Policy and Public Health

NCD D43 Programs’ activities have informed policies and practices at a national or international level. Examples are demonstrated in five unique case studies including:

- Primary care health agents (HAs) in the Jujuy Province of Argentina have been trained through an NCD-Lifespan grant on early identification, referral and follow up of individuals with psychosis. With this proper training, the Ministry of Health was able to develop (with the help of the local co-investigators of the NCD grant) the first implementation of an early detection of psychosis plan in Jujuy.

- In 2013, the first national mental health law of China was enacted. Much of the empirical work that supported the drafting of this bill (including the controversial provision that psychiatric treatment was voluntary) was conducted by fellows on an NCD grant.
- An NCD grant has collected data and provided evidence on the highly addictive and abused opioid, Tramadol. The research has helped inform the Government of Egypt, the WHO and the United Arab Emirates about treatment protocols and has helped promote the approval of addiction medications in these countries.

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1.0 Introduction and Background

According to the World Health Organization, 39.5 million or 70% of total deaths for all ages are due to chronic diseases.² Of these non-communicable disease (NCD) deaths, over three quarters occur in low- and middle-income countries (LMICs). Without concerted efforts and investments, the NCD burden is projected to increase and by 2030, NCDs will be the greatest cause of mortality in LMICs.³

In many LMICs, gains in life expectancy have been a key determinant of the growth in prevalence of NCDs. The increase in life expectancy can be attributed to trends such as declines in childhood mortality, more effective public health measures to combat and prevent infectious diseases and improvements in economic and social welfare (e.g., increased per capita income).⁴ A byproduct of these gains in life expectancy is an increase in the length of time adults are exposed to or will live with known risk factors for noncommunicable diseases, such as smoking, malnutrition, or obesity.⁵

Goal Four of the current John E. Fogarty International Center (FIC) Strategic Plan⁶ states that FIC will “support research and research training in clinical, behavioral and population sciences.” The NCD D43 Programs described and analyzed in this review are instrumental to achieving this goal.

1.1 Program Review

The FIC at the National Institutes of Health (NIH) supports international collaborative research and training programs that advance the NIH mission through international partnerships. Guided by the FIC Framework for program assessment,⁷ FIC conducts reviews for each of its extramural programs. The purpose of these reviews is to analyze program implementation, as well as identify near-term and long-term outputs, outcomes and impacts.

This report reflects the results of a review of FIC’s training investment in non-communicable diseases through the International Clinical, Operational, and Health Services Research and Training Award (ICOHRTA) Program, the Millennium Promise Awards: Non-communicable Chronic Diseases Research Training Program (NCoD), and the Chronic, Noncommunicable Diseases and Disorders Research Training Program (NCD-Lifespan). The ICOHRTA Program began in 2001 as the first of a series of non-communicable disease (NCD) research training programs sponsored by FIC with the intention to build sustainable research capacity related to NCDs and disorders at institutions in LMICs. The next iteration of the program, the Millennium Promise (NCoD) Program, was established in 2008. Most recently, the NCD-Lifespan Program began issuing awards through their D43 and D71 training grant mechanisms in

² World Health Organization. 2018. “NCD mortality and morbidity.” http://www.who.int/gho/ncd/mortality_morbidity/en/ Accessed 2/9/18

³ Robinson HM, Hort K. Non-communicable diseases and health systems reform in low-and-middle-income countries. *Pac Health Dialog*. 2012 Apr;18(1):179-90.

⁴ Fogarty. “Fogarty Strategic Plan 2008-2012.” <https://www.fic.nih.gov/About/Documents/fogarty-international-center-nih-strategic-plan.pdf>. Accessed Feb 9, 2018

⁵ Friedrich, MJ. (2015). Rates of Noncommunicable Diseases Increasing in Developing Countries. *JAMA*. 313(3):235. <https://jamanetwork.com/journals/jama/fullarticle/2091318>

⁶ Fogarty. “Fogarty Strategic Plan 2008-2012.” <https://www.fic.nih.gov/About/Documents/fogarty-international-center-nih-strategic-plan.pdf>. Accessed Feb 9, 2018

⁷ Available online at <https://www.fic.nih.gov/About/Staff/Policy-Planning-Evaluation/Pages/evaluation-framework.aspx>

2010. These three programs (ICOHRTA, NCoD and NCD-Lifespan) encompass what will hereafter be referred to as the “NCD D43 Programs” at FIC.⁸

This report describes the results of the NCD D43 Programs’ review and is laid out in six sections. It begins with a description of the methods used to collect and analyze data on the NCD D43 Programs (Section 1). The next two sections describe the programs’ history, context and implementation (Sections 2 and 3). Section 4 describes the NCD D43 Programs’ outputs, outcomes, and impacts in four categories: 1) leveraged funding (Sub-Section 4.1); 2) enhanced empirical evidence (Sub-Section 4.2); 3) policy or implementation (Sub-Section 4.3); and 4) capacity building (Sub-Section 4.4). Finally, Section 5 outlines evaluation conclusions and recommendations.

1.2 Evaluation Methodology

The primary objective of this evaluation is to assess the influence of the NCD D43 Programs’ activities on the goals of enhancing research collaborations and building sustainable research capacity in NCDs (for a full list of goals by NCD Program see Appendix A). Given these goals, the evaluation approach uses a blend of quantitative and qualitative data collection methodologies. Guided by the FIC Framework for Evaluation, and in consultation with the FIC NCD Program Officer, a set of evaluation study questions were developed (Appendix B). These questions were used to help frame the data collection and analysis for the evaluation.

Data collection for the review of the NCD D43 Programs included the following:

- *Administrative sources (including NIH databases)* were collected and reviewed to identify the universe of grants, investigators, publications, and trainees associated with the programs.
- A *trainee roster* of all trainees trained by the programs was developed based on the FIC CareerTrac database. This database contains information on trainees’ in-training and post-training activities to help establish FIC’s impact on trainee career trajectory.
- *Publication* information was collected to assess capacity-building and collaboration between LMIC and U.S. researchers during and after the grant award.
- A *survey* was administered to U.S. grantees and foreign collaborators to collect project level information regarding training and outcomes.
- *Interviews and discussions* with FIC staff were used throughout the project to provide qualitative insights into program design, management, and results.

Further explanation of these methods is discussed in detail below. Where appropriate, limitations and potential sources of bias are acknowledged and addressed.

⁸ Other NCD programs are administered at FIC. However, other programs are tailored to a specific NCD disease or risk factor (e.g., Environment, Brain Disorders) or population (e.g., Maternal Child Health). Similarly, research programs in NCDs vary in structure and emphasis more than training programs in NCD. The three programs reviewed in this report are all training programs that encompass an array of NCD allowable topics.

1.2.1 Administrative Sources

Data pulled from NIH databases includes funding, publications and geographical information for the grants administered under the NCD D43 Programs. Program documents included the 2001, 2006, 2008 and 2010 Funding Opportunity Announcements (FOAs), original and renewal applications for funded grants, and investigator progress reports. Available documentations from network meetings were extracted and manually reviewed.

This evaluation also utilized an ICOHRTA outcome evaluation conducted in 2006.

1.2.2 Trainee Roster

Trainee data was obtained through the FIC CareerTrac database. Data on a trainee's in-training experience and post-training accomplishments (funding, employment and policy impacts) were exported and sent to each grantee group for validation.

Grantees that did not have data in CareerTrac (1 ICOHRTA; 5 NCoD; 8 NCD-Lifespan) were asked to provide trainee data using a blank Excel spreadsheet with the data fields explicitly stated in each column.

Eighty-two percent (61) of the 74 grantee groups provided trainee data.

It should be noted that the trainee data is incomplete, and information may be lacking for certain data elements.

1.2.3 Publications

Publications citing an NCD Program award were extracted from NIH RePorter, PubMed/MEDLINE, and the Science and Social Sciences Citation Indexes in the Web of Science (WOS). A total of 982 publications, published between 2003 and 2017, were retrieved. The first article associated with NCD D43 programs was published in 2003. Sixty of the 75 grants associated with awards funded before 2017 resulted in publications. The bibliometric and citation analysis includes 591 of these 982 publications; articles published after 2015 were excluded, as publications must be at least two years old to have received enough citations for bibliometric indicators to be reliable.

A co-authorship network analysis was developed for alumni grantees' publications that were published after the completion of their NCD project and did not cite an NCD award. Creating a network of co-authors is a powerful tool to assess collaborations and relationships between U.S. and LMIC researchers. For the analysis, electronic searches were performed for a list of 55 alumni grantees from 38 grants. A grantee was included if s/he was listed as a PI on the grant for more than one year. Publications were identified and analyzed by searching PI names and institution affiliations in Scopus. Forty-nine PIs had post-grant publications between 2007 and 2017 that could be retrieved in Scopus, and 1,779 post-grant publications were found in Scopus published by these PIs. Publications were analyzed using the PMIDs to search PubMed for major MeSH terms and to search WOS to create co-author network graphs. In WOS, data for 1,596 of 1,779 publications was available.

1.2.4 Interviews with Program Staff and PIs

Interviews with NIH Staff. Informational interviews were conducted via telephone with the FIC Program Officer responsible for the NCD D43 Programs.⁹ The interview guide for these interviews is available in Appendix C.

Interviews with PIs. Five PIs were contacted to provide further explanation of the impacts their grants had on policy or practice. PIs were emailed a set of questions and responded via email or with a telephone call. PIs were selected for interviews based on the outcomes and impacts they expressed in their survey responses or progress reports.

1.2.5 Survey of Principal Investigators and Major Foreign Collaborators

A web-based survey of Principal Investigators (PIs) and primary foreign collaborators was conducted. The purpose for the survey was to systematically collect information on program outcomes, including additional leveraged funding for each project, publications, trainees, and other capacity-building outcomes. The survey instrument is included in Appendix D.

The contact PI and primary foreign collaborators (as identified by the FIC Program Officer and/or the PI) for 71 grants were invited to participate in a web-based survey implemented via SurveyMonkey. The five grants issued in 2017 were not included in the survey as they were determined to be too new. Three grants from the ICOHRTA program were also omitted from the survey as they were a unique subset allowed to focus on HIV. Email addresses were extracted from a list maintained by the program staff and supplemented by web searches and inquiries to PIs as necessary. The first round of the survey was open for approximately 2 months (from November 30, 2017 to January 20, 2018). Additional follow-up emails were sent on January 23rd and February 20th. The survey was closed on March 7th, 2018.

The survey generated responses from 91 individuals. Of these individuals, one declined participation and 17 individuals logged into the survey but only answered either one or two questions; since an answer to the first question was required to reach additional questions, these were not included in the analysis. Seventy-three individuals answered three or more questions and represented 51 of the 71 (72%) grants.

The analysis of survey results, described in Section 3 and Section 4 of this review, merged entries pertaining to the same project. The thirteen programs that were multi-generational, legacy programs that have extended across multiple NCD D43 Programs were also merged, if a response was provided. An example of a multi-generational program is one in which a U.S. PI that held an ICOHRTA in the early 2000s and then was awarded the NCD-Lifespan grant in 2010. Ten multi-generational programs (representing 20 grants) provided responses for the survey. In sum, the 51 unique grants responding to the survey were merged to a total of 41 projects.

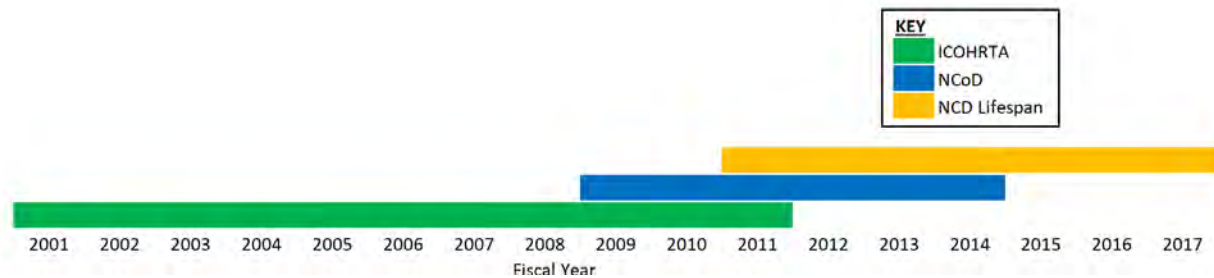
⁹ An attempt was made to talk with representatives from six Institutes and Centers that have funded at least one NCD project. However, given a low response rate, information was not obtainable.

2.0 Program Background and Description

2.1 Program History

The NCD D43 Programs are composed of three programs starting in 2001 and continuing into the present. The first program, ICOHRTA, was funded from fiscal year (FY) 2001 to 2011. The NCoD Program began in FY2009 and was last funded in FY2014. The NCD-Lifespan Program, which is currently active, made its first awards in FY2011. As illustrated in Figure 1, the NCD D43 Programs overlapped. Of note, in FY2011, all three NCD D43 Programs were funding at least one grant.

Figure 1: Funding Years for NCD D43 Programs



2.1.1 Origin and Evolution of the NCD D43 Programs

The concept for the ICOHRTA Program was developed in response to a perceived gap in support for international training in clinical and health services research, including operations and prevention research across the spectrum of infectious and noncommunicable diseases and disorders. To help understand the gap, a consultation was convened in 2000 to get input from potential partners on a new program. NIH Institutes and Centers (ICs) participating in this consultation included: National Institute for Mental Health (NIMH), National Institute on Drug Abuse (NIDA), National Center for Complimentary and Integrative Health (NCCIH), and National Institute for Child Health and Human Development (NICHD).

The ICOHRTA Program launched a year later, in 2001, with the overarching goal to strengthen the global capacity to conduct clinical, operational, health services and prevention science research necessary to measure incidence and prevalence of chronic diseases and conditions, characterize disease burdens, devise and evaluate interventions, and to help LMICs contribute to, and benefit from, international efforts to apply current knowledge to clinical public health practice.



A nurse meets with a research subject in Kampala, Uganda.
Photo Courtesy of Richard Lord for FIC/NIH

The decision to exclude infectious diseases in the original FOA was due to a lack of NIAID participation. However, the first ICOHRTA FOA did include research training on interventions to prevent the spread of HIV in high risk populations. HIV was added as an eligible research training topic in ICOHRTA because of the importance of extending the research training focus on clinical operational and health services research to HIV; in addition, both FIC and partner ICs had funding designated for HIV/AIDS research and research training that they could contribute to the program.

As the program matured, the goals and objectives of ICOHRTA were refined and reorganized. In the second FOA for ICOHRTA (TW-06-002) HIV research was ineligible, shifting the program to an exclusive focus on non-communicable diseases and disorders. This was due to the launch in 2002 of the ICOHRTA AIDS/TB Program (PA-02-022), a program dedicated to the clinical, translational, and health services needs of HIV research. Given these factors, the second FOA for ICOHRTA was solely focused on NCDs and applicants focused on HIV were directed to apply to the ICOHRTA AIDS/TB.

By the mid-2000s the growing burden of NCDs in LMICs was receiving more attention from the global health community. An update to the Global Burden of Disease¹⁰ was published in 2006 that highlighted the NCD diseases with the highest burden in LMICs. In recognition of the fact that the ICOHRTA grants did not address these diseases in a focused way, the Millennium Promise (NCoD) Program was developed to address the four significant NCDs: cancer, lung disease, diabetes, and cardiovascular disease. The launch of this new program coincided with the 2008-2012 FIC Strategic Plan¹¹ which placed an emphasis on NCDs (Goal 1) and enhancing FIC's portfolio to include more research and training in NCDs.

Since the NCoD Program was designed to encourage applications for research training addressing NCDs that were not well represented in the ICOHRTA grants, the hope was that the NIH ICs that focused on the four major categories of NCDs would join the NCoD FOA (e.g., NHLBI in heart/lung diseases, NIDDK with diabetes, NCI for Cancer). However, of these three ICs, only NCI participated in NCoD. The NCoD ended in 2010 and was rolled into the broader NCD-Lifespan Program which started later that year.

The official notice of the NCoD Program's termination (NOT-TW-10-457) states that the program was consolidated to place a greater emphasis on training across the research continuum including basic biomedical, clinical, translation and implementation science for NCDs. Notably, when the NCD-Lifespan Program was being developed, there was a new appreciation of lifespan approaches to research. The concepts of epigenetics and early developmental origins were starting to gather momentum in the scientific community. The Program Officer heading NCD research and research training at FIC recognized that there should be a more holistic approach to NCDs that encourages the study of the impacts of early development on adult NCDs. As such, the program was designed to emphasize the lifespan approach to addressing NCDs. Therefore, the NCD-Lifespan Program was a culmination of the desire to emphasize training across the age continuum, the new appreciation for epigenetics and early development origins in research, the need to align the program more closely to the FIC strategic plan,

¹⁰ Ezzati, Majid [editor]; Jamison, Dean T. [editor]; Lopez, Alan D. [editor]; Mathers, Colin D. [editor]; Murray, Christopher J. L. [editor]. 2006. Global burden of disease and risk factors (English). Disease Control Priorities. Washington, DC: World Bank. <http://documents.worldbank.org/curated/en/251181468140658232/Global-burden-of-disease-and-risk-factors>

¹¹ Fogarty. https://www.fic.nih.gov/About/Documents/stratplan_fullversion.pdf. Accessed Feb 9, 2018

and the importance of addressing the shifting global burden of disease and disability. The current objectives and goals of the currently active NCD-Lifespan Program can be found in Section 2.2.

2.1.2 Other Relevant FIC Programs

FIC has other research training programs both current and past that also focus on NCDs. These programs are described below.

- **Global Injury and Trauma Research Training Program:** The Trauma Program supports research and capacity building relevant to the health needs of LMICs on issues related to the diagnosis, prevention, or treatment of injury and trauma. The overall aim of the program is to support grantees in designing and implementing short and long-term training activities to fill specific gaps in human trauma and injury research expertise at collaborating LMIC institutions with an ultimate goal of developing a critical mass of scientists, nurses, and health professionals who conduct injury research, understand the pathophysiology, and prevent or treat injury or the sequelae of injury in their country.

The FIC Trauma program began in 2004 by funding 12 grants across 12 countries. Eight grants were funded in the most recent round (competed in 2016). The Trauma Program focuses on a wide range of research areas ranging from pediatrics to violence against women to road traffic injuries. Alumni grantees have achieved notable successes including training thousands of health care workers, publishing over a hundred journal articles, and participating in a wide variety of research networks. Notably, five awardees have leveraged part of their grant to create centers within a LMIC dedicated to trauma and injury research and training. These centers were most often established with the partnership of government ministries, academic institutions or the World Health Organization (WHO).

An outcome evaluation of the Trauma Program during the period of 2005 to 2014 is available on the FIC website: <https://www.fic.nih.gov/About/Staff/Policy-Planning-Evaluation/Pages/fogarty-program-evaluation-trauma-injury.aspx>.

- **Global Research Training in Population Health (POP):** Established in 1995, the POP Program trained scientists from around the world in the fields of reproductive biology and population, as well as factors affecting birth rates and aging. The program's training emphasis was on the doctoral and post-doctoral level scientists and clinicians. Its aim was to strengthen the ability of LMIC scientists to contribute to global population research efforts and to communicate and disseminate knowledge in support of population policies appropriate for their home countries or international guidelines. In addition, the POP Program was intended to contribute to the establishment and strengthening of centers of excellence with significant research resources in population health sciences. The POP program funded 13 grants through three funding cycles (TW-05-002, TW-00-004, TW-95-002). The projects funded through the program made important contributions to supporting basic biomedical and behavioral research on fertility and contraception in LMICs.

A review of the programs' first ten years, and first nine grants was conducted in 2004 and can be found here: [https://dpcpsi.nih.gov/sites/default/files/o pep/document/Final_Report_\(04-105-FIC\)%202004.pdf](https://dpcpsi.nih.gov/sites/default/files/o pep/document/Final_Report_(04-105-FIC)%202004.pdf). This review identified a total of 161 long-term trainees and 336 short-term trainees from 31 countries. An additional 9,408 participations attended 142 workshops organized by the POP grantees. Research conducted under the program was disseminated through 336 publications in international peer-reviewed journals such as *Science*, *Journal of*

Biological Chemistry, and Pediatrics. Most trainees in reproductive biology programs came from Latin America, India and China, while the population studies programs drew trainees more widely from institutions in Latin America, South Asia, and sub-Saharan Africa. One recommendation stemming from the evaluation was to broaden the topical scope to emphasize aging and adult health. The recommendation reflected the need for a program that was more flexible in its design of population studies to include the “lifespan” as well as various risk factors beyond fertility such as environment and nutrition. The POP program was eventually discontinued in 2010 and integrated into the NCD-Lifespan Program in 2010.

- **International Maternal and Child Health (MCH) Research and Training Program:** FIC initiated the MCH program to help build research capacity related to maternal and child health. Co-funded with the National Institute of Child Health and Human Development (NICHD) and Centers for Disease Control and Prevention (CDC), the program aimed to increase expertise of scientists in developing countries in MCH research, support the collaborative training between U.S.-based and foreign scientists, and establish MCH Centers of Excellence in the home countries of trainees.

The first FOA for the MCH program resulted in seven awards totaling more than \$1.4 million. The second and final round of competition resulted in four additional awards. All of the funded awards offered training activities ranging from long-term trainings to short-term trainings to workshops. The goals of these training activities varied widely between grants. Some grants



Woman and newborn in Barranquilla, Colombia
Photo Courtesy of [Barranquilla se mueve contra el Zika/PAHO/CC BY-NC 2.0](#)

sought to improve research capacity in basic science and directed their attention and funding towards post-doctoral or doctoral training. Other grants enrolled lab technicians or other scientists for short-term training to improve capacity of local hospital or district laboratories. Workshops were utilized as tools to help disseminate information and bring together scientists from a given region. Some of the more popular topics of these workshops include a focus on HIV/AIDS, nutrition, and basic reproductive health. Through

collaborative trainings, these activities strengthened ties between U.S. and LMIC institutions as well as facilitated new networks abroad. The program ended in 2007 due to FIC budget constraints and re-prioritization for partnering ICs.

- International Training and Research in Environmental and Occupational Health (ITREOH):** With the close support of the National Institute on Environmental Health Sciences (NIEHS) and the National Institute for Occupational Safety and Health at the CDC, ITREOH was the first program at FIC aimed at training LMIC professionals in research on workplace and environmental protection and public health and safety. Established in 1995, the program provided 5-year awards to U.S. institutions to partner with LMIC institutions in research training around one or more areas of environmental and occupational health. The program was intentionally flexible to accommodate the diverse needs and interests of both the U.S. academic centers and their international partners around the world. Training activities ranged from long-term U.S. based academic training toward degrees for international students, to shorter length courses and workshops at host country institutions and mentored research collaborations on diverse topics. During the program's 19 years (1995-2014), 22 projects of varied duration conducted training to enhance the research capabilities of scientists at 75 institutions in 43 countries and supported productive research relationships between these scientists and their U.S. partners. The ITREOH Program resulted in basic scientific advances, stronger research capacity for individuals and institutions, and policy impacts. Specifically, the program supported more than 333 individuals from over 40 countries in a formal degree training toward a Bachelor's, Masters, or PhD. The research conducted represented a diversity of scientific and health areas of emphasis, including research on reproductive health effects, cancer, respiratory disease, and water quality, among others; research supported through ITREOH were published in over 460 publications. Numerous examples illustrate the scientific impacts of the program as well as its influence on policy and program implementation in LMICs. For example, researchers in Chile monitored ambient nicotine levels before and after a partial federal smoking ban. The study found that a partial ban policy (allowing designated smoking areas in an establishment) was ineffective in protecting individuals from secondhand smoke exposure. This study provided concrete evidence that helped the Chilean Legislature enact comprehensive smoking ban policies in public places and the workplace.¹²

As the ITREOH Program continued to mature, there was a growing movement within the NIH and FIC towards the development of regional centers of excellence to address issues common to several contiguous countries. Recognizing the need to evolve to meet today's scientific and institutional needs, the ITREOH Program was reengineered to support and catalyze a multi-national network of regional hubs funded through the current FIC Global Environmental and Occupational Health Program (GEOHealth).



A man sprays insecticide using a fog machine.
Photo Courtesy of Songpin/iStock/Thinkstock

¹² Erazo M, et al. Secondhand tobacco smoke in bars and restaurants in Santiago, Chile: Evaluation of partial smoking ban legislation in public places. *Tob Control*. 2010;19:469–474.

2.2 Program Purpose and Objectives

In general, the NCD D43 Programs were designed to build research capacity in LMICs by providing research training to address NCDs. The specific objectives and program designs have evolved over time. Table 1 outlines the objectives for the NCD D43 Programs. Each grant, at its core, trains individuals in research and builds institutional capacity. The priority areas and specific means by which each program aims to achieve these objectives differs slightly.

Table 1: Objectives by Program

ICOHRTA	NCoD	NCD-Lifespan
Support research training of LMIC scientists and clinicians to: <ul style="list-style-type: none"> ·build and contribute to global and local clinical, operational, health services and prevention science research efforts related to NCDs ·communicate and disseminate knowledge in support of policies appropriate for their home countries and established international guidelines 	Train a cadre of experts who can: <ul style="list-style-type: none"> ·assess the magnitude of diseases such as cancer, cerebrovascular disease, and obesity as well as genetics, environmental factors and lifestyle factors related to these conditions in LMICs ·identify economic factors that influence chronic disease risks ·develop evidence regarding the impact of chronic non-communicable diseases on families and communities ·translate research into public health policy and into programs of care ·perform NCD research across a broad range of research areas from genetics to epidemiology to clinical research to implementation science 	Train a cadre of experts who can: <ul style="list-style-type: none"> ·assess the magnitude, etiology of, interventions for and other aspects of NCDs ·contribute to science advances and affect clinical practice and public health policy in their country
Provide a variety of training opportunities for LMIC scientists and clinicians within the context of ongoing U.S. research collaborations	Support training-related research projects (degree-related or mentored research) that address issues of importance to chronic disease, directly relevant to the needs of the people in the foreign country, and are culturally sensitive	Support training-related research (degree-related or mentored research projects) that is directly relevant to the health priorities of the LMIC and to global health
Help to build and maintain centers of research excellence with significant research resources in clinical, operational, health services and prevention science research efforts related to NCDs	Build on existing research programs on chronic diseases at the foreign sites to strengthen the local research training capacity and institutional infrastructure	To strengthen the research and research training capacity of LMIC institutions by building on existing research and public health programs in the LMIC; the goal for these institutions to become national, regional and international centers of expertise in NCD research

ICOHRTA	NCoD	NCD-Lifespan
Increase the research capacity of the foreign investigator and institution to address health problems relevant to the participating foreign country related to clinical, operational, health services and prevention science research on NCDs	Develop methods to monitor and understand the etiology of chronic non-communicable disease	Support multidisciplinary research training in basic through translation and implementation science to address NCDs
Foster foreign collaborations that will extend or enhance the clinical, operational, health services and prevention science research interests of both the U.S. PI and the foreign co-investigator equally		Integrate with other efforts to strengthen core research support capabilities needed to manage research and research training grants at the LMIC institution

The current NCD-Lifespan Program has an overall aim of sustainably strengthening the research capacity at LMIC institutions and training LMIC scientists to conduct research on NCDs and disorders across the lifespan. Specifically, the goal is to provide a solid research foundation that will help influence the development and implementation of evidence-based interventions for NCDs.

As outlined in Table 1, the specific objectives of the current NCD-Lifespan Program are to 1) strengthen the research capacity of LMIC institutions so they can become national, regional and international centers of expertise in NCD research 2) support multidisciplinary research training across the research continuum 3) train a cadre of LMIC scientists NCD relevant research that will contribute to scientific advances and changes in clinical practice and public health policy 4) support training-related research that is directly relevant to the health priorities of the LMIC 5) integrate with existing NCD research and public health programs in the LMIC and 6) strengthen core research support capabilities needed to manage grants at an LMIC institution.

2.3 Program Structure

The NCD D43 Programs strengthen the research base of U.S. and foreign institutions while simultaneously training in-country experts to conduct research on NCDs. To best achieve these goals, FIC utilizes the International Research Training Grant (D43) mechanism. The D43 mechanism supports research training programs for U.S. and foreign scientists to strengthen global health research and international research collaborations.

The D43 mechanism provides support for up to five years and limits facility and administrative costs to eight percent of allowable costs. Over the duration of the NCD D43 Programs, limits on the annual direct costs varied (See Appendix A). ICOHRTA allowed up to \$250,000 direct costs per year during the 2001 FOA. The 2006 FOA decreased funding for new applicants to \$150,000 direct costs per year; however, individuals re-competing from the previous cycle were eligible for \$200,000 a year. NCoD provided funding of up to \$220,000 total direct costs per year and the NCD-Lifespan currently supports grants for up to \$250,000 a year.

A developmental or planning component has also been utilized in the three NCD D43 Programs. The purpose of a planning award is to support an applicant in planning the necessary steps and tools to apply for a five-year D43 award. The planning application outlines how a grantee intends to build collaborations, utilize existing resources, enroll potential trainees and organize the full D43 application. Under the ICOHRTA and NCoD Programs, the developmental awards (3-year awards for ICOHRTA and 2-year awards for NCoD) were components within the D43 mechanism. At that time, NIH policies were more flexible with respect to funding structures of grants and allowed for one FOA to contain multiple mechanisms. The developmental ICOHRTA awards were eliminated after the first FOA but were brought back with the NCoD FOA due to a recommendation provided in the ICOHRTA 2008 Evaluation (Table 1). By 2010, NIH limited the use of multiple mechanisms in a single, stand-alone FOA. To ensure that a developmental or planning award was still available to applicants, the NCD-Lifespan Program offered a new mechanism, the D71, for planning grant awards. The only other programs that utilized the D71 prior to 2011 were the ICOHRTA AIDS/TB and ICOHRTA Malaria Programs. In addition to U.S. institutions utilizing planning grants to plan their D43 NCD-Lifespan applications, they were also used by LMIC institutions that needed additional preparation to be a D43 site.

Another noteworthy element of the mechanism was the criterion of a “parent grant.” The capacity building efforts of ICOHRTA were intended to build upon existing strong research training or curriculum development programs supported by NIH. As such, to be eligible for the first (2001) ICOHRTA Program, applicants had to be PIs on an active and funded “parent grant” of an institutional research curriculum development or institutional research training award or center grant related to clinical, population, operational or health services research from a participating NIH IC. The FIC D43 training mechanism did not meet the requirement as an eligible parent grant. In 2006, the “parent grant” requirement was modified to include active research awards and it could be satisfied by any faculty member involved in the project, as opposed to the PI-only requirement in 2001. This switch in 2006 was consistent with the requirements of other FIC D43s. The parent award requirement acts as an insurance that the grantees are knowledgeable in the field, have experience conducting research or research training, and have a base of research funding.

Training in the NCD D43 Programs have included a mix of long, medium and short-term training and in-country mentored research to address the research training needs for NCDs in LMICs. During the early



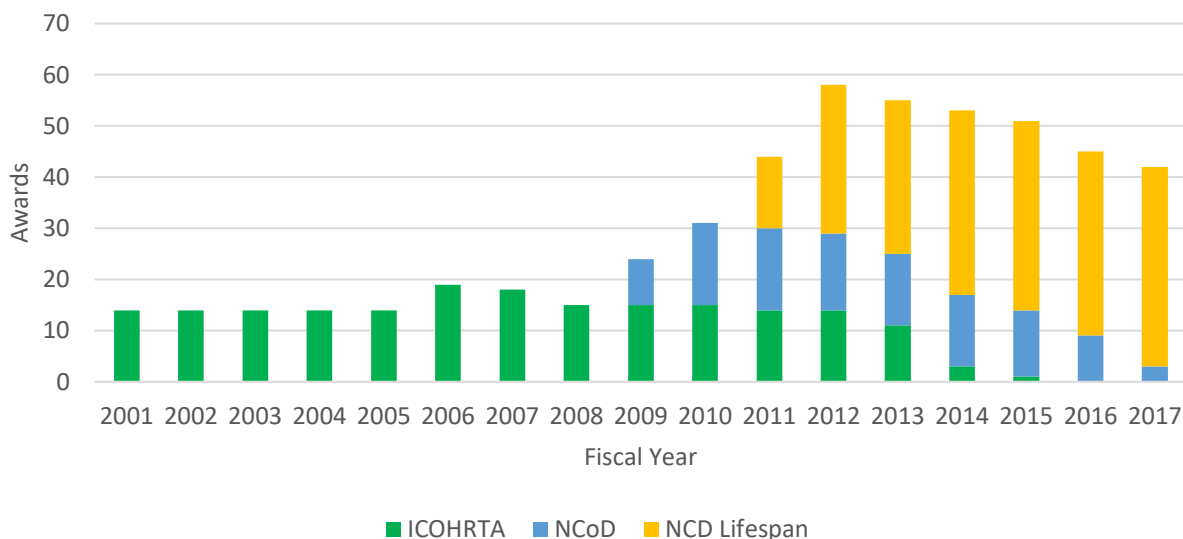
Medical students attending a lecture at Black Lion Hospital, Addis Adaba University, School of Medicine. Photo Courtesy of Richard Lord for FIC/NIH

stages of the NCD D43 Programs (e.g. ICOHRTA), the training would generally take place in the U.S., as foreign research institutions lacked the resources and facilities. As the research capacity in LMICs increased over time, a greater emphasis was placed on training at the foreign institutions by the foreign collaborators. By the time of the NCoD and NCD-Lifespan awards, trainings were often taking place at foreign institutions. While the training slowly transferred from U.S. to LMIC institutions, the training-related research supported was always carried out in the LMIC site.

2.4 Portfolio of Funded Awards

Between 2001 and 2017, a total of 79 awards were funded across the three NCD D43 Programs. Figure 2 illustrates, by program, the number of awards active in each FY. Active awards could extend beyond the time a program was terminated, as some awards were on no-cost extensions (NCE).¹³ For example, the ICOHRTA Program was last funded in 2011; however, 14 programs received NCEs that allowed them to continue participating in the program beyond 2011.

Figure 2: Active Awards by NCD Program, 2001-2017



As illustrated in Figure 2, the ICOHRTA Program started with 14 awards in 2001 and supported up to 19 awards in a given year (FY2006). The introduction of the NCoD Program doubled the total number of active NCD-related awards; in 2010 there were 15 ICOHRTA grants and 16 NCoD grants. The number of supported awards continued to increase with the introduction of the NCD-Lifespan D43 and D71 grants in FY2011. The peak was in FY2012, with the most active awards in a given year (58). Of all the NCD D43 Programs, the NCD-Lifespan Program has funded the most awards in a given year. The number of active awards through the NCD-Lifespan Program has steadily been increasing, starting with 14 awards in FY2011 and growing to 39 active awards in FY2017.

The 79 awards funded through the NCD D43 Programs between FY2001 and FY2017 had a total value of \$79.4 million. Of that, FIC has contributed a total of \$50.5 million, about 64% of the program's total cost. Notably, the FIC contribution as a percentage of total cost has decreased significantly over the past two FYs. For the first time in the history of the NCD D43 Programs, FIC is contributing less than 50% of the program's total annual costs.

¹³ A no-cost extension (NCE) extends a grant's final budget period beyond the original project's expiration date without additional funds. NCEs are given when additional time is needed to ensure adequate completion of the original project's goals or continuity of the grant is required while a competing continuation application is under review. To qualify for a NCE there must be no additional funds requested from the NIH awarding office nor a change to the project's original approved scope.

2.4.1 Applications and Success Rates

The first of the NCD D43 Programs was launched in FY2001 with the issuance of the ICOHRTA FOA. Since then there have been five funding cycles of the NCD Programs: ICOHRTA in 2006, NCoD in 2008, NCD-Lifespan D43 and D71 in 2010 and NCD-Lifespan D71 in 2017. All applications were reviewed through the NIH peer review process, which was overseen by the Center for Scientific Review at NIH.

Since 2001, a total of 279 applications had been submitted by 190 applicants to the NCD Programs. Eighty-eight applications (from 79 unique awards) were funded during the same period--a 32% success rate for all applications. Of the 88 funded applications, 70 (80%) were awarded on their first try while 18 (20%) submitted a second application or amendment before being funded. Two funded applications were unsuccessful in securing funding during the re-competition of their awards. Of the 191 applications that never received funding, 23 applications were submitted more than once.

Table 2: Applications and Success Rates by FOA

	ICOHRTA TW-01-003	ICOHRTA TW-06-002	NCoD PAR-08-175	NCD-Lifespan (D43) PAR-10-257	NCD-Lifespan (D71) PAR-10-277	NCD-Lifespan (D71) PAR17-097
Funded	14	14	16	3	36	5
Not Funded	12	16	50	7	106	0
Total	26	30	66	10	142	5
Success Rate	54%	47%	24%	30%	25%	100%

In its first year (2001), the ICOHRTA Program received 26 applications of which 14 (54%) were funded (Table 2). The next iteration of ICOHRTA averaged a 47% success rate, with 14 of the 30 applications being funded. Of those 14 funded applications in FY2006, 11 were re-competitions for ICOHRTA grants from the first FOA. During these early years, the success rates averaged approximately 50% with the first iteration of ICOHRTA averaging a 54% success rate and the second cycle averaging 47%. The success rate dropped with NCoD with a success rate for 24% for all applicants (Table 2). The D43 NCD-Lifespan saw the highest number of awards funded (36), and the highest number of applications (142). Of the 36 funded applications for the NCD-Lifespan D43s, 14 were from PIs previously involved in other iterations of the NCD D43 Programs: 11 former ICOHRTA PIs and three former NCoD PIs.

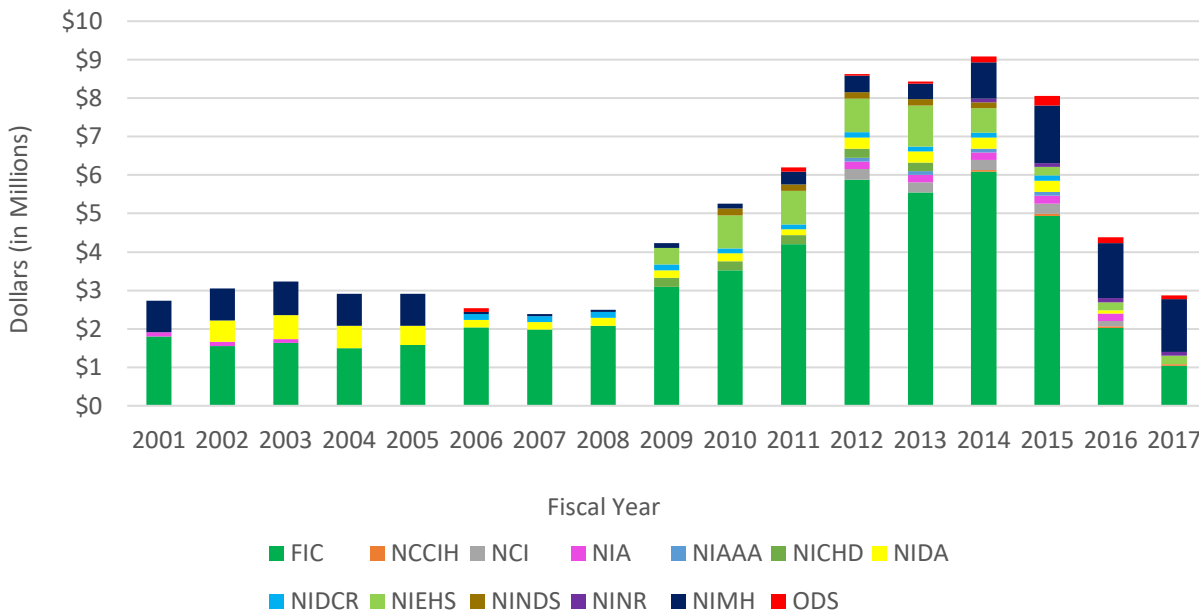
2.4.2 Funding by IC Program Partners

NIH partners have been instrumental in the development and evolution of the NCD D43 Programs. ICOs were engaged in formal consultations and informal meetings with FIC during the development of new iterations programs. In addition, given the requirement that applicants had to have a parent award from another IC, many ICs were already indirectly connected to the NCD D43 Programs.

Over the years, the NCD D43 Programs have leveraged funding from across the NIH (Figure 3). The following ICOs have participated in the NCD D43 Programs: NCCIH, NCI, NIA, NIAAA, NICHD, NIDA, NIDCR, NIEHS, NIMH, NINDS, NINR, and ODS. These eleven partner ICs plus the NIH Office of the Director’s ODS contributed a total of \$28.9M, or 36% of the NCD D43 Programs’ total costs. Interestingly, NIAAA contributed to one NCD-Lifespan D43 award even though the IC was never listed as partner on the FOA. The FIC Program Officer explained that she attempts to interest and engage all

ICs, regardless of their official participation on the FOA once it becomes apparent that an eligible and high scoring applicant’s proposal may interest a specific IC.

Figure 3: Funding Sources by NIH IC, 2001-2017



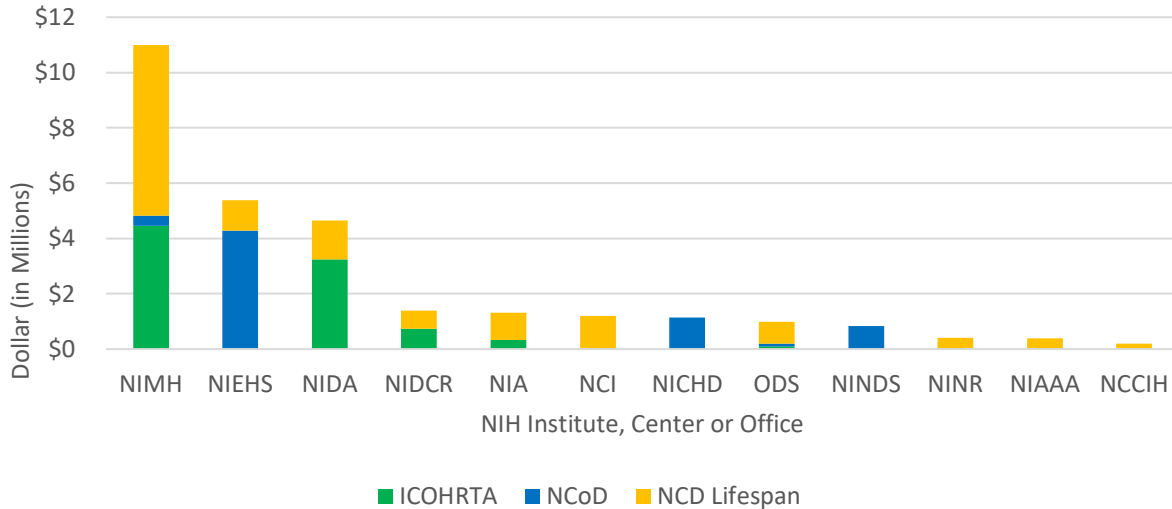
The NCD D43 Programs have successfully catalyzed engagement across the NIH. In the first year, seven ICOs signed onto the ICOHRTA FOA and five went on to financially support awards within the program. ICOHRTA included strict guidance that the topic of research must interest one of the funders listed on the FOA. The NCoD Program had six ICOs participate on the FOA and all but one (NIDA) contributed funds. The original hope was that the three NIH ICs that focused on the four big NCDs (cardiovascular disease, cancer, respiratory disease, and diabetes) would join the NCoD FOA. However, only NCI participated. A key partner during ICOHRTA, NIMH, did not participate on the new NCoD FOA as mental health was not emphasized. One explanation for the decrease in funding partners during this FOA was that the NCoD Program was not strict about applications having to relate to topics of interest to the ICs listed on the FOA. In the most current round of NCD-Lifespan, nine ICOs were listed on the FOA and 10 ICs (due to the addition of NIAAAA) provided funding to the program. Of all the NCD Program iterations, the NCD-Lifespan Program has been most successful in leveraging participation and funding from other ICOs.

Three ICs (NICHD, NIMH and NIEHS) have administered their own NCD awards: NIEHS administered two NCoD awards and one NCD-Lifespan award; NICHD administered one NCoD; and NIMH administered two NCD-Lifespan awards.

NIMH has been extremely influential in the NCD D43 Programs’ design. Their participation and contributions to the ICOHRTA Program are one reason that many awards within the program deal with mental health research (See section 2.4.4). NIMH not only administers two awards, but it is also the most significant contributor investing over \$11M to the NCD D43 Programs (Figure 4). NIMH has provided monetary contributions every year between 2001 and 2017 (Figure 3), with an average annual

contribution of \$647,082. Of the remaining partners, NIEHS and NIDA contributed \$5.4M and \$4.7M followed by NIDCR, NIA, NCI and NICHD (Figure 4).

Figure 4: Total Funding by NIH Partners, 2001-2017



2.4.3 Program Snapshot by Region

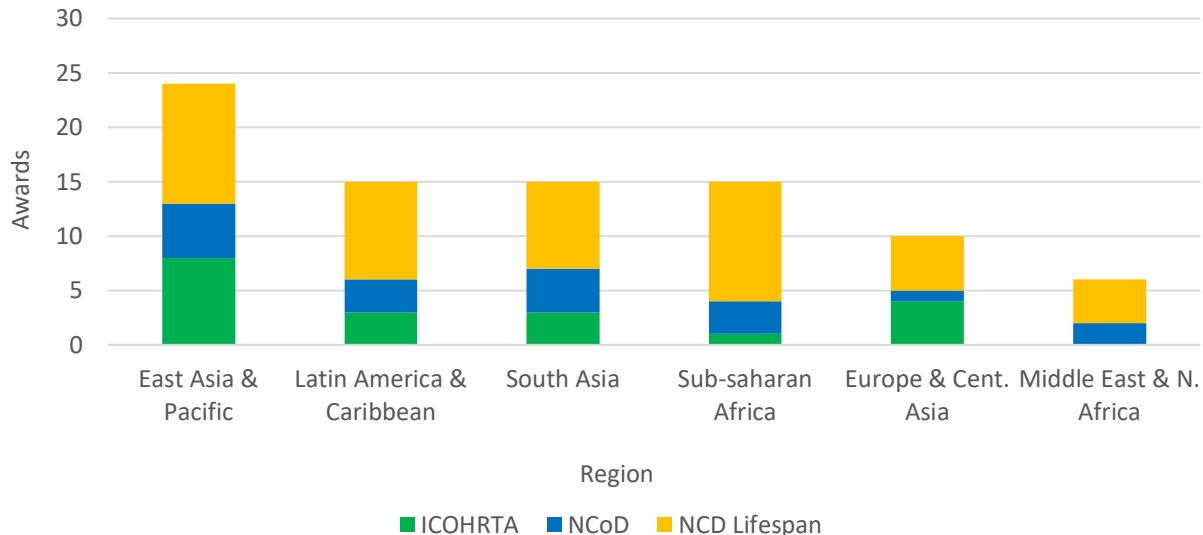
The NCD D43 Programs have had research projects in 44 countries in six regions (Figure 5). Countries were classified using the World Bank’s regional categories.¹⁴ Most of the awards (24, 31%) have supported research and training in East Asia and the Pacific (Figure 6). China and India participated in the most NCD D43 Programs with 11 awards per country.

Figure 5: Country Focus Research of NCD Awards



¹⁴ The World Bank. World Bank Country and Lending Groups. Available at: <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>

Figure 6: Total Number of Awards by Region, 2001-2017



As the research capacity at LMIC institutions grows, their ability to successfully compete for grants and funding increases. The NCD D43 Programs have awarded 14 grants directly to institutions in LMICs, all of which occurred in the past 10 years. Nine of the 14 awards were planning grants (8 NCD-Lifespan and 1 NCoD) awarded to institutions in eight different countries. Uganda’s Makerere University has received the most direct awards (2).

2.4.4 Program Snapshot by Disease Category and Methodology

The research focus of NCD D43 Programs’ awards have evolved over time. In its first FOA, the ICOHRTA Program allowed for a focus on all diseases provided that the research pertained to operational science. The second FOA of the ICOHRTA Program narrowed the focus to NCDs, excluding any infectious disease research. The NCoD Program was focused primarily on the four main NCDs: cardiovascular diseases, cancers, diabetes and chronic lung diseases. However, the NCoD Program did accept and fund other cross-cutting topics such as genetics, environmental factors and lifestyle factors related to NCDs. The NCD-Lifespan Program encouraged all NCDs, risk factors for NCDs and cross-cutting issues.

For the 88 awards in the NCD D43 Programs, the most popular research topics were mental health (24, 27%) and cardiovascular disease (21, 24%) (Figure 7). Mental health and substance abuse are prominent research areas supported within the NCD D43 Programs (ICOHRTA and NCD-Lifespan). At the beginning of the ICOHRTA Program, NIMH promoted the FOA by sending it to their community of grantees. Their continued funding and administering of NCD grants through the evolution of the NCD D43 Programs have resulted in strong representation of mental health.

Figure 7 also illustrates that the NCoD was successful in increasing research and training in the big four NCD areas. Research training related to cancer, respiratory disorders and metabolic disorders were not funded until NCoD; cardiovascular disease (CVD) research was represented in one ICOHRTA grant that was renewed in 2006. During the 2008 NCoD request for applications, 66 applications were submitted

and reviewed of which 42 focused on one or more of the big four NCDs. The most popular NCD of the NCoD applications was cancer with 24% of the 66 applications focused on this disease (Figure 8).

Although NCI was a participating IC on the FOA, they did not support any of the awards for NCoD. Seventeen applications were submitted with cancer as a research focus; however, only two applications were funded. Cancer represented 24% of the applications but only 13% of the funded awards. In contrast to the low success rate of cancer focused awards, CVD-related applications fared well (Figure 8). Nine of the 20 applications centering on CVDs were funded. As a representation of total awards, CVD awards constitute 40% of all NCoD awards-- compared to only 22% of the NCoD applications. Of note, NHLBI did not participate in any of the NCD D43 Programs.

Figure 7: Research Topics of Funded Awards, 2001-2017

Note: Applications can focus on more than one research area. As such, a grant can be counted in more than one NCD category.

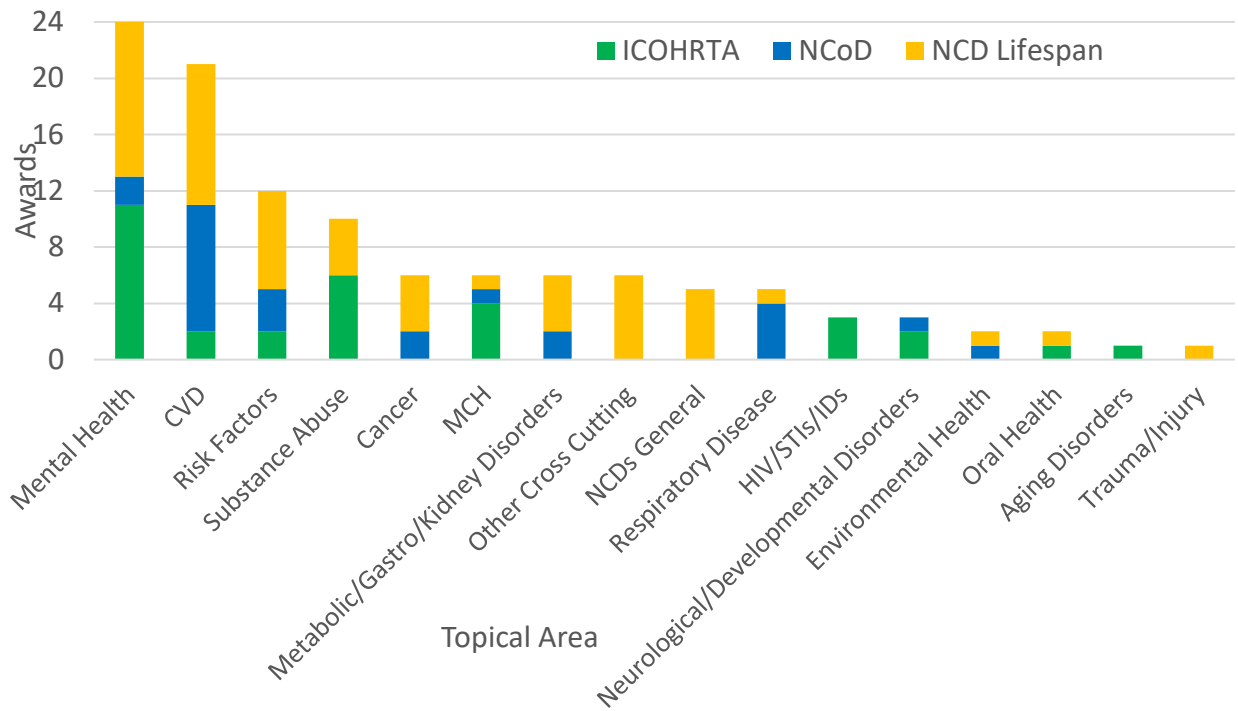
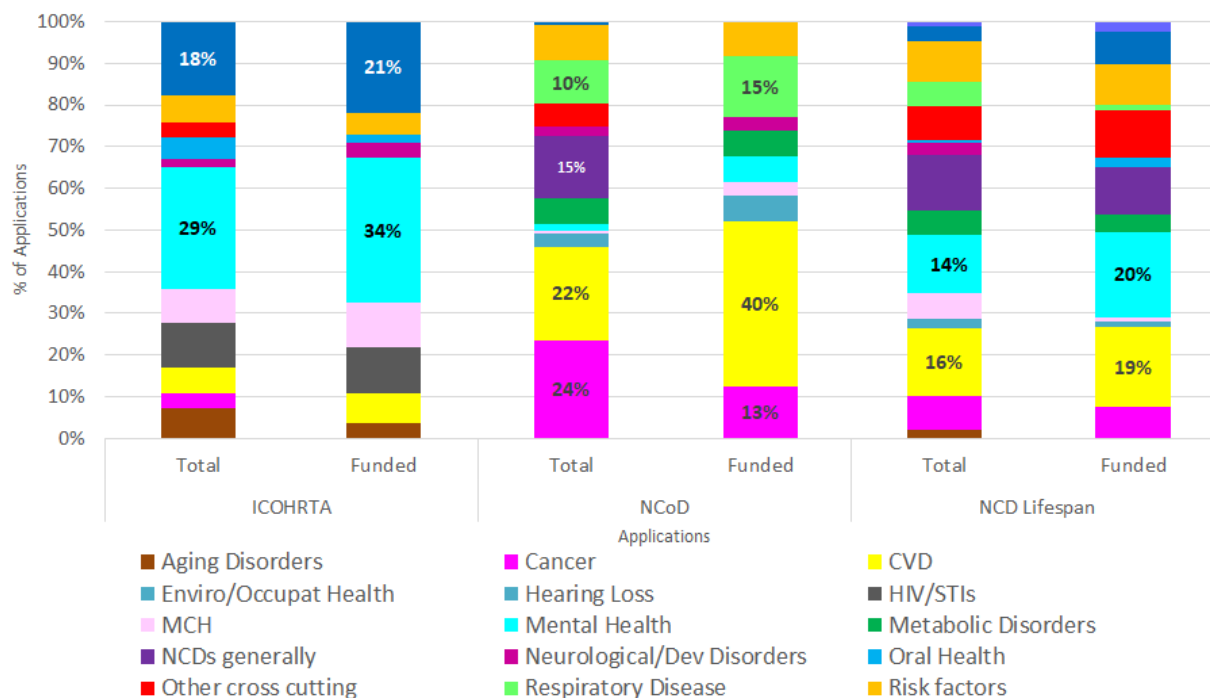


Figure 8: Topical Areas of Funded v. Unfunded Awards, 2001-2017

Note: Applications can focus on more than one research area. Therefore, a grant was evenly distributed between the multiple NCDs to total 100%.



The PARs for the NCoD and NCD-Lifespan Programs also emphasized research on lifestyle and behavioral risk factors that can escalate the burden of NCDs. Some common risk factors include under- and over-nutrition, obesity, and tobacco smoking. Of the 36 applications focused on risk factors, 18 (50%) included a specific NCD along with a risk factor. In the NCD-Lifespan Program, seven of the 22 applications (32%) with a risk factor topic were funded. As a representation of all funded awards in NCD-Lifespan, these seven grants constituted 10% (Figure 8). The NCD D43s Programs have stimulated research and supported training in risk factor focused applications at a steady rate over time. Since ICOHRTA, partners have steadily co-funded about half of the risk-factor awards.

Another cross-cutting issue for NCD research is comorbidities. The NCD-Lifespan has successfully attracted some applications that seek to understand the way diseases interact with one another and how to best treat them given their relationships. Two of the six applications (33%) related to comorbidities were funded since 2010.

While the NCD D43 Programs have successfully attracted a variety of research related to NCDs, cross-cutting themes and risk factors, there are a few areas that have not been funded. Applications have been submitted focusing on gastro disorders, hearing issues and chronic kidney diseases but none of these NCDs have been funded to date (Figure 8).

As mentioned in Section 2.1.1, HIV was originally included in the 2001 FOA for ICOHRTA. As such, there are three grants in the NCD D43 Programs that are infectious disease related (Figure 7). These HIV researchers acted as mentors to other grantees in the 2001 ICOHRTA cohort. The three HIV researchers had already been involved in other FIC D43 programs, such as the AIDS International Training and

Research (AITRP). With their prior experience with other research training programs, these researchers had the knowledge and practice of how to build a successful research training program in a LMIC. Their roles as mentors were most evident during the network meetings when grantees met to exchange ideas, best practices, struggles and challenges.

3.0 Process-Related Results

To evaluate whether the NCD D43 Programs operated as intended, process-related questions related to continuity across the programs and networking opportunities (among other aspects) were assessed.

3.1 Continuity Across the NCD D43 Programs

The NCD D43 Programs encompass three programs that, in total, issued six funding announcements. Notably, 14 of the NCD-Lifespan D43 grantees were previously funded under an earlier iteration (11 grantees from the ICOHRTA Program and three from the NCoD Program).

While many grantees have successfully transitioned from an earlier NCD Program (e.g. ICOHRTA or NCoD) to the current NCD-Lifespan Program, some grantees expressed concern regarding the termination of programs like the ICOHRTA and the lack of continuity regarding research priorities between programs.

“It was a disappointment to be unable to re-compete for renewal under the ICOHRTA mechanism. In some respects, we built up a head of steam but then had to abandon the forward progress except for annual visits of the state-side faculty to the LMIC sites and some additional visits of the fellows to scientific meetings and the like. These have been financed by our home institution and with personal funds (with NIDA supporting fellows to travel to scientific meetings as well). The most recent of these visits [was December 2016] to meet with and encourage fellows and faculty of our program... showing the continuing engagement and value of the program.”

“[Our] program has been highly valued and much appreciated. Current/ongoing uncertainty about programmatic priorities [and] continuing mechanisms has left uncertainty re: our efforts to continue such work.”

“It would be excellent if there would be opportunities to apply for a further round of research training funding based on successful conduct of the initial training programs to support long-term sustainability of training programs set-up in LMIC.”

Another concern mentioned by grantees was the length of the funded research and training. Some grantees reflected that the five years of funding (typical of the D43 mechanism) was not long enough to create long-term change and impact in research and building capacity, and that a longer funding period may be necessary in some LMICs. Recall that as of 2018, the only NCD Program to offer a D43 FOA reissuance was the 2006 ICOHRTA Program. Regarding this issue, grantees noted in their survey that:

“The challenge of cutting the initial award from a 5-year project to 4-years on top of another administrative cut was difficult to navigate. But this circumstance was beyond our control and likely Fogarty's as well.”

“Need to have 10-15 year cycles for some countries”

“The D43 was very transformative, making training for implementation of NCD research possible. Five years support is short.”

“This was a great program but five years is way too short to train folks in this kind of research.”

Lastly, some grantees expressed concern about the change in country eligibility for FIC training programs (NOT-TW-12-011) in 2013. As of 2013, FIC no longer accepted research training or career development applications from, or involving scientists from, upper middle-income countries (UMICs) that are also members of the G20 except for sub-Saharan African countries. Such a policy impacted some prior NCD grantees, who shared:

“The program was key to advance a very important line of investigation. My country is no longer eligible for it but hopefully it will be again in the future.”

“Unfortunately, FIC took the decision not to fund Middle Income countries and consequently we could not proceed with FIC support, a fact that strongly jeopardized our training program and the achievements obtained in such a program.”

3.2 Networking Opportunities

Collaboration among U.S. and LMIC researchers allows people, institutions and countries to capitalize



Individuals gather at the NIH to discuss global health at their universities.

Photo Courtesy of Jeff Gray for NIH/FIC

on individual strengths beyond the reach of any single entity. The NCD D43 Programs encourage the establishment and fostering of partnerships among researchers and institutions.

When asked if the NCD D43 Programs provided sufficient opportunities to interact with other awardees and their collaborators, 92% of the responding grants “Agreed” or “Strongly Agreed” with the statement (Table 3). Ninety-two percent of grants also “Agreed” or “Strongly Agreed” that the LMIC institution was supportive of their NCD Project. All respondents agreed that their

network of contacts expanded due to the NCD D43 Programs. When asked if they felt that the NCD D43 Programs encouraged the engagement of alumni; 90% of grantees “Agreed” or “Strongly Agreed,” 5% were “Neutral” and 5% “Disagreed” with the statement.

Table 3: Survey Response Regarding the Collaborative Experience During the NCD Award (Range from Strongly Disagree to Strongly Agree)

Statement	No. of Grants	Responses
The NCD D43 Programs provided sufficient opportunities to interact with other awardees and their collaborators	39	Strongly Agree: 20 (51%) Agree: 16 (41%) Neutral: 3 (8%)
The LMIC institution was supportive of our NCD Project	40	Strongly Agree: 23 (57%) Agree: 14 (35%) Neutral: 3 (8%)
Participation in the NCD D43 Programs expanded my network of contacts among NCD researchers in my collaborator’s country or region	41	Strongly Agree: 25 (61%) Agree: 16 (39%)
The NCD D43 Programs encouraged the engagement of alumni	41	Strongly Agree: 23 (56%) Agree: 14 (34%) Neutral: 2 (5%) Disagree: 2 (5%)

3.2.1 FIC NCD Network Meetings

Network meetings are held annually to support past and current grantees involved in the NCD D43 Programs. The purpose of the network meetings is to provide an opportunity to exchange research and training experiences and coordinate program activities. All individuals involved in the grant, including PIs, foreign collaborators, program administrators and trainees, are encouraged to attend. PIs who are inactive (e.g. on no-cost extensions, previous grantees) are also invited to attend. Active grants are encouraged to budget for these meetings in their annual expenses.

The meeting helps foster a network of current and former NCD grantees that can share their experiences, learn and interact with scientists in their field. Most grantees felt the meetings were worthwhile, while there were some suggestions for improvement.

“Meeting with other grantees in NIH Bethesda broadened my view on translational and implementation science. I have built a richer network of collaborators.”

“I enjoyed the networking at NIH NCD meetings”

“Learning from other programs is very helpful but every other year FIC meetings makes networking more difficult. Would be helpful to have an annual meeting and perhaps more networking tools”

As mentioned, trainees are also encouraged to come. Usually a panel session is dedicated to trainees and their experiences. In prior years, there were activities clearly oriented towards trainees; for example, workshops on grant writing and scientific publishing were given during network meetings.

3.2.2 Networking with Centers of Excellence

Strong partnerships are key to leveraging resources, harnessing expertise outside of an institution, and building synergy across a region.

Grantees were asked how their training projects incorporate or interact with research networks and Centers of Excellence in the regions where the research takes place. Responses ranged from no interactions to sustainable, long-term interactions with institutions for research or capacity building efforts. A full list of these responses is found in Appendix E.

Limited to No Interaction. A handful of grantees reported instances of limited or strained interactions with local institutions. Some grantees noted that there were no Centers of Excellence or strong research networks within their region; therefore, they often would link their program to existing NIH funded studies in the area or local researchers with overlapping areas of interest. Other grantees noted that the political or government climate inhibited their project and interactions with local institutions.

Research or Training Interactions. The majority of responding grantees provided examples where their NCD grant interacted with other local research institutions or Centers of Excellences.

Sometimes co-PIs involved in the NCD D43 Programs were already linked to other institutions:

“The local PIs are Directors or PIs to Centers of Excellence involved in capacity building and research such as Nigeria’s Centre for Population and Reproductive Health, College of Medicine ... Therefore, it was easy to interact and incorporate these with our training models. They enlarged the coverage of the training models including workshops and stakeholder meetings. Research collaboration in NCD between the LMIC and U.S. became enhanced and enlarged.”

“We tapped into several networks for our students and usually they were related to the PI activities. Some examples: Heart of Africa; Cardiovascular networks in Africa; Human Heredity and Health in Africa (H3Africa); International Network for the Demographic Evaluation of Populations and Their Health in Developing Countries (INDEPTH).”

Grantees also integrated with regional institutions via shared trainings, mentoring and workshops:

“The training is based on a strong collaboration with an in-country Center of Excellence, where 50% of the training took place. The center is part of very extensive national and international research networks.”

“The trainees were either employees or collaborators of reference research institutes from Romania. Every other year an NCD conference was organized, bringing together both the trainees and researchers & practitioners in the field of NCD.”

“Our program selected all fellows from two of the most important centers of excellence in China: the Shanghai Mental Health Center, and the Peking University Institute of Mental Health. We worked closely with the networks of researchers based in these organizations.”

“Training was provided to students from other academic institutions. Professors from other institutions participated in courses and workshops.”

“Makerere and Hopkins both have many such research centers and our fellows had access to both sides; we had seminars with lecturers from such centers.”

Some grantees shared how their award interacts with other FIC or NIH-funded projects:

“Builds upon other prior NIH and FIC training efforts. Links to other NIH projects funded at in-country institutions - PEPFAR, NIAID projects, MEPI etc.”

“Our training took full advantage of on-going cohort studies that we are leading at the LMIC and on-going research projects at Vanderbilt by involving trainees in the research activities. We also collaborating the LMIC partners to organize in-country workshops.”

“Collaboration in research/studies/mentorship support with a network of Fogarty Trainees trained under ITREOH at the University of Iowa.”

3.3 Other Sources for Funded Projects

One of the key lessons learned from early attempts to develop scientific research capacity in LMICs is the importance of in-country institutional support. While institutional support can take many shapes, from financial to technical to infrastructure support, the backing of the LMIC institution is an indication of the institutional commitment to the goals of the training or research project.

Grantees were asked about supplemental contributions to their NCD grant. Thirty-seven (90%) of the 41 grants surveyed reported that their NCD grant had support from a source other than the NIH. Since five of the awards were direct awards to a foreign institution, they did not have a U.S. institution collaboration and are excluded from the U.S. Institution Column. The type and sources of support are described in Table 4.

Table 4: Survey Responses Regarding Source(s) for Supplemental Resources

Resource	U.S. Institution* (n=36)	LMIC Institution (n=41)	Third Party (n=41)
Supplemental Funds for Research	15 grants (42%)	18 grants (44%)	12 grants (29%)
Salary Support for your LMIC collaborators	6 grants (17%)	25 grants (61%)	5 grants (12%)
Facilities or Equipment	21 grants (58%)	26 grants (63%)	4 grants (10%)
Technical Support including paid students	13 grants (36%)	18 grants (44%)	5 grants (12%)
Administrative Support	20 grants (56%)	24 grants (59%)	5 grants (12%)
Other	3 grants (8%)	1 grant (2%)	1 grant (2%)

*Five grants were direct awards to a foreign institution. They do not have a U.S. Institution collaborator and are excluded from the final count.

Of those 37 grants, 19 provided additional explanation of the sources and use of these funds including:

- American University of Beirut provided funds to implement the protocol
- Anonymous donor provided Administrative support
- Bill & Melinda Gates Foundation provided supplemental funds for research

- China’s CMB provided supplemental funds for research
- Faculty and fellows received funding to support services, research, policy programs, from the Chinese CDC, Ministry of Health, and Ministry of Finance, and many other international sources as well.
- Private donations like freezers, etc. to SHARE Research Foundation
- Indian Council of Medical Research provided supplemental funds for genomics research
- Japanese Agency for International Development supported purchase of equipment
- Regional WHO office funded some trainee research and salary support
- Johns Hopkins University contributed time and effort beyond grant funding, especially for administration and lab supplies during training; trainee travel funding to scientific meetings; hosting trainees in laboratories;
- School of Public Health of the Health University of Mongolia contributed funds and equipment, as well as partial support for administrators
- Mongolian government provided student stipends
- University of Pittsburgh provided support like faculty salary support, faculty travel, graduate student support and travel
- Suranaree University of Technology provided support every year for one of our collaborators, space, hotel housing for conference speakers, and hosting support for a national conference
- Postdoctoral trainees' institutions continued to pay their salaries while they were in the US
- University of Michigan provided office space, computer workstations, and library access.

3.4 Other Issues Raised by Awardees

Concerns regarding collaborations with the LMIC institution included:

- The need to satisfy multiple IRBs
- The challenge of distributing funds
- The lack of interest if there was no immediate clinical or treatment focus
- The limited amount of time and funds available to perform dedicated research (instead of patient or clinical care)

A more comprehensive list of research challenges can be found in Section 4.5.

3.5 Stakeholder Engagement and Dissemination

Community engagement in research ensures that the research being

I want to express my deep gratitude to FIC NIH. I have made sure everywhere in Guatemala knows where this support is coming from. We are deeply grateful to the University of Pennsylvania. I can say that the Guatemala-Penn Partnership has been a success, and in addition, our Universidad de San Carlos de Guatemala has been deeply strengthened with this support from FIC/NIH. As a matter of fact, this year 5 new schools joined us in strengthening the collaborative efforts between [Latin American] countries. I hope that, as the new kids in the block, we obtain the proper respect and recognition of other institutions that work with NIH and FIC. We do not need to work separately, and hope they can understand we are here, with a new vision, energy, enthusiasm, and are ready to produce... Thanks again for all of your support, the advisors, and the fantastic team from FIC and NIH. We are making sure that your trust and support changes research culture and policies in Guatemala!

Foreign Collaborator on a NCoD Award

conducted aligns with local health priorities. Engaging community members at the beginning of the research process builds buy-in and may improve the probability that research findings will be adopted.

As part of the FOA, the NCD D43 Programs instruct applicants to “describe how the proposed research training program might serve as a bridge among the academic research community, policy makers and public health communities in the country”¹⁵. To address this requirement, applicants may choose to conduct a needs assessment or engage with local health stakeholders at various points throughout the project.

When asked how the local needs of the community were determined prior to initiating the NCD award in the LMIC, the majority of the 41 responding grantees (33; 80%) reported that they or their collaborator had previously been conducting NCD research at the LMIC/institution prior to securing FIC funding (Table 5). Roughly 59% (24) of the survey grants stated that they had conducted a needs assessment while 15% (6) of the grants stated that they had not.

Table 5: Survey Responses Regarding Determining Community Local Needs Prior to NCD Award

Response	No. of grants	Percentage of grants
Myself or my collaborator has previously been conducting NCD research in this field at this institution/region prior to us getting FIC funding	33	80%
We conducted a NCD needs assessment that took into account the input of potential end-users and LMIC institution stakeholders of that LMIC.	24	59%
We looked at the Global Burden of Disease to determine the needs of the region/LMIC.	18	44%
The LMIC institution came to me or my collaborator asking for us to build research and training capacity in NCD research	14	34%
We did not conduct a rigorous needs assessment	6	15%

Grantees were also asked how they shared the details of the research training projects with end-users in the LMIC (Table 6). The majority (28; 68%) of responding grantees stated that they discussed the project with end-users during and after the period of FIC support. Only one grant (2%) did not engage with end-users about their project.

Table 6: Survey Responses Regarding the Sharing of Information with LMIC End-Users

Response	No. of grants	Percentage of grants
Yes, we discussed the project with potential end-users during and after the period of FIC support	28	68%
Yes, we discussed the project with potential end-users during the period of FIC support	11	27%
Yes, we discussed the project with potential end-users after the period of FIC support	1	2%
No, we have not conferred with potential end-users about the details of the funded project	1	2%

¹⁵ Chronic, Non-Communicable Diseases and Disorders Across the Lifespan: Fogarty International Research Training Award (NCD-LIFESPAN) (D43). <https://grants.nih.gov/grants/guide/pa-files/PAR-10-257.html>

The 40 grantees who actively disseminated results did so through in-country workshops, events, seminars or conferences (36, 90%); individual meetings or emails (33, 83%); and/or peer review papers (26, 65%). See Table 7 for other mechanisms utilized in sharing with end users.

Table 7: Survey Response Regarding How Information was Shared with LMIC End-Users

Mechanism of Sharing info	No. of grants	Percentage of grants
In-country workshops, events, seminars or conferences	36	90%
Individual emails or in-person meetings (one-on-ones)	33	83%
Peer review papers	26	65%
Community agency publications, websites or list-servs	14	35%
Media coverage or press releases to the media	13	33%
Flyers, posters, brochures, newsletters	12	30%
Policy briefs	12	30%

4.0 Program-Related Results

Over the past two decades, the NCD D43 Programs have helped generate scientific advances to inform healthcare systems, raise awareness regarding the increasing burden of NCDs, increase the NCD research capacity in LMICs and inform NCD-related policies and practices. This section discusses the contributions of the NCD D43 Programs in terms of scientific outputs (e.g. publications, funding), public health outcomes (e.g. policy, practice), and capacity building efforts (e.g. trainees).

4.1 Enhanced Empirical Evidence

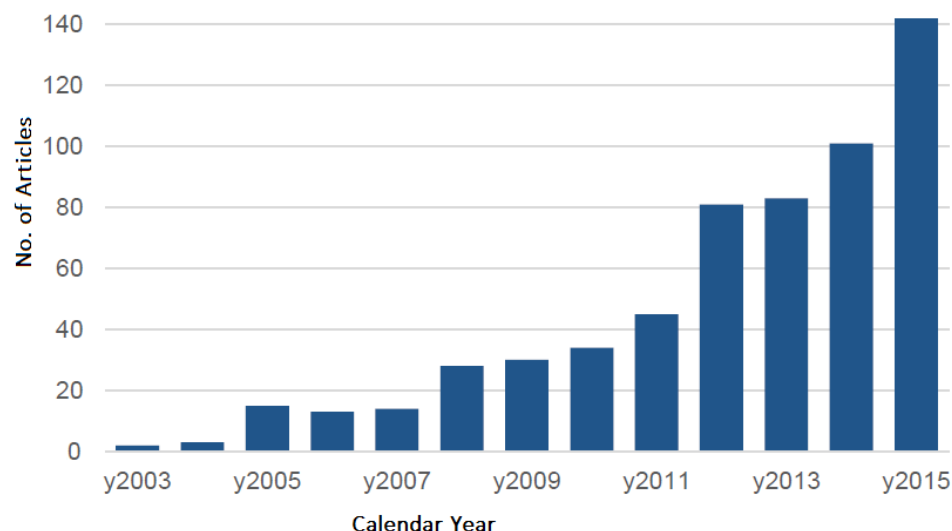
4.1.1 Publications

The NCD D43 Programs have contributed to progress in key scientific areas by generating evidence related to NCDs including, among others, mental health, risk factors like nutrition and obesity, and cardiovascular disease.

Publications Citing FIC Grant: From 2003 to 2017, a total of 982 publications citing an NCD grant were published. A list of all publications can be found in Appendix F.

A bibliometric analysis of these publications was conducted on article counts, collaborations, research themes and citation impact. Citation analysis data was limited to 2003-2015. A cut-off of 2015 was selected because publications must be at least two years old to have received enough citations for bibliometric and citation indicators to be reliable. As such, the following data includes a total of 591 publications published by 54 of the 75 NCD D43 Programs' grants. Of the 591 publications 85% were articles, 7% editorial material, 4% review articles, 4% other (e.g. letters, proceeding documents). The data demonstrates that the number of publications steadily increased between 2003 and 2015, with the most articles published in 2015 (Figure 9). This is likely due to the rise over time in the number of active grants.

Figure 9: Articles per Year, 2003-2015



Mental health, risk factors (e.g., obesity, nutrition), and cardiovascular disease were the most prevalent topics (Figure 10). Of the total number of articles published, 128 articles (22%) were focused on mental health (mental health was focal point of 24 grants (30%) funded through the NCD D43 Programs). “Risk Factors” were the focus of 120 publications despite only 15% of the funded grants focused on risk factors.

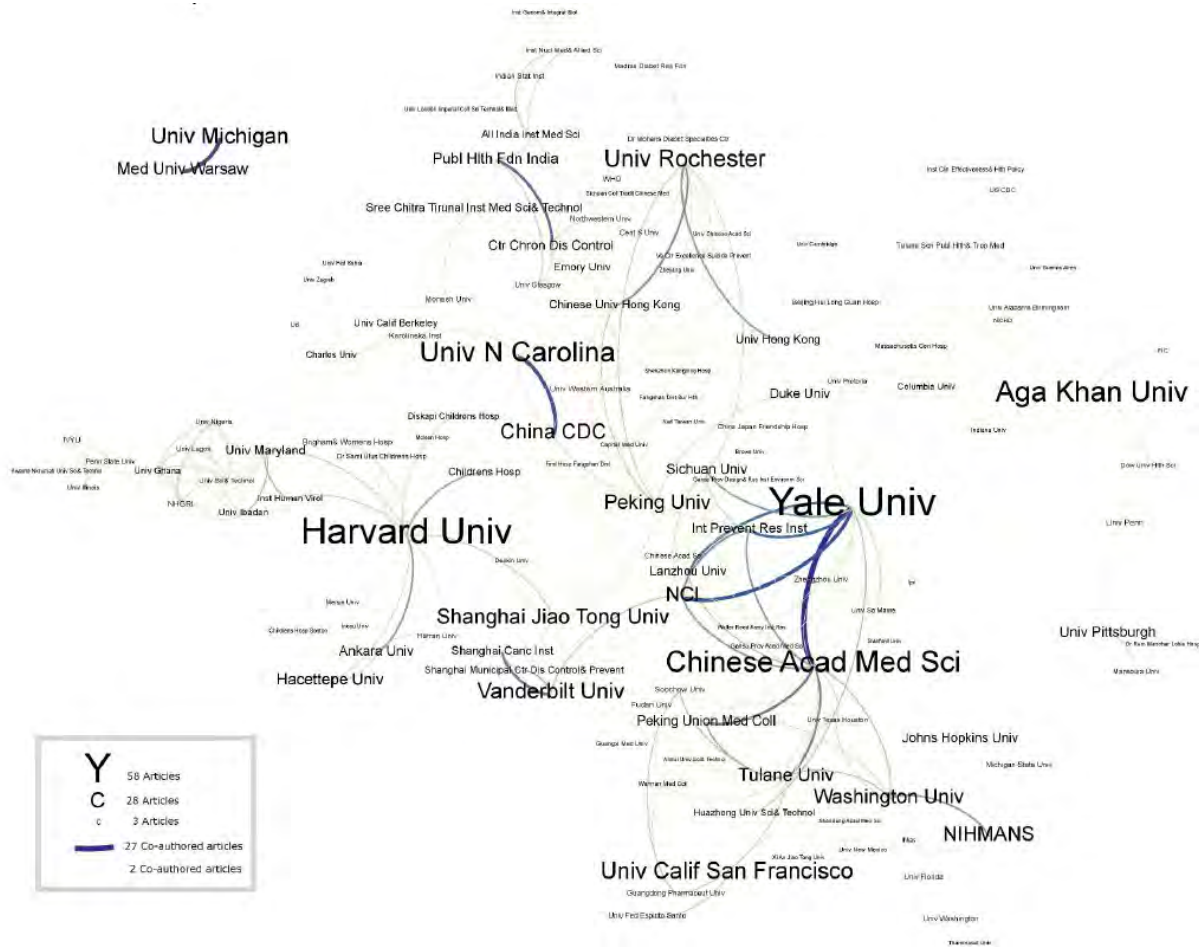
Figure 10: Top Categorization of the NCD Articles, 2003-2015

Note: Articles can focus on more than one research area. As such, a grant can be counted in more than one NCD category.

NCD category	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Grand Total
Mental Health/Behavioral Health		1	7	4	2	12	13	10	10	15	9	20	25	128
Risk Factors						4	6	8	11	17	25	27	22	120
Cardiovascular Diseases					2		2	1	6	14	15	16	35	91
Substance Abuse/Addiction			4	3	1	5	6	7	6	13	11	8	12	76
Cancers			1				1	10	8	11	13	7	11	62
Metabolic/Gastro/Digestive/Kidney Disorders	1		2		3	1	2		1	6	11	10	18	55
HIV/STIs/Infectious Diseases			2	5	1	8	6	4	4	2	6	12	4	54
Trauma/Injury	1		2		3	3	5	4	6	7	6	5	10	52
Neurological/Developmental Disorders		1	3	3	3	2	2	2	3	6	9	5	5	44
Maternal/Child Health				1		2			1	2		2	9	17
Reproductive								2	1	2	3	1	1	10
Environmental/Occupational Health									2	1	2		2	7
Bone Diseases							1		1	2	1	1		6
Eye Diseases						1	2	1					1	5
Respiratory Diseases							1			2		1	1	5
Oral Health										1			1	2
Aging Disorders												1		1
Grand Total	2	2	21	16	15	38	47	49	60	101	111	116	157	735

The institutional affiliations of co-authors were mapped (Figure 11) to illustrate collaborations across countries and institutions. Institution names are sized based on the number of articles with institution affiliations and are connected if authors from those institutions co-authored at least two articles. Yale and Harvard Universities had the most publications (58 and 53 respectively) followed by the Chinese Academy of Medical Sciences (41) and Aga Khan University in Pakistan (40). As shown in Figure 11, the groups of institutions with the most collaborations and greatest productivity are clustered into the center of the image, while institutions who work more independently are located on the periphery.

Figure 11: Institutional Co-Authorship Network for NCD-Funded Publications, 2003-2015



When aggregated by country, authors from the U.S. (436 publications) and China (186 publications) had the most publications.

A citation analysis was also conducted for the 591 publications citing a NCD grant. Table 8 lists common bibliometric indicators. The self-citation rate (2%) is the percent of the citations received by these articles that were made by all authors of the papers in this analysis. Most disciplines have rates between 2 and 10%. The h-Index (40) indicates that the authors published 40 articles between 2003 and 2015 that have each been cited at least 40 times. The “percentage of articles in the top 10% for citations” indicator illustrates that 9% of all publications were cited enough times to place them in the top 10% for articles published in the same discipline during the same year; this is a normal value for a program.

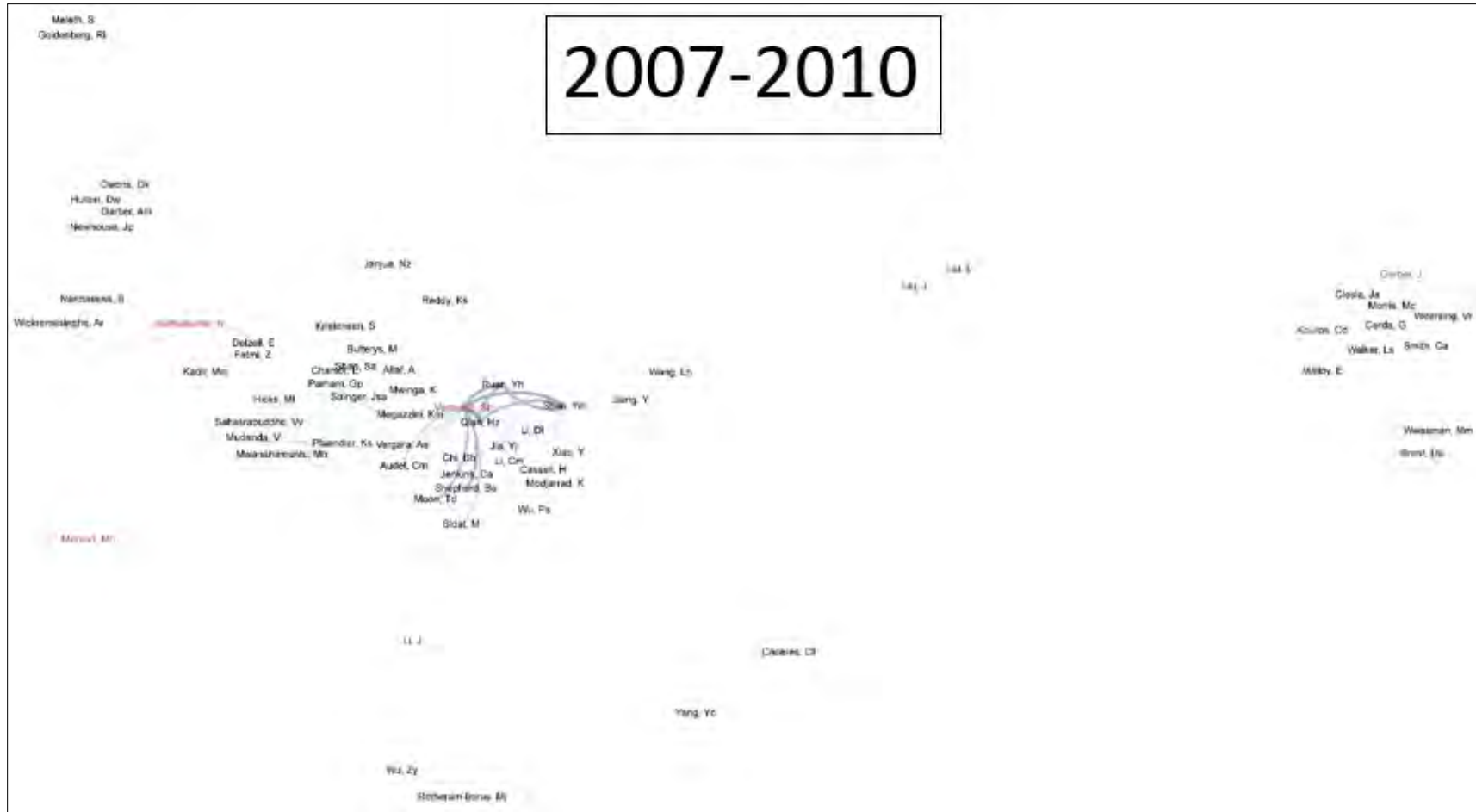
Table 8: Bibliometric Indicators for NCD Citing Articles, 2003-2015

Bibliometric Indicator	Value
Number of Citations (Times Cited)	7,761
Mean citation count	13.13
Median citation count	7
Self-citation rate	2%
Portfolio h-index	40
No. of articles in the top 10% for citations	51
Percentage of articles in the top 10% for citations	9%

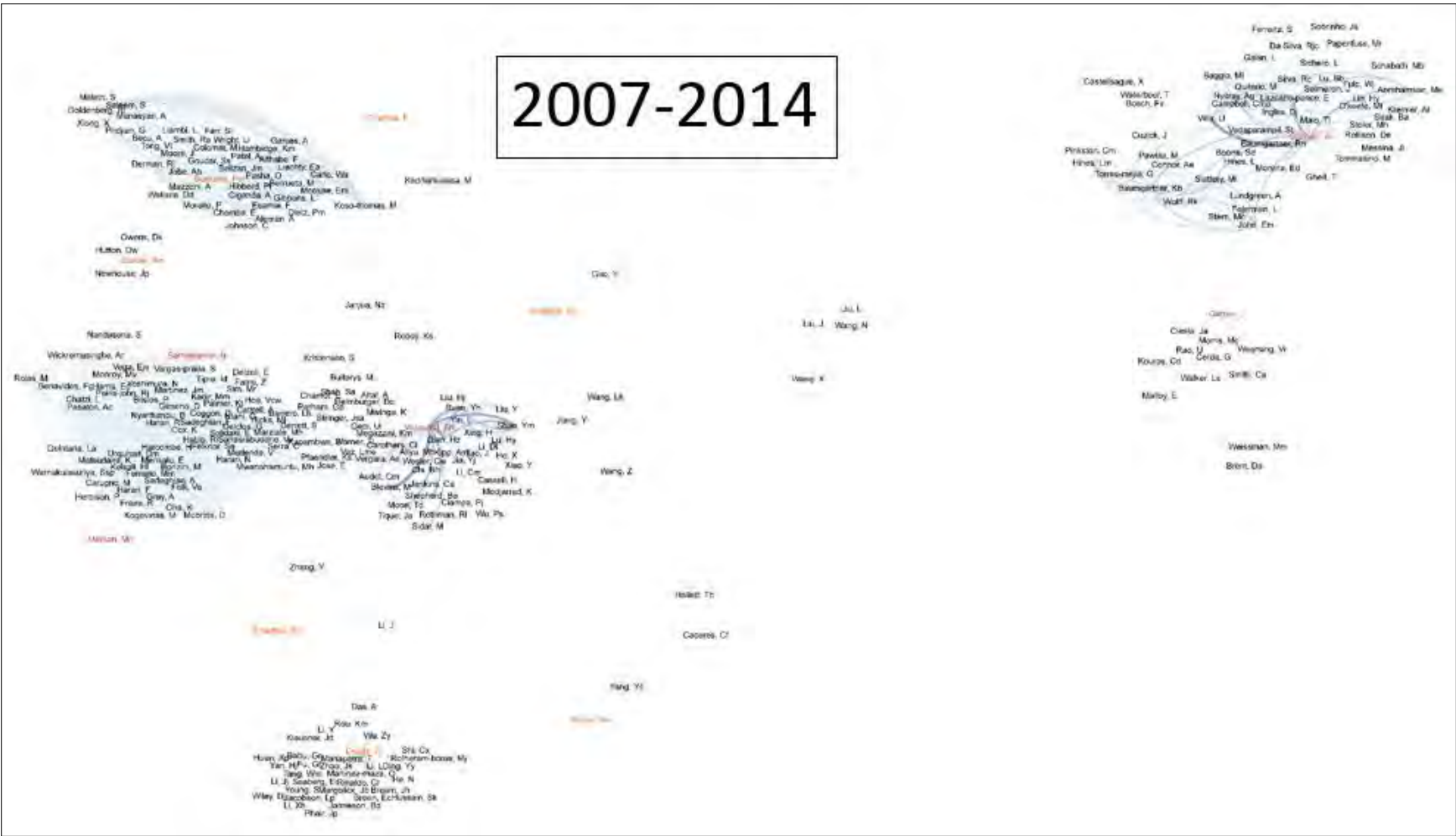
Co-Authorship of Alumni: The impact of the NCD D43 Programs on collaborations between U.S. and LMIC researchers was assessed through a co-authorship network analysis of alumni grantees, those grantees whose NCD grants have ended, and their subsequent, non-NCD funded publications. A network looking at solely alumni grantees and their co-authors helps determine if the research relationships fostered during the NCD D43 Programs were sustainable and extended beyond the funding period of their grant.

A time series co-authorship network (Figure 12) was developed to show the change over time in collaborations on academic papers. The publications included in this alumni analysis are publications that do not cite their previously funded NCD D43 grant. The graphic displays co-authors of post-grant publications between 2007 and 2017 produced by alumni grantees of the NCD D43 Programs. For this analysis, only authors who published at least five articles are included in the network and to be connected to another author, one must have co-authored at least three articles. PI names are colored based on the time periods in which they first published after their grant ended, beginning with 2007-2010 denoted in red to 2015-2017 denoted in green.

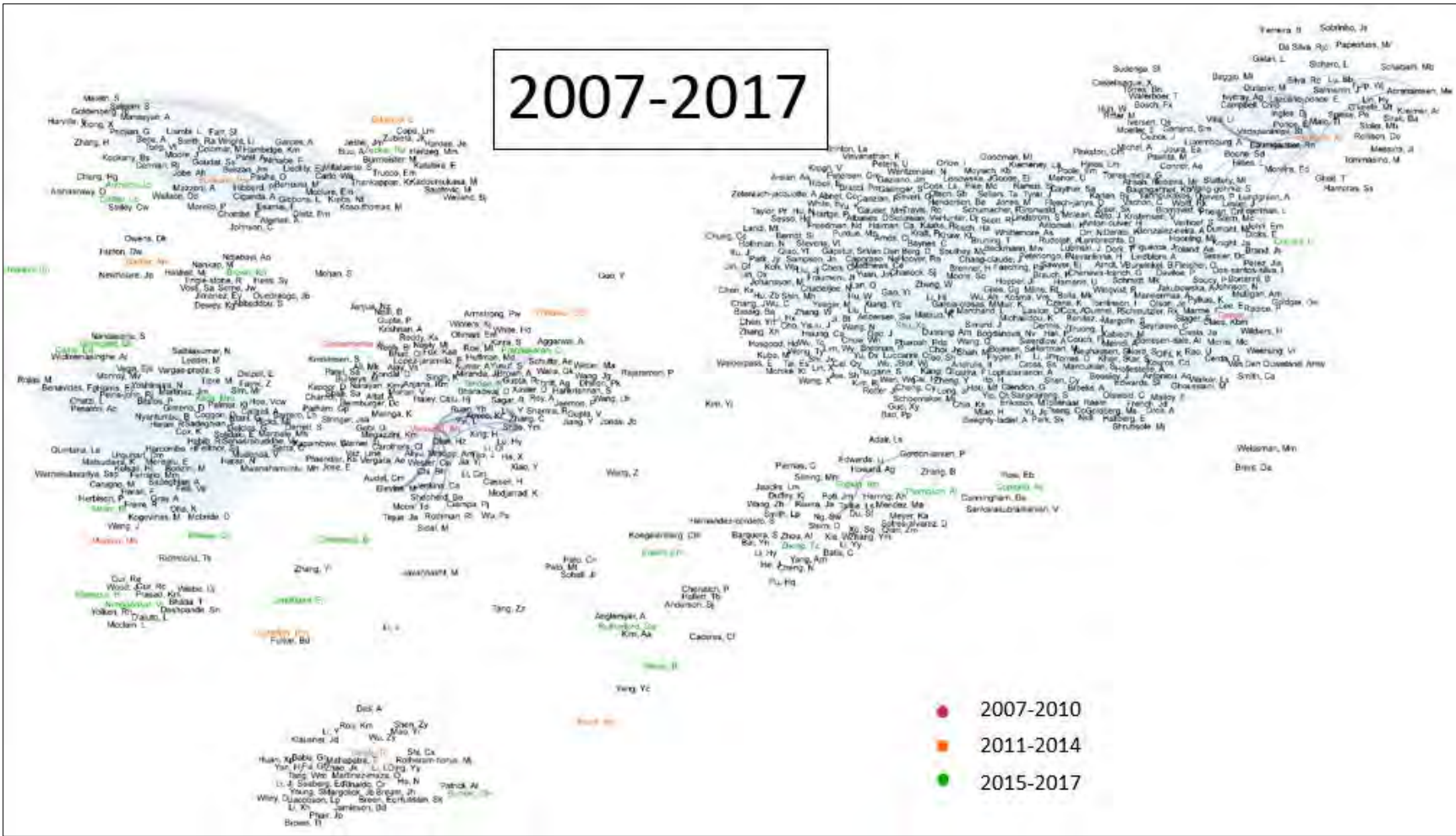
Figure 12: Co-Authorship Alumni Network Over Time, 2007-2017



2007-2014



2007-2017

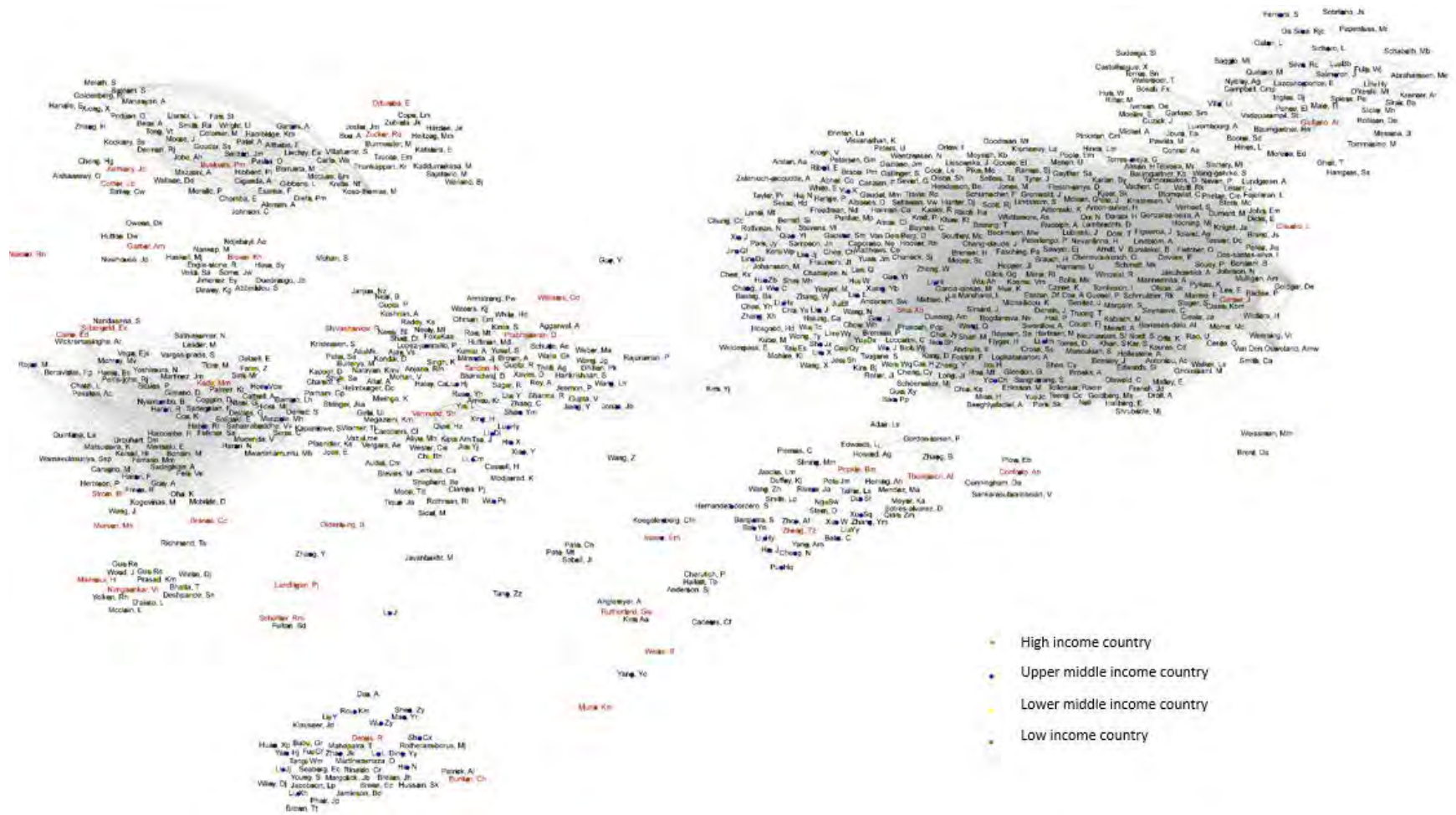


A total of 49 alumni grantees have published 1,779 post-grant articles between 2007 and 2017. Thirty-eight of these 49 grantees fit the criteria as a “major author” having published more than five articles since their tenure as an NCD grantee. Some authors (7) are depicted in the figure as not having many co-authors. This may be because most of them are recent alumni and may have not had as much time to publish.

The 2007 to 2017 time series of the co-authorship network (Figure 12) illustrates the increase in collaborations between authors over time. This increase may be due to the growth in the number of alumni of the programs over time.

The co-author network was disaggregated by income levels to examine who the major authors were (Figure 13). The color dots next to an author’s name represent the income level of the country with which the author is affiliated. The country is determined by the author’s affiliated institution. From 2007-2017, the majority of grantees (26; 69%) published at least three articles or more with a co-author from an LMIC. Since these are publications post-NCD funding, this suggests that the grantees are continuing their collaborations with foreign scientists.

Figure 13: Co-Authorship Alumni Network by Income Level, 2007-2017



Interestingly, the article topics published post-NCD award shifted slightly. The most common research topics for funded NCD grants were mental health and cardiovascular disease (Figure 7). Similarly, for articles citing an NCD award, mental health, risk factors and cardiovascular disease were the most published topics (Figure 10). However, the number of alumni publishing articles on cardiovascular disease decreased. Risk factors (e.g., nutrition, obesity), maternal/child health and mental health (Figure 14) were the topics most published on post-awarded publications. These shifts suggest that the alumni grantees continue to conduct NCD-related research but not necessarily in the NCD area of their original NCD D43 grant.

Figure 14: Alumni Articles per Major NCD Category, 2007-2017

NCD category	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Grand Total
Risk Factors		3	1	2	6	5	10	61	72	108	104	372
Maternal/Child Health		2	1	1	3		10	14	17	16	17	81
Mental Health/Behavioral Health	6	4	3	2	2	3	3	12	20	13	10	78
Reproductive	1	2	6	3	4	6	6	12	12	16	7	75
HIV/STIs/IDs		5	4	6	5	5	7	14	14	7	7	74
Substance Abuse			1	2	2		3	4	5	7	5	29
Environmental/Occupational Health		1	4			2	2	1		2	13	25
Genetic Predisposition to Disease							1	1	1	14	3	20
Metabolic/Gastro/Digestive/Kidney Disorders							1	2	1	7	3	14
Cardiovascular Diseases				1			3		2	4	3	13
Cancers				1		1		1	1	6		10
Trauma/Injury								1	4		3	8
Oral Health							1	2	1	3		7
Neurological/Developmental Disorders								1	3	1	1	6
Bone Diseases										2	3	5
Aging Disorders		1						1		1		3
Other							2				1	3
NCDs General										1		1
Respiratory Diseases										1		1
Grand Total	7	18	20	18	22	22	49	127	153	210	179	825

Overall, the results of the bibliometric analysis and co-authorship network suggest that grantees and alumni are producing high quality scientific articles, continuing to foster collaborations between U.S. and foreign scientists, and have contributed to important empirical evidence to combat NCDs in LMICs.

4.1.2 Other Research Outputs

Aside from publications, the NCD D43 Programs have contributed to other research outputs. Survey respondents were presented with a list of possible research outputs and asked to indicate whether their grant contributed to any research outputs. Results are summarized in Table 9.

Table 9: Survey Responses Regarding Research Outputs Other Than Publications

	No. of Grants	Percentage of Grants (n= 40)
Clinical protocols	19	46%
Patient registries or other databases	17	42%
Software or other analytic tools	11	28%
Devices or prototypes	4	10%
None of the below answers	3	8%
Patents or patent applications	1	3%

Clinical protocols. Nineteen projects (46%) reported developing a clinical protocol to be used in the LMIC context. Specific examples include:

- A new protocol on clinical trials of anticancer therapy in breast cancer patients
- A provincial protocol for 1) assessment of first episode psychosis and prodromal status; 2) assessment of untreated psychosis and reduction of untreated psychosis
- A mhGAP-based (WHO Mental Health Gap Action Program) protocol for use by diverse types of providers
- Research protocol for management of sickle cell disease in Ghana
- Protocols for air sampling and analyses in Mongolia
- Evaluation (e.g., dosing, safety, tolerability) of soy-protein isolate Russian tarragon (*Artemisia dracunculus* L.) complex as a dietary supplement to improve carbohydrate metabolism
- New protocols (translated from NIAAA protocols) implemented in Ukraine for primary care physicians treating addicted patients
- Protocol for clinical use of dental prostheses designed for periodic uptake of fluoride
- Recent life changes questionnaire and stress scale for quantification of stress in a developing country is being adapted and validated to include stressors that are regionally relevant for Pakistan

Patient registries or databases. Development of patient registries or databases were reported by 17 (42%) of the grants. These databases collected information ranging from stroke incidence in Peru to biospecimens (e.g., frozen serum, buffy coat) in China to alcohol addiction in Poland. In Nigeria, for example, an NCD grant developed a Food Frequency Questionnaire (FFQ) that provides information on aggregate dietary intake over time and a Validation of Food Frequency Questionnaire with dietary recall and biochemical markers that tells researchers how well the FFQ is working, the degree of error associated with it and how to use the error to adjust the data in statistical analyses.

Software or other analytic tools. Other information-related outputs were reported by 11 grantees. One such tool is a software application that was developed by an NCD-Lifespan team working in Thailand. The software will assist in analyzing large Thai national health data sets for diabetes studies. Another example is a data analysis platform for genetic studies (PGMRA) used to identify genotype-phenotype relations in genome-wide association studies.

Devices or prototypes. Four grantees reported the development of a device or prototype. For example, one project developed a dental prostheses prototype designed to absorb fluoride. Another grantee used nanotechnology and stem cells to develop cardiac cells to repair the heart.

4.2 Leveraged Funding

Grantees from the NCD D43 Programs have obtained additional or new funding for “spin-off” projects that continue the work initiated during their NCD award. “Spin-off” projects illustrate the NCD D43 Program’s ability to support independent, successful scientists interested in NCD research. The NCD D43 Programs have created a cadre of domestic and international researchers successful in applying for subsequent funding in NCD research.

Grantees were asked to report on additional funding they secured to continue the research training (Table 10) and/or research projects (Table 11) initially funded by the NCD D43 Programs. Forty NCD grants reported on whether a PI or collaborator applied for funding to support the training component of their award. Of those 40 grants, 80% had applied for additional research training funding from FIC, other ICs or LMIC entities. Similarly, those applications that were successful (20; 63%) were funded mostly by NIH or an LMIC source (Table 10).

Table 10: Survey Responses Regarding Type of Funder to Which Respondents Successfully Applied for Research Training Funds

Funder	No. of NCD grants (n=20)	Percentage of NCD grants
FIC	11	55%
Other ICs	9	45%
LMIC entity	9	45%
Other	3	15%
USG Agency	1	5%

Thirty-one grants provided a response to whether a PI or collaborator applied for funding to support the research projects funded previously by the NCD Program. Of those 31 grants responding, 21 (68%) were successful, eight (26%) applied unsuccessfully and two (6%) did not apply. Similar to the findings for applications for training funds, the majority of applications for subsequent funding went to FIC (48%), another NIH IC (41%), or LMIC entity (38%). Most successful applications were funded by an LMIC source (48%) such as an institution, foundation, or government (Table 11).

Table 11: Survey Responses Regarding Type of Funder to Which Respondents Successfully Applied for Research Funds

Source	No. of NCD grants (n=21)	Percentage of NCD grants
LMIC entity	10	48%
FIC	8	38%
Other IC	8	38%
Other	7	33%
USG Agency	0	0%

Survey respondents who reported that they had not applied for additional research funding were asked to choose from a menu of possible explanations. Of the eight grants that did not apply for training funds, three reported that “the original project is not yet complete or there hasn’t been time to apply for additional funding” (Table 12). The same answer was selected for the two NCD grants not applying for additional research funds (Table 12).

Table 12: Survey Responses Regarding Reason for Not Applying for Additional Funding

Response	Response for those Applying to:	
	Research Training	Research
Our original project is not yet complete or there hasn't been time to apply for additional funding.	3 grants 37%	2 grants 100%
The research training project has reached its logical conclusion and/or is no longer of importance or interest to the LMIC institution	2 grants 25%	
We are no longer involved in NCD related research	1 grant 13%	
We are not confident that we could compete successfully for additional funding at this time	1 grant 13%	
We are too busy with other research projects to continue with this one	1 grant 13%	

As illustrated in Table 10 and Table 11, funding was leveraged from a variety of sources and countries. Several awards were successful in leveraging funding from government institutions, multilaterals (WHO), and foundations (the Bill & Melinda Gates Foundation). Examples of funding from these sources can be found in Table 13.

Table 13: Survey Responses Regarding Outside Funding Sources

Type of Source	Specific Source	Combined Total
NIH	Office of the Director	\$1,100,000
NIH	NIDA	\$3,000,000
NIH	NIMH	\$3,000,000
NIH	NCCIH	\$5,664,111
NIH	NIAAA	\$3,561,000
NIH	FIC	\$100,000
HIC Government	EU cross-country research project	\$100,000
LMIC Institution	Vietnam National University	\$800,000
LMIC Government	Polish in-country research funding	\$25,000
LMIC Government	Government of Tajikistan	\$446,750
LMIC Institution	Khon Kaen University	\$5 - 10,000
LMIC Institution	Health Planning Committee of Shanghai	\$204,037
LMIC Institution	University of Chinese Academy of Science	\$12,260
LMIC Government	Vietnam National Science Foundation	\$400,000
Multilateral Organization	Pan American Health Organization/WHO	\$80,000

4.3 Research Evidence and Capacity Informing Policy or Practice

While there is a growing body of research on NCDs in LMICs, the application of this research to inform evidence-based practices, interventions and policies in the healthcare sector and public health settings

continues to lag.^{16,17} The ICOHRTA Program focused on promoting operational research which “encompasses translation of knowledge and technologies to field and clinic use, how to best implement existing and new prevention strategies, therapeutic tools and other interventions for broad-based field use, and the study of barriers to such translation and implementation.”¹⁸ The later iterations of the NCD D43 Programs also supported this type of research, although it was called implementation science in the FOAs.

With effective dissemination, research findings supported through the NCD D43 Programs can and have reached local communities and been translated into practices that help public health programs and policies and improve quality of care. The NCD D43 Programs encourage the proactive dissemination of information on research findings, new interventions and improved practices. Examples of grants that have created impacts in either policy or practice in a LMIC are described below.

Training Health Workers in Psychosis Identification and Treatment

Psychosis, including schizophrenia, presents itself as a major disturbance or alteration in the way a person perceives, thinks or behaves. Research has shown that a delayed diagnosis of psychosis in an individual can reduce improvements in patient outcomes and treatment responses.¹ Recognizing the need to better assist in psychosis detection, a seven-year surveillance program under the Investigation of Movement Abnormalities and Genetic of Schizophrenia study (IMAGES) was established in Argentina’s Jujuy Province using funds from a Fogarty R21 exploratory research planning grant and an ARRA supplement. The work under the R21 was expanded with an NCD-Lifespan grant in 2013. Since then, the grantee has been successfully training primary care health agents (HAs) in the Jujuy Province on early identification, referral and follow up of individuals with psychosis. These HAs are heavily relied upon in the primary care system of Jujuy, and until this grant, never received training in mental health. With the proper training, the first implementation of an early detection of psychosis plan by the Ministry of Health in Jujuy was developed by the local co-investigators of IMAGES with a grant from the Argentina federal government. The region has seen a twofold increase in the number of psychologists and psychiatrists in the ministry services. The grant has also successfully participated in the PAHO-sponsored meeting to develop a research agenda for the mental health reform at the national level by the Government of Peru. IMAGES co-investigators provided evidence of the success of community based early detection/early intervention programs in reducing duration of untreated psychosis and improving long term outcomes. They also participated in the discussion to establish a strategic plan for research in mental health in Peru.

1. Padilla E, Molina J, Kamis D, Calvo M, Stratton L, Strejilevich S, Aleman GG, Guerrero G, Bourdieu M, Conesa HA, Escobar JI, de Erausquin GA. The efficacy of targeted health agents education to reduce the duration of untreated psychosis in a rural population. *Schizophr Res.* 2015 Feb;161(2-3):184-7.

¹⁶ Subramanian, S. et al. (June 2017). Research for Actionable Policies: implementation science priorities to scale up non-communicable disease interventions in Kenya. *Journal of Global Health.* 7(1).

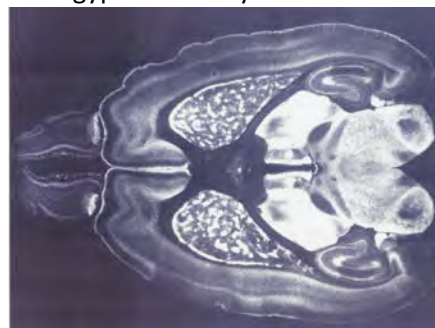
¹⁷ Goyet, S. et al. (Feb 2015). Gaps between research and public health priorities in low income countries: evidence from a systematic literature review focused on Cambodia. *Implementation Science.* 10(32).

¹⁸ Title: International Clinical, Operational and Health Services Research Training Award (ICOHRTA) [D43] <https://grants.nih.gov/grants/guide/rfa-files/RFA-TW-06-002.html>

Combatting Opioid Abuse through Research

The fight against opioid abuse and addiction is a global phenomenon afflicting both developed and developing countries. In Egypt and other countries in the Middle East, a synthetic opioid called Tramadol has become increasingly popular¹ especially with the youth.² The growth in Tramadol abuse accelerated after the Egyptian Revolution of 2011 and the ousting of the Hosni Mubarak's regime; drug use surveys, treatment admissions, and first-hand accounts from drug users all indicate a worsening Tramadol problem.³ The Indian and Chinese-made Tramadol is sold cheaply on street corners in Egypt and contains a higher level of amphetamines, making it dangerously toxic. With support from the NCD Lifespan grant "UCLA-Cairo University Addiction Unit Research and Training Program," UCLA researchers worked with counterparts in the Addiction Unit of Cairo University to bolster awareness of research and research training needs in addiction and to understand the research questions that would be of greatest use to Egyptian society.

The research conducted under the grant included the development of a multi-country study of Tramadol addiction, with an identical battery of data collected in Egypt at 2 hospitals and at an addiction treatment center in Abu Dhabi (National Rehabilitation Center) and a characteristic comparison between Tramadol and Heroin-dependent patients. The evidence collected through these studies and others has helped inform the Government of Egypt, the WHO and the United Arab Emirates about the treatment needs of Tramadol users and has promoted the approval of addiction medications in these countries. Data from this project have been presented at the WHO Middle East regional working group meeting in Abu Dhabi on two occasions and at conferences for the International Society of Addiction Medicine in Montreal (2016) and Abu Dhabi (2017). Among the most important findings from the work is that grand mal seizures have occurred to 28.5% of the participants during prior withdrawal periods from tramadol. For this reason, treatment centers in the UAE and Egypt now routinely have seizure prevention strategies routinely provided as part of withdrawal management treatment plans. Three papers from this project have been published and three others are in preparation.^{4,5,6} Discussion among Egyptian, UAE and US colleagues continue regarding future grant proposals.



Black and white photomicrograph in dark field illumination to reveal mu opioid receptor distribution in a rat brain. White areas show intricate pattern of opioid receptor distribution in well-defined brain areas.

Photo by Miles Herkenham, NIH/NIMH, courtesy of NIDA

1. Tecimer, Natalie. January 19, 2018. The Diplomat. "Tramadol: The Dangerous Opioid from India".

<https://thediplomat.com/2018/01/tramadol-the-dangerous-opioid-from-india/>.

2. UCLA. "UCLA Integrated Substance Abuse Programs: International Projects". www.uclaisap.org/InternationalProjects/html/egypt.html

3. Ibid.

4. Miotto, K., Cho, A.K., Khalil, M.A., Blanco, K., Sasaki, J.D., & Rawson, R.A. (2016). Trends in tramadol: Pharmacology, metabolism, and misuse. *Anesthesia & Analgesia*. [Epub ahead of print, Nov. 17]

5. Rawson, R.A., & Clark, N. (2017). Interventions for the management of substance use disorders: An overview. *Eastern Mediterranean Health Journal*, 23(3), 214-221.

6. Elkashef, A., Alhyas, L., AlHashmi, H., Mohammed, D., Gonzalez, A., Paul, R., Wanigaratne, S., Gawad, T., Rawson, R., Al Marzooqi, A., & Al Ghaferi, H. (2017). National Rehabilitation Center programme performance measures in the United Arab Emirates, 2013. *Eastern Mediterranean Health Journal*, 23(3), 182-188.

Advancing the NCD Agenda with Research

Trainees under the NCD-Lifespan-sponsored Scholars in Health Research Program (SHARP) at the American University of Beirut (AUB) have assisted in conducting research that was used to advance the NCD agenda, including conducting a review on osteoporosis disease burden in the Middle East (in progress) and informing policy guidelines related to osteoporosis and Vitamin D supplementation. One trainee, who has completed a Master's in Health Research, assisted in developing FRAX-based osteoporosis treatment guidelines in Lebanon that were endorsed by ministerial decree from the Lebanese Ministry of Health (MOH). The new guidelines include a new hybrid algorithm that takes into consideration the risk for major osteoporotic fractures and the proportions of subjects considered for treatment. The trainee later went on to be involved in the implementation of the first Fracture Liaison Service at AUB, a quality care intervention to improve outcomes in patients admitted with hip fractures. Trainees also developed a Policy Brief: "Gaps in Osteoporosis Diagnosis and Treatment in Lebanon," where the developmental milestones will be implemented and followed by the department of Health Policy at AUB in collaboration with the Lebanese MOH. Other trainees participated in an array of research projects related to Vitamin D including a randomized trial of maternal and neonatal outcomes in pregnant women with low 25 hydroxy-vitamin D levels and the optimal supplementation of Vitamin D in post-operative bariatric patients. The research from these studies provide solid evidence that helped formulate revisions to the National Vitamin D policy in Lebanon for the general population, pregnant women, and obese patients undergoing bariatric surgery. The on-going Vitamin D pregnancy trial is the nucleus of a maternal fetal cohort that aims to investigate the fetal and developmental origins of generalized NCDs, osteoporosis and obesity.

"The SHARP has also provided me with the needed skills and quantitative methods to become a scientist, and start a career in the obesity field, one of the most prevalent non-communicable diseases. I have submitted several projects on medical weight management for funding opportunities. One of them consists of a randomized controlled trial that evaluates an evidence based multi-disciplinary program for weight loss and was recently funded by a seed grant from the American University of Beirut. I am currently also leading 2 systematic reviews on diet therapy and weight reducing drugs. Results of these projects are expected to have an impact on the approach to patients with excess weight."

Former SHARP trainee who is now on SHARP faculty



REGIONAL OUTREACH

Blue dots are enrolled students from region

National and regional representation of the human capital being built through the SHARP Program (2017).

Photo Courtesy of Ghada El-Hajj Fuleihan

Creating Policy Change within the Ministry of Health and Government

A series of ICHORTA/NCD-Lifespan grants over 17 years has provided the opportunity to develop and support collaboration with individuals across all levels of the Vietnamese government, increasing the extent to which mental health policy and treatment dissemination considerations are integrated into empirical research. Examples of how the research and training provided through these grants has impacted various government levels include:

- Prime Minister: Through a collaboration with the Vietnam National University (VNU), the grant increased the understanding of the former Dean of VNU School of Education regarding mental health and school-based mental health. After leaving VNU, she joined the Prime Minister's Committee for Educational Reform where one of her main domains of responsibility is school-based mental health.

Elementary school children take the mental health survey in a rural village in Danang Province.
Photo Courtesy of Bahr Weiss



As part of this committee, she is developing a comprehensive national policy to integrate mental health into the schools.

- Ministry of Health (Child Health): After completing the first nationally representative child mental health epidemiology survey in the country, researchers from this grant published results in several Vietnamese-language publications (as well as English-language publications) and conducted a half day press conference. This meeting included representatives from the Ministry of Health (MOH) as well as people from the media. The MOH representatives were intrigued by relations between mental health and functional impairment (e.g., there was a greater than 550% increase in risk for functional impairment if a child had significant mental health problems), and in particular in regard to academic impairment (e.g., significant behavioral mental health problems were associated with an approximately 350% increase for risk of significant academic functional impairment). It was this information that led to an increased interest in child mental health at MOH. In 2015, child mental health became a priority for the VN MOH and the national health insurance started covering certain child mental health conditions.
- Ministry of Education and Training (MOET): The faculty at VNU developed a plan with MOET to provide training in mental health literacy to teachers at the three (south, center, north regions) Annual National Teacher Professional Training Workshops. Mental health literacy (basic understanding what mental health is, how mental health problems develop, etc.) is the foundation for all mental health support, including school based mental health (SBMH). The grantee and colleagues helped implement the mental health literacy program for MOET, and in the process of developing the program have also educated members of MOET regarding mental health literacy.

Another instance of supporting the MOET came from a former grant trainee who is now a faculty member in the grant training program (a clinical psychology graduate program) at VNU. He is actively working with the MOET to develop and implement a classroom behavior management program. Adaptive teacher classroom behavior management is a central part of SBMH, supporting both behavioral and emotional student mental health. This program is in the pilot stages but ultimately will be implemented nationally.

- Danang Provincial Department of Education: The impetus for a school-based mental health program in Danang came from a meeting between the grant's research team and the Danang Provincial Department of Education where researchers were discussing a U.S. NIH-funded mental health risk-factor study being conducting in Danang high-schools. Upon hearing study results and of the high school students' strong interest in mental health issues, the Danang superintendent hired Bachelor's-level psychologists and placed them in Danang high-schools to support students. Further discussions are taking place between the grant researchers and the Danang superintendent to extend the program to middle schools (grades 6-9). Grant researchers are currently working the Danang Department of Education to develop, implement, and evaluate this middle-school program.
- Ministry of Health (Autism): Cong Tran, a former grant trainee and current faculty member for the grant's research training program at VNU, has focused his research on Autism Spectrum Disorders (ASD). In 2015 he studied the centers and programs focused on providing autism services¹ and found a significant lack of standards for the services that were provided. This article helped generate concern within MOH regarding unregulated and non-EBT services for ASD. This contributed to MOH's interest in ASD and their understanding of the importance of making it a medical disability so that services would be under their regulatory control. In 2015 Dr. Tran opened the Hung Dong Center (www.hungdongcenter.org) in Hanoi, focused on research, training, and services for children with ASD. The center now has three sites in the greater Hanoi area. Dr. Tran subsequently founded and is the director of the Northern Vietnam Network for Autism and Developmental Disabilities, a network of nine centers and schools focused on providing services for ASD and other developmental disabilities. The goal of this network is to provide for effective dissemination of EBT services for ASD and developmental disabilities in Vietnam. This is the first network of this kind in Vietnam and has helped increase awareness of ASD as a medical and mental health condition for which there are effective services that can reduce the behavioral symptoms. As part of this network, Dr. Tran is developing an evidence-based set of Operating Standards for ASD centers in Vietnam, but that can also be applied to other LMIC.

1. Tran, C. V., Weiss, B., Khuc, T. N., Tran, T. T. L., Nguyen, T. T. N., Nguyen, H. T. K., & Dao, T. T. T. (2015). Early identification and intervention services for children with autism in Vietnam. *Health Psychology Report*, 3, 191-200. PMID: PMC4831621

Reforming Mental Health Laws Through Research

In the early 2000s, the local and national governments in China committed to building a public mental health system and investing in mental health services in the country. A 2005 initiative called the National Continuing Management and Intervention Program for Psychoses (also known as the '686 Program'), was launched as the first NCD program to be included in the national public health program. The 686 Program was a non-traditional model that moved mental health care out of hospitals and into the community setting with multifunctional teams focused on rehabilitation and recovery.¹ However, the program had essentially no research component to study the model's effectiveness. To help address this need for research, an ICOHRTA grant² already working in China with the Shanghai Mental Health Center and the Chinese University of Hong Kong, began working closely with Dr. Ma Hong, who headed the 686 Program, and her staff. With funding provided by the ICOHRTA grant, several staff members were brought to Harvard to partake in a training program that would focus on conducting research, evaluating the program's effectiveness and developing data for advocacy. A training workshop developed by Dr. Ma Hong in collaboration with the NCD-Lifespan grant, brought together leaders of the 686 Program from around China for an Implementation Research Leadership Program intended to help with research methods for IS research.

Another landmark event occurred in 2013 when the first national mental health law of China was enacted. This bill, which was commissioned three decades earlier in 1985, is composed of seven chapters and 85 articles. One of the more significant and controversial changes in the law was the requirement, under most circumstances, that psychiatric treatment be voluntary.³ Much of the empirical work that supported the drafting of the bill was done by persons who were fellows with the NCD grant. For example, two fellows conducted research looking at the effectiveness of the implementation of the mental health laws passed for major urban provinces, including Shanghai and Beijing, before the national mental health law was passed. Another fellow worked on issues related to 'guardianship' — what it meant for families to have a guardianship relation to persons with severe mental illness, the role they played in hospitalizing patients, etc. The research conducted provided information to support the development and ongoing implementation of the national mental health law. The current local PI of the NCD grant, who prior to his involvement in the NCD-Lifespan grant was a co-author of the national law, is still deeply involved in the law. His current work is interested in the implementation of the national law, providing information to mental health specialists throughout the country about the provisions of the law, as well as, studying the effectiveness of the implementation process.

The work undertaken by the NCD grantees was recognized by the Shanghai Municipal Government Foreign Affairs Office. The 2012 Silver Magnolia Award was bestowed upon the grantees in recognition for “their dedication to mental health services in Shanghai, in China, policy advice, and capacity building of public mental health leaders.”⁴ The grantees have provided training for a large number of young and mid-career mental health professionals. Their efforts have made a significant contribution to forming Shanghai’s mental health policy and helping to transform the mental health services in the city.

1. Park, L; Xiao, Z; Worth, J; Park, J. (2005). Mental Health Care in China: Recent Changes and Future Challenges. *Harvard Health Policy Review* 2:35–45.
2. Good BJ, Good MJ. Significance of the 686 Program for China and for global mental health. *Shanghai Arch Psychiatry*. 2012 Jun;24(3):175-7.
3. This grant was awarded twice under the ICOHRTA Program and most recently in 2010 with the NCD-Lifespan Program.
4. Phillips MR, Chen H, Diesfeld K, Xie B, Cheng HG, Mellsop G, Liu X. China's new mental health law: reframing involuntary treatment. *Am J Psychiatry*. 2013 Jun;170(6):588-91.

4.4 Enhanced Research Capacity

Given the growing rates of NCDs in LMICs, building local and national capacity to address research and evidence needs is an essential step in combatting the epidemic. Training the next generation of researchers on the science of NCDs and NCD control is the focus of the NCD D43 Programs. Indeed, the NCD D43 Programs have invested in local researchers, catalyzed partnerships between talented U.S. and LMIC scientists, and strengthened the research capacity within LMIC institutions.

4.4.1 Types of Training

The NCD D43 Programs allow training in both the U.S. and LMICs. However, the long-term goal for all grants is to have training occur within the LMIC by the end of the initial funding period. Where the training occurs depends on factors such as training needs, existing infrastructure and level of training capacity in the LMIC institution. The training location for the 40 grants responding to the survey (representing 71% of all funded grants prior to 2017) ranged from 100% training in the foreign country to 100% training in the U.S. The average program, however, spent 36% of the training in the U.S., 62% in the LMIC and 2% other (e.g., online).

The NCD D43 Programs encourage degree-related and mentored research activities. While innovative research training models are encouraged, the typical training includes a mix of non-degree trainings (e.g., workshops) and degree-related training. The methods in which these trainings take place is diverse. In the survey, respondents were asked to select the training methods they utilized. Most awards stated that they engaged in educational exchanges to the U.S. or LMIC institution (90%) and in-country training workshops (90%). Seventy-one percent of grants reported independent learning and self-instruction methods, as well as interacting with other national and regional efforts. A little over half of the grants (59%) included distance learning, online courses or eLearning methods and 54% reported computer-based training.

Some grants offered activities to enhance a trainee’s research skills. For example, many programs offered courses aimed at enhancing a trainee’s command of the English language or teaching research

manuscript writing. Implementation science (IS) was incorporated into many curricula and/or the research components of the grants. Implementation science is paramount to ensuring that research is effectively translated into policy or practice. Nineteen of the 41 responding grants (49%) noted that they conducted implementation science activities; activities included:

- Developing ways to most effectively disseminate the research to end-users (4)
- Training courses and workshops to emphasize and incorporate methods to promote the integration of evidence-based practices and interventions to promote NCD health (11)
- Incorporating IS experts into the staff (1)
- Conducting IS-related research (e.g., evaluating new models of care or national reform programs) (5)

4.4.2 Mentoring Strategies and Activities

Integral to many of the training programs is an emphasis on mentoring the next generation of global health researchers and leaders. Effective mentoring builds human capacity by enhancing the training experience and promoting career development. Survey respondents were asked to specify how mentoring was conducted and/or utilized by their grant. Responses can be binned into the following categories: one-on-one mentoring, dual mentoring (U.S. and LMIC mentor), panel of mentors, distance/online mentoring, and on-the-job research mentoring. Examples of mentoring strategies are listed below, with a full list of responses available in Appendix G.

One-on-One Mentoring

“Trainees were required to work with a mentor. Mentors were responsible for guiding the trainees in working on their research projects and in preparing new proposals. Mentors and trainees met at least once a month, in person or via videoconference, and they agreed upon quantifiable objectives to be met for each semester.”

“Each trainee had the possibility to propose a research question, and based on that, a mentor was identified and contacted. The mentor had periodical meetings with the trainee, to address issues pertaining to the thesis, and in addition, for career opportunities and other issues that came along.”

“Applicants were required to identify mentors from [the] onset. Beneficiaries submitted regular reports under supervision of mentors. Several training, workshops and meetings were held for richer interaction between mentees and mentors. Further grant writing activities were coordinated with mentors.”

“Mentoring is very specific and intense. Fellows are matched based on interest and expertise and work closely with the mentor throughout the two years and beyond. That relationship, based on personal experience, is a ‘forever’ relationship.”

Mentoring Panel or Committee

“Mentor teams would meet with trainees while in Seattle for methodology/MPH training to assist with developing research project[s] that would be implemented in Peru. Mentoring continued throughout implementation, analysis and publication of [the] project.”

“Each medium and long-term trainee is provided with a mentorship team. The team is comprised of: 1) a lead mentor to provide oversight of resources to support the mentee's work, assist with navigating institutional challenges and facilitate networking with local, national, and international colleagues; 2) a research mentor to provide expertise in the mentee's area of research and advise on development of the research project, career development, and communication of findings, including: oral presentations, preparation of abstracts and manuscripts and development of grant applications; 3) a co-mentor to provide mentoring in specialized content or methodological areas; and 4) a peer mentor who is a previous scholar, to provide advice on cultural and academic challenges and opportunities.”

Dual Mentoring

“Mentoring is used as the core strategy. Fellows are assigned in country and international (US) mentors. Mentor-mentee interactions are scheduled, but irregular (on demand or spontaneous) interactions are encouraged. Formalized reports from mentors are required, and a structured project shared by the mentor-mentee teams is expected as the primary outcome of the training. Mentoring is a key element of the training. Fellows are assigned local and international mentors and provided a mentoring structure that is formalized in schedule and assessment.”

“We follow a dual mentoring model i.e., each trainee will have mentor/s in both the US and India. The TAG recommends mentors based on the trainee's area of interest. Trainees and mentors will sign AAMC mentor-mentee compact and mentors make a training plan with their mentee depending on the training needs.”

“Each trainee has been assigned with at least two mentors: one from [sic] LMIC and one from the USA institution. LMIC mentors have direct constant contact with the trainees. The USA mentors are communicating with the trainees on average once a month over the Skype or other internet connection tools. They also maintained efficient email contact. In addition, The USA mentors visited LMIC and participated in annual meetings. During those meetings US Mentors delivered, lectures, workshops and evaluated progress of the trainees. Some of the LMIC mentors visited the USA to participate in scientific meetings and communicate with the US mentors.”

Function or Research-Based Mentoring

“Trainees were required to work with a mentor. Mentors were responsible for guiding the trainees in working on their research projects and in preparing new proposals. Mentors and trainees met at least once a month, in person or via videoconference, and they agreed upon quantifiable objectives to be met for each semester.”

“Mentors provide trainees ongoing assistance with developing and implementing an in-country research project, posters and presentations at scientific conferences, and help provide assistance with authoring peer-reviewed publications in order to publish research results.”

“Faculty provide mentoring on research by collaborating on research projects. They also provide training by having students as teaching assistants.”

Distant or Online Mentoring

“Mentoring is provided to: 1) in-person to fellows that come to the U.S., 2) remotely to fellows who conduct in home country research, 3) during workshops in home country, and 4) via online course training.”

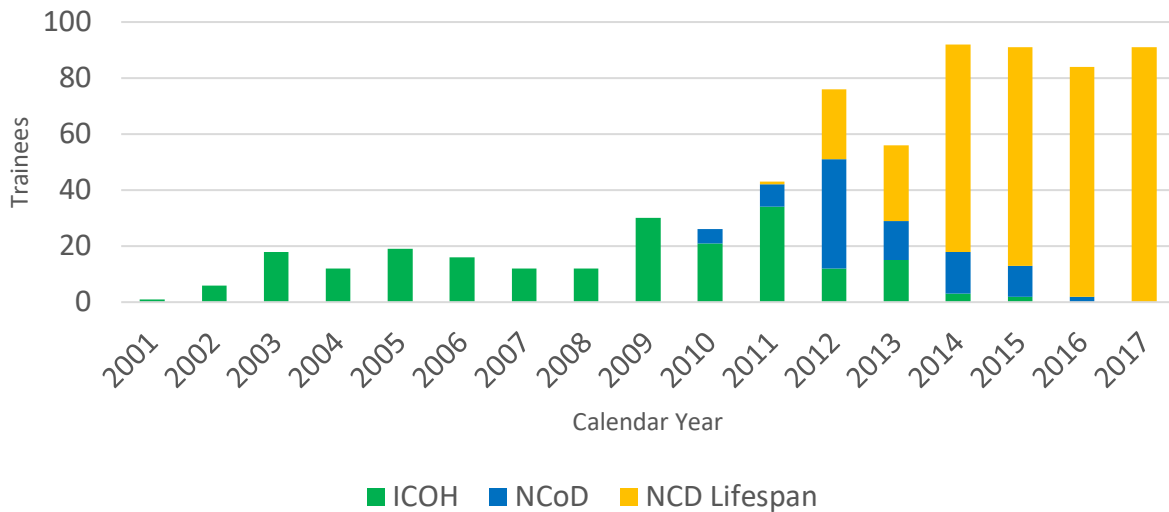
“Mentoring was at two levels: a) individual mentors for Fogarty fellows doing a post-doctoral traineeship in the US; b) Mentoring at a distance by US faculty mentoring in-country research projects ...at a distance. All Post-Doctoral Fogarty Fellows/Trainees are paired with a research training mentor at the University of Michigan Department of Psychiatry. Mentors provide trainees ongoing assistance with developing and implementing an in-country research project, posters and presentations at scientific conferences, and provide assistance with authoring peer-reviewed publications in order to publish research results.”

4.4.3 Trainees

A total of 660 long-term trainees were trained through the NCD D43 Programs. Six trainees participated in more than one NCD grant and nine trainees received more than one training experience (e.g., PhD followed by a post-doctoral). Figure 15 shows the increasing number of enrolled long-term trainees receiving long-term training in each calendar year of the various NCD D43 Programs. The number of trainees increased until 2014 with a total of 92 trainees between the three NCD D43 Programs. As of 2017, the NCD-Lifespan Program has 91 trainees enrolled.

Figure 15: Active Trainees, 2001-2017

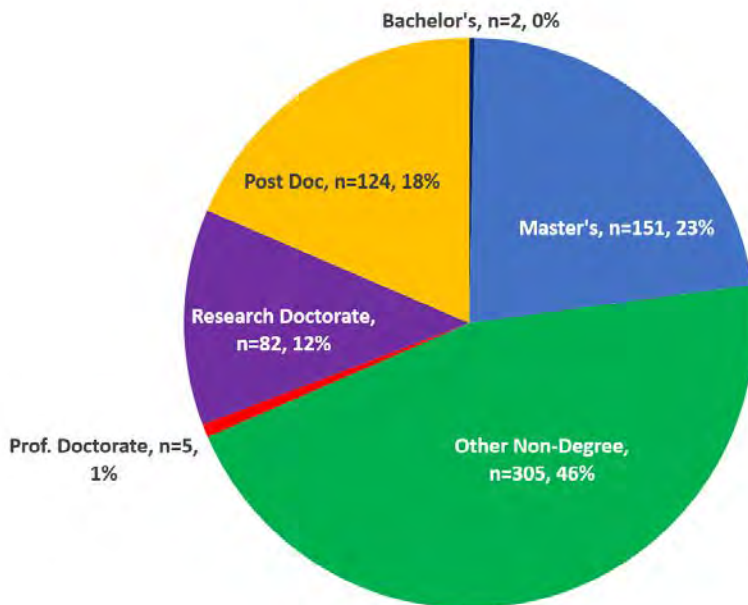
Note: Only shows trainees that provided start and (projected) end dates.



Degrees. The NCD D43 Programs offer both long-term and short-term training with varying goals. Some grants seek to improve research capacity through post-doctoral or doctoral training. Other grants focus on short-term trainings specializing in areas like laboratory techniques, implementation science, research methodologies, grant writing, or research protocol development. Excluding the eight planning grants (D71s), 52 grants (74%) intended to include a short-term training component, according to their applications.

While most programs offer short-term trainings, long-term activities represent the core training activities for the grants and are directed at increasing deeper expertise among developing country scientists. Long-term training opportunities were provided for pre- and post-doctoral students. For grants that supported long-term training (defined as six or more months of funded training support), most trainees participated in non-degree programs (46%) including fellowships or certificate programs (Figure 16). Other trainees participated in Master’s (23%), post-doctoral positions (19%), Research Doctorates (e.g., PhDs) (12%), or Professional Doctorates (e.g., MDs) (1%).

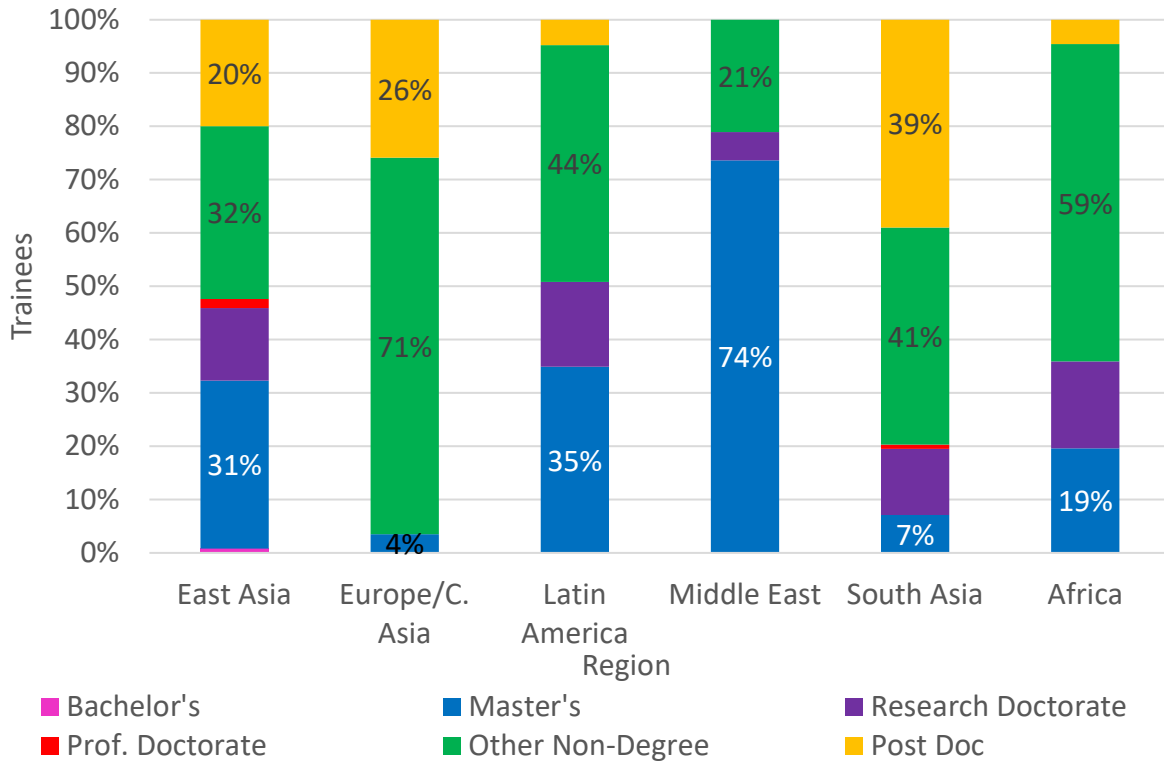
Figure 16: Degree Obtained by Training Experience, 2001-2017



There also appear to be variations in the type of training received depending on where the training occurred. Figure 17 suggests that most training experiences, across all regions except the Middle East, were likely to result in a non-degree experience. Almost three quarters of the training experiences for trainees from the Middle East (74%) resulted in a Master’s degree. This is due to one of the three grants in the Middle East, which predominately trained Master’s students. Multiple variables influence patterns of degrees received in particular regions, including the PIs’ decisions on how to focus the training, the primary degrees of the faculty in the region, and regional training needs.

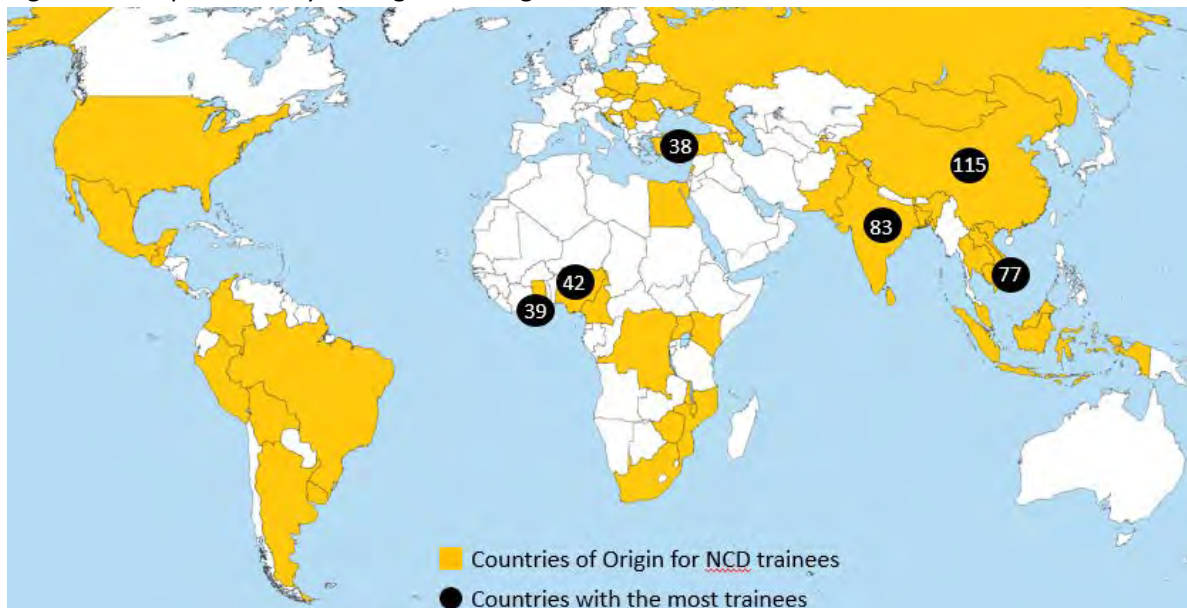
Figure 17: Degrees Received by Region, by Training Experience, 2001-2017

Note: Regions are binned based on the categories set by The World Bank.¹⁴



Geographical Distribution. Since the beginning of the ICOHRTA Program in 2001, the NCD D43 Programs have trained people from 46 countries around the world. Countries marked in orange in Figure 18 illustrate these 46 countries; the top six countries are highlighted with the number of long-term trainees: China (115 trainees), India (83), Vietnam (77), Nigeria (42), Ghana (39) and Turkey (38). More than half (394, 60%) of the trainees come from these six countries.

Figure 18: Map of Country of Origin for Long Term Trainees, 2001-2017



Most trainees over the lifetime of the NCD D43 Programs have come from East Asia and the Pacific (35%) and sub-Saharan Africa (23%) (Table 14). However, slight shifts in regional distribution of trainees have occurred. Trainees under the ICOHRTA Program were mostly from East Asia (40%) and Europe/Central Asia (35%). During the NCoD Program, most trainees continued to be from East Asia (36%), as well as South Asia (39%). With the NCD-Lifespan Program, 34% of the trainees were African and 32% East Asian. The initially high number of trainees originating in Eastern Europe was temporary. By 2008, less than 1% of new trainees would come from Europe (0% in NCoD and 1% in NCD-Lifespan). There has been a steady growth in trainees from Africa; in the ICOHRTA Program only 5% of trainees were from sub-Saharan Africa. This number grew to 16% in the NCoD Program and 34% in the NCD-Lifespan Program.

Table 14: Country of Origin for Trainees in the NCD D43 Programs, 2001-2017

Note: Six trainees participated in more than one grant. They are represented in both programs.

Country of Origin	ICOHRTA	NCoD	NCD-Lifespan
EAST ASIA & PACIFIC			
Cambodia			3
China	47	18	50
Indonesia	1		
Laos	1		
Malaysia		7	
Mongolia		4	
Thailand	4		19
Vietnam	26		52
EUROPE & CENTRAL ASIA			
Croatia	3		
Czech Republic	1		
Latvia	1		
Poland	10		
Romania	5		
Russia	1		
Serbia			1
Slovakia	5		
Turkey	38		
Ukraine	5		4
LATIN AMERICA & CARIBBEAN			
Argentina	4		11
Bolivia	1		
Brazil	2		3
Colombia	1		
Costa Rica		1	
Guatemala		7	4
Mexico			19
Peru	7		2
Uruguay	2		

Country of Origin	ICOHRTA	NCoD	NCD-Lifespan
MIDDLE EAST & NORTH AFRICA			
Egypt		1	3
Lebanon			15
NORTH AMERICA			
United States	1		
SOUTH ASIA			
Azerbaijan			8
Bangladesh	5		1
India	16	20	50
Pakistan		5	
Sri Lanka		6	
Tajikistan			13
SUB-SAHARAN AFRICA			
Cameroon			1
Congo Dem	1		
Ghana			39
Kenya	3	2	25
Malawi			1
Mozambique			8
Nigeria	3	1	39
South Africa	1	5	0
Uganda	1	1	17
Zimbabwe		2	

Trainee areas of research focus. FIC’s trainee tracking system, CareerTrac, collects information on the research and scientific focus of a trainee’s training experience. When asked to select one research area that best defines the training focus, 212 (33%) trainees selected mental health.

Cross-tabulation of research focus and degree training led to similar insights. Over half of the trainees receiving a Master’s degree were likely to conduct their training in the field of mental health (50%). Mental health was also the most studied for post-doctoral trainees (27%), other non-degree trainees (31%), and doctoral trainees (19%). Trainees who received a doctorate were the most likely to report mental health (19%), chronic diseases (22%) or nutrition (10%) as their broad area of research.

“One [former fellow] after another told us about how their careers were totally changed by their time at Harvard — how they had little idea that they would really become researchers. Individuals told about this [experience] as the turning point in their careers.

Our former fellows have become the national leaders in a number of utterly critical areas [examples include mental health services for elders and early psychosis research]. Watching the quality of research now being done in China ... is extremely striking. We are very impressed by what has happened to those who came as young fellows at Harvard ... years ago.”

-ICOHRTA and NCD-Lifespan grantee

When further disaggregated, trainee research projects reporting at least one scientific area (587) focused on epidemiology (167, 28%), behavior (149; 25%) or psychiatric disorders (142, 24%). Trainees' mental health research fell into four main categories: psychiatric disorders (e.g., schizophrenia), addiction (e.g., smoking, addictive behaviors and substance abuse), affective disorders (e.g., depression, OCD, anxiety) and cognitive disorders (e.g., developmental disorders).

Return Home Rate. To build sustainable local capacity, FIC stresses the importance of trainees returning to their home countries upon the completion of their training. As more grants are centering their research and training activities in LMICs, trainees are less likely to come to the U.S. for an extended period, thereby increasing the odds that their expertise is retained in the LMIC.

While complete data for this measure is scarce, with only 400 alumni trainees reporting if they returned home, the reported numbers are encouraging. Over 90% of trainees across all regions returned home (Table 15). Of the 80 sub-Saharan African trainees, 98% returned to their country. The lowest return home rate, 93%, was for trainees returning home to countries in South Asia.

Table 15: Trainees Returning to Home Country, Post-Training

Region	Returned	Total Completed	Percent Returned
East Asia & Pacific	156	164	95%
Europe & C. Asia	70	72	97%
Latin America & Caribbean	29	31	94%
Middle East & N. Africa	7	7	100%
South Asia	43	46	93%
Sub-Saharan Africa	78	80	98%

Post-Training Funding. Another indication of sustainable research capacity is the ability of trainees to continue their research by securing funding from other funders. When PIs were asked in the survey if their trainees applied for additional funding, 31 of the 40 responding grants (78%) reported that at least one of their trainees applied for funding. The applications were for funding from a LMIC funding entity (61%), FIC (35%), or another NIH IC (32%). Twenty-four of the 31 grants stated that at least one of their trainees was successful in obtaining additional funding from various entities (Table 16).

Table 16: Survey Response for the Funding Source of Successful Trainee Applications

Source	No. of grants	Percent of grants
LMIC entity	17	71%
Other IC	7	29%
FIC	5	21%
USG Agency	2	8%
Other	9	38%

Examples of LMIC entities that funded a trainee included:

- Vietnam National University, Vietnam National Science Foundation, and the Korean Science Foundation
- National Research Fund (FNI) of Mozambique

- Executive Unit for Financing Higher Education in Development and Innovation Research Romania
- Argentinian Ministry of Health, Province of Jujuy
- National Natural Science Foundation of China
- Scientific and Technological Research Council of Turkey
- Khon Kaen University in Thailand
- SHARE INDIA Research Foundation

Post-Training Employment. Training alumni have obtained professorships, research positions and other upper-level jobs in government and not-for-profits. Examples include:

- Vice Principal at MediCiti Institute of Medical Sciences in India
- Social scientist for the Ministry of Water and Environment in Uganda
- Lab Director at Center for Research in Innovative Technologies, the Academy of Sciences of the Republic of Tajikistan
- Team leader for the AMPATH Population Initiative at Moi University in Kenya
- Associate chief physician at the First Hospital of Xiamen in China
- Division health inspector for the Kampala Capital City Authority, Makindye Division in Uganda
- Clinical cyotechnologist at King Faisal Hospital in Rwanda
- Lecturer in dentistry at Thammasat University in Thailand

Table 17: Employment Sector and Emphasis of Position for Trainees, Post-Training

Sector	Trainees	Percentage	Emphasis	Trainees	Percentage
Academia	195	52%	Administration	37	10%
Government	66	18%	Clinical	91	25%
Industry	8	2%	Policy	6	2%
Not For Profit	38	10%	Research	172	47%
Other	66	18%	Teaching	91	25%
			Other	6	2%

The majority of trainee alumni went into the academic sector (52%) where their roles ranged from instructing the next generation of researchers to leading clinical rounds at a University hospital to conducting research in a lab (Table 17). The major emphasis of all types of employment was research (47%) followed by clinical and teaching (25% each). Notably, while 18% of those reporting employment were in government, only 2% of the positions focused on policy.

4.4.4 Enhanced Institutional Research Capacity

Beyond supporting individual training, the NCD D43 Programs have also strengthened institutional research capacity. Institutional capacity is built through investments in research support infrastructure and training in areas that support a productive research environment (e.g., grants management and research ethics). A strong research environment benefits both the scientists and institutions; for scientists, it ensures that local scientists can stay and conduct research in their home country. For institutions, a strong research environment can attract international scientific collaborations and more funding.



A student gets hands-on lab experience at the Center for Botanicals and Metabolic Syndrome in Tajikistan.
Photo Courtesy of Ilya Raskin

Survey respondents were asked how their grants contributed to various types of research capacity building efforts in their LMIC institutions. Of the 39 grants responding, 36 (92%) reported that one impact was the increase in awareness and interest among students, faculty and administrators in NCD research. Also reported was enhanced networking among faculty and students interested in NCD research (85%). Many of these grants noted that networking resources, groups and materials were made available to former trainees. Some utilized social media websites (e.g., WhatsApp, Twitter) or local newsletters to communicate with alumni about upcoming conferences or NCD research opportunities. Many grants noted specific examples of formal and informal networks that help to keep NCD researchers connected. For example:

- North-East Indian fellows formed a group that mutually supports each other's research efforts
- The road traffic injuries research network connects over 1800 researchers in the field
- The University of San Carlos in Guatemala created a group of trainees that want to take part in NCDs initiatives
- Trainees and senior colleagues developed large research networks focused on mental health services throughout China

About half of responding grants (54%) stated that the award contributed to the enhanced recruiting of new faculty members or retaining of existing ones focusing on NCD research. One grantee working in Romania stated that the “NCD training contributed to [the] development of faculty [and] staff in the field of NCD at the Cluj School of Public Health, Babes – Bolyai University. This training had an enormous impact on the ongoing NCD prevention programs in collaboration between the Cluj School of Public Health and local communities and other stakeholders.”

Thirty-six grants (92%) reported that the award had supported the creation of new curricula, labs, positions and programs at the LMIC institution. Specifically, 27 projects noted that the training helped develop or support research support infrastructure such as IRB offices, grant management and manuscript writing. Examples of some institutional capacity building efforts include the:

- Creation of the Clinical Epidemiological Program and the Pharmacoepidemiology Program within the Research Center at the School of Medicine, University of San Carlos in Guatemala.
- Development of a new Department in Occupational and Environmental Health at the School of Public Health, University of Mongolia
- Development of a new research division, Mental Health Research Division, housed within the Ministry of Health of Mozambique
- Formation of new positions for additional rehabilitation specialists at the National Institute of Neurological Sciences in Peru after assessment of post-stroke rehabilitation needs identified paucity of speech therapists and physical therapists
- Commitment from the Vice-Minister of Health of Mozambique to guarantee human resources within the Ministry to address the neuropsychiatric treatment gap
- Development of training materials for re-entry grant awardees in Nigeria in the areas of nursing, public health and pharmacogenetics.
- Creation of the Vietnam National University's Center for Research, Information, and Service in Psychology Center to promote and foster the application of psychological knowledge through research, training, and evidence-based treatment services
- Enhancement of training on clinical trials and ethics of clinical trials at the Center for Population and Reproductive Health and Center for Drug Discovery, Development and Production in Nigeria
- Production of 20 recorded seminars used in the Moi University School of Medicine Master's of Medicine Curriculum made available on CD and online
- Development of new curriculum (online courses and new training workshops) on Botanicals and Metabolic Syndrome which was made available online
- Creation of a cancer epidemiology certificate program within Morocco and shared across the region
- Development of a e-learning platform with online courses that Moroccan faculty can refer to or adapt to face-to-face courses
- New training materials for local community mental health and general practitioners working with dementia patients in China
- Creation of a nutrition program that assists with the identification of research priorities, facilitation of inter-divisional research activities, and fostering collaborations in the Clinical Sciences Division of the International Centre for Diarrheal Disease Research in Bangladesh
- Formation of a new Master's in Clinical Research curriculum at the University of Ibadan
- Creation of a new laboratory at the State Laboratory of Medicinal Plants at the Institute of Botany, Plant Physiology and Genetics of Tajik Academy of Science

More examples of departments, labs, and degree programs created and supported by the NCD D43 Programs can be found in Appendix H.

4.4.5 Other Capacity Building Outreach

Other research training outputs include outreach materials designed to support and educate users of research evidence such as young NCD researchers, policymakers and local community members.

Research training materials. Material was developed to support and encourage young investigators to enter the field of NCD research and, ultimately, provide a network for future mentoring, opportunities and growth. Of the 40 grants participating in the survey, 44% responded that they had created outreach materials for young investigators. Many projects noted the use of social media sites (e.g., Facebook), newspaper articles, TV spots, editorials, and conferences to help disseminate the material. For example, one grant developed an online trainee directory that contains the trainee's personal details such as affiliation, contact information, research area interests, research grants, and publications. The purpose of the directory is to both showcase the trainees' accomplishments and to facilitate collaborations.

Community-oriented materials. Education and outreach material was developed and circulated among local communities to help disseminate information on prevention and materials for training health workers. Fourteen grants (36%) reported providing material for community-oriented outreach. One example includes an education campaign in Mongolia to reduce mental illness stigma and increase knowledge about mental illness. Through another project, materials related to occupational safety were developed and circulated to workers and supervisors in Mongolian mines. In China, products were developed for schools, mental health services and local clinics to be shared to training practitioners and workers in these settings.

Policy-maker oriented materials. Materials designated for policymakers are critical to ensuring that research findings inform policies. In the survey, 46% of the grants cited the use of education and/or outreach to the policy community. Many grants noted the development of briefings, consultancies or policy documents to help reach this community. Other grants cited direct engagement with policymakers at forums and regional conferences. For example, in Uganda, an annual policy and injury forum was attended by members of both the research and policy communities. One grant used their research findings to develop advocacy material for the Chinese Ministry of Health and Ministry of Finance, as well as provincial and regional governments. Another grant wrote extensive written reports to the National Research Institute in Kenya that could be used to guide policy and program development on NCDs, specifically stroke and cardiovascular disease.

Practice-oriented materials. Forty-six percent of grants created education or outreach material for practitioners and community workers. Material was developed and shared on issues ranging from psychotherapy to addiction treatment protocols to post-stroke rehabilitation to occupational health. For example, research and material on psoriasis patients' management and tramadol treatment helped create guidelines in Romania and Egypt, respectively.

4.5 Challenges and Future Needs for NCD Research

4.5.1 Research Infrastructure Challenges

When asked about barriers to building research capacity at the LMIC institution, responses focused primarily on three topics: grant accounting and management (12 comments); IRBs (11) and administrative delays (8). Specifically, respondents commented on each of the following points:

- Bureaucratic delays for getting timely approvals and permissions
- Administrators requiring training especially on NIH policies
- Lack of administrative support
- Grant submission and grant oversight issues
- Non-existent or lacking accounting infrastructures and support
- Lack of standardized processes for transferring, accepting, managing or administering funds locally
- IRBs not trained to deal with mental health topics
- Lack of IRBs and/or delays in IRB approvals

Other suggestions can be found in Appendix I including some suggestions regarding administrative support, political issues and financial support.

4.5.2 Unmet Needs

When asked about unmet needs for NCD research in LMICs, answers spanned a wide range of diseases and risk factors, including diabetes, addiction, epigenetics, smoking cessation, lung disease, cancer, trauma and injury and mental health. However, some larger themes did emerge:

Continue to Build a Critical Mass of NCD Researchers and Mentors. Confronting the global NCDs crisis requires a critical mass of scientists who are well versed in regional health problems and understand the cultural, social, economic, and political contexts that influence the effectiveness of interventions to address NCDs. While the NCD D43 Programs have helped build the NCD research capacity in LMICs by training individuals and bolstering research infrastructure, there is still much to be done. The diversity of NCDs adds complexity to the process of building capacity. For example, a country may have built a critical mass of researchers in cardiovascular disease, but there remains a lack of experts that can manage the growing diabetes, trauma/injury or hypertension issues in the country. Many projects noted that LMICs need more individuals skilled in research that can mentor and assume leadership roles.

Moreover, building a sustainable and critical mass of NCD research experts requires a career path. Many grantees noted that there needs to be more support for early stage investigators through career development awards targeting specifically for young researchers. Another grantee noted that research training needs to start earlier. Trainees come in the training with a very limited background in research, and earlier exposure to research methodologies and practice would be beneficial.

Support of Implementation Science. While the field of implementation science remains a new topic of exploration for many grantees, U.S. and foreign alike, there is a growing appreciation for the impact of such research. Many grantees noted that understanding how to adapt and scale programs, guidelines,

and instruments is critical to addressing NCDs. One grantee stated that nearly all areas in mental health and addiction services need implementation and policy research.

Continue to Support Mental Health Research and Training. Considering that a large portion of the grants funded by the NCD D43 Programs were in the field of mental health (Figure 7), many responses also focused on the continued need for mental health research and training. One grantee wrote:

“A very wide range of research activities are needed to develop effective programs for care using non-psychiatrists (task-sharing), improving communications across systems of care, implementing national mental health policies, providing new models of in-patient care, and supporting more effective training of psychiatrists, psychologists, and nurses to work in community mental health care. Very special needs include research on developing recovery-oriented rehabilitation services within communities, specialized programs for children, specialized programs for demented elders, programs for persons with addiction problems, and school-based programs.”

Other grantees discussed the need to bolster mental health services for ethnic or indigenous populations and the need for mental health literacy, stigma reduction efforts, and integrating community and health services with mental health care.

Increase Funding Opportunities for NCD Research and Training. Many of the surveyed NCD grantees reported that the funding prospects for conducting NCD training and research are still limited. While appreciation and recognition of the need for this work has grown, there are still limited funding opportunities. Grantees wrote that national budgets are too strained to support NCD research, the ability for trainees to compete and win grants are limited, and the disparities in the LMIC’s policies and budget allocation regarding NCD research do not provide ample opportunities to leverage or optimize local support.

Create Protected Research Time. Many of the trainees graduating from the NCD D43 Programs return to their institution with the hope of continuing to grow their research careers. However, academic researchers find themselves with competing interests that split their time and effort between clinical, teaching and research responsibilities. Many grantees noted that finding protected time for faculty to conduct research is a struggle. This is especially true for early career researchers, for whom receiving the support and time from their institution to conduct research will help propel them into a long-term research career.

5.0 Summary Findings

Dramatic gains and unintended consequences of a greater life expectancy increase the need for more research and training in NCDs related to aging, lifestyle, environmental and genetic factors.

When the NCD D43 Research Training Programs began in 2001, the global health research community was just starting to acknowledge the need for research and training on NCD issues relevant to LMICs. Over the course of 16 years and three programs, the NCD D43 Programs at FIC have advanced the Center’s goals of training individuals in NCD research, building lasting relationships between U.S. and LMIC researchers, and building sustainable NCD research capacity at LMIC institutions.

5.1 Highlights

As the burden of NCDs in LMICs has grown, the NCD D43 Programs have evolved. In the early years of the ICOHRTA Program, an emphasis was placed on clinical, operational, and health services research related to NCDs due in part to the partner ICs' primary focus on mental health and substance use disorders, along with some cross-cutting programs like implementation science research. The recognition that not all NCDs were able to be addressed by the ICOHRTA program led to the formation of the NCoD Program, which expanded the focus to four core NCDs (cancer, diabetes, cardiovascular disease and respiratory disease). As the foundation for NCD research grew in the global arena, areas of importance such as lifestyle, risk factors and early developmental origins of disease were incorporated into the program priorities. The program's responsiveness to the evolving health landscape ensured that the work being conducted through the program was both timely and beneficial to LMICs and the NCD research community.

The NCD D43 Programs have made important contributions to the research and capacity building efforts in 44 countries. With the help of 11 ICOs, the NCD D43 Programs have brought together U.S. and foreign collaborators to work together on research training that addresses issues ranging from risk factors to interventions and population demographics. The most frequently addressed research topics throughout the NCD D43 Programs were mental health (24; 27%) and cardiovascular disease (21; 24%), followed by substance abuse and cancer. The balance of topics, however, changed over time as previously described in Section 2.4.4.

Building Individual Capacity. The NCD D43 Programs have trained 660 long-term trainees from over 46 countries. More than half of these trainees (894; 60%) have come from China, India, Vietnam, Nigeria, Ghana or Turkey. While most trainees over the lifetime of the NCD D43 Programs have come from East Asia and the Pacific (35%), there has been a shift in the recent years to training researchers in sub-Saharan Africa. During the ICOHRTA Program only 5% of trainees were from sub-Saharan Africa. However, this number grew to 16% in the NCoD Program and 34% in the NCD-Lifespan Program.

Integral to the Programs was an emphasis on mentoring the next generation of global health researchers. The evaluation highlighted five mentoring models utilized throughout the NCD D43 Programs: dual mentorship with a U.S. and a LMIC mentor assigned to a trainee; one-on-one mentorship where a mentor is assigned to each trainee; panel mentorship where trainees receive mentors for an array of persons ranging from senior PIs in the U.S. to peer mentors in the LMIC; distance or online mentorship; and functional mentorship where trainees receive a research mentor to help them through the research component of their training. Activities to enhance a trainee's research skills have been offered by a number of grants. For example, many projects offered courses aimed at enhancing a trainee's command of the English language or teaching research manuscript writing. Implementation science (IS) was incorporated into many (49%) projects' curricula and/or the research components of the grants.

Importantly, many trainees have successfully transitioned into independent researchers who have successfully secured funding or conducted research as part of their employment. Information on subsequent funding for trainees can be found in Section 4.4.3.

Building Institutional Capacity. The NCD D43 Programs have made important contributions to strengthening research capacity at the institutional level as well. A sustainable base of research institutions in LMICS equipped with the knowledge and resources to conduct NCD research will help advance the field. Of the grants responding to the survey, 36 (92%) reported that the award supported the creation of new curricula, labs, positions and programs at the LMIC institution. Specifically, 27 projects noted that the training helped develop or support research support infrastructure such as IRB offices, grant management and manuscript writing.

Some LMIC institutions and governments are supporting NCD research and/or research training efforts led by former or current NCD D43 PIs, collaborators or trainees. Notably, the NCD D43 grants with the longest investment, having started in the ICOHRTA Program and transitioning to the current NCD-Lifespan Program, reported getting more support from LMIC institutions or entities. This suggests that long term investments take time to mature but do pay off at the end by leveraging local funding.

Another aspect of building sustainable institutional capacity is fostering collaborations of local researchers, institutions or networks. The evaluation helped demonstrate the unique collaborations and relationships being built through the NCD D43 Programs. LMIC institutions provided support to NCD D43 awards by contributing supplemental contributions to their NCD grant, providing facilities or equipment and by supplementing salary support.

The relationships built and fostered among the faculty during the NCD D43 Programs appear to be enduring. Program alumni who are no longer funded through the NCD D43 Programs often publish with researchers in LMICs. A co-authorship network analysis demonstrated that 69% of alumni grantees have published at least three or more articles with a co-author from an LMIC since leaving the NCD D43 Program.

Enhancing NCD Research. The NCD Programs have successfully contributed to the body empirical evidence related to NCDs. Publications have helped disseminate the NCD research generated by the NCD D43 Programs. A total of 982 publications that cited an NCD award were published between 2003 and 2017. The most prevalent topics were aligned with the most popular topics within the NCD D43 funded applications of mental health/substance abuse, risk factors (e.g., obesity, nutrition), and cardiovascular disease. Other popular topics included cancer, metabolic disorders and infectious disease/comorbidity.

The NCD D43 Programs have also helped to catalyze funding from sources beyond Fogarty to support both research and research capacity building related to NCDs in LMICs. Fifty percent of survey grants stated that a PI or collaborator successfully applied for additional research capacity building funding. Sixty-eight percent of grants had a PI or collaborator who were successful in securing funding, usually from an LMIC source such as an institution, foundation, or government, to continue their NCD research.

The training component of the NCD D43 Programs are training successful, independent LMIC researchers. Trainees demonstrated success in developing and funding new research projects. Over 47% of trainees are employed in a job with an emphasis on research and 60% of grants reported having at least one trainee successfully apply for a “spin off” or new research project.

5.2 Recommendations

To provide some context, in 2008, an evaluation of the ICOHRTA program provided 14 recommendations for future iterations of the NCD D43 Programs. Table 18 includes the 14 recommendations and how these were incorporated into future iterations of the NCD D43 Programs.

Table 18: ICOHRTA Evaluation Recommendations and Resolutions

Recommendation	Implementation of Recommendation
1. Broaden the range of eligible NCD topics to better reflect the priorities in LMICs	The NCD-Lifespan encourages research on all NCDs, lifecycle and early life determinants of NCDs, co-morbid conditions and risk factors.
2. Consider the use of a Program Announcement (PA) instead of a Request for Application (RFA)	The NCoD and NCD-Lifespan solicitations all utilized the Program Announcement. In particular, they used the PAR which is a PA with special receipt, referral and/or review considerations.
3. Allow PI flexibility in order to meet the diverse capacity-building needs of their partner countries	PIs in NCoD and NCD-Lifespan are instructed to select the appropriate type of capacity building activities, ranging from short term workshops to long-term doctoral programs, based on the needs of the topic/country.
4. Revise the parent grant requirement	The initial requirement required a curriculum, center or training grant as a parent grant. This has since changed to allow research grant(s) as a qualified parent grant.
5. Adjust the language in solicitations regarding implementation research to be consistent with the FIC Strategic Plan	The “operational research” language in the ICOHRTA was removed in future iterations. The NCoD and NCD-Lifespan revised their FOAs with the use of “implementation and dissemination research”, as consistent with the FIC Strategic Plan.
6. Hold a pre-review meeting to help orient reviewers to the D43 mechanism	At the request of the Scientific Review Officers, Program staff may participate at pre-review, orientation meetings for the reviewers.
7. Re-introduce the developmental and planning awards	NCoD allowed for developmental awards under the D43. The NCD-Lifespan Program includes two mechanisms: D43 and D71 (planning grant).
8. Strengthen efforts to engage with NIH IC partners	The NCD Programs have involved many ICs. Three ICs went beyond the normal scope of co-funding a FIC grant to administering the grants themselves under the FIC FOA. This commitment illustrates a new level of partnership and involvement in the program.
9. Increase the frequency of network meetings and explore options to facilitate communication and networking across the PIs	Network meetings are held annually. PIs are encouraged to publicize and share information and training resources including the scientific courses given by their training program.

Recommendation	Implementation of Recommendation
10. Encourage training activities to take place in the LMIC	The NCoD and NCD-Lifespan all encourage the training, as well as the research, to take place in the LMIC. Fourteen grants (23%) of the 60 NCoD and NCD-Lifespan grants were awarded directly to a LMIC.
11. Require LMIC institution to make an up-front commitment of time/resources/funds	Letters of support from all participating institutions are required for the NCD-Lifespan.
12. Allow facility and administration costs for the LMIC to be budgeted as direct costs	Under NIH Policy, NOT-OD-05-004, facility and administrative costs are not to be included in the direct cost limitation.
13. Require PIs to set milestones and self-monitor progress	Awardees of all NCD Programs are required to track and document the long-term impact of this training program. The NCD-Lifespan Program explicitly mentions in the FOA that benchmarks should be included in this plan of self-evaluating.
14. Develop outcome indicators against which future NCD Programs can be measured	Outcome indicators are guided by the Fogarty Program Evaluation Framework. Indicators are adapted to meet the particular goals and aims of each program.

While many of the recommendations from ten years ago have been addressed in one dimension or another, there are still areas for improvement to the current iteration of NCD-Lifespan Program.

Integrated approach. LMICs face a dual burden of NCDs and infectious diseases. Collaboration between the infectious disease and NCD scientific communities will be critical to addressing the complexities of this dual burden. Future iterations of the NCD D43 Programs should consider ways to encourage research on the nexus between NCDs and infectious diseases and research related to co-morbidities.

Partners. The number and variety of IC partners have grown since the first NCD D43 Programs launched in 2001. In 2001, the first ICOHRA FOA had 5 ICs signed onto the announcement; the first NCD-Lifespan FOA has 9 partners. Any plans of action for moving forward, such as the inclusion or exclusion of specific disease and topical areas, will have to be carefully weighed against the possible impacts and priorities of IC partners.

Cross-Cutting Themes. With its cross-cutting mission, FIC is uniquely positioned to fund topics and research training for NCDs that may otherwise not receive high priority at more disease-specific ICs. Examples of cross-cutting themes relevant to the NCD D43 Programs include prevention, implementation science, common risk factors, developmental origins, maternal and child health and stigma. These types of themes should be prioritized in future iterations of the Program.

Underrepresented Topical Areas. Similar to the catalytic role that FIC can play in identifying and funding cross-cutting issues, addressing disease areas in a global context remains a unique niche for FIC. While the NCD D43 Programs have successfully attracted a range of research related to NCDs, there are several areas that have not been addressed. Applications have been submitted on research training in under-represented areas such as metabolic disorders, hearing issues and chronic kidney diseases; yet none of these NCDs have been successful enough in review to be funded to date (Figure

8). Similarly, neurological disorders aren't well represented in the funded cohort, considering the burden these diseases play in the LMICs. Future iterations of the NCD D43 Program should prioritize these understudied areas.

LMIC Networking. As the NCD D43 Programs mature and foreign institutions receive more direct awards, new challenges arise in the context of grantee networking. To date, network meetings have been held in Bethesda, MD. This may not be a feasible option for LMIC grantees. Thus, it is important to implement strategies that support the involvement of LMIC PIs in program-wide networking opportunities. Such strategies may be as simple as offering Web Ex or Skype options to the Network Meetings. Other options may be to offer off-site Network Meetings in different areas of the world or to attach them to other broad NCD meetings (e.g., the Global Alliance for Chronic Diseases Meetings) that grantees may already be attending.

Trainee Preparation. The cornerstone of any research training program is the trainee. With the goal of creating independent researchers, the NCD D43 Programs support training on an array of skills. One critical step in becoming an independent researcher is successfully applying for grants. Projects may consider requiring trainees to write and submit a grant since the actual process of writing a grant application and getting feedback is valuable a valuable career skill, whether or not the grant is funded.

5.3 Current Status and Next Steps

At the time of publication, the NCD-Lifespan Program is accepting applications for the D43 FOA (PAR-18-901), with deadlines in November 2019 and 2020. The new FOA, while similar to the 2010 FOA, has been modified to reflect new findings from the evaluation process, participation from IC partners and priorities within FIC. In particular, FIC's emphasis in the newest FOA includes the need for more applications focused on cross-cutting issues and a shift from U.S.-led projects to LMIC-led projects. Renewal applications funded solely by FIC must come from foreign PIs; this shift helps to bolster the institutional capacity of the LMIC to secure its own funding. New U.S. applicants are expected to collaborate with a single LMIC institution as the major partner, so that resources and training opportunities are concentrated for the first five years to build a strong base in research capacity. Renewal applications with established collaborative research training programs are expected to expand to other LMIC institutions to help build a research network throughout a country or region.

While the NCD D43 Programs will continue to support research training efforts in LMICs to build a network of researchers in NCD research, the alumni of these programs have other opportunities at FIC to continue fostering and utilizing the research skills they acquired through their initial training. For example, FIC supports NCD scientists through the career development (K43) and exploratory/developmental research (R21). In 2016, a R21 exploratory and developmental FOA was issued (PAR-16-052) to support the planning, designing and piloting of locally relevant and catalytic research on NCDs in LMICs. The intent of the new program, called "Global Non-Communicable Diseases and Injury Across the Lifespan: Exploratory Research (R21)" is to provide opportunity for LMIC investigators to jumpstart research programs related to LMIC needs in NCDs, trauma and injury and to provide an opportunity for LMIC trainees and collaborators from FIC D43 programs to advance in their research. The K43 "Emerging Global Leader Awards" provide research support and protected time to LMIC scientists who hold a position at an LMIC academic or research institution.

Although it is too early to know, the hope is that the K43 and R21 programs will provide opportunities within a researcher's career to help him or her stay in research, grow their research foundation and mentor the upcoming generation of researchers. Providing these opportunities will help ensure that the investments made during the NCD D43 Research Training Program are not lost and will encourage research leaders to remain in-country. Future analysis of the NCD D43 Programs should examine this career trajectory to assess if, how and when alumni trainees or collaborators utilize these mechanisms to bolster their research careers. Understanding how FIC can best meet the career development and research needs of trainees being developed through the NCD D43 Programs will be paramount to building that critical mass of NCD researchers needed globally.

Acronyms

CDC= Centers for Disease Control and Prevention

FIC= Fogarty International Center

FOA= Funding Opportunity Announcement

ICOHRTA= International Clinical, Operational, and Health Services Research and Training Award

ICs= Institutes and Centers

ITREOH= International Training and Research in Environmental and Occupational Health

LMIC= Low- and Middle-Income Country

MCH= Maternal and Child Health

NCCIH= National Center for Complementary and Integrative Health

NCD= Non-Communicable Disease

NCD-Lifespan= NCD Chronic, Noncommunicable Diseases and Disorders Research Training

NCoD= Millennium Promise Awards: Non-communicable Chronic Diseases Research Training Program

NICHD= National Institute of Child Health and Human Development

NIDA= National Institute on Drug Abuse

NIEHS= National Institute of Environmental Health Sciences

NIH= National Institutes of Health

NIMH= National Institute of Mental Health

PA= Program Announcement

PI= Principal Investigator

POP= Global Research Training in Population Health Program

RFA= Requests for Applications

U.S.= United States

Appendices

Appendix A: Program Elements

Partners	NCCIH, NIA, NIDA, NIDCR, NIMH, NINDS, ODS		NCI, NICHD, NIEHS, NINDS, NINR, ODS		NCI, NIA, NIAAA, NICHD, NIDA, NIEHS, NIMH, NINDS, NINR, ODS	
D43 Broad Objectives	<ol style="list-style-type: none"> 1) Train LMIC scientists in clinical, operational, health services and prevention science research on NCDs 2) Support a variety of training opportunities 3) Strengthen LMIC scientists' ability to collaboratively contribute to the global and local NCD research efforts 4) Help build and maintain NCD centers of excellence 		<ol style="list-style-type: none"> 1) Train a cadre of NCD experts 2) Support training-related research projects relevant to the LMIC 3) Strengthen research training capacity and institutional infrastructure 4) Train scientists who can identify economic factors for NCDs and/or translate research into practice 		<ol style="list-style-type: none"> 1) Strengthen the institutional capacity to train NCD experts 2) Support training-related research projects relevant to the LMIC 3) Support multidisciplinary research training and implementation science research 4) Build on existing NCD research and public health programs in the LMIC 5) Integrate with other efforts to strengthen research support capabilities 	
Priority Research Areas and/or Diseases	<ul style="list-style-type: none"> ● Health services and outcomes ● Patient oriented research ● Operational and translational science ● HIV risk factors (only for 2001 cohort) 		<ul style="list-style-type: none"> ● NCDs (cancer, cerebrovascular disease, lung disease, obesity) ● Risk factors (epigenetics, environmental exposures, behavior, nutrition) ● Multi/Transdisciplinary approaches ● Dissemination and implementation science 		<ul style="list-style-type: none"> ● Lifespan approach ● NCDs (cancer, cardio- and cerebrovascular disease, lung disease, diabetes, mental illness, neurological, substance abuse, genetic disorders, birth defects, developmental disorders) ● Risk factors (lifestyle, environmental, socio-economic, behavior) ● Spectrum of research disciplines (e.g., basic, behavioral, social sciences) ● Implementation science 	
Mechanism(s)	<p style="text-align: center;">D43</p> <p style="text-align: center;">↙ ↘</p> <p style="text-align: center;">Developmental Standard</p>		<p style="text-align: center;">D43</p> <p style="text-align: center;">↙ ↘</p> <p style="text-align: center;">Planning Standard</p>		D71	D43
Award Length	< 3 years	< 5 years	2 years	< 5 years	< 2 years	< 5 years
Funding	● 2001: <\$100,000/yr	● 2001: <\$250,000/yr ● 2006: <\$150,000/yr for new awardees and \$200,000/yr for re-competing 2001 awardees	● \$27,000/yr	● \$220,000/yr	● \$27,000/yr	● \$250,000/yr

Partners	NCCIH, NIA, NIDA, NIDCR, NIMH, NINDS, ODS	NCI, NICHD, NIEHS, NINDS , NINR, ODS	NCI, NIA, NIAAA, NICHD, NIDA, NIEHS, NIMH, NINDS, NINR, ODS
Other	<ul style="list-style-type: none"> ●2001 grantees must be on an eligible, funded parent grant ●50% of the funds over the time of the award must be spent in the LMIC 		

Appendix B: Evaluation Study Questions

Study Questions
A. Program Logic
What are the program goals and objectives?
What activities have been supported (including research, training, networking, other)?
What are the expected outputs/outcomes/impacts?
B. Evolution
How/why has the program evolved from ICOH to Lifespan?
Which FOAs were RFAs v PARs (Recommendation 2 from ICOH)?
How do the current NCD programs (e.g., Tobacco, Trauma, Brain) complement NCD-Lifespan?
Has the NCD program evolved with the changing NCD landscapes in LMICs (e.g. co-morbidity) as they have come up?
Does the current NCD-Lifespan program have flexibility to adjust to the changing NCD needs of LMICs (Recommendation 2 from ICOH)?
C. Portfolio
How many and what types of awards have been funded (including mechanism, institution, country/region, research topic, direct/indirect, etc.)?
In what disease areas do we have co-funding partners?
Of the applications coming in (ie., what the community is asking for funding in), how many (and what topics) are cross-cutting?
How many of these cross-cutting awards are co-funded and has this changed over time (ie., Have ICs become less siloed)?
How/has the portfolio of topics change over time (Recommendation 1 from ICOH)?
D. Models
Within the portfolio of NCD awards, is it possible to identify distinct approaches or models for LMIC capacity building?
Do models work for specific diseases (or regions) or would the model be successful across all NCDs?
E. Program Planning
What was/is the strategic planning process for the program?
How were/are the program goals developed?
Were alternate mechanisms/models/strategies considered?
What role(s) have various stakeholders played?
What niche does the program fill/what would the field look like if the program did not exist?
Is the current program too broad in its scope of "NCDs"?
F. Visibility and Applicant Pool
What have been the application and success rates?
How has the program advertised itself to potential applicants?
Have sufficient efforts been made to attract applications from diverse NCDs?
G. Institutional Support
Is there evidence that awarded LMIC institutions have provided sufficient support for the program (administrative, other)?
Are there significant challenges or barriers?

H. Alignment with strategic priorities
Do the program goals align appropriately with the FIC strategic plan and/or with other FIC initiatives?
What about the strategic plans and initiatives elsewhere at NIH?
Has Implementation Science projects increased over time given it's in SP (Recommendation 5 in ICOH)?
I. IC Partners
Which ICs have provided co-funding, and at what levels? Have other partners been involved?
What roles have partners played in the program?
Are the needs of the partners being met?
Are there any barriers to participation?
Are there additional potential partners who might be tempted to participate?
How does the program affect the plans and portfolios of partner ICs?
Are other funders supporting similar research and capacity-building? (Look at people, places and investment landscape)
Is FIC filling a strategic gap by supporting developing-country researchers to do their research?
J. Communication Among Awardees
Are there adequate mechanisms for sharing data and/or best-practices among awardees/trainees? (Recommendation 9 of ICOH)
What networks have been retained for alumni from previous FIC NCD programs (ICOH, POP)?
K. Proposal and Project Planning
Do applicants/awardees conduct local needs assessments as part of the planning process?
How satisfied is the user community?
Are they getting the information they need? How is the information shared?
L. Research
What have been the research outputs and outcomes of the NCD D43 Programs?
How do the priorities and accomplishments align with the NCD burden in LMICs?
How successful has the NCD D43 Programs been in catalyzing further interest in related topics?
How many trainees have continued in NCD research and gotten NIH funding?
How many of the PIs are receiving RPG support from other ICs to do LMIC NCD work?
Has the program catalyzed other ICs to fund this type of research independently or do they continue to rely on this announcement to bring in relevant research that they would not otherwise be able to fund?
M. Training
What have been the training outputs of the program?
Do training outcomes differ for those grants with IC partners
How many people have been trained, in what NCDs and have former trainees established productive research careers in the LMICs?
What have been the networking/career development outcomes for the trainees?
Are we building a large enough cadre of researchers (capacity) in specific NCDs? Which NCDs?
Can you develop a capacity in NCD generalized across diseases or do you need specific disease focus?
What does critical mass look like? What would you envision seeing at a LMIC institution that has built capacity and been "successful" (e.g., NCD department, 2-3 experts for each of the major NCD diseases)?
What programs have (and in what ways since ICOH Review) have projects incorporated IS training?
N. Network Analysis
Is there evidence that supported activities facilitated new or enhanced relationships among investigators?
What alumni investigators have worked with each other (or trainees) since?

O. Awareness
Is there any evidence that the program has catalyzed additional support for related topics by raising awareness among funders?
Is there any evidence that the program has raised awareness of NCD-related research topics within LMIC research communities?
Has NIH support for the NCD project helped raise awareness/interest of NCD-related research at the LMIC institution?
P. Policy and/or public health impact
Is there evidence of any direct impact of funded activities on policy or public health?
Have there been interactions between awardees/trainees/projects and policy-makers and/or the general public in developing countries?

Appendix C: Interview Questions for FIC Program Officer

1. Programs
 - How did each of the programs (ICOHRTA, NCoD and NCD-Lifespan) originate? When did planning begin? Why were some programs two cycles and others one?
 - Why was ICOHRTA and NCoD a D43 but a 3 year developmental option under the same FOA (same with NCoD)? Why add the D71 mechanism for the NCD-Lifespan?
 - For the first ICOHRTA FOA, why did ICs want to allow for HIV? Why were the HIV/ID topics removed in 2nd ICORHTA FOA?
 - Why were the programs (ICOHRTA and NCoD) terminated?
 - Why did you need to have a parent award to be eligible for ICOHRTA? Why did the second ICOHRTA RFA makes no mention of this criteria.
 - Why was the Lifespan approach important to add?
2. Stakeholders
 - What roles did the stakeholders have in the developing of each program?
 - Are there additional potential partners who you think should participate but currently (or formerly) did? Why did former partners drop out?
3. Review Process
 - Are you happy with the diversity in applicants NCD topics/geographic ranges?
 - Anything unusual about the review processes?
 - Did the reviewers understand the capacity building goals (especially early on with IS)?
 - Why did NIAAA put money on Zucker's NCD-Lifespan grant even though they are not on the FOA? How and why did they get involved in the program?
4. Network Meetings/Interactions
 - Do we know the years of network meetings?
 - What do you hope PIs get out them?
5. Misc.
 - Anything you would have done differently in retrospect?
 - Have you ever considered narrowing the scope of topics allowed?
 - How does the R21 NCD program interact with the D43 program?
 - What would a critical mass of NCD experts look like? Can you develop capacity in general NCDs or do you need specific disease focus experts?

Appendix D: Survey Questions

The purpose of this survey is to collect information relevant to the evaluation of three NCD D43 Programs administered by the John E. Fogarty International Center:

- International Clinical, Operational and Health Services Research Training Award (ICOHRTA)
- Millennium Promise Awards: Non-communicable Chronic Diseases Research Training Program (NCoD)
- Chronic, Noncommunicable Diseases and Disorders Research Training (NCD-Lifespan)

You have been invited to participate in the survey because you participated in one or more research projects funded through one of these NCD D43 Programs. Please note that the evaluation will be focused on the suite of programs for NCD research training as a whole rather than on your individual funded project.

If you agree to participate in the survey, you will be asked a series of questions about your experiences. You may refuse to answer any question and you may stop answering questions at any time. Your responses will be kept confidential. You will not be identified as the individual who provided specific information in any reports or publications resulting from the evaluation. All names and identifying information for any answers will be removed.

If you have any questions or concerns about the evaluation study, please contact the Fogarty Evaluation Officer, Rachel Sturke, at Rachel.sturke@nih.gov or (+1) 301-480-6025.

- I have reviewed this statement and agree to participate.
- I decline to participate at this time.

1. Which of the following training methods have you used for your NCD Program(s)? [Choose all that apply]

- Educational exchanges to the U.S. or LMIC institution
- Independent Learning and self-instruction
- Computer Based Training
- In-country training workshops
- Interaction with other national and regional efforts
- Distance learning, online or eLearning
- Other (please specify)

2. Please specify what percent of the training is conducted in the US and in the LMIC? (Please only put in values equaling 100%)

U.S. ___% LMIC ___% Other ___%

3. Please specify how mentoring was used in your training model?
4. How does your training model incorporate or interact with the research networks and/or centers of excellence that exist in the region where your research takes place?
5. Did **you and/or your collaborator** apply for additional funding (from NIH or other sources) to continue the research **training** projects funded by the NCD Program after your award was complete? [Choose all that apply]
- Yes, we applied for and were successful in obtaining additional funding
- Yes, we applied for additional funding but were **not** successful in obtaining
- No, we did not apply for additional funding
6. If yes to Q#5, to which funder(s) did you and/or your collaborator apply? [Choose all that apply]
- The Fogarty NCD Program (ICOHRTA, Millennium Promise, NCD-Lifespan)
- Another NIH Institute, Center, or program
If selected, which NIH Institute? _____
- Another US government agency
If selected, which USG agency? Select: NSF, CDC, FDA, DoD, NASA, USAID, DOE
- A source in my collaborator's home country or region (please specify) _____
- Another source (e.g. third-party government or non-governmental organization or charitable foundation; please specify) _____
7. If yes to Q#5, what was the total amount you received (if you were funded) for each funder?

8. If no to Q#5, why not? [Choose all that apply]
- Our original project is not yet complete or we haven't yet had time to apply for additional funding
- The research training project has reached its logical conclusion and/or is no longer of importance or interest to the LMIC institution
- We are too busy with other research projects to continue with this one
- We are not confident that we could compete successfully for additional funding at this time
- I am no longer involved in NCD related research training

9. Did **you and/or your collaborator** apply for additional funding (from NIH or other sources) to continue the **research** projects funded by the NCD Program OR to start new research projects related to the topic of your NCD Program? [Choose all that apply]
- Yes, I/we applied for and were successful in obtaining additional funding
- Yes, I/we applied for additional funding but were **not** successful in obtaining
- No, I/we did not apply for additional research funding
10. If yes to Q#9, to which funder(s) did you and/your your collaborator apply? [Choose all that apply]
- Fogarty Funded Program (such as, the K43 Career Development award, Global Brain Research, Global NCD research, Mobile Health research, etc.)
- Another NIH Institute, Center, or program
If selected, which NIH Institute? _____
- Another US government agency
If selected, which USG agency? Select: NSF, CDC, FDA, DoD, NASA, USAID, DOE
- A source in my collaborator's home country or region (please specific) _____
- Another source (e.g., third-party government or non-governmental organization or charitable foundation; please specify) _____
11. If yes to Q#9, what was the total amount received (if you were funded)? _____
12. If no to Q#9, why not? [Choose all that apply for you and/or your collaborator]
- The original project is not yet complete or there hasn't been time to apply for additional funding.
- The research projects related to the research training program reached their logical conclusion and/or are no longer of importance or interest to the LMIC institution
- I/We are too busy with other research projects to continue with this one
- I/We are not confident that we could compete successfully for additional funding at this time
- I/We are no longer involved in NCD related research

13. Did **your trainees** apply for additional funding (from NIH or other sources) to continue the **research** projects funded by the NCD Program OR to start new research projects related to the topic of your NCD Program? [Choose all that apply]

- Yes, they applied for and were successful in obtaining additional funding
- Yes, they applied for additional funding but were **not** successful in obtaining
- No, they did not apply for additional research funding

14. If yes to Q#13, to which funder(s) did your trainees apply? [Choose all that apply]

Fogarty Funded Program (such as, the K43 Career Development award, Global Brain Research, Global NCD research, Mobile Health research, etc.)

Another NIH Institute, Center, or program

If selected, which NIH Institute? _____

Another US government agency

If selected, which USG agency? Select: NSF, CDC, FDA, DoD, NASA, USAID, DOE

A source in my collaborator's home country or region (please specific) _____

Another source (e.g., third-party government or non-governmental organization or charitable foundation; please specify) _____

15. If yes to Q#13, what was the total amount received (if a trainee was funded)? _____

16. If no to Q#13, why not? [Choose all that apply for your trainees]

The original project is not yet complete or there hasn't been time to apply for additional funding.

The research projects related to the research training program reached their logical conclusion and/or are no longer of importance or interest to the LMIC institution

The trainees were too busy with other research projects (not NCD related) to continue with this one

The trainees are not confident that they could compete successfully for additional funding at this time

The trainees are no longer involved in NCD related research

17. Apart from trainees and research outputs, what (if any) of the following types of **research training outputs** were products of either trainees or faculty projects under your NCD award? [Choose all that apply and please describe]

- Curricula or training materials (Please describe) _____
- Post-training networking resources/ groups/ materials (Please describe) _____
- New departments devoted to research/ research training in the area of interest (Please describe) _____
- Research trainee outreach materials (to encourage young investigators to enter the field) (Please describe) _____
- Community-oriented education and outreach materials (Please describe) _____
- Policy-maker oriented education and outreach materials (Please describe) _____
- Practice- oriented education and outreach materials (Please describe) _____
- Other research training outputs (Please describe) _____

18. Apart from the NCD training program, did your project contribute to any of the following types of research capacity building at the LMIC institution? [Choose all that apply]

- Increased awareness of and/or interest in NCD research among students, faculty and/or administrators
- Enhanced recruiting of new faculty members or retention of existing ones focusing on NCD research
- Development of research support infrastructure such as IRB or grant offices
- Creation of a new laboratory, faculty position, department, degree program, or other institutional subdivisions in NCD areas (Please specify) _____
- Enhanced networking among faculty and students interested in NCD research
- None of the above

19. Apart from publications, which (if any) of the following types of **research outputs** did faculty or trainees produce under your NCD award? [Choose all that apply]

- Software or other analytic tools (Please describe) _____
- Patient registries or other databases (Please describe) _____
- Patents or patent applications (Please describe) _____
- Devices or prototypes (Please describe) _____
- Clinical protocols (Please describe) _____
- Curricula or training materials (Please describe) _____
- Other research outputs (Please describe) _____
- None of the above

20. Did any institution or funder other than NIH contribute the following types of resources to your NCD project? [Choose all that apply]

	Your Home Institution	Your Collaborator's Home Institution	Another Third Party (Please Describe _____)
Supplemental Funds for Research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Salary Support for Your Foreign Collaborators	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Facilities or Equipment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technical Support, Including Paid Students/Post Doc	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Administrative Support	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (Please Describe)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

21. Were there research infrastructure (e.g., administration, IRB, ICT) barriers at the LMIC institutions? Yes/No

If so, please specify. _____

22. Are there any comments you would like to add about your collaborating or home institution in relation to your NCD project? _____

23. Please rate the degree to which you agree or disagree with the statements below regarding your experience during the NCD award

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The NCD program provided sufficient opportunities to interact with other awardees and their collaborators	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The LMIC institution was supportive of our NCD Project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Participation in the NCD program expanded my network of contacts among NCD researchers in my collaborator's country or region	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The NCD program encouraged the engagement of alumni (trainees, PIs)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

24. How were the local needs of the community determined prior to initiating your project in that setting?

- We conducted a NCD needs assessment that took into account the input of potential end-users and LMIC institution stakeholders of that LMIC.
- Myself or my collaborator has previously been conducting NCD research in this field at this institution/region prior to us getting FIC funding
- We looked at the Global Burden of Disease to determine the needs of the region/LMIC.
- We did not conduct a rigorous needs assessment.
- The LMIC institution came to me or my collaborator asking for us to build research and training capacity in NCD research.

25. Did you ever share the details of your research training projects (e.g., research findings, study design) with end-users (e.g., providers, public health officials, NGOs, policy-makers) in your LMIC? [Choose all that apply]

- Yes, we discussed the project with potential end-users during the period of FIC support
- Yes, we discussed the project with potential end-users after the period of FIC support
- Yes, we discussed the project with potential end-users during and after the period of FIC support
- No, we have not conferred with potential end-users about the details of the funded project

26. If yes, how was this information shared with the end-user? [Choose all that apply]

- In-country workshops, events, seminars or conferences
- Individual emails or in-person meetings (one-on-ones)
- Media coverage or press releases to the media
- Flyers, posters, brochures, newsletters
- Policy briefs
- Community agency publications, websites or list-servs
- Other (Please specify) _____

27. Has your project incorporated implementation science (IS) training into the curriculum or research?

- Yes, our application proposed to include IS components and we executed these IS activities during the duration of our grant. (Please describe) _____
- Yes, our application proposed to include IS components but we did not execute any IS activities during the duration of our grant. (Please describe) _____
- Yes, we had IS activities (research or training) but our original application did not note or emphasize the IS activities. (Please describe) _____
- No, we did not plan or execute any IS activities. (Please describe) _____

28. Please describe any impact(s) that your NCD research has had on healthcare policy or practice in your LMIC or region. _____

29. What do you see as the most critical unmet needs for NCD research in LMICs? _____

30. Is there anything else you would like to tell us about your experience with the NCD programs? Improvements/changes? _____

Appendix E: Response to how a program incorporated or interacted with the local research networks and/or centers of excellence

- A good deal of the training is integrated with all existing resources including Centers.
- All Fogarty trainees participate in a U.S.-based short course on research methodology, along with other postdoctoral trainees.
- All research is done in collaboration with a research institution in each LMIC
- An oral presentation of my research proposal was given in the research center. I was also supervised by senior researcher from the center.
- Attempts to interact with American university of Beirut were not successful. We interacted with another Fogarty grant holder for the ethics training
- Based at the Peruvian Instituto Nacional de Ciencias Neurologicas (INCN); collaborated with the national stroke group "Grupo Stroke", developed alliances with neurologists across Peru to assess incidence of stroke; working on developing a stroke fellowship at INCN.
- Builds upon other prior NIH/FIC Training efforts. Links to other NIH projects funded at in-country institutions - PEPFAR, NIAID Projects, MEPI etc.
- By nature of our program, all trainees work or study in the leading research and training institutions in Tajikistan. The interdisciplinary nature of our research training requires that all trainees interact with their peers in other research networks and centers of excellence. The most prominent institutions (centers of excellence) involved in our program are Avicenna Tajik State Medical University, Tajik National University, Institute of Avicenna's Medicine and Pharmacology, Institute for Botany, Physiology and Genetics of Plants, Pamir Institute of Biology, Center for Preventive Medicine, State Center for Nutrition Problems.
- By one to one contact with colleagues, symposia in workshops and conferences etc.
- Collaboration in research/studies/mentorship support with a network of Fogarty Trainees trained under ITREOH (International Training and Research in Environmental and Occupational Health) at the University of Iowa
- During the training period we and the fellow had a strong interaction with the University where she/he belongs.
- Following last coup attempt on July 15 in 2016, many things have been changed. Many universities and institution has been closed. A declaration of a state of emergency had been announced. That extraordinary state, sadly, is still going on. Many academics and their research studies have been affected by this situation.
- highly integrated into on-going research work groups and COE depending on trainee's research interest
- I assisted during the whole program to the research center, and worked together in the development of the project with them
- I had support from research networks at local and regional level. Unfortunately there were not enough centers of excellences in the area.
- Interaction related to the training model was only to a limited degree because of the relative absence of research networks and centers of excellence in both Poland and Ukraine. However, interaction developed over time. In Poland it led to a long standing, relatively permanent consultative relationship with the Federal agency most responsible for alcohol research. this led thereafter to some jointly sponsored workshops in Poland and an Intergovernmental

agreement between the Polish agency and NIAAA. IN Ukraine, due to corruption, early relationships with ostensible centers of excellence and of research collapsed over time as the leadership in these centers was moved out with a change in government, and as personnel in these agencies left because of problems with the university's corrupt leadership. In our later years in interaction in Ukraine, we established two excellent interactive relationships, one with the Kharkiv branch of the National. We provide in-person workshops in Ukraine, we work closely with NGO's and Universities in Ukraine to on research initiatives and have fostered numerous research collaborations between researchers and institutions within the United States and Ukraine.

- It is difficult to collaborate with other NIH funded projects because of intense competition for funding. Other US-funded groups are generally not interested in collaborating because of a lack of desire to collaborate.
- It is embedded within the School of Public Health at the Mongolian National University of Medical Sciences as a new drafuaye level training and research program. We collaborated with another Fogarty DE43 from Hopkins.
- Makerere and Hopkins both have many such research centers and our fellows had access to both sides; we had seminars with lecturers from such centers
- Many of the trainees were associated with an NIH NCD center of excellence in India.
- mentees are part of the cancer center at Fez and interact with numerous departments within the cancer center and the broader university located in Fez
- My training model was half time at Stanford University, half time at Health development research center of the Chinese National Health Planning Commission and connected through project.
- our program occurred in a country where there was no research network. We linked our program to existing NIH-funded studies in some cases.
- Our program selected all fellows from two of the most important centers of excellence in China: the Shanghai Mental Health Center, and the Peking University Institute of Mental Health. We worked closely with the networks of researchers based in these organizations.
- Our task over the years has been to facilitate the building of local infrastructure (centers) and then to work with trainees in these contexts.
- Our trainees are embedded within these networks
- Our training took full advantage of on-going cohort studies that we are leading at the LMIC and on-going research projects at Vanderbilt by involving trainees in the research activities. We also collaborating the LMIC partners to organize in-country workshops.
- Students might get additional funding support from research groups.
- Students were located within existing in-country academic programmes, and were registered at established programmes located in the region, rather than in the US
- The local PIs are Directors or PI to centers of excellence involved in capacity building and research such as Centre for Population and Reproductive Health (CPRH), College of Medicine. This network contributed to the percentage attributed to "other" in Q2 University of Ibadan, and Centre for Drug Discovery Development of Production (CDDDP), University of Ibadan, therefore it was easy to interact and incorporate these with our training models. They enlarged the coverage of the training models including workshops and stakeholder meetings. Research collaboration in NCD between the LMIC and US became enhanced and enlarged

- The mentors will link trainees to other research centers networks/ centers of excellence based on trainee's training needs. The mentors usually facilitate these interactions. Sometimes, the trainee brings up to the mentor's notice their specific interest and the mentor weighs in the need and links the trainee to other research networks in the region
- The program is integrated with other regional hubs via shared trainings, mentoring and workshops
- The trainees were either employees or collaborators of reference research institutes from Romania. Every other year an NCD conference was organized, bringing together both the trainees and researchers & practitioners in the field of NCD.
- The training is based on a strong collaboration with an in-country center of excellence, where 50% of the training took place. The center is part of very extensive national and international research networks.
- The training model has been built on the existence of research networks / centers of excellence related to non-communicable disease in the region
- the training was under the universities (both US and LMIC) which have reputation in the research area of the region
- There is a close collaborative relationship with PI's/mentor's and Chulalongkorn.
- Trainees became integral to the development and maintenance of regional centers of excellence
- Trainees projects were integrated into long term research goals, ongoing research and national programs
- Training was provided to students from other academic institutions. Professors from other institutions participated in courses and workshops.
- Under current training model all the research has been conducted in the LMIC. Trainees are associated with the leading research and training institutions in the country. The interdisciplinary nature of the research requires from trainees to be involved with several research networks and centers of excellence. The most prominent institutions are Avicenna Tajik State Medical University, Tajik National University, Institute of Avicenna's Medicine and Pharmacology, Institute for Botany, Physiology and Genetics of Plants, Pamir Institute of Biology, Center for Preventive Medicine, State Center for Nutrition Problems.
- via individual activities of fellows within their domestic colleagues
- we collaborate with other researchers who have overlapping interests. there are no "centers of excellence"
- We created a strong interactive network of centers of excellence in three US universities, one university in Peru, one in Argentina, and one in Bolivia, all contributing equally to research rotations and mentoring. Collaborations on research projects tailored to the trainees are built around LMIC-US collaborations, and some include LMIC-LMIC collaborations as well.
- We developed a durable research partnership with BITS-Pilani, a premier engineering university geographically near our rural medical college. Also developed ties to Gandhi medical school, Fever Hospital, and PathCare, and advanced private laboratory.
- We developed close collaborations with NIH-funded Principal Investigators and with the national health institutes and leading research facilities.
- we extensively interacted with WHO centers in Mongolia in both occupational and environmental health. We also enlisted other educational institutions in Mongolia and Korea

- We have involved the Egyptian Department of Mental health and the WHO EMRO office.
- We have partnered with academic institutions in our host countries (5).
- We interact with home country leaders from universities who are conducting research via: a) our training workshops, and b) sponsoring them as short-term visiting fellows
- We published a paper this year that explains how our training program interacted locally with research networks (<https://www.frontiersin.org/articles/10.3389/fpubh.2017.00070/full>)
There is one center of excellence located in Guatemala, and we developed a line of communication with them. However, our training program were fundamentally established in the academy, and the center of excellence is in an international cooperation institution that also applies for the same grants that we do, therefore, the communication has been more in the direction to avoid double efforts in the same areas of interests. I must say at this point that we have constantly tried to approach this Center of Excellence to develop collaborative opportunities together, but this has been not viable, at least from their end. The perspective I am sharing is from my point of view as a faculty at the Universidad de San Carlos de Guatemala, the only and biggest public university in Guatemala, and (as stated in the paper) we have solid links with Ministry of Health, Social Security and other universities (like UFM, a private university that is part of this initiative). Through this links we have been participating in significant advances in the research and ethical areas. And we are actively engaging in new research and training proposals, based on invitations that local and regional institutions are sending after seeing the results of the quality of training we have had with the great support of FIC NIH, and UPenn. It is my understanding that there is interest in developing new Centers of Excellence in Guatemala, focused on cancer. The PIs of such collaborative efforts have been advised to contact us by their institutions, but no contact has been made by them at this point, despite of our to do so. I hope we can find a way to interact better with this Center of Excellence, however,
- We rely heavily on local resources. Fellows carry out research rotations in South America at University labs affiliated with the grant, and post-training reinsertion grants rely on collaborative efforts with local networks and investigators.. Fellows rotate in the LMIC research facilities with local mentors at half of the schedule rotations (the other half are at research facilities in the US). Fellows develop independent research projects at LMICs in collaboration with the regional faculty at those centers.
- We tapped into several networks for our students and usually they were related to the PI activities. Some examples: Heart of Africa; Cardiovascular networks in Africa; H3Africa, INDEPTH, AWI-Gen
- We visited colleges in the PBRI network in several regions of Thailand and also visited Centers such as Cancer Institute, Data Science Institute and several Bureaus. We visit with leadership to discuss needs/access of our post docs during and after formal training. We support building linkages with key leaders across these institutes to support trainees and also build capacity across Thailand.
- We were able to leverage ongoing capacity building projects in the country including training in reproductive health and other cancers
- We worked with PAHO/OPS and Cayetano in Lima

Appendix F: Publications Citing a FIC Grant

[See additional material]

Appendix G: Responses to mentoring strategies

- Each trainee has been assigned with at least two mentors: one from LMIC and one from the USA institution. LMIC mentors have direct constant contact with the trainees. The USA mentors are communicating with the trainees on average once a month over the Skype or other internet connection tools. They also maintained efficient email contact. In addition, The USA mentors visited LMIC and participated in annual meetings. During those meetings US Mentors delivered, lectures, workshops and evaluated progress of the trainees. Some of the LMIC mentors visited the USA to participate in scientific meetings and communicate with the US mentors.
- Mentors creating mentors. PI mentors in country mentors
- Applicants were required to identify mentors from onset. Beneficiaries submitted regular reports under supervision of mentors. Several training, workshops and meetings were held for richer interaction between mentees and mentors. Further grant writing activities were coordinated with mentors
- Mentoring has been an important aspect of the training programme to prepare trainees for a future career in research
- Mentoring was provided by meeting with faculty, workshops and seminars.
- attend meeting / workshops
- They guided me to choose the courses, and made a surveillance of the program
- We developed and implemented Individuals Development Plans (IDP).
- Mostly by discussions, seminars and direct supervision.
- Trainees were required to work with a mentor. Mentors were responsible for guiding the trainees in working on their research projects and in preparing new proposals. Mentors and trainees met at least once a month, in person or via videoconference, and they agreed upon quantifiable objectives to be met for each semester.
- Mentoring was used by pairing Egyptian fellows with UCLA faculty during the visit to the US. The UCLA faculty went to Cairo for short training courses and intensive work with fellow. Weekly skype calls were used to design new research and produce manuscripts and publications.
- Each trainee has been assigned at least two mentors: one from LMIC and one from the USA institution. LMIC mentors have direct constant contact with the trainees. The USA mentors are communicating with the trainees at least once a month over the Skype or other internet connection tools. They also maintain email contact. In addition, USA mentors visited LMIC and participated for the annual meetings. During those meetings, US mentors delivered lectures, short classes and evaluated progress of the trainees. Selected LMIC mentors also visited the USA to participate in scientific meetings and communicate with the US mentors.
- Individual and grouping mentoring as well as distance mentoring.
- Mentoring is provided to: 1) in-person to fellows that come to the U.S., 2) remotely to fellows who conduct in home country research, 3) during workshops in home country, and 4) via online course training
- Mentoring was at two levels: a) individual mentors for Fogarty fellows doing a post-doctoral traineeship in the US; b) Mentoring at a distance by US faculty mentoring in-country research projects ...at a distance. All Post-Doctoral Fogarty Fellows/Trainees are paired with a research

training mentor at the University of Michigan Department of Psychiatry. Mentors provide trainees ongoing assistance with developing and implementing an in-country research project, posters and presentations at scientific conferences, and help with authoring peer-reviewed publications in order to publish research results.

- regular supervision through skype
- Direct online mentoring
- Trainees came to University of Pittsburgh for up to 2 months of mentoring with numerous faculty. University of Pittsburgh faculty (4 or 5) visited SHARE approximately 20 times (length of visit 5-50 days) to teach in methods courses and mentor on collaborative research projects at all stages of development. Approx 10 Pitt Public Health graduate students visited (some several times) and mentored as above (visit length 1-6 months)
- Each mentee from the intermediate trainings (semester-long training in the US) was allocated a mentor from US and a mentor from LMIC. They pursued to apply for competitive pilot grants and, if successful, implement it under the supervision of mentors.
- Trainees were assigned a U.S. faculty member as a mentor in developing and carrying out their research project.
- Mentoring was a major aspect of the training. We paired each trainee to a senior mentor and each pilot project was led by a mentor and several trainees.
- Each postdoctoral fellow from Thailand worked with a mentor for the first year of training in the US and during the trainees second year in country research project.
- Critical aspect of curriculum including mentored research requirement
- Faculty provide mentoring on research by collaborating on research projects. They also provide training by having students as teaching assistants.
- We use mentoring for research, training, and clinical service provision. We serve as mentors in research collaborations, we serve as mentors in training, by co-teaching courses or workshops, and we serve as mentors for clinical service provision by providing clinical supervision.
- Fellows were involved in ongoing research projects of our Institute previously deciding jointly with them subjects of their interest. We tried that the fellows were involved in all the components of research activities like proposal writing, data collection, data analysis and paper writing. We are pleased that all our grantees finalized their training with a paper published in an index journal as first author.
- Trainees were offered support to develop and conduct research studies in their home country with research mentorship available throughout the course of their research by University of Iowa faculty and other Fogarty Trainees.
- Ongoing mentoring for continuing projects.
- One-on-one mentoring for grant writing and manuscript preparation
- used throughout for guidance in didactic learning and in developing and carrying out research projects as well as preparing papers for publication and presentation
- Each Trainee was expected to find a research mentor
- To advise and monitor summer projects and thesis projects
- After training course in US, trainees returned to their home country to work on mentored research projects.
- Open to communication whenever I need. Arrange scientific learning opportunities. Invite and promote my progress about topics especially important for LMICs

- Mentoring is the essential core of our training program. Post doc fellows work directly with UM faculty in their labs/programs of research, collect data, assist in writing papers, and receive direct feedback and guidance from faculty.
- The supervisor gave suggestions on the course selection in my education exchange to US, the revision of research protocol and the field work.
- In five ways. 1. Junior researchers were brought to Harvard Medical School for 4-9 months of training, including writing of research proposals. 2. Senior researchers came to Harvard for 1-2 months. 3. Harvard Faculty went to Beijing and Shanghai to participate in research training workshops. 4. We mentored and supported individual research projects of fellows. 5. We supported the development of research training programs in the Chinese institutions.
- Doctoral students had an in-country supervisor/mentor, together with a US based supervisor
- Mentoring is a central part of the model. We have mentoring teams with one LMIC and one US-based mentor for each student. Additional mentoring as needed for specific topics or projects is also facilitated and encouraged.
- Mentoring is used as the core strategy. Fellows are assigned in country and international (US) mentors. Mentor-mentee interactions are scheduled, but irregular (on demand or spontaneous) interactions are encouraged. Formalized reports from mentors are required, and a structured project shared by the mentor-mentee teams is expected as the primary outcome of the training. Mentoring is a key element of the training. Fellows are assigned local and international mentors and provided a mentoring structure that is formalized in schedule and assessment.
- We follow a dual mentoring model i.e., each trainee will have mentor/s in both the US and India. The TAG recommends mentors based on the trainee's area of interest. Trainees and mentors will sign AAMC mentor-mentee compact and mentors make a training plan with their mentee depending on the training needs.
- US mentors assigned when fellows in US for one year; following 2-year period, continued support (distance and in-country) by US mentors plus local mentors.
- identify one mentor from US and other from LMIC to supervise the student/participant research, after attending the training workshop
- Main research mentors are from LMIC where most research were conducted. US mentors worked closely with trainees when they spent one year in the US to take coursework and develop research proposal.
- As specific "triads" with Guatemalan trainees, in-country faculty, and US faculty
- Throughout the training program both Ugandan and US mentors were working with trainees
- Each mentee was assigned a mentor. Degree-earning fellows also had multiple member guidance committees.
- A group of faculty with different expertise where available to mentor participants throughout their projects from proposal development to publication
- Our MSc and PhD students were mentored by one to three supervisors who also played a mentorship role. The four PIs of the program cross mentored the students, postdocs and young investigators and outside mentorship was sought in some cases.
- Mentor teams would meet with trainees while in Seattle for methodology/MPH training to assist with developing research project that would be implemented in Peru. Mentoring continued throughout implementation, analysis and publication of project.

- Each fellow has a LMIC mentor, a US mentor, and a third relevant to the topic mentor in another country.
- Each fellow has access to a local mentor, a US based mentor and a PhD mentor
- face to face
- diverse, direct and indirect interaction between mentors and fellows
- Individual mentoring
- Each trainee had the possibility to propose a research question, and based on that, a mentor was identified and contacted. The mentor had periodical meetings with the trainee, to address issues pertaining to the MSCE thesis, and in addition, for career opportunities and other issues that came along
- One to one mentoring for research projects
- All trainees were assigned a faculty mentor and met regularly with the mentor
- On-site mentoring under supervision of site and project PIs and co-leaders
- Mentoring is very specific and intense. Fellows are matched based on interest and expertise and work closely with the mentor throughout the two years and beyond. That relationship, based on personal experience, is a "forever" relationship.

Appendix H: Responses regarding new laboratory, faculty position, department, curricula, or other institutional subdivisions in NCD areas

Latin America

- New courses on implementation sciences in Argentina.
- PDF files with talks from training courses to students who completed the courses in Brazil.
- The Clinical Epidemiological Program and the Pharmacoepidemiology Program at the Research Center at the School of Medicine, Universidad de San Carlos de Guatemala was created by a former trainee. We developed three years of lectures and training materials for Critical Appraisal Program at the University of San Carlos of Guatemala which has graduated nearly 75 faculty members over the years.
- An academic foundation for stroke fellowship is now affiliated with a Peruvian university.
- New positions for rehabilitation specialists were created at the Instituto Nacional de Ciencias Neurológicas in Peru after assessment of post-stroke rehabilitation needs identified paucity of speech therapists and physical therapists.
- A funded program in the detection of early psychosis was created in the province of Jujuy, Argentina. This is the creation of the first program in early intervention in psychosis in Argentina.
- There is new curricula for graduate level courses in neuroanatomy, biostatistics, neuroimaging, and psychopathology in Argentina.

Sub-Saharan Africa:

- A new research division within the Mozambique Ministry of Health, Mental Health Research Division, was created.
- Trainer manuals of evidence-based interventions created in Mozambique.
- A new laboratory called Diagnostic laboratory in University College Hospital, Ibadan
- Clinical trials and ethics of clinical trials curricula available in various programs in University of Ibadan, Nigeria.
- Computer based e-learning materials in occupational respiratory diseases were developed and available in southern sub-Saharan African countries.
- Three courses at Makerere University were established.
- New courses in nutrition and economics.
- An annual NCD epidemiology course at Wits University in South Africa. There are plans to translate this into an online course that can be remotely accessed.

Central, South, and East Asia

- The formation of the Vietnam National University VNU Center for Research, Information, and Service in Psychology (CRISP).
- Degree programs developed in Vietnam include a Ph.D program in child clinical psychology and material for graduate programs in clinical psychology.
- Developed the Center of Excellence in Child Mental Health in Vietnam.
- Supported the creation of the Research Center at Hunan Maternal & Child Health Hospital in China.
- There is a new center for elder research at Zhejiang University, China.

- A new Ethics curriculum for mHealth in China.
- Created the China Hospital Development Institute.
- Training materials was created and made available at Madras Diabetes Research Foundation in India. There is also a new Genetics Lab and Clinical Trials Lab at the site.
- A new environmental sciences degree program in Mongolia.
- The creation of the Imaging, Statistical Genetics, and Molecular Genetics laboratories at the National Institute of Mental Health and Neuro Sciences, Bangalore, India.
- A new department in occupational and environmental health at School of Public Health, Health Sciences University of Mongolia was created. There are new courses in this field for medical and postgraduate students.
- A new laboratory was created: State Laboratory of Medicinal Plants at the Institute of Botany, Plant Physiology and Genetics of Tajik Academy of Science in Tajikistan. It was established by Tajik government with significant input from the NCD grantee. The appointed director of this laboratory is a trainee.
- A new center, the Center of Innovation Development of Science and New Technologies, related to the NCD grant activities was established by the Academy of Sciences of the Republic of Tajikistan. A Laboratory for Innovation Technologies in Pharmacology, Pharmaceutics and Therapy, was established within this Center, and is headed by a trainee.
- New curriculum on botanical therapeutics was developed to target Tajik trainees and broader audiences. Three new online courses and four new training workshops were developed.

Middle East

- Cancer Epidemiology certificate in Morocco was created.
- Educational material available online for grant writing, establishing research teams, and ethics in Morocco. This was circulated around Morocco to other universities and across the region to faculty in Lebanon.
- Created a Summer intense certificate and MS in Health Research in Lebanon.

Europe

- Created a course in Research Methods at the University of Medicine and Pharmacy Targu-Mures in Romania
- Revamped the Department of Psychiatry's research and clinician training at the Medical University of Warsaw, Poland.
- Two on-line research methods courses for Ukrainian scientists.
- Created the Divisions for Sleep Problems in children and a Excellence Centers for Autism in Turkey.

Appendix I: Response to research infrastructure barriers at the LMIC

- Not enough time for research. Lack of technical and software material Lack of coordination Bureaucratic difficulties.
- Limited space, availability of equipment for research projects and of computers. Lack of administrative support. Slow internet access.
- IRB approvals of trainee driven advanced in-country grants take time. Similarly, administrative barriers include getting timely approvals and permissions
- IRBs are not trained to deal with psychiatric studies. Administrators in LMICs require training.
- Administrative delays
- Bureaucratic administration.
- Delay in some administrative processes
- Registration of SAM and getting DUNS number were challenge due to language barrier at institutional administrative level.
- At the outset there was no IRB available in the province, or in Bolivia. Lack of IRBs in two countries. Both had to be set up. Likewise, administrative accounting infrastructure had to be built. Lack of laboratory infrastructure for genetic studies. Lack of existing databases. Reduced access to the internet.
- Some put their MDs back into clinical work, despite assertions that they would not. Others had problematic financial departments, requiring the development of ways of assuring that support funds 'made it' to the trainees.
- Research departments needed significant development to support grant submission and grant oversight activity including preparation/receipt of budgets. Research administrators also needed development in the understanding of the time commitment of research faculty to enable success
- Ease of communication and grants administration delays w transition of grant w relocation of PI to be expected. Disruption w national elections necessitated major alteration in on-site training conference(s) that were planned.
- steep learning curve for understanding and implementing NIH requirements for fiscal management
- The Universities did not have a way to administer funds locally, and that is still a limitation. We are discussing the best way to overcome this limitation. We were able, through this grant, to support and update the two IRBs we have in our University, however, we are still no FWA approved and despite we have a local FIC trained person in charge in this matter, he has not lead and guided this process properly. I still do not understand why this colleague is not supporting this, and I wish we could have more action on his part on this area.
- Lack of standardized processes for management and auditing of funds in one LMIC institution. Lack of IRB availability in one LMIC institution.
- No major barriers other than slow IRB reviews at times; careful tracking of all fiscal grant issues for timely invoicing/payments
- Setting up financial systems to transfer US funds and manage these funds were initially a problem that took longer than expect to resolve. Morocco is primarily a French and Arabic speaking country so increasing capacity to write in English has been a challenge

- Many of the institutions did not have the infrastructure to properly accept and manage trainee research funds. Some institutions required payment of indirect costs from the trainee's research funds
- Poor local financial support
- In some countries, limited internet access, limited access to online full text journals or libraries with hardcopies
- Multiple levels of IRB. Poor research infrastructure all kinds
- For Cairo University to become a realistic research institution, they would need to allow junior faculty to buy release time to do research. At present, that is not possible
- Limited to non-existent time-off support for clinician/researchers to carry out their research work. In most instances it was contributed by the investigator.
- Lack of commitment to research and the scientific method.
- Lack of IRB, lack of a reliable system to transfer funds
- IRBs are not trained to deal with mental health projects
- The institutional IRBs were barriers, but were for the most part reasonable and helpful
- Ethics committee training
- Need more trained and qualified personnel
- Political struggles that effect many academicians in our country